PICES Seventeenth Annual Meeting

Beyond observations to achieving understanding and forecasting in a changing North Pacific: Forward to the FUTURE

North Pacific Marine Science Organization

PICES

October 24 – November 2, 2008
Dalian, People's Republic of China

Contents

Abstracts for oral presentations are sorted first by session and then by presentation time. Abstracts for posters are sorted by session and then by paper ID number. Presenter name is in bold-face type and underlined. Some abstracts in this collection are not edited and are printed in the condition they were received.

Notes for guidance

The Annual Meeting is hosted by the State Oceanic Administration (SOA), People's Republic of China, in coordination with the PICES Secretariat. Local arrangements are made by the National Marine Environmental Monitoring Center (NMEMC) of SOA. All Sessions and Workshops will be held at the Kempinski Hotel (see floor plan on page vi)

Presentations

In order to allow the sessions to run smoothly, and in fairness to other speakers, please note that all presentations are expected to adhere strictly to the time allocated. (On average, time slots for contributed oral presentations are **20 minutes**. All authors should designate at least **5 minutes** for questions.)

Authors should provide their presentations on **CDs** or **USB** memory sticks, preferably a day before their presentations, to PICES staff for uploading in the registration area. **PowerPoint** is the preferred media for oral presentations.

If complications occur due to incompatibilities between PCs and Macs, Macintosh owners may use their own computers to make presentations.

Posters

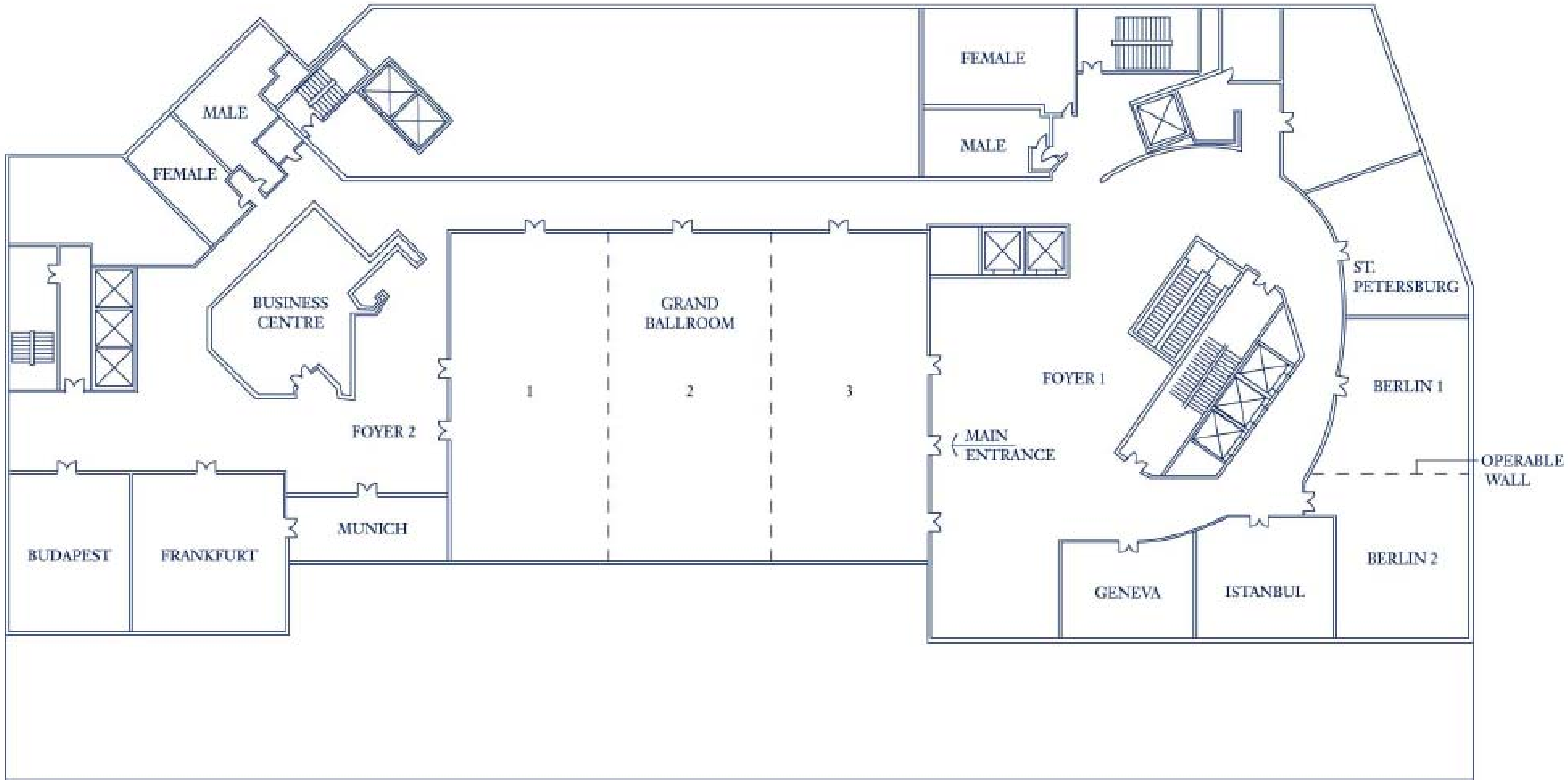
Posters will be on display from October 28 (a.m.) until October 31 (a.m.). The Wine & Cheese Poster Session will be held from 18:30-20:30, on the evening of October 30, when poster presenters are expected to be available to answer questions. Posters must be removed on the morning of October 31.

Internet access

Internet access via wireless LAN will be available on the whole Meeting floor. A few desktop computers will also be available for participants to use in the Geneva Room.

Social activities

27 October (18:30-21:00)	Welcome Reception hosted by the State Oceanic Administration (SOA) (Swissôtel, Grand Ballroom, 7th floor)
30 October (18:30-20:30)	Wine & Cheese Poster Session (Kempinski Hotel, Ballroom 3)



Floor Plan for the Kempinski Hotel

Keynote Lecture

Wave-tide-circulation coupled model: To improve the forecasting ability for FUTURE

Fangli **Qiao**, Zhenya Song, Changshui Xia and Yeli Yuan

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As mixing is essentially an energy balance problem, surface waves should play a controlling role in the upper ocean as they are the most energetic motions. Unfortunately, in most ocean dynamics studies, wave motions have always been treated separately from the ocean circulation. So most ocean circulation models have overlooked the role of the surface waves, or just considered wave breaking effects. Consequently, these models have produced insufficient vertical mixing and this resulted in an under-prediction of the mixed layer depth and an over-prediction of the sea surface temperature, particularly during the summer season. As the ocean surface layer determines the lower boundary conditions of the atmosphere, this deficiency has severely limited the performance of the coupled ocean-atmospheric models and hence climate studies. To overcome this shortcoming, we have established a new theory on the wave-induced vertical mixing that will correct this systematic error due to insufficient mixing. This wave induced vertical mixing is due to Stokes drift rather than wave breaking. Our studies indicate that the wave-induced mixing penetration depth can reach nearly 100m in high latitudes and about 30m in tropical areas. The new scheme has enabled the mixing layer to deepen, and shows an excellent agreement with observed climatologic data. Different OGCMs such as POM, ROMS and HIM show similar improvements, and this surface wave correction can alleviate the too-cold tongue in the tropical area of CCSM3 which is a common problem for all climate models without flux correction. In shallow coastal waters, tidal current-induced vertical mixing is very important for the formation of temperature fronts. So a wave-tide-circulation coupled model has been set up. This new generation ocean circulation model can improve the forecasting ability of temperature, salinity and currents.

Schedules and Abstracts

S1 Science Board Symposium
Beyond observations to achieving understanding and forecasting in a changing North Pacific: Forward to the FUTURE

Co-convenors: *John E. Stein (SB), Michael J. Dagg (BIO), Gordon H. Kruse (FIS), Glen S. Jamieson (MEQ), Hiroya Sugisaki (MONITOR), Michael G. Foreman (POC), Bernard A. Megrey (TCODE), Harold P. Batchelder (CCCC), Michio J. Kishi (CCCC), Fangli Qiao (China), Sinjae Yoo (Korea) and Mikhail Stepanenko (Russia)*

FUTURE (**F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems), the new Science Program undertaken by PICES member countries, has the broad goals of: (1) understanding the responses of marine ecosystems in the North Pacific to climate change and human activities at basin-wide and regional scales; (2) providing forecasts of what might be expected based on a current understanding of how nature works; and (3) communicating this information effectively to its members and to society in general. Past advances in understanding marine ecosystems in the North Pacific have been largely based either on the direct analysis of observations, or on the development of conceptual and numerical models that help to describe the processes underlying the observations. Though these activities will continue to play an important role in FUTURE, the provision of forecasts and estimates of their associated uncertainties necessitates moving beyond observationally based understanding, so that ecosystem responses to natural and anthropogenic changes can be anticipated and communicated effectively to society. Presentations are invited to address the goals of FUTURE and the three key research questions that it identifies:

1. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?
2. What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?
3. How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?

Presentations addressing other components of FUTURE such as: (1) communicating scientific information to governments, policy makers, and society at large and (2) forging partnerships with social scientists, are also welcome.

Monday, October 27, 2008 10:50 – 18:00

10:50 **Fangli Qiao, Zhenya Song, Changshui Xia and Yeli Yuan (Keynote)**
Wave-tide-circulation coupled model: To improve the forecasting ability for FUTURE

11:30 **Lawrence C. Hamilton (Invited)**
Ocean, fishery and society: Interconnections among systems in change (S1-5404)

11:55 **Eitaro Wada (Invited)**
Marine ecosystem studies of today and tomorrow with emphasis on the western North Pacific Ocean (S1-5220)

12:20 **Jeffrey J. Polovina, Melanie Abecassis, Evan A. Howell and Séverine Alvain**
Developing an understanding of future changes in the North Pacific Subtropical Gyre marine ecosystem (S1-5260)

12:40 ***Lunch***

14:00 **J. Icarus Allen (Invited)**
On the simulation of the impacts of multiple climatic and anthropogenic drivers on marine ecosystems (S1-5136)

14:25 **Hiroaki Saito (Invited)**
A strategy for marine ecosystem studies in the first half of the 21st century (S1-5387)

14:50 **Emanuele Di Lorenzo, Jason Furtado and Niklas Schneider**
North Pacific decadal variability in the future (S1-5392)

15:10 **Shin-ichi Ito, Taizo Morioka, Yasuhiro Ueno, Satoshi Suyama, Masayasu Nakagami, Akihiro Shiomoto, Fumitake Shido and Michio J. Kishi**
Future projection of Pacific saury to climate change and its improvements by experimental and observational approaches (S1-5246)

15:30 **Harold (Hal) P. Batchelder, Michael Harte, David Ullman and William Peterson**
Bayesian decision support to improve flexibility and reduce uncertainty in ecological forecasting of coho salmon marine survival (S1-5378)

15:50 ***Coffee / tea break***

16:10 **George Sugihara (Invited)**
Causality, prediction and nonlinearity in fisheries ... why adaptive fitting fails (S1-5492)

16:35 **Paul J. Harrison and Kedong Yin (Invited)**
Eutrophication impacts in Hong Kong waters are reduced by physical and chemical factors (S1-5150)

17:00 **Rong-shuo Cai, Qi-long Zhang and Ji-long Chen**
Spatial and temporal oscillations of SST and atmospheric circulation divergence in the offshore area of China and its adjacent ocean and their associations with the red tide (S1-5268)

17:20 **Joji Ishizaka**
Long-term change of primary production in the Yellow Sea and East China Sea (S1-5305)

17:40 **Song Sun, Chaolun Li, Fang Zhang and Yuanzi Huo**
A changing ecosystem: The Yellow Sea (S1-5295)

S1 Posters

S1-5017 **Vladimir B. Darnitskiy and Maxim A. Ishchenko**
Some properties of oceanic waters off Japan

S1-5145 **Lyudmila I. Mezentseva and Oleg V. Sokolov**
Change of weather components at the seashore of the Far East as a result of the changes in general circulation of atmosphere

S1-5256 **Vadim V. Navrotsky**
On the role of ocean ecosystems in Global Climate Change

S1-5285 **Sukgeun Jung, Dong-Woo Lee, Yeonghye Kim, Hyung-Kee Cha, Hak-Jin Hwang and Jeong-Yong Lee**
Contrasting recruitment of two gadoid species (*Gadus macrocephalus* vs. *Thergra chalcogramma*) to Korean coastal waters in relation to climate change

S1-5354 **Vladimir Ponomarev, Elena Dmitrieva and Nina Savelieva**
Changing climate and teleconnections in the Asian Pacific

S1 Oral Presentations

27 October, 11:30 (S1-5404) Invited

Ocean, fishery and society: Interconnections among systems in change

Lawrence C. **Hamilton**

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Interdisciplinary studies of linked ecological and social changes in fisheries-dependent regions reveal a number of broad patterns. Large ecological shifts, disastrous to historical fisheries, have resulted when unfavorable climatic events occur on top of overfishing. The "teleconnections" linking fisheries crises across long distances include human technology and markets, as well as climate or migratory fish species. Overfishing and climate-driven changes have led to downwards trophic shifts in some ecosystems from dominance by bony fish to crustaceans. Fishing societies adapt to new ecological conditions through social reorganization that benefitted some people and places, while leaving others behind. Characteristic patterns of demographic change are among the social indicators marking such reorganization. Economic stagnation resulting from fisheries troubles creates pressures for expanded fishing efforts despite weakened resources. It can also motivate energy and other industrial development as a new alternative to fishing, but with the potential for feedbacks that cause further environmental changes. Examples from the northern Atlantic and Alaska illustrate such interconnections between ocean, fishery and society.

27 October, 11:55 (S1-5220) Invited

Marine ecosystem studies of today and tomorrow with emphasis on the western North Pacific Ocean

Eitaro **Wada**

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The fifty-year history of aquatic ecosystem studies is summarized with emphasis on the various international cooperative research programs that address increasing atmospheric carbon dioxide. These programs are IBP (International Biological Program), MAB (Man and the Biosphere Programme), IGBP (International Geosphere-Biosphere Programme), DIVERSITUS (DIVERSITAS Programme) and IHDP (International Human Dimensions Programme on Global Environmental Change). At the beginning of the 21st century, we need to integrate WCRP (World Climate Research Programme), IGBP and IHDP to provide significant practical solutions and scenarios for social sciences and public involvement. International initiatives such as the Earth System Science Partnership (ESSP) and Global Earth Observation System of Systems (GEOSS) are now well established together with simultaneous promotion of Earth Observation Systems involving developments of satellite remote sensing and automatic field observation systems. Current global environmental studies seek to provide clear-cut scientific scenarios to solve various environmental problems within the next 50 to 100 years using reliable databases and simulation studies. Integrative studies involving observation, modeling and simulation may be connected to Plan-Do-Check-Action systems for social management. Considering the above, I will summarize the results of several process studies on aquatic nitrogen dynamics by using the ^{15}N tracer technique and natural carbon and nitrogen isotope abundance methods. These emphasize the western North Pacific Ocean and aquatic ecosystems in East Asia. In addition, I will introduce several process models and simulation models from our Ecosystem Change Research Program, FRCGC, JAMSTEC, including terrestrial ecosystem models and associated satellite studies.

27 October, 12:20 (S1-5260)

Developing an understanding of future changes in the North Pacific Subtropical Gyre marine ecosystem

Jeffrey J. **Polovina**[1], Melanie Abecassis[2], Evan A. Howell[1] and Séverine Alvain[3]

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Over the past decade SeaWiFS ocean color data show that surface chlorophyll densities in the subtropical gyre of the North Pacific have declined coherent with a warming of the surface. The subtropical gyre has become more oligotrophic. This trend is consistent with increased vertical stratification due to global warming. To investigate in more detail how the North Pacific Subtropical Gyre might continue to change, we use data from both the bottom and top levels of the ecosystem. At the bottom of the ecosystem, we extend our analyses of surface chlorophyll trends with a dataset of five phytoplankton species functional groups estimated from the SeaWiFS data based on the model PHYSAT. PHYSAT estimates a time series over the past decade of diatoms, haptophytes, *Prochlorococcus*, *Synechococcus*-like cyanobacteria, and *Phaeocystis* based on properties of their water-leaving radiances from SeaWiFS data. We will use these data to examine spatial changes over time of these phytoplankton functional groups in the North Pacific with particular focus on the subtropical gyre. Representing the top of the food web, we use data from the Hawaii-based pelagic longline fleet that fishes a large area in the central North Pacific from close to the equator to 40^{o}N latitude and from the dateline to about 140^{o}W longitude. Based on the logbook data from the longline fishery we develop species-specific recruitment indices for large pelagic fishes since 1998. We will consider whether changes observed at both ends of the trophic web are consistent with a subtropical gyre growing more vertically stratified.

27 October, 14:00 (S1-5136) Invited

On the simulation of the impacts of multiple climatic and anthropogenic drivers on marine ecosystems

J. Icarus **Allen**

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A great challenge for marine ecology is how we push forward the state-of-the-art of our understanding of impacts of global climate change and direct anthropogenic drivers on marine ecosystems end to end. Underpinning this is the challenge of developing coupler methodologies to link models using Newtonian approaches (*e.g.*, physics and phytoplankton), with those of the Darwinian world (*e.g.*, zooplankton and fish) and those of the human world (economics and policy). Approaches to these problems will be discussed and illustrated with examples from regional ecosystems model simulations forced under climate change scenarios.

27 October, 14:25 (S1-5387) Invited

A strategy for marine ecosystem studies in the first half of the 21st century

Hiroaki **Saito**

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Increasing pressure from anthropogenic forcing is making it more scientifically difficult to forecast the North Pacific. Our understanding of ecosystem regime shifts induced by natural climate variability is still limited and the mechanisms are unknown. In addition to the natural forcing, anthropogenic forcing, especially global warming, is altering the North Pacific. Although a marked advance has been achieved for the global warming scenario by IPCC AR4, there is still uncertainty especially for the ocean domain. It is estimated that the global warming impact on the North Pacific SST will be as large as that of natural climate variability in 25-55 years. This means that considering both the impacts of natural and anthropogenic forcing for the forecasting of the North Pacific is essential in the first half of the 21st century. In spite of the difficulty, the request from society

to the scientific community for this forecasting is getting more critical because forecasts in the global warming era are essential for sustainable use of marine ecosystem services on which our society largely depends. In order to address this difficult theme, I propose that it is important to understand the mechanism of past regime shifts. Marine ecosystems feature resiliency to perturbations but it is suggested that some specific ecosystem processes are sensitive or vulnerable to specific environmental changes, and these changes induce the abrupt and drastic changes in ecosystem structure and productivity. Identifying the sensitivity is also essential for estimating the ecosystem response to global warming. In the Kuroshio Extension region, a new regime shift program SUPRFISH (Studies on Prediction and Application of FISH Species Alternation) is ongoing. The strategy for understanding regime shift mechanisms in SUPRFISH, especially coupling between physical oceanographic studies and ecosystem studies, and the feedback between the obtained information and modeling studies will be presented.

27 October, 14:50 (S1-5392)

North Pacific decadal variability in the future

Emanuele **Di Lorenzo**[1], Jason Furtado[1] and Niklas Schneider[2]

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2 International Pacific Research Center, University of Hawaii at Manoa, 1680 East West Rd., Honolulu, HI, 96822, USA

Recent studies show that decadal climate and ecosystem variations in the North Pacific are largely explained by the first two dominant modes of ocean-atmosphere co-variability evident in sea level pressure and sea surface height. The first co-variability mode tracks changes in the Aleutian Low and is associated in the ocean with the well known Pacific Decadal Oscillation (PDO). The second mode tracks variability in the North Pacific Oscillation (NPO) – a dipole structure in sea level pressure with low pressure over the Bering Sea and high pressure north of Hawaii. The oceanic expression of the NPO is the recently identified North Pacific Gyre Oscillation (NPGO) – a decadal mode of climate variability that reflects changes in strength of the central and eastern branches of the subtropical gyre and of the Kuroshio-Oyashio Extension (KOE). The NPGO is also linked to previously unexplained fluctuations of salinity, nutrient and chlorophyll fluctuations in the Northeast Pacific.

Using a set of ten coupled climate models from the Intergovernmental Panel on Climate Change (IPCC) we (1) assess the degree of realism of the IPCC models to reproduce the first two decadal modes of ocean-atmosphere co-variability in the North Pacific during the twentieth century (1900-2000), (2) explore how decadal variability is projected to change in future scenarios (2001-2100) and (3) discuss strategies for downscaling and regional biophysical model forecasts of climate change.

27 October, 15:10 (S1-5246)

Future projection of Pacific saury to climate change and its improvements by experimental and observational approaches

Shin-ichi **Ito**[1], Taizo Morioka[2], Yasuhiro Ueno[3], Satoshi Suyama[3], Masayasu Nakagami[3], Akihiro Shiomoto[4], Fumitake Shido[1] and Michio J. Kishi[5,6]

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An ecosystem based bioenergetics model NEMURO.FISH (North Pacific Ecosystem Model for Understanding Regional Oceanography. For Including Saury and Herring) was developed and successfully reproduced realistic growth of Pacific saruy with parameters mainly determined based on field observations. This model was used to investigate responses of Pacific saury to global warming using the sea surface temperature (SST) of current climatology and a global warming condition generated by CCSR/NIES/FRCGC coupled atmospheric-ocean model output with A2 scenario. The saury showed decrease in both wet weight and body length under global warming. Also the migration pattern was modified by increased SST. Higher SST in the mixed water region under global warming prevented southern migration of saury in the first winter. As a result, the egg production was enhanced by higher availability of prey zooplankton. However, while a lot of parameters were determined based on field observations, several parameters have been still unknown and the values of those parameters were borrowed from herring ones. Sometimes this kind of immature estimation of parameters brings misunderstandings of saury response to climate or anthropogenic forcing. To minimize uncertainty of the bioenergetics model, raring experiments of Pacific saury were conducted. The results of raring experiments showed higher consumption rate and lower feed conversion efficiency (28%) compared with those estimated from observations. This big gap between raring experiments and field observations seems to be caused by the difference of quality of food. Raring experiments with natural food are expected to improve the model.

27 October, 15:30 (S1-5378)

Bayesian decision support to improve flexibility and reduce uncertainty in ecological forecasting of coho salmon marine survival

Harold (Hal) P. **Batchelder**[1], Michael Harte[1], David Ullman[2] and William Peterson[3]

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We describe a new multidisciplinary decision support approach that integrates ocean science observations of physical and ecological conditions in the Pacific Northwest coastal ocean, coupled physical-ecological models, and satellite products in order to support coho salmon management. Early forecasts of coho salmon survival will enable harvest policy decisions that provide protection for both (1) the sustainability of fish resources, and (2) the economic and social livelihoods of communities that rely on these fisheries resources. The NOAA-Northwest Fisheries Science Center uses a multiple indicator approach, using large-scale ocean and atmospheric indices, and local-to-regional physical and biological indicators to evaluate the suitability of the coastal ocean to support coho salmon. The forecasts are qualitative, being “good”, “bad” or “neutral” in terms of their relative impact on salmon marine survival. The method we describe enhances this existing “multi-indicator” approach using Bayesian enhanced multidimensional decision support theory to consider (1) data and information that is uncertain, incomplete or inconsistent, and (2) salmon-management choices that have broadly-divergent ecological and/or environmental risks (consequences of being wrong). This approach will be able to provide quantifiable answers to “what if?” questions. For instance, if stakeholders values differ from the experts, or there are differences in expert opinion, the method can evaluate how these differences influence the recommended policy decisions and consequences to all components of the natural-human system.

27 October, 16:10 (S1-5492) Invited

Causality, prediction and nonlinearity in fisheries ... why adaptive fitting fails

George **Sugihara**

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The widely missed distinction between how well a model fits the historical data *versus* how well it predicts will be highlighted. This distinction is especially important in nonlinear nonequilibrium ecosystems prone to regime-like and nonstationary behavior. As a positive alternative to classical correlation models and equilibrium-based fishery modeling approaches, concepts and forecasting methods from nonlinear time series analysis will be introduced and applications will be discussed that hold implications for a nonequilibrium ecosystem-based management of fisheries. The concepts and methods provide a simple framework for ecosystem-based fisheries stock prediction that relate to many disciplines involving complex webs of mutually interacting parts.

27 October, 16:35 (S1-5150) Invited

Eutrophication impacts in Hong Kong waters are reduced by physical and chemical factors

Paul J. **Harrison**[1] and Kedong Yin[2]

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The Pearl River Estuary is a sub-tropical estuary and the second largest in China based on discharge volume from the Pearl River. Processes in the estuary vary spatially and temporally (wet *vs.* dry season). In the wet season, the SW monsoon winds push the Pearl River estuarine plume into Hong Kong waters and hence eutrophication impacts are a combination of nutrient loads from the Pearl River plus local sewage discharge. Eutrophication is not as severe as one would expect from these very high nutrient loads. This estuary shows a remarkable capacity to cope with excessive nutrients. Physical processes such as river discharge, tidal flushing, turbulent dispersion, wind-induced mixing, estuarine circulation and a shallow water column play important roles in controlling the production and accumulation of algal blooms and the potential occurrence of hypoxia. Superimposed on the physical processes of the estuary are the chemical and biological processes involved in the production of algal blooms. For example, the 100N:1P ratio of estuarine waters indicates that phosphorus potentially limits the amount of algal biomass (and potential biological oxygen demand) in summer. While extended periods of hypoxia are rare in Hong Kong waters, episodic events have been reported to occur during late summer due to factors such as low wind, high rainfall and river discharge which result in strong density stratification that significantly dampens vertical mixing processes. Nutrient loads are likely to change over the next several decades and monitoring programs are essential to detect the response of the ecosystem.

27 October, 17:00 (S1-5268)

Spatial and temporal oscillations of SST and atmospheric circulation divergence in the offshore area of China and its adjacent ocean and their associations with the red tide

Rong-shuo **Cai**[1], Qi-long Zhang[2] and Ji-long Chen[3]

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Based on monthly mean sea surface temperatures (SST) and atmospheric circulation divergences (ACD), the spatial and temporal oscillation and long-term variation of SSTA (SST anomaly) in the China Sea and its adjacent ocean, and ACDA (ACD anomaly) over the same areas were analyzed using empirical orthogonal function (EOF), polynomial function and spectrum analysis. The long term temporal variation of SST and ACD are discussed, and are compared with the frequency of 'red tides' (*i.e.*, harmful algal blooms) in China Sea from 1972 to 2005. The results show that SSTA and ACDA fields have three major patterns – there is obvious inter-annual and inter-decadal variations, respectively, the regional seas have become warmer and are warming more quickly since 1980s, and the atmospheric circulation divergences intensified in this area. The analyses also imply that regional climate change may be one of main reasons for the initiation of red tides, other than eutrophication due to discharges of domestic sewage and agricultural wastes.

27 October, 17:20 (S1-5305)

Long-term change of primary production in the Yellow Sea and East China Sea

Joji **Ishizaka**

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Environmental conditions in the Yellow Sea and East China Sea are changing radically. Ocean color data from satellites has been used to study the past 10 years of chlorophyll-*a* distribution in the Yellow Sea and East China Sea. Seasonal analysis showed that the satellite chlorophyll-*a* and water-leaving radiance was high in the coastal area during winter, indicating the possible overestimation of chlorophyll-a in the area due to resuspended sediment. However, the large area in the middle of the Yellow Sea and East China Sea showed a clear spring bloom, indicating less influence of resuspension except in winter. The Changjiang River plume extended to the Tsushima Strait during summer. The area and concentration of the high chlorophyll-*a* plume varied significantly depending on discharge from the Changjiang River. The influence of the Three Gorges Dam was not clear from large-scale ocean-color information. However, a significant change is expected if freshwater discharge changes dramatically. In the Yellow Sea, the magnitude of the spring bloom increased during the last 10 years, and this may indicate eutrophication. These changes of ocean color may be directly related to other environmental changes reported in the area.

27 October, 17:40 (S1-5295)

A changing ecosystem: The Yellow Sea

Song **Sun**, Chaolun Li, Fang Zhang and Yuanzi Huo

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The Yellow Sea Ecosystem is changing continuously; it seems to be in a regime shift phase. Many ecological events have happened in recent years including the giant jellyfish bloom, the starfish bloom, the salp bloom and the green algae bloom. What causes these ecological events? Is it human activities or climate change? This issue will be discussed, based on analysis of data from our cruises and from our understanding of ecosystem dynamics. The ecosystem structure, functional groups and a model of physical and biological coupling will also be discussed.

S1 Posters

Poster S1-5017

Some properties of oceanic waters off Japan

Vladimir B. Darnitskiy[1] and Maxim A. **Ishchenko**[2]

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In this presentation we describe analyses based on observations carried out over 10 years (1981 - 1991) on the DVNIGMI R/V as part of the large national program "RAZREZY", as well as independent cruises on the TINRO R/V with the purpose of studying Kuroshio and Subarctic front ecosystem (Belyaev, 2004). As these expeditions were not coordinated in some cases they had a complementary character or were partially duplicating. The general period of these research studies covered the beginning of the international expedition CSK, (1965 - 1970), with the 1970s largely on the TINRO R/V and the 1980s on the DVNIGMI R/V. The long-term variability of various thermohaline parameters and their derivatives, (*e.g.*, transport water, heat content, anomalies of temperature, amplitudes of variability in temperature and salinity, the minimum salinity layer in Northwest Pacific in Kuroshio and Subarctic front area) in upper 600-1500 m layer are described. Cyclic fluctuations of various parameters in the top layers of the ocean and on standard horizons up to 600 m are

discussed. The features of interannual eddy activity in the area of a northeast branch of Kuroshio are considered. Developments from all the Far East Marine Scientific Research Institutes: DVNIGMI, TINRO-CENTER, POI DVO RAS are used.

Poster S1-5145

Change of weather components at the seashore of the Far East as a result of the changes in general circulation of atmosphere

Lyudmila I. **Mezentseva** and Oleg V. Sokolov

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Meteorological conditions depend upon general atmospheric circulation patterns on the Earth and its features in the region. Fluctuations of circulation systems inevitably influence weather conditions particular for each region.

The investigation of long-term patterns of wind velocity at the stations of the Far East concludes that there has been a significant decrease within last two decades. This process is most evident at the coastal stations of the Far East due to the larger wind intensity at the coast. In winter, the process of attenuation of wind velocity is represented at the stations of Lopatka Cape and Kuril'sk (the Kuril ridge). Wind velocity is reduced 1.0-1.1 *m/s per 10 years* (at other coastal stations it is reduced 0.5-0.6 *m/s per 10 years).* In spring and autumn, the majority of coastal stations also show significant negative trends (0.3-0.6 *m/s per 10 years,* with a coefficient of determination R^2 = 0.4-0.6). Summer wind velocity has no trend at the stations of the Kuril ridge; but they do exist at the stations of Sovetskaya Gavan', Terney, Nakhodka (continental area) (coefficient of the trend is about 0.3 *m/s per 10 years,* R^2 *=0.4-0.6).* Linear parameters of the trendare calculated by processing the data of wind velocity time series for the period of 1966 – 2003. The investigation of long-period fluctuations of circulation systems revealed significant changes in the middle of the 1970s by intensification of the west-east air mass transportation in the middle latitudes, concentration of cyclonic formations in sub polar zones, decrease of inter-latitudinal exchange in middle and subtropical latitudes, and "lock" of Arctic and Antarctic air masses in the Polar area. The results are calculated for the period from 1950 till 2001.

Poster S1-5256

On the role of ocean ecosystems in Global Climate Change

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Most climate-ecosystem studies look for effects of Global Climate Change on land and ocean ecosystems. But we know that the present physical and chemical state of the Earth's surface, oceans, and atmosphere is a result of active interaction between living matter and inanimate nature. So we should anticipate that the Earth heat balance is partially controlled by life, but we hardly can estimate the real value of the control, the main time-space scales and mechanisms of interactions. That is especially important because living matter is greatly influenced by many non-climate factors of extra and intra terrestrial origin, and they are interlaced with anthropogenic effects.

The aim of this work is to identify the life-climate interactions, their mechanisms, and outline directions for future studies. Several aspects of the interactions analyzed include:
1) feedbacks of land and ocean living matter to climate changes; 2) ecosystem changes due to anthropogenic influence – different for oceans and land; 3) due to functuations in solar and geomagnetic activity; 4) factors, acting simultaneously on ecosystems and climate, but differently in space and in their various subsystems; and 5) mechanisms of heat balance anomaly formation and propagation in time and space. Estimates show that prevailing role of the world oceans in global climate change is due not only to physical, but also to biological processes, which are very sensible to extraterrestrial and intra terrestrial forcing.

Poster S1-5285

Contrasting recruitment of two gadoid species (*Gadus macrocephalus* vs. *Thergra chalcogramma*) to Korean coastal waters in relation to climate change

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The two Gadoid species, Pacific cod (*Gadus macrocephalus*) and Alaska pollock (*Thergra chalcogramma*), have been traditionally important commercial fish species in Korea, but their responses to climate change are contrasting. The two species are similar in that they were once major commercial fish species in Korea, and are deep-water species, spawning at cold water during the winter. However, they differ in the vertical depth ranges with respect to spawning and hatching (demersal *vs.* pelagic). In Korean coastal waters, global warming has apparently increased sea surface temperatures by ca. 1°C during the past 40 years whereas bottom temperatures have not significantly increased. However, since the late 1990's, bottom temperatures during the winter significantly did decrease in some areas, probably by strengthened mixed layer, especially in the southern Korean coastal waters, favoring recruitment of Pacific cod whose eggs are demersal and hatch at 5-12°C. Recruitment of cod seemed to become lower from the 1950's to the 1990's, because catch levels were lower compared with the 1920-1940's. Since 1998, however, catch has continued to increase from 0.5 x 10^3 metric tons in 1998 to 7.2 x 10^3 tons in 2007, reaching a record high. In contrast to Pacific cod, catch of Alaska pollock reached a record high (166 x10^3 metric tons) in 1981, but has steadily decreased since 1990, reaching a record low in 2007 (< 0.1 x 10^3 tons). The eggs of pollock are pelagic and we speculate that increasing sea surface temperatures inhibit hatching, and subsequently reduce recruitment and migration of adult pollock to Korean coastal waters. In addition to the temperature changes, bottom-up control by Pacific herring (*Clupea pallasii*), driven by increased biomass of meso-zooplankton after 1998, also could have helped recruitment of the Pacific cod in Korean coastal waters.

Poster S1-5354

Changing climate and teleconnections in the Asian Pacific

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Tendencies and statistical relationships between different climatic indexes and anomalies of the Pacific SST and Ice Extent, as well as surface air temperature and precipitation in the Northeast Asia, are estimated for different observational periods. Changing climatic tendencies and tropic-Arctic - extratropic teleconnections are analyzed using centennial-scale data sets. It is shown that SST cooling is typical for the subarctic West Pacific during last 56 years from January to September while warming occupies most of the Japan - Okhotsk Sea area and Kuroshio region. This warming accompanies a decrease of the Ice Extent in the Okhotsk and Japan Seas from 1956 to 2006 and changes in the relationship between SST anomalies in different Pacific key areas, anomalies in the centers of action and SSTs in the Pacific / marginal seas, and air temperature / precipitations in the North East Asia. The typical change in the Pacific SSTA relationship is associated with an amplification of the AO signal in the tropical-equatorial Pacific. In the last several decades a positive AO-SSTA lagged correlation pattern occupied the Okhotsk and Japan/East Seas. The negative correlation between SSTA in the south western area of the subtropical gyre and subarctic Pacific was amplified in winter and weakened in summer during substantial Global Warming. A similar situation occurs in the correlations between SSTA in the Gulf of Alaska area and the central/ tropical North Pacific. Global Warming accompanies the rising of winter temperature contrasts in the ocean and atmosphere of the Asian Pacific.

S2 MONITOR/TCODE/BIO Topic Session
Linking biology, chemistry, and physics in our observational systems - present status and FUTURE needs

Co-Convenors: *Hernan E. Garcia (U.S.A.), David L. Mackas (Canada), S. Allen Macklin (U.S.A.), Jeffrey M. Napp (U.S.A.), Young-Jae Ro (Korea) and Toru Suzuki (Japan)*

Numerical models are becoming increasingly complex, attempting to integrate vertically and horizontally ecosystem forcing, processes and predictions across multiple trophic levels from bacteria to human populations. Data requirements for daily, seasonal, annual and decadal predictions differ according to single species, species assemblages or multi-trophic level interests. To add to the challenge, the types of sensors and frequency of measurements vary greatly across ecosystem components, particularly in the biological sector. This session encourages contributions that: (1) define and specify the types, frequency, duration and spatial resolution of observational data required for current numerical models; (2) review existing and emerging advanced technologies capable of supplying biomass and species or functional group information; (3) review existing and emerging data sources and technologies capable of integrating these data with physical and chemical information; and (4) showcase novel data assimilation techniques and formal organization of data or database frameworks that facilitate the operational use of observational data to predict the effects of anthropogenic and climate forcing on the major ecosystems of the North Pacific.

Thursday, October 30, 2008 09:00 – 17:30

09:00 ***Introduction by convenors***

09:10 **Yasuhiro Yamanaka, Yoshie Naoki, Maki Noguchi Aita, Taketo Hashioka, Hiroshi Sumata, Naosuke Okada, Takeshi Okunishi and Shin-ichi Ito (Invited)**
Observational data for determining physiological parameters and validating model simulations: Suggestions by NEMURO developers (S2-5323)

09:40 **Francisco P. Chavez and Fei Chai (Invited)**
The realities of integrated measurement and modeling systems (S2-5439)

10:10 **S. Allen Macklin and Bernard A. Megrey**
The PICES Metadata Federation: Pacific-wide marine metadata discovery, management and delivery for FUTURE (S2-5269)

10:30 ***Coffee / tea break***

10:50 **Young Jae Ro, Kwang Young Jung and Chung Ho Lee**
"Hebei Spirit" oil spill fate and trajectory modeling in the western coast of Korea, Yellow Sea (S2-5035)

11:10 **Jennifer Menkel and William T. Peterson**
Status of Krill (*Euphausia pacifica* and *Thysanoessa spinifera*) in the northern California Current EEZ: A review of sampling methods and data sets (S2-5374)

11:30 **Hiroya Sugisaki, Kiyotaka Hidaka, Tadafumi Ichikawa, Yutaka Hiroe and Yuuichi Hirota**
Introduction for long-term monitoring in the sardine spawning area: Seasonal and annual variations of plankton biomass and compositions (S2-5143)

11:50 **Yong Tang, Kohji Iida, Tohru Mukai and Yasushi Nishimori**
Measurement of fish school abundances in shallow sea using omnidirectional multi-beam sonar (S2-5177)

12:10 **Zhen-dong Zhang, Shu-fen Wang and Ya-nan Zou**
DGGE technique and its application in marine environmental microbial diversity study (S2-5084)

12:30 ***Lunch***

14:00 **Shin-ichi Ito, Yugo Shimizu and Shigeho Kakehi**
An application of a deeper-type underwater glider to observe temperature, salinity, DO and Chl-*a* distributions and its connection to an operational ocean forecasting model (S2-5247)

14:20 **James R. Christian**
Photosynthesis, photoacclimation, and ocean surface pCO_2 (S2-5168)

14:40 **Petr P. Tishchenko, Pavel Ya. Tishchenko and Alexey M. Koltunov**
Peculiarities in distribution parameters of the carbonate system of Amurskiy Bay (East/Japan Sea) during summer 2007 (S2-5311)

15:00 **Hao Ma, Mingduan Yin, Liqi Chen, Jianhua He, Wen Yu and Shi Zeng**
Upper ocean export of particulate organic carbon in the Bering Sea estimated from thorium-234 (S2-5001)

15:20 **Ziwei Yao, Zhongsheng Lin, Xindong Ma, Yanjie Wang and Dongmei Zhao**
Distribution maps of persistent organic substances in the coastal zone of China (S2-5226)

15:40 **Mikhail V. Simokon and Lidia T. Kovekovdova**
Assessment of trace metals contamination in surface sediments of Peter the Great Bay (Japan/East Sea) (S2-5218)

16:00 ***Coffee / tea break***

16:20 **Georgiy Moiseenko, Vadim Burago, Igor Shevchenko and Yury Zuenko**
The application of empirical orthogonal functions in the ocean remote sensing (S2-5009)

16:40 **Sonia Batten, Bill Sydeman, Mike Henry, David Hyrenbach and Ken Morgan**
Ship of opportunity observations of mesoscale eddies in the Gulf of Alaska (S2-5147)

17:00 **Vladimir V. Bezotvetnykh, Evgeny A. Voytenko, Yury N. Morgunov and Dmitry S. Strobykin**
Multifunction acoustic hardware and software system for support of works execution and studies in ocean shelf zones (S2-5008)

17:20 ***Summary***

S2 Posters

S2-5037 **Bin Liang, Yumin Yang, Hanpeng Jiang, Binxia Cao and Yaobing Wang**
DNA fingerprint via REP-PCR of *Escherichia coli* isolates from different point sources of fecal pollution in Jinzhou Bay of China

S2-5039 **Hongbo Li and Yubo Liang**
The distribution character of Cyanobacteria *Synechococcus* sp. in the Northern Yellow Sea, China

S2-5040 **Igor Burago, Georgiy Moiseenko, Olga Vasik and Igor Shevchenko**
From metadata federation to geospatial portal

S2-5054 **Igor D. Rostov, Natalia I. Rudykh, Vladimir I. Rostov and Valentina V. Moroz**
Oceanographic atlas of the South China Sea

S2-5056 **Evgeniya A. Tikhomirova**
Oceanographic regime of Peter the Great Bay (Sea of Japan)

S2-5065 **Qilun Yan and Gengchen Han**
National coastal ecological system monitoring program–SOA

S2-5081 **Dongmei Li, Sha Liu, Yanan Yu, Xingbo Wang, Tao Song, Xing Miao, Guanhua Chen and Yubo Liang**
Real-time PCR for quantification of the protistan parasite *Perkinsus olseni* in Manila Clam *Ruditapes philippinarum*

S2-5129 **Anatoly Obzhirov, Renat Shakirov, Olga Vereschagina, Natalia Pestrikova, Anna Venikova, Olesia Yanovskaja and Elena Korovitskaja**
Methane investigation in water column and sediment in the Okhotsk Sea

S2-5138 **Renat B. Shakirov, Anatoly Obzhirov, Jens Greinert and Urumu Tsunogai**
Methane venting, gas hydrates and mud volcanoes linked to the oil-gas accumulations in the Sea of Okhotsk and Sakhalin Island

S2-5146 **Avianna F. Zhukovskaya, Nina N. Belcheva and Viktor P. Chelomin**
The role of high molecular weigh proteins in response to cadmium in scallop *Mizuhopecten yessoensis*

S2-5182 **Joseph Paimpillil and Kizekpat Balakrishnan**
Ground-water flux to inter-tidal regions and its impacts on coastal primary production

S2-5195 **Valentina V. Slobodskova, Evgeniya E. Solodova and Viktor P. Chelomin**
DNA damage (Comet Assay) as a biomarker of Cd exposure in 1-year-old marine seed scallops *Mizuhopecten yessoensis*

S2-5209 **In-Seong Han, Takeshi Matsuno, Tomoharu Senjyu, Young-Sang Suh and Ki-Tack Seong**
Behavior of a low salinity water mass during summer in the South Sea of Korea using *in-situ* observations

S2-5210 **In-Seong Han, Young-Sang Suh, Lee-Hyun Jang and Ki-Tack Seong**
Ship of opportunity monitoring for short-term variability of the thermohaline front across the Jeju Strait

S2-5242 **Sergey Kamenev and Alexander Tagiltsev**
High-resolution acoustic complex for marine environment monitoring

S2-5255 **Xindong Ma, Zhongsheng Lin, Liangliang Chu and Ziwei Yao**
Distribution and sources of typical persistent organic pollutants in surface sediments from the southern Yellow Sea

S2-5291 **Akira Nakadate, Hiroyuki Sugimoto and Naotaka Hiraishi**
Improvement of the ocean CO_2 flux analysis for the subtropical North Pacific Ocean

S2-5294 **Daoming Guan, Huade Zhao and Ziwei Yao**
Distribution and flux of nitrous oxide in the Liaohe Estuary

S2-5343 **Alexey V. Bulanov, Pavel A. Salyuk, Alexey A. Ilin and Sergey S. Golik**
Application of efficient optical methods for determination of some major chemical components in seawater and phytoplankton

S2-5424 **Shu-Qi Deng, Xue-Kun Li, Xin-Liang Lin, Bao-Hui Li, Xu Wang and Man-Li Wang**
Automatic acquisition of air, ocean and ice temperature fields and ice thickness images in the Bohai Sea

S2-5457 **Sarah Ann Thompson, William J. Sydeman, Franklin B. Schwing, John L. Largier and William T. Peterson**
The California Current Integrated Ecological Database (CCIED): Linking ocean observing with Integrated Ecosystem Assessments (IEA)

S2- 5500 **Zhongqiang Li, Zhiguo Bu and Wenlin Cui**
Demonstration system of real-time monitoring eco-environment of the Bohai Sea

S2 Oral Presentations

30 October, 9:10 (S2-5323) Invited

Observational data for determining physiological parameters and validating model simulations: Suggestions by NEMURO developers

Yasuhiro **Yamanaka**[1,2,3], Yoshie Naoki[4,5], Maki Noguchi Aita[2], Taketo Hashioka[2,3], Hiroshi Sumata[1], Naosuke Okada[1], Takeshi Okunishi[4] and Shin-ichi Ito[4]

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NEMURO (North Pacific Ecosystem Model Used for Regional Oceanography) and NEMURO.FISH (NEMURO For Including Saury and Herring) were developed by the Model Task Team and recently embedded in a general circulation model, COCO (CCSR Ocean Component Model), with medium (~100 km) and high (~20 km) resolutions. A recently developed extended version of NEMURO, eNEMURO, adds subtropical groups of phytoplankton and zooplankton in order to estimate prey fields for young stages of small pelagic fish off the south coast of Japan. The extension required several types of observational data: physiological parameters for setting each process among components in models, and physical and biogeochemical data for initial and forcing data and for validating simulation performances. Data quality and quantity vary for each purpose. For example, estimates of physiological parameters for each plankton functional group and fish spices are needed for developing model parameter sensitivity studies, although more plentiful data with less uncertainty are welcome. The desired quality of physical data, such as ocean circulation and temperature and salinity distributions depends on the model's use: theoretical demonstrations require only a small data set, whereas more realistic simulations for discussing inter-regional, inter-annual differences, especially, data-assimilation studies, need higher degrees of data quality and quantity to simulate physical forcing. Dialogue between researchers who conduct model and observation studies is most essential, although constructs for such conversations may not yet exist. We request observational data, including satellite data, for developing the next NEMURO

30 October, 9:40 (S2-5439) Invited

The realities of integrated measurement and modeling systems

Francisco P. Chavez[1] and Fei **Chai**[2]

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It is abundantly clear that there is a need for both measurement and modeling components for operational ocean observing systems. Yet each of these components matures at a different rate, and a similar problem exists within ecosystem components, *i.e.* physics is well in front of chemistry, chemistry is well in front of biology, phytoplankton is well in front of fish. In the classical scientific process, a set of measurements leads to the development of a conceptual and then typically a numerical model. This model suggests the need for new measurements which either prove the model logic or lead to a reworking of the models. New technologies lead to new measurements (typically over time and space scales not available previously) that result in similar adjustments to the process. At times, some of the discoveries are so novel that they require complete model adjustment. The integration of management into this coupled system generates a new paradigm. In this new process, models develop predictions that lead to management action, *i.e.* global warming will lead to less productive subtropical gyres, hence we should deploy wave generated pumps to fertilize surface waters. The management action leads to a measurable (or not) response by the observing system, and this new knowledge is used to both improve the model predictions and to adjust the management action. Here we provide a few

examples of these systems and predict the time scale of their evolution with reference to measurement and model resolution for some of the components. Measurement intensity and resolution will necessarily be problem dependent and require agile deployment or redistribution of resources.

30 October, 10:10 (S2-5269)

The PICES Metadata Federation: Pacific-wide marine metadata discovery, management and delivery for FUTURE

S. Allen **Macklin**[1] and Bernard A. Megrey[2]

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FUTURE requires assembly of large amounts of disparate information for processing by assessment and forecast tools. These data must be easy to discover and access. The member countries of the North Pacific Marine Science Organization (PICES) separately maintain vast quantities of marine ecosystem data, stored in different languages and formats. To provide common access to these data, we created a PICES "metadata federation" of member countries (Canada, Peoples Republic of China, Japan, Republic of Korea, Russian Federation, and United States of America). Through 1) English-language coding of metadata using the Federal Geographic Data Committee standard, 2) acquisition, installation and configuration of ANSI Z39.50-1995 (ISO 10163-1995) open-source communications software on a public-access server and 3) registration with a common clearinghouse, it is possible for any metadata-serving agency to become part of the PICES Metadata Federation. The federation enables an Internet user to search the collected metadata holdings of any or all members, thus providing access to information across national holdings in a single search. To date, metadata collections from Japan, the Russian Federation, Republic of Korea, USA and China are federated. This activity supports three PICES' goals: to promote and coordinate marine scientific research in the northern North Pacific and adjacent marginal seas; to advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impact of human activities on them; and to promote the collection and rapid exchange of scientific information on these issues.

30 October, 10:50 (S2-5035)

"Hebei Spirit" oil spill fate and trajectory modeling in the western coast of Korea, Yellow Sea

Young Jae **Ro**, Kwang Young Jung and Chung Ho Lee

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"Hebei Spirit" spilled crude oil in the amount of 12,300 liter on Dec. 7, 2007 off the coast of Taean Peninsula, S. Korea in the Yellow Sea. This spill accident was the worst case recorded in Korea in terms of the spilled amount, stained coverage area and degree of impact on the local eco-system. In addition, spill clean-up operation has been carried out since the beginning of the accident and recorded over one million voluntary participants from the Korean citizens. Research and Investigation team have been formed to study the impact of the spilled crude oil on the marine and coastal environment as well as on the aqua-cultural sites extended over 200 kilometers. The numerical models have been developed to hindcast the spreading and diffusion of the spilled oil to estimate the areal coverage of the spill. In addition, fate model of the spilled oil is also being developed as well to predict the behavior of the oil pollutant in the aquatic and benthic environment.

We are developing various modules for the Hebei Spirit oil spill based on the ECOMSED (http://www.hydroqual.com). Model configuration is as follows: model domain is designed 1x1 degrees to cover the dispersion for the initial 30-day period. The model domain is being expanded to cover the much wider spill coverage. Grid system was designed to resolve nearshore area in fine scales down to 100 meter and offshore area in coarse scales up to several kilometers. Model open boundaries are forced by the 4 major tidal constituents to reproduce tidal current system.

Reproduced tidal currents are shown on the flood and ebb phases. They are directing north-south in the off shore waters, whereas in the inshore waters, they are more rectilinear along the coastline. Spreading and diffusion of the Hebei Spirit oil spill will be estimated and their animation will be shown in the presentation.

30 October, 11:10 (S2-5374)

Status of Krill (*Euphausia pacifica* and *Thysanoessa spinifera)* in the northern California Current EEZ: A review of sampling methods and data sets

Jennifer **Menkel**[1] and William Peterson[2]

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[2] NOAA-Fisheries, Northwest Fisheries Science Center, Hatfield Marine Science Center, Newport, OR, 97365, USA

Many types of nets are used to sample krill: how will modelers properly assemble these data from different sampling methods? Modelers need clean, consistent data, with high frequency, long duration, broad spatial resolution, and few time breaks. How do we reconcile our current state of data with what modelers need? How do we bridge the gap between historical data sets (that likely undersample euphausiids) and those from modern technologies such as acoustics and video cameras? How exactly are we to determine the true biomass of krill? Another unknown is the size of "krill swarms" and "patchiness". What we know is that *E. pacifica* and *T. spinifera* exhibit extreme variability across their range and within years. We summarize the status of reported information on *E. pacifica* and *T. spinifera* densities and biomass from historical data sets collected within the California Current, including La Jolla, Monterey, Newport and Vancouver Island. We also discuss the catchability of krill by species, length, and reproductive state for several net types: MOCNESS, bongo and vertical net. The comparison of traditional samplers (bongos and multi-nets) with simple vertically towed ring nets will reveal if other research groups with extensive vertical ring-net sample archives can use such samples to estimate historical krill biomass. We also attempt a comparison of krill biomass estimates derived from net tows and acoustics.

30 October, 11:30 (S2-5143)

Introduction for long-term monitoring in the sardine spawning area: Seasonal and annual variations of plankton biomass and compositions

Hiroya **Sugisaki**[1], Kiyotaka Hidaka[1], Tadafumi Ichikawa[1], Yutaka Hiroe[1] and Yuuichi Hirota[2]

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The Kuroshio warm current sea area is known as a main spawning field of various important pelagic fishes (*e.g.* Japanese sardine, Pacific saury). However this area is thought to be a low nutrient and primary production area. The long term variation of the stock size of these pelagic fishes has been observed. The important mechanism of the variation is thought to be bottom up controlled by the abundance and composition of phytoplankton and zooplankton. Therefore, we have been conducting monitoring research of the ecosystem in the Kuroshio area, and analyzing seasonal and annual variations of plankton biomass and compositions in relation to physical conditions since 2002.

The seasonal variation of primary production has been well observed. In the main spawning area of sardine, the primary production and chrolophyll-*a* concentrations during late winter and early spring were both high compared to other seasons. High abundance of small copepods followed the high seasonal abundance of phytoplankton. The main spawning seasons of sardine and saury in the Kuroshio area are winter and early spring. Therefore it seems that the high abundance season of low trophic level production was well timed for the reproduction and larval survival of sardine and saury in this region. The annual variations of plankton biomass were also observed. These variations seem to affect the fluctuation of nutritional condition for survival of larval pelagic fishes. Long term monitoring of the ecosystem of Kuroshio area is necessary for the analysis of stock condition of Japanese fisheries.

30 October, 11:50 (S2-5177)

Measurement of fish school abundances in shallow sea using omnidirectional multi-beam sonar

Yong **Tang**[1], Kohji Iida[2], Tohru Mukai[2] and Yasushi Nishimori[3]

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Previous studies have estimated stock abundance of pelagic fish schools using commercial scanning sonar. However, such measurements are influenced by reverberations from the sea surface and bottom in shallow areas. We have developed a method to extract the regions of fish school echoes from the reverberation using raw volume backscattering strength signal (RSV, the output signal with 20log*r* TVG and factor of multiple echo). Field investigations of pelagic fish school were conducted in shallow seas using omnidirectional multi-beam sonar (FSV30 research version, 24 kHz, Furuno). After recording the RSV of fish school echoes, the school biomass was measured by purse seine capture. In post-processing, the fish school echoes were extracted and the relationships between a school's biomass, its echo area, and the averages of RSV per ping were considered for various species. We found a positive correlation between the sonar-measured school area and school biomass, but no correlation between the average of RSV and school biomass. The echo integration method for sonar survey using RSV over a broad area, and methods for averaging the target strength (TS) in three dimensions with respect to echo integration method are also discussed.

30 October, 12:10 (S2-5084)

DGGE technique and its application in marine environmental microbial diversity study

Zhen-dong **Zhang**[1], Shu-fen Wang[2] and Ya-nan Zou[2]

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Microorganisms are highly abundant in the marine environment and play important roles in marine ecological systems. Marine microbes represent a potential source for important bioactive compounds and their bioremediation capabilities are also remarkable. But we know little (approximately 1%) about marine microorganisms resources and their diversity, owing to the limitation of traditional microbiology technology and methods. In recent years, modern molecular biotechniques have been developed which have been rapidly and widely used in the study of marine microorganisms. This facilitates understanding of the marine microbial diversity and their ecology. In the present paper, the principle and application of denaturing gradient gel electrophoresis (DGGE) technique is described, including its potentials and disadvantages. Furthermore, PCR-DGGE was performed to make a preliminary investigation on *vibrio*s in the inshore area of Dalian in different seasons. *Vibrio*s are widespread in eutrophic environments, including estuaries, marine coastal waters and sediments and aquaculture settings. Seawater samples were collected from 2 stations and bacteria mixtures were captured by vacuum filter method. An improved method for rapid DNA extraction of bacteria was developed. *Vibrio* species target fragments were amplified with a set of *vibrio* specific primers followed by DGGE analysis of PCR products. The results showed that the bacterial community structures are different between the 2 stations and bacterial cell density fluctuated in different seasons. This whole culture-independent method can be performed in less than 30 h. Compared with traditional culture-dependent analysis, the PCR-DGGE method proved to have a much higher sensitivity and efficiency to analyze microbial community structure and fluctuation in a fast, reliable, and reproducible manner.

30 October, 14:00 (S2-5247)

An application of a deeper-type underwater glider to observe temperature, salinity, DO and Chl-*a* distributions and its connection to an operational ocean forecasting model

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Underwater gliders create horizontal propulsion by converting vertical velocity generated by buoyancy to forward velocity and enable sawtooth trajectory observations. A deeper-type underwater glider (Slocum, Webb Research Corporation) was deployed and tested in Japanese coastal waters. The glider is able to dive to 1000 m, and its observational endurance is about 30 days. The horizontal speed is 0.4 m/sec, making the observational range 1500 km. The glider was equipped with a CTD (Neil Brown Ocean Sensor), a DO-sensor (Aanderaa Optode 3830) and a fluorometer (Wet Labs. FLNTUSLK). Unfortunately, the total volume of data sent from equipped sensors was too large for the receiving computers, and data records were lost. Additionally, several sensors showed bias error. Most of these problems can be solved. The data observed by the glider have much finer horizontal resolution (about 1 km) than standard ship observations (about 20 km). Especially, 1-km chl-*a* data showed more complex features than expected. Fisheries Research Agency (FRA) Japan is operating an ocean forecasting model (FRA-JCOPE). We are planning to undertake operational monitoring with gliders and incorporate those data into data assimilation of FRA-JCOPE. This connection between glider and model is expected to bring more precise prediction and reanalysis data for ocean conditions. Such a coupling is an important step forward in the conduct of ecosystem-based management.

30 October, 14:20 (S2-5168)

Photosynthesis, photoacclimation, and ocean surface pCO_2

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Surface ocean CO_2 partial pressure (pCO_2) data collected underway by research ships and Volunteer Observing Ships represent the largest available ocean carbon data archive, and are arguably the most spatially extensive data set in ocean chemistry. Satellite ocean colour data, by contrast, are global and synoptic but offer only indirect inferences about the carbon cycle. Phytoplankton photoacclimation is a key process tying the 'observable' quantity (ocean colour) to the processes of interest (phytoplankton photosynthesis and regulation of surface ocean pCO_2). In a recent model sea-truth exercise, it was shown that (1) modeled primary production showed interannual variability similar to that calculated from ocean colour observations, (2) model configurations with the most interannual variability in primary production had the highest predictive skill for pCO_2, and (3) modelled pCO_2 was much more sensitive to slight differences in model configuration than was primary production. In other words, some model configurations accurately modelled primary production but had little predictive skill with respect to pCO_2. These examples indicate the inadequacy of some of the usual measures of model skill, and show that interactions of upper ocean physics, chemistry, and biology affect air-sea CO_2 exchange in complex and sometimes counterintuitive ways.

30 October, 14:40 (S2-5311)

Peculiarities in distribution parameters of the carbonate system of Amurskiy Bay (East/Japan Sea) during summer 2007

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An extensive hydrochemical survey of Amurskiy Bay (East/Japan Sea) was carried out in August 2007. Measured parameters included temperature, salinity (S), dissolved oxygen, total alkalinity (TA), pH at 20°C, nutrients (ammonium, nitrite, nitrate, phosphates, and silicates), concentration of humic substances (HS) and

chlorophyll *a*. Estimates of $pH_{in\ situ}$, DIC (Dissolved Inorganic Carbon), and pCO_2 (partial pressure of carbon dioxide) were calculated from the measured pH (20°C), TA, and concentrations of HS. Distribution of the carbonate system parameters revealed non-linear dependence of TA *vs.* S for the Razdolnaya River-Amurskiy Bay estuary. This fact is better explained by temporal variability of TA in the river than by actual nonconservative behavior of TA during mixing of fresh and salt waters. Very low CO_2 partial pressures (about 150 uatm), measured within the 20-25‰ salinity range were caused by intensive photosynthetic activity. Significantly low values of normalized TA were obtained at some sites within Novik Bay (a secondary bay of Amurskiy Bay) where *zostera manna L.* grows. Probably the humification process of dead seaweed is responsible for the low normalized TA. There is an area in the central part of Amurkiy Bay with very high CO_2 partial pressure (more than 2000 uatm) in a near-bottom layer of water. This finding is most important because the high CO_2 partial pressure area is co-located with an area of heavy hypoxia.

30 October, 15:00 (S2-5001)

Upper ocean export of particulate organic carbon in the Bering Sea estimated from thorium-234

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During the Second Chinese National Arctic Expedition from July to September 2003, depth profiles of dissolved and particulate ^{234}Th in upper water columns were collected at two stations in the Bering Sea and another one station on the northern mouth of the Bering Strait. Thorium-234 was sampled by using a traditional $Fe(OH)_3$ co-precipitation technique, which is a reliable approach to ^{234}Th measurement. We observed ^{234}Th excess at one station below the euphotic zone, which is possibly due to intensive remineralization of particulate matter. Particulate organic carbon (POC) was estimated from a one-dimensional irreversible steady state model of ^{234}Th fluxes together with measurements of the POC/^{234}Th ratio on the suspended particles. The POC export from the euphotic zone varied between 15.39 and 23.38 mmol C m^{-2} d^{-1}. In comparison with observations of other seas, our results suggest that the biological pump would run effectively in summer in the Bering Sea, sub-arctic Pacific Ocean.

30 October, 15:20 (S2-5226)

Distribution maps of persistent organic substances in the coastal zone of China

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Persistent organic substances mapped were organic pollutants that exist widely in the marine environment, including PAHs, PCBs, pesticides, PBDEs, TBT and some other hazardous substances. On a national basis, PAHs levels in the atmosphere were relatively high, especially in the north. Furthermore, surface water was universally polluted by PAHs in some areas. The concentration of PAHs in sediments tended to be a low risk in most areas, while the distribution profile in sediment cores showed a tendency of rapid increase with economic development. No regional distribution chrematistics of PCBs were found in the coastal zone of China; point-source pollution was the common pattern of contamination, influenced primarily by local geographic, economic, management and historical factors. Dalian Bay in northeastern China, and Pearl River and Taiwan Province in southeastern China had relatively high level of PCBs, while most other regions had lower average concentrations of PCBs. Serious pollution of PCBs was found in some locations, most of which are harbors and industrial areas, the places where improper disposal of, and leakage from, PCB containers taken place. Concentrations of PBDEs in sediment samples and biology samples from the coastal zone of the Bohai Sea were 0.074~5.24pg/g and 0.31~2.73pg/g (dry weight), respectively. The concentration in sediments of Tianjin and Liaoning provinces were lower than those in Shandong and Hebei provinces. The main pollutant monomers were low PBDEs, which reached 75.3% of total components, and the highest were BDE28, 47, 66, 99 and 100. The largest differences from the references occurred with the monomers BDE28 and 66.

30 October, 15:40 (S2-5218)

Assessment of trace metals contamination in surface sediments of Peter the Great Bay (Japan/East Sea)

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Pollution is an important constituent of ecosystem impact in the urbanized coastal regions. In global climate change conditions, pollution may perform an even more dramatic role, when the local ecosystems become altered and more vulnerable. Peter the Great Bay (Japan/East Sea), having unique floral and faunal composition, is influenced from significant anthropogenic loading, including heavy ship traffic, navy, port facilities, predominantly untreated municipal and industrial wastes from Vladivostok (the largest city of Primorskiy krai) and other cities and towns. Metals are the common tracers of overall pollution and may form geochemical anomalies in the vicinity of discharge points. This study assessed the environmental impact of hazardous metals on coastal waters of Peter the Great Bay. The multivariate statistics and GIS approaches revealed the primary sources of metal entry to the embayment and enabled contouring of local areas with increased metal concentrations in bottom sediments. The important part of this study was the firm estimation of modern background levels of metals in sediments, calculated on the basis of robust estimators. Such background levels efficiently eliminate existing outliers in the data set and have predictive capability. Results of the study revealed that up to 20% of coastal areas of the bay are moderately polluted with metals and metalloids, and only local areas are heavily polluted. Increased levels of hazardous metals such as As, Cd, Cr, Cu, Hg, Ni, Pb in bottom sediments produce negative biological effects on benthic organisms. In fact, these effects were varied from the metals' accumulation in native bivalve species to the evident disturbances in benthic community structure in the locations contaminated.

30 October, 16:20 (S2-5009)

The application of empirical orthogonal functions in the ocean remote sensing

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The empirical orthogonal functions method is used for processing of visible spectrum data from MODIS imagery. The normalized water-leaving radiance spectra are expanded into series using empirical orthogonal functions (eigenvectors of a covariance matrix) as a basis. In this study 11 bands of MODIS from 412 nm to 748 nm are involved in analysis. Only few eigenvectors are responsible for a major part of spectra variability. It allows performing classification of pixels using the expansion coefficients. In the space of the first three coefficients it is possible to split spectra into classes corresponding to water masses with a different optical response. Examples from Great Peter Bay are presented.

30 October, 16:40 (S2-5147)

Ship of opportunity observations of mesoscale eddies in the Gulf of Alaska

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Anticyclonic mesoscale eddies are a common feature of the rim of the Gulf of Alaska and contribute to cross-shelf exchange and the overall productivity of the region. They are readily visible on satellite images of sea surface height anomalies. Ships-of-opportunity have crossed the Gulf of Alaska since 2000 collecting plankton samples with a Continuous Plankton Recorder towed behind the vessel, some chlorophyll data and also with a

bird and mammal observer on many of the transects. Some 34 eddies have been opportunistically sampled in the Gulf of Alaska by the survey. This dataset has allowed us to examine the influence of the size, age and intensity of eddies on distributions, abundances and species composition within lower and upper trophic level pelagic communities. For example, both taxonomic richness and planktonic abundance appear to be increased within the eddies, particularly in large, younger eddies. The frequency of eddies is linked to climatic conditions (wind strength) and is therefore likely to change as climate changes in the future. This study emphasises that observations and models in this region need to account for mesoscale physical forcing of biological parameters.

30 October, 17:00 (S2-5008)

Multifunction acoustic hardware and software system for support of works execution and studies in ocean shelf zones

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Future economic development of ocean and sea shelf zones requires knowledge of the dynamics and structure of the water column in the operating areas of undersea robots, boring towers, platform *etc.* Acoustic tomography (temperature and fow field reconstruction from the measured acoustic transmission time along the rays propagating from source to receiver) offers great potential for remote acoustic monitoring of dynamic processes in shallow water areas but requires suitable acoustic hardware and analysis methods. Experimental and theoretical studies in the Japan Sea shelf zone serve as the basis for evaluation of a multifunction acoustic hardware and software system that can be applied in other shallow zones. The system uses multiplex phase manipulated signals, and allows one to identification and travel times measurement of sound impulses propagating along different ray trajectories in diagnosed hydroacoustic duct. By using the inversion of travel time one can reconstruct temperature and flow fields, tidal and inner waves parameters. The signals can also be used for navigation and control of undersea robots, and information transmission in the systems deployment zone. In the paper, we present the specification of the system and results of experimental tests of its functional capabilities.

S2 Posters

Poster S2-5037

DNA fingerprint via REP-PCR of *Escherichia coli* isolates from different point sources of fecal pollution in Jinzhou Bay of China

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Fecal pollution is a serious environmental problem that affects many coastal regions in China and worldwide. Pathogens associated with fecal pollution can lead to human disease and economic losses in industries that depend on coastal waters, such as shell fisheries. This is an important problem which greatly impacts the water quality of Jinzhou Bay. But it has been difficult to track the sources of fecal pollution. Fecal coliform bacteria have been extensively used as an indicator of fecal pollution and the potential presence of other pathogenic microorganisms in water. *Escherichia coli* is a common inhabit of animal and human intestines and recent studies have shown that isolates from humans and various host animals (*e.g.* cattle, chickens, and pigs) may differ genetically and phenotypically. It's simple to isolate and enumerate *E. coli* strains in water. A developing science referred to as bacterial source tracking (BST) which employs genetic and biochemical tests may allow the original host animal and likely sources of bacterial contamination of water to be identified. The scope of this study was to identify and differentiate between *Escherichia coli* strains which originated from the feces of humans or various agricultural animals, using the repetitive extragenic palindromic elements-polymerase chain reaction (REP-PCR) protocol. Thirty-two different isolates were identified from fecal samples obtained from

chook, cow, pig and human. All these strains were analyzed by genomic DNA extraction, REP-PCR amplification and agrose gel-electrophoresis detection, and *E.coli* strain ATCC 25922 was used for the standard-isolation of the REP-PCR reactions to assess reproducibility and as positive control. The DNA fingerprint obtained from gel-electrophoresis showed the high genetic diversity between different source samples and low genetic diversity between same source samples.

Poster S2-5039

The distribution character of Cyanobacteria *Synechococcus* sp. in the Northern Yellow Sea, China

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The abundance, biomass and character of distribution of *Synechococcus* in the Chang-Shan Islands of Northern Yellow Sea were investigated as well as the contribution of *Synechococcus* to the total planktonic biomass in four seasons, winter (Jan.), spring (Apr.), summer (Jul.) and autumn (Oct.) in 2007. In spring, summer, autumn and winter, the abundance of *Synechococcus* was 1.67×10^3 cells/ml, 10.21×10^3 cells/ml, 6.28×10^3 cells/ml and 3.05×10^3 cells/ml. The seasonal variation was summer>autumn>winter>spring. The *Synechococcus* to the total planktonic biomass in the four seasons were on average 1.56% in spring, 4.26% in summer, 3.11% in autumn and 7.44% in winter, the character of seasonal distribution was winter>summer> autumn>spring. The relationships between *Synechococcus* biomass and nutrients, including nitrate, nitrite, ammonium, phosphate and silicate, were analyzed with the software SPSS11.0. The results showed the correlation coefficient between *Synechococcus* biomass and nitrate, ammonium were 0.81 and 0.55 ($n = 30$, $p < 0.05$), respectively, in winter. The correlation coefficient between *Synechococcus* biomass and nitrate, silicate were 0.74 and 0.49 ($n = 90$, $p < 0.05$) in spring. The correlation coefficient between *Synechococcus* biomass and nitrate, ammonium were -0.71 and -0.77($n = 90$, $p < 0.05$) in summer. The correlation coefficient between *Synechococcus* biomass and nitrite, nitrate, phosphate were -0.83,-0.55 and -0.65($n = 90$, $p < 0.05$) in autumn. So, the relationship between nitrate and *Synechococcus* biomass was significant, which suggests that nitrate was a limiting factor in the four cruises.

E/Poster S2-5040

From metadata federation to geospatial portal

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One of the main outcomes of the PICES Metadata Federation project [1] is the formation of a community of distributed data providers from the PICES member countries who publish their collections of metadata. However, the technology and standards used and services provided by the employed NSDI [2] have several disadvantages for PICES as an international organization. GeoNetwork opensource [3] was considered by the MDF team only as an alternative tool for searching against several Z-servers created in the frame of the project [1]. In fact, it allows much more. GeoNetwork opensource is an implementation of the OGC Reference Architecture [4]. In combination with such a free tool as GeoServer [5] it provides:

- Portal Services for authentication and access control, advanced metadata editing, map visualization, *etc.*,
- Catalog Services that actually implement a metadata, data, information, and services clearinghouse,
- Data Services components to access spatial content and allow data processing,
- Portrayal Services to process geospatial information and prepare it for presentation to the user.

GeoNetwork opensource and GeoServer were installed and configured on the PICES rented server as a prototyping geospatial portal [6]. These new services available online may be used by the PICES secretariat, members of scientific committees, programs and projects for sharing and distribution of metadata, data, information and services easily and systematically.

E/Poster S2-5054

Oceanographic atlas of the South China Sea

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The electronic Atlas presents a summary of many of the most important aspects of the South China Sea (SCS) regional oceanography. The first version of CD-ROM includes both software and the generalized available historical data and information on the FES physical and geographical characteristics, hydrometeorological regime, physical and chemical oceanography, presented as tables, pictures and text materials. It is based on the WOA'2001 and POI archival oceanographic data, as well as on the results of completed research studies scattered in numerous special scientific transactions, archives and web-pages. It comprises figures, tables, data and short description of: 1) Geographical and climate features. 2) Horizontal and vertical distribution of temperature, salinity, sound velocity and chemical elements by month and seasons. 3) Water masses. 4) General circulation and surface currents by seasons. 5) Tidal phenomena. 6) Links to other data and information on WEB. The system provides quick access to raw data, gridded data and information specially selected and stored on CD-ROMs and in the "on-line" mode (http://pacificinfo.ru/data/cdrom/9/).

Poster S2-5056

Oceanographic regime of Peter the Great Bay (Sea of Japan)

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Peter the Great Bay is located in the northwestern part of the Japan Sea and bounded by a line going from the Tumen River mouth to Povorotniy Cape. The distribution and variability of oceanographic parameters (water temperature and salinity, dissolved oxygen content, and concentration of phosphates and silicates) in Peter the Great Bay are analyzed using all available data series for the period 1925-2001 (obtained by regional Hydrometeorological agencies, Pacific Fisheries Research Center, Hydrographic Service, and Russian Academy of Sciences). The total number of the analyzed oceanographic stations is 25,062. The data are distributed by 10'longitude x 10'latitude squares. The spatial scale of data averaging depended on the distribution of source data and was chosen to get a more detailed picture of the distribution of oceanographic parameters. The vertical distribution of oceanographic parameters and their spatial and temporal variability have been described for 5 large geographic parts of Peter the Great Bay (Amursky Bay, Ussuriyskiy Bay, offshore waters of the bay, Posiet Bay, Nakhodka Bay, and Vostok Bay). The parameters distribution is explained by multiyear monthly averaged charts for the depth 0, 20, 30 and 50 m (moreover, 10 m for dissolved oxygen). The set of the charts characterizes seasonal variability.

Poster S2-5065

National coastal ecological system monitoring program–SOA

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The State Oceanic Administration conducted ecological monitoring in 18 coastal ecological monitoring and control zones since 2004. So far, the total area of the monitoring and control zones is 52 thousand square kilometers. The dominant ecological types include typical marine ecological systems as gulfs, estuaries, coastal wetlands, coral reefs, mangroves and sea grass fields, *etc.* The content of monitoring included environmental quality, structure of organism community, function of the breeding grounds as well as development activities, *etc.* Results of monitoring indicate that, most of the eco-systems of the coral reefs, mangroves and sea grass fields were in a state of healthy conditions. However, ecosystems in bays, estuaries and coastal wetlands were in a state of sub-healthy and non-healthy conditions. Successive monitoring over the past four years indicate that,

major ecological problems of the ecosystems of the bays, estuaries and wetlands of China were eutrophication and imbalance in nitrogen/phosphate proportion, environmental pollution, habitat lost or changed, abnormal structure of organism community as well as degeneration of estuary breeding grounds, *etc.* Dominant impact factors were the land based pollutant discharges into the sea, invasion of marine habitat due to reclamation of land from the sea and excessive exploitation of marine resources. Generally speaking, the trend of deterioration of the ecological environment of marine ecosystems of the coastal waters of China had not yet been effectively mitigated.

Poster S2-5081

Real-time PCR for quantification of the protistan parasite *Perkinsus olseni* in Manila Clam *Ruditapes philippinarum*

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The protistan parasite *Perkinsus olseni* is a severe pathogen present in shellfish throughout the world. Developing more sensitive and rapid molecular diagnostic techniques than traditional PCR is important for the management of *Perkinsus olseni* disease in shellfish. SYBR Green I and TaqMan real time PCR assays were developed in this study for quantification of *P. olseni* in shellfish with the species-specific primers and probe designed by targeting the multi-copy internal transcribed spacer region of 18S-28S rRNA. The results show that both the two real time PCR assays were more rapid, sensitive, and specific than traditional PCR. To compare the two real-time PCR assays, both the standard curve of the SYBR Green I (detection range from 1×10^1 to 1×10^8 copies per reaction, slope = -3.481044, R^2 = 0.999321) and TaqMan (detection range from 1×10^0 to 1×10^8 copies per reaction, slope =-3.430722, R^2=0.999430) real-time PCR assays showed very good linear regression between threshold cycle (Ct) and log starting quantity of copy numbers. The melting curve analysis of the SYBR Green I real time PCR showed melting temperature at 84.8°C, indicating PCR products were that of the *P. olseni* sequence and thus the standard DNA used in this study was specific for *P. olseni.* Furthermore, the result of the detection limit for the SYBR Green I real time PCR assay was 10 copies of *P. olseni* DNA per reaction. The TaqMan-based real-time PCR assay was more sensitive than the SYBR Green I and can even detect 1 copy of DNA per reaction. Thus the two real time PCR assays using the standard *P. olseni* DNA had a high sensitivity for quantification of *P. olseni*.

Poster S2-5129

Methane investigation in water column and sediment in the Okhotsk Sea

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Measurements of methane dissolved in the water column and sediment in the shelf, slope and deep parts of the Derugin Basin in the Sea of Okhotsk have been collected since 1984 (Obzhirov *et al.*, 1989, Obzhirov, 1993). Between 1884 and 1988 background methane concentrations were 20-30 nl/l in the bottom waters of the Sea of Okhotsk. Methane anomalies (300-400 nl/l) were found usually located over oil-gas deposit sites. After 1988 background methane concentrations increased to 70-80 nl/l and anomalies to 10000-20000 nl/l in water column of the shelf and slope Sakhalin area of Derugin Basin. More extensive methane sampling was conducted in the water and sediment of the Sea of Okhotsk during 8 expeditions of the KOMEX-project (GEOMAR Reports 82, 88 and 110, 1998-2002) and four expeditions CHAOS projects (2003, 2005 and 2006). Expeditions during projects were carried out on the Russian research ship “Akadimik Lavrentyev”.

The main objectives of this study were:

- To study in more detail methane distributions in an area with methane flares and gas hydrates (NE Sakhalin slope near “Obzhirov” flare) and “Barite Mounds”.
- To use methane flares and methane concentration fields in water and sediments as a criteria to search for new areas with gas hydrates.

- To study the relationship between gas hydrates and anomalies of methane concentrations in the water column and sediments and methane flares.

There main findings of this study can be summarized as follows:

- Increased methane concentrations in water column from 1988 to 2007. The first peak anomaly of methane (1000 nl/l) in bottom water came before the Neftegorsk earthquake (May 1995). After this methane concentration continued ncrease to 1500 nl/l before 1999. In 2000 methane concentration decreased again about 1000 nl/l and in 2001-2002 it sharply increased.
- Increasing number of methane fluxes (flares) in Eastern Sakhalin shelf and slope. Bubbles of methane with fluid migrate from sediment to water via zone fault and forms sound-scattering body like flare. They come from bottom water to up about 300-500 m and some time later, distribute to surface water and with intermediate water layers to semi-horizontal direction.
- Methane concentrations in water column show a high correlation to the number of flares.
- Sources of methane are oil-gas deposits and destabilized gas hydrates.
- Bubbles of methane create morphological holes and mounds structures in surface sediment and mineral assemblages with carbonate concretion
- Methane concentration inside flare is greater than 20000 nl/l and near flares about 1000-3000 nl/l. The sediment in NE Sakhalin slope areas show methane concentration of 5-10 ml/l
- Together with methane anomalies of mercury were found as well as in water columns and in free gas of mud volcano on the East shore of Sakhalin.
- In shelf and middle slope (depth 500-700 m) of NE Sakhalin area content 4 layers in water column with methane anomalies: surface, sub-surface, intermediate, and bottom. It connects with many flares of methane bubbles and hydrology mobility in this area.
- Methane monitoring showed that the surface water on shelf and slope East Sakhalin area of the Sea of Okhotsk has anomalies of methane (500-1000 nl/l) mostly in Autumn and Spring seasons. In these seasons methane is more intensive will emanate from surface water to atmosphere.
- Field of methane anomaly in bottom water was found in area “Barite Mounds”. Thickness layer of methane anomaly is 50-70 m only. It locates in depth 1400-1500 m above mounds contented sediment with barite mineralization.

Poster S2-5138

Methane venting, gas hydrates and mud volcanoes linked to the oil-gas accumulations in the Sea of Okhotsk and Sakhalin Island

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We investigated methane emissions from the oil-gas and gas hydrate bearing interior induced by different geological conditions in the second largest marginal sea of the Pacific Ocean, the Okhotsk Sea and Sakhalin Island. Methane escape geo-systems explored for 1989-2007. The distribution of all discovered sites of methane emission are related genetically with hydrocarbon accumulations, spatially with local structures, and controlled by recent deep faulting especially along the sea margins. Eastern Sakhalin, eastern Sakhalin offshore region are related to a transform tectonic plate boundary. Most onshore and offshore hydrocarbon accumulations in this region have been discovered here. Modern high seismic activity and active faults that break through the sea floor create a favorable gas-permeable state along this border. Anomalously high ambient methane concentrations in the water column (up to 30.000 nl/l above gas hydrates locations) reflect that situation geochemically. We observed that when gas saturated fluids penetrate the sea floor, particularly via the system of faults, deformations of the BSR, mud volcanoes, gas-hydrothermal springs, and pockmark-like structures are originated. Submarine gas vents are usually accompanied by contrast acoustic anomalies in the water column (up to 300 flares prior to 2007 above methane hydrates off NE Sakhalin). It is important to conduct comparable type research in sediment basins, which are located onshore Sakhalin and continue offshore. The Yuzhno-Sakhalinsky Mud Volcano (YSMV) is the most active with regard to gas emission and mud/water discharges relative to other Sakhalin Island mud volcanoes. In the YSMV, during the observation periods, the methane content showed a range of 32-2 vol%, since a main gas component of this volcano was CO_2: 66–94 vol% correspondingly. The increase of spontaneous gas emission

and gas chemical variations as well temperature growth under the mud field surface of the YSMV observed during earthquakes in August 2007 (Nevelsk Earthquake, 6.7 in the Richter scale, 2 August 2007) south of Sakhalin. This and other outcomes are indicators of tectonic stress behavior during seismic activity.

It is highly likely that the intersections of the NE-striking transverse faults on land with the Central Sakhalin and Hokkaido-Sakhalin Shear Zones determines the sites of the mud volcanoes, and that this pattern continues offshore where the intersections with the East Sakhalin and West Derugin Shear Zones determines the sites of the gas venting. On the NE Sakhalin we investigated numerous hydrothermal springs (T 39-52°C) supplied by methane bubbles (90-93 vol.%), which we supposed also on the neighboring shallow shelf. The analysis of CH_4-carbon stable isotopes (MS analyses) from both volcanoes shows YSMV: - 23 till -29 per mille PDB; PMV: -22 till -23 per mil PDB, which specifies methane thermogenic origin. Interrelation of mud volcanoes and offshore seepage gas geochemical mode with seismic activity of fault zones is undoubtfull. But it is very complicated and its revealing is an actual problem of modern geological researches.

Thus, active methane venting within the studied thick hydrocarbon prone Cenozoic sediment basins (up to 10 km sediments) in study area naturally linked to multiple hydrocarbon accumulations: oil and gas deposits, and gas (methane) hydrates. There are many geological types of methane emission are classified: cold seepage, hot venting, mud volcanoes, wide seepage areas above oil-gas deposits and abrasion zones, submarine methane-barium saturated fluid vent and others. The methane and gas hydrates origin, gas flux and temperature are discussed. That work is supported by Fund of Russian Science Support 2008, Russian State Project 02.515.11.5017.

Poster S2-5146

The role of high molecular weigh proteins in response to cadmium in scallop *Mizuhopecten yessoensis*

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Organisms have evolved cellular response called stress protein response that increases their tolerance in adverse environmental conditions. It is well known that among several stress proteins metallothioneins (MT) bind essential and toxic metals. The scallop *Mizuhopecten yessoensis* is the most interesting organism because it is able to accumulate toxic cadmium in its digestive gland. However in the digestive gland of *Mizuhopecten yessoensis* MT (metallothioneins) have not been found. We found that cadmium can induce high molecular proteins in the digestive gland of *Mizuhopecten yessoensis*. The results of experiments have shown that Cd-binding proteins have a number of properties similar to MT: acetone and temperature stabilities; binding of some metals, including copper, zinc and cadmium. Protein chromatography (FPLC, Superosa 6) from the digestive gland of the scallop *M. yessoensis* has shown that cadmium is associated with high molecular weight Cd-binding proteins (43, 68 kDa and more). In experiments we have been shown that Cd-binding proteins are able to induce under cadmium exposure. Further, we have been also found that Cd-binding stress-proteins possess an antioxidant activity. The results of this study strongly suggest that the scallop *Mizuhopecten yessoensis* has a unique and a well-developed system of detoxification of heavy metals and it provides maintenance of a relatively stable biochemical system under heavy metals pollution conditions.

Poster S2-5182

Ground-water flux to inter-tidal regions and its impacts on coastal primary production

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Ground-water discharge influences coastal chemistry through supply of nutrients and trace metals. Boosting of primary productivity in regions of subterranean water discharges into the Arabian Sea was recently identified. The decadal trend of chlorophyll showed a "greening" of the near-shore waters with 3 times greater chlorophyll-*a*

than reported values. These ground-water fluxes depend on 1. climatic (monsoon) variability, which controls the flood discharges into backwaters and provides the force to overcome the frictional resistance of the porous sediment beds, 2. human factors (land use mosaic, socio economic and sanitary conditions) and 3. tidal factors that control the hydraulic difference between sea and brackish water. The most significant quantity of ground-water flow occurs during the monsoon months when water level in the backwater is high and sea level at its annual low. The possibility of heavy rains and flash floods are high with climate variability. Such critical conditions can occur during other seasons and also at similar locations. The significance of this study is that subterranean flows could redefine the very concept of formation of mudbanks, which is currently recognized only as an oceanographic process. Remote forcing from the land (subterranean flow) appears to be an initializing mechanism for certain coastal oceanographic processes and fishery resources. If the existence of the subterraneous channels linking the backwaters to the adjacent coast region is proved, it might even re-construct the historical evidence that subterranean flow plays a decisive role in the formation of mudbanks along this region.

Poster S2-5195

DNA damage (Comet Assay) as a biomarker of Cd exposure in 1-year-old marine seed scallops *Mizuhopecten yessoensis*

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Cadmium (Cd) is one of the most toxic heavy metals and can induce the production of toxic hydroxyl radicals that cause various oxidative processes including DNA damage. The assessment of DNA damage by the single cell gel electrophoresis or Comet assay has been described as a useful nonspecific general biomarker of stress in many marine organisms. The marine scallop *Mizuhopecten yessoensis* is the most interesting organism because it is able to accumulate the toxic cadmium in tissues. The aim of the present study was to estimate the influence of cadmium accumulation on the level of DNA damage. Genotoxic damage, expressed as DNA strand breaks, were measured in isolated gill cells from the marine mollusks *M. yessoensis,* age 1 year, using the Comet assay. Significant increase in DNA damage was observed after exposure to Cd compared with control marine scallops. The level of DNA damage was assessed using an image analysis package expressed as % DNA in Tail and Tail Moment. The results of experiments have shown that cadmium accumulation can contribute to the damaging effects to DNA. The data from the present study indicate that the Comet assay is a useful and relatively sensitive tool for detecting DNA damage in marine invertebrates exposed to toxic heavy metals such as cadmium.

Poster S2-5209

Behavior of a low salinity water mass during summer in the South Sea of Korea using *in-situ* observations

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A low salinity water mass (LSWM) <28 psu originated by Changjian Diluted Water frequently approaches Jeju Island and the South Sea of Korea during summer. This LSWM occasionally flows into the East/Japan Sea through Korea Strait and damages coastal fishing grounds and farms around Jeju Island. The National Fisheries Research and Development Institute (NFRDI) has conducted serial oceanographic investigations in the northern East China Sea since 1995 and the South Sea of Korea since 1961. NFRDI also operates a real-time observation system, which continuously measures surface temperature and salinity across Jeju Strait using an instrumented ferryboat since 2006. Temperature and salinity sensors also are moored at fisheries set-nets around Jeju Island and Korea Strait by Kyushu University (KU) since 2004. NFRDI and KU deployed 7 satellite-tracked surface drift buoys around the northern East China Sea in August 2007. These observations show the behavior of LSWM around Jeju Island and the South Sea of Korea in summer. From results in 2006 and 2007, LSWM, which appeared about 175 km west of Jeju Island, approached the west coast of Jeju Island about 8-9 days later. Then, it flowed into the East/Japan Sea through Jeju Strait about 10-12 days later. Salinity concentration in the

LSWM continuously increased from ~25 psu west of Jeju Island to ~32 psu at Korea Strait, and its drift velocity was usually ~20-30 cm/s northeastward. This information will aid prediction of the behavior of LSWM around the South Sea of Korea.

Poster S2-5210

Ship of opportunity monitoring for short-term variability of the thermohaline front across the Jeju Strait

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The sharp and stable thermohaline front between Tsushima Warm Current and South Korean Coastal Water is usually formed around the southwestern coast of Korea during winter and early spring. Though several studies examined its formation mechanism and structure, its short-term temporal and local spatial variability could not be described from the limited observation period. Since 2006, National Fisheries Research and Development Institute (NFRDI) operates a real-time observation system aboard a ferryboat that crosses Jeju Strait. The observing system measures surface temperature and salinity across the strait twice a day and transmits the obtained data to a NFRDI server in real time. Using this ship of opportunity's hydrographic and wind data from February to April 2007, we examined the short-term and local variation of the thermohaline front across Jeju Strait in detail. A distinctive thermohaline front appeared around 34°N, and its spatial temperature gradient gradually weakened. It fluctuated spatially with a period ~3-10 days, and its formation location also moved southward. The estimated velocity of its spatial fluctuation, inferred from temporal variation of the maximum temperature gradient, was about 5-30 cm/s. Wind speed data from a meteorological station near Jeju Strait, showed that a strong northerly monsoon affects the observation area from winter to early spring. The period of this strong northerly monsoon was also about 3~10 days, and short-term temporal variations of the thermohaline front and northerly monsoon were closely correlated. It could be surmised that short-term variation of the thermohaline front across Jeju Strait is related to short-term variation of the northerly monsoon pattern.

Poster S2-5242

High-resolution acoustic complex for marine environment monitoring

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New technical equipment was elaborated for marine environmental monitoring of the World Ocean. The instrument complex includes a narrow-beam waveguide transmitter with the beam width of 35^o at -3 dB level and the frequency bandwidth of 2500-4000 Hz. Additionally, the complex has a hydrophone and deepwater asymmetrical pressure gradient sensor. Such narrow-beam transmitters can be effectively used to examine local small-scale features of inhomogeneous media. The equipment was used to provide several research experiments in the shelf zone of the Japan/East Sea and was found to be highly efficient to resolve marine objects as small as 3-4 m. The waveguide transmitter enabled us to estimate parameters of the object's motions, its density, and other characteristics, which is important in monitoring fish schools, large marine animals, and zooplankton. The essential property of this equipment, crucial for monitoring living organisms, is the reduced acoustical pulse volume, which was attained by high spatial selectivity, low emanation level and short exposition timing.

Poster S2-5255

Distribution and sources of typical persistent organic pollutants in surface sediments from the southern Yellow Sea

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The pollution status of typical persistent organic pollutants (POPs) in the surface sediment of the southern Yellow Sea was examined. Fifteen polycyclic aromatic hydrocarbon (PAHs) compounds in the surface sediment of the southern Yellow Sea were inspected quantitatively with GC-MS. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) were 61.5~214.4 ng/g dw. The levels were relatively lower than those of the other sea areas. Based on the diagnostic ratios of phenanthrene/anthracene (Phe/An) and fluoranthene/pyrene (Flu/Pyr), the dominating source of PAHs in the southern Yellow Sea was the incomplete combustion of fossil fuel. Perylene (Per) was detected from most samples. The low ratio of Per/ΣPAHs (0.1) indicated that the substances from terrestrial source had a low contribution for the accumulation of PAHs in the southern Yellow Sea. The primary input mechanism could be atmospheric transport. The major monomers of organic chlorinate pesticides (OCPs) were HCHs (with the major isomers of α- and β-HCH) and DDTs (with the major isomer of *p,p'*-DDD), whose concentrations were at the range of 1.03~6.26 ng/g (mean = 3.38 ng/g) and 0.11~3.15 ng/g (mean = 1.30 ng/g), respectively. The concentrations of polychlorinated biphenyls (PCBs) were 0.32~14.82 ng/g (mean = 3.75 ng/g). The primary congeners were 4, 5 and 6 chlorinated species, which were up to 32.3% of total PCBs. Atmospheric transport was confirmed to be a major source of the contaminants by investigating the ratio of HCHs and DDTs and the principal component analysis of PCBs.

Poster S2-5291

Improvement of the ocean CO_2 flux analysis for the subtropical North Pacific Ocean

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Japan Meteorological Agency (JMA) annually has produced estimates of CO_2 fluxes for the subtropical region of the northwestern Pacific, since 1999, and the equatorial region of the Pacific, since 2007. Estimates are determined by empirical analysis of CO_2 data observed by the research vessels “Ryofu-maru” and “Keifu-maru”. The current method for the subtropical area is based on the linear relationship between sea surface CO_2 partial pressure and temperature (Murata *et al.*, 1996), but it has a large error in the northeastern Pacific. Because this area is occupied by sub-arctic origin water with low temperature, CO_2 and salinity, the current method might not capture advection effects. By focusing on the relationship between sea surface salinity and CO_2 concentration, we developed a new empirical method by a multiple regression of sea surface temperature and salinity to infer the CO_2 flux in the subtropical area. The new method significantly improved the error in this area, which is confirmed by comparison with data published by Takahashi *et al.* (2007). We will introduce this flux data into the atmospheric inversion model for the analysis of 3-D global CO_2 concentration planned by WDCGG (World Data Centre for Greenhouse Gasses) of GAW. This CO_2 flux information is expected to reduce uncertainty in global warming predictions thorough improvement in the CO_2 analysis of WDCGG.

Poster S2-5294

Distribution and flux of nitrous oxide in the Liaohe Estuary

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Nitrous oxide is one of the important greenhouse gases in air. During May and August 2007, samples of air and water in Liaohe Estuary were collected. The static head space gas-chromatography method was employed to determine the concentrations of nitrous oxide in air and in seawater. The concentration of nitrous oxide dissolved in water ranged from 12.46 to 456.67 $nmol \cdot L^{-1}$ in spring, and from 9.12 to 181.59 $nmol \cdot L^{-1}$ in summer,

revealing that concentrations of dissolved nitrous oxide were higher in spring than in summer. Concentrations of dissolved nitrous oxide in the Liaohe River were much higher than in the coastal area, 14 times more in spring and 10 times more during summer. Dissolved nitrous oxide was supersaturated in all surface water in both spring and summer. There was a notable negative correlation between the concentrations of nitrous oxide and oxygen dissolved in water, with R^2=0.92 in spring and R^2=0.87 in summer. Nitrification and denitrification played an important role in affecting the concentration of dissolved nitrous oxide in water. The fluxes of nitrous oxide from seawater to air were also calculated. The average air-water flux was 145.1$\mu mol \cdot m^{-2} \cdot d^{-1}$ in spring and 4.6$\mu mol \cdot m^{-2} \cdot d^{-1}$ in summer. The Liaohe Estuary area was a source of atmospheric nitrous oxide during the study period.

Poster S2-5343

Application of efficient optical methods for determination of some major chemical components in seawater and phytoplankton

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Knowledge of chemical composition of seawater and phytoplankton is significant in ocean study, particularly in problems of carbon cycle and climate change. Present and FUTURE research, especially that connected with climate, requires efficient methods of measurement. Optical methods allow rapid measurements over a wide range of spatial scales. Laser-induced breakdown spectroscopy (LIBS) was used to determine the chemical composition of seawater and phytoplankton in the Sea of Okhotsk and the East/Japan Sea. The following scheme was used. Breakdown was excited by the in-focus radiation of a Nd:YAG laser. The image of a laser spark is analyzed by a specially designed optical system using a multichannel optical spectrum analyzer. Emission lines of magnesium, sodium, calcium, potassium and carbon were registered in the spectral range 190-800 nm. Also, the LIBS method allows detection of pollutant elements (*e.g.* barium, mercury, strontium) accumulated by phytoplankton. Another useful active optical method is laser-induced fluorescence LIF. Analyses of dissolved organic matter (DOM) and chlorophyll fluorescence intensity obtained by LIF were compared with analyses of carbon, calcium and magnesium measured by LIBS. Simultaneous application of LIF and LIBS on-line provides more information about the chemical composition of seawater and phytoplankton. Such active optical methods are very applicable for efficient large-scale measurements.

Poster S2-5424

Automatic acquisition of air, ocean and ice temperature fields and ice thickness images in the Bohai Sea

Shu-Qi **Deng**, Xue-Kun Li, Xin-Liang Lin, Bao-Hui Li, Xu Wang and Man-Li Wang

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Research on mechanisms for abnormal ice conditions occurring in seas of the temperate zone" is funded by the National Natural Science Foundation of China. The research team used temperature sensors and micro-cameras, designed and built a small, free-moored floating buoy, and established a temperature measurement and underwater camera system. A field test using this system in the Bohai Sea, China, from November 18, 2000, to March 31, 2001, obtained air, water, and ice temperatures and ice thickness images. The observed changes in ice conditions with time provided a valuable basis of information for research on ocean-atmosphere interaction, ice thickness growth processes and sea ice forecasting.

Poster S2-5457

The California Current Integrated Ecological Database (CCIED): Linking ocean observing with Integrated Ecosystem Assessments (IEA)

Sarah Ann Thompson[1], William J. **Sydeman**[1,2], Franklin B. Schwing[3], John L. Largier[2] and William T. Peterson[4]

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Ecosystems are geographic regions comprised of highly complex, and often non-linear, biogeochemical relationships. The developing IOOS and management schema, highlighted in particular by NOAA's Integrated Ecosystem Assessment initiative, should be linked by comprehensive bio-physical ecological databases that can be used to describe spatio-temporal ecosystem dynamics. Understanding and forecasting potential will be enhanced when appropriate derived data from a variety of sources are combined to represent meaningful ecological relationships. However, this is a difficult undertaking. Using information and complex long-term physical, chemical, and biological data from the California Current large marine ecosystem, we have created a simple ecological database (CCIED) focused on derived data maintained by distributed sources. Complex data are condensed into annual, seasonal, or monthly values, and related to complex biological data. As an example, we have created derived data from hourly HF radar plots in northern California and combined this information with derived data on copepod communities off central Oregon from another source, which then are related to salmonid and seabird productivity (again using derived data) from both regions. Derived values are developed using simple averaging to multivariate techniques (EOF/PCA), and represent qualitative indices of ecosystem state and status. In this presentation, we describe the CCIED, and demonstrate how it can be used to address multiple management (wildlife and fisheries) issues simultaneously.

Poster S2-5500

Demonstration system of real-time monitoring eco-environment of the Bohai Sea

Zhongqiang Li, Zhiguo Bu and Wenlin Cui

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The article study on how to use computers, geographic information systems (GIS), databases and other technology to establish the ship-borne rapid monitoring system, the aviation remote sensing application system, the automatic monitoring station unmanned underwater system, the ecological buoy monitoring system, the UAV remote sensing application system, satellite remote sensing applications system, routine monitoring system and other business systems, which formed the demonstration system of real-time monitoring eco-environment in Bohai Sea. The function of the demonstration system are the reception of the real-time environment monitoring data, storage management, analysis and information issuance and other functions. The article also explores the marine Eco-environment monitoring system for the development and application.

S3 MEQ Topic Session
Species succession and long-term data set analysis pertaining to harmful algal blooms

Co-Convenors: *Hak-Gyoon Kim (Korea) and Mark L. Wells (U.S.A.)*

Increasing numbers of harmful algal bloom (HAB) events in many coastal locations are a result of significant changes in the dominant species compared to earlier periods. These changes may stem from introductions of new species or from range extensions, but they seem more likely to have arisen from changes in the environmental conditions that promote the dominance of a particular HAB species. Often, it has been concluded that anthropogenic influences on hydrology, land-use, nutrient inputs, *etc.* are the root cause of these changes, but there are examples of HAB incursions into regions that lack these pressures. An ecosystem approach focusing on decadal-scale changes in environmental conditions and planktonic species composition may provide some clarity on the causes of intensified HAB events. Talks on physical-scale to nutrient-scale factors that may affect species succession towards HAB species dominance are especially welcome.

Tuesday, October 28, 2008 09:00 – 12:35

09:00 ***Introduction by convenors***

09:05 **William Sunda, D. Rance Hardison and Kyle Shertzer (Invited)**
Positive feedback and the development of ecosystem disruptive algal blooms (S3-5003)

09:30 **Jinhui Wang, Yanqing Wu, Zhien Li and Lingyun Xiang**
The succession of bloom caused species: A result of complexity and variability of Changjiang estuary ecosystem (S3-5274)

09:50 **Hak-Gyoon Kim, Heon-Meen Bae, Chang-Kyu Lee, Sam-Geun Lee, Yang-Soon Kang, Young-Tae Park, Wol-Ae Lim, Sook-Yang Kim, Chang-Su Jung, Jeong-Min Shim and Yoon Lee**
An overview on the species succession of HABs in Korean coastal waters for the last three decades (S3-5094)

10:10 **Kedong Yin**
Long-term trend in phytoplankton species composition in the Pearl River estuarine coastal waters during 1991-2004 (S3-5313)

10:30 ***Coffee / tea break***

10:50 **Songhui Lu (Invited)**
Ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005 (S3-5469)

11:15 **Tatiana Yu. Orlova, Inna V. Stonik and Olga G. Shevchenko**
Long-term changes in the phytoplankton of the coastal waters off Vladivostok (Amurskii Bay, the Sea of Japan), 1992-2007 (S3-5055)

11:35 **Raphael Kudela, Vera L. Trainer, Grant Pitcher, Teresa Moita, P. Figueiras, Trevor Probyn and Theodore J. Smayda**
GEOHAB Core Research Project – Species succession of harmful algal blooms in upwelling systems (S3-5458)

11:55 **Renyan Liu and Yubo Liang**
The review of study on shellfish poisoning toxins in China (S3-5438)

12:15 **Feng-ao Lin, Xing-wang Lu, Hao Luo and Ming-hui Ma**
The historical and present situation of the red tide and its characteristics in the Bohai Sea of China (S3-5069)

S3 Posters

S3-5071 **Olga I. Nedashkovskaya, Seyng Bum Kim, Makoto Suzuki and Anna M. Stenkova**
Taxonomic diversity and ecophysiology of bacteria of the phylum *Bacteroidetes*, isolated from five algal species inhabited the Sea of Japan

S3-5101 **Yaqu Chen, Liyan Shi and Weimin Quan**
Ecological restoration of an artificial lagoon in the Hangzhou Bay, Shanghai

S3-5384 **David G. Foley** *(also gives oral presentation in the HAB Section Meeting, October 26)*
Data integration to help identify and monitor harmful algal blooms along the west coast of North America

S3-5451 **Mingyuan Zhu, Ruixiang Li and Zongling Wang** *(also gives oral presentation in the HAB Section Meeting, October 26)*
Study on growth of macro green algae *Enteromorpha prolifera*

S3-5504 **Aijun Zhang, Hong-Liang Zhang and Zijun Xu**
Research on the characteristics of red tides in Qingdao

S3 Oral Presentations

28 October, 9:05 (S3-5003) Invited

Positive feedback and the development of ecosystem disruptive algal blooms

William **Sunda**, D. Rance Hardison and Kyle Shertzer

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Ecosystem disruptive algal blooms (EDABs), which severely alter or degrade ecosystem function, are occurring with increasing frequency. These blooms are often caused by toxic or unpalatable species that decrease herbivore grazing rates, and thereby disrupt the transfer of nutrients and energy to higher trophic levels, and decrease nutrient cycling. Many factors, such as nutrient availability and herbivore grazing have been proposed to separately influence EDAB dynamics, but interactions among these factors have less often been considered. Here we discuss positive feedback interactions among nutrient availability, herbivore grazing, and nutrient regeneration, which can substantially influence the dynamics of EDAB events. The positive feedbacks result from a reduction of grazing rates on EDAB species caused by algal toxicity or unpalatability, which promotes the proliferation of the EDAB species, but also lowers grazer-mediated recycling of nutrients and thereby decreases nutrient availability. Since many EDAB species are well-adapted to nutrient-stressed environments and many exhibit increased toxin production and toxicity under nutrient limitation, positive feedbacks are established which can greatly increase the rate of bloom development and the adverse effects on the ecosystem.

28 October, 9:30 (S3-5274)

The succession of bloom species: A result of complexity and variability of Changjiang estuary ecosystem

Jinhui **Wang**[1,2,3], Yanqing Wu[3], Zhien Li[1,2] and Lingyun Xiang[1,2]

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The species composition of phytoplankton blooms has shifted in last decades from *Skeletonema costatum* and *Noctiluca scintillans* to *Karenia mikimotoi* and *Prorocentrum dentatum*. In 2008, a large bloom of *Enteromorpha* sp. occurred instead of other regular bloom species. As the most eutrophic marine area in China, the Changjiang Estuary has experienced continuous change associated with fast urbanization and other projects within the Changjiang watershed. The observed direct effects resulting from these changes include adjustment of river flow among seasons, and decreases in turbidity, dissolved oxygen, and concentrations of silicate since 2003, whereas phosphorous concentrations have increased in the last decades. Have these environmental changes contributed to the observed changes in species succession and the increased frequency, spatial extent and intensity of harmful algal blooms? We describe here field results on the fluctuations in plankton abundance and species composition in this region (1990s~present) and results from phosphate enrichment mesocosm experiments. The variation of community structure describes a different ecotype for the Changjiang Estuary.

28 October, 9:50 (S3-5094)

An overview on the species succession of HABs in Korean coastal waters for the last three decades

Hak-Gyoon **Kim**[1], Heon-Meen Bae[2], Chang-Kyu Lee[2], Sam-Geun Lee[2], Yang-Soon Kang[2], Young-Tae Park[2], Wol-Ae Lim[2], Sook-Yang Kim[2], Chang-Su Jung[2], Jeong-Min Shim[2] and Yoon Lee[2]

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Korea has identified 63 species responsible for harmful algal blooms (HABs) during 1981-2005. They are mostly diatoms and dinoflagellates, but other forms include species of the Chrysophyceae, Raphidophyceae, and Euglenophyceae. To clarify species succession, this study compares the regions; the semi-enclosed Jinhae Bay and the offshore open coast of Yeosu in the central part of the South Sea of Korea. Based on regular HABs monitoring, the prevailing species in the 1980s were mostly diatoms with sporadic dinoflagellate blooms in the summer season, but this changed in 1990-2000 with dinoflagellates generating numerous outbreaks of HABs. In species succession, spring diatom blooms dominated by *Skeletonema costatum* are replaced by *Heterosigma akashiwo* and then *Prorocentrum* spp. Following these, large dinoflagellates, *Gymnodinium* spp., are predominant in summer bloom. From late fall, *S. costatum* and *Thalassiosira* spp. gradually become predominant, and transition is completed into the winter scanty community in the whole Korean coastal waters. The significant difference in the species succession between the two regions in this study is that the consecutive and dominant occurrence of neritic flagellates such as *H. akashiwo, P. mican*, *Noctiluca scintillance*, and *Gymnodinium* spp. in Jinhae Bay, while the fish-killing *Cochlodinium polykridkoides* have occurred in offshore waters of the Yeosu coast since 1995. We must clarify whether these changes are an early bird indicator of climate change or the result of persistent coastal eutrophication.

28 October, 10:10 (S3-5313)

Long-term trend in phytoplankton species composition in the Pearl River estuarine coastal waters during 1991-2004

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An estuary is an interface between rivers and oceans and hence, in the estuary and estuarine coastal waters, there is not only a large gradient of physical and chemical conditions, but also a hyper-dimensional matrix of various factors for phytoplankton species diversity. The dynamics of this matrix can contribute to an estuary's ecosystem buffering capacity against eutrophication, which may make some estuaries more vulnerable to nutrient enrichment and others more robust.

We hypothesize that whether anthropogenic influences such as an alteration of flow patterns and changes in loadings of nutrients, or the concentration of nutrients and ratios of nutrients lead to a significant change in the composition of the phytoplankton species assemblage may depend on how large the change is in the limiting factor or which controlling factor is dominant at that time. These factors include physical dilution, vertical mixing, light limitation or nutrient limitation.

The Pearl River is the second largest river in China and the Pearl River estuary is located in the subtropical south coast of China. Hong Kong waters are located at the western edge of the estuary and they are largely influenced by the estuarine discharge, especially in summer. The Pearl River discharge is low in winter, starts to increase in spring and reaches a maximum in summer before decreasing again in the fall. The nitrogen concentration in the Pearl River is estimated to have increased in the past few decades and is very high at present (~100 uM), whereas phosphorus remains relatively low (~1 µM). As a result, the N/P ratio is > 16:1 in the ambient waters where there is an influence from the Pearl River discharge. We used a 14 year (1991-2004) data set of salinity, nutrients, and phytoplankton species abundance and composition, which were collected by the Hong Kong Environmental Protection Department who maintains a long term water quality monitoring program in Hong Kong waters. We used data from three zones which represent an estuarine condition in the west (estuarine zone) and a coastal/oceanic condition (oceanic zone) in the east and a seasonal transitional

condition influenced by the estuary in summer and by coastal/oceanic water in winter (transitional zone). The preliminary data analysis has shown some interesting patterns. During the 14 years, total species richness including diatoms and dinoflagellates appeared to increase. Diatoms are the dominant group of phytoplankton. However, dinoflagellate species richness and abundance increased too. This may coincide with the increased frequency of Si limitation. A very interesting observation is that temporal increases in diatom abundance appear to be negatively correlated with the abundance of dinoflagellates and other species of phytoplankton. The above observations appeared to be more apparent before 1998, and between 1999 and 2004 the changes were more stable. This two phase trend of changes coincides with climatic changes around 1996-1998 that are coherent with a regime shift in the PDO and large-scale changes in ocean temperature, regional wind patterns, and biological communities across the Pacific basin. There have been a few observations indicating a basin scale change oceanographic processes in South China Sea during the El Niño in 1997-1998 and consequently, there were more harmful algal blooms during the spring of 1998 in coastal waters of south China.

28 October, 10:50 (S3-5469) Invited

Ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005

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A large bloom of *Karenia mikimotoi* co-occurring with *Prorocentrum donghaiense* was recorded in coastal waters of Zhejiang Province, the East China Sea during 2005. The bloom covered an area of 15,000 km^2 and lasted about one month. Results from a research cruise during this time revealed a clear population succession over the course of the bloom following the order of *Karenia mikimotoi*, *Prorocentrum donghaiense* and finally transitioning to *Noctiluca scintillans*. The population dynamics of *Karenia mikimotoi* was studied in addition to characterizing the relationship between the bloom and environmental factors, such as salinity, temperature, fronts, nutrients, as well as polyamines. Possible outbreak mechanisms will be discussed.

28 October, 11:15 (S3-5055)

Long-term changes in the phytoplankton of the coastal waters off Vladivostok (Amurskii Bay, the Sea of Japan), 1992-2007

Tatiana Yu. **Orlova**, Inna V. Stonik and Olga G. Shevchenko

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Amurskii Bay is characterized by the greatest eutrophic level in the northwestern part of the Sea of Japan. This area is adversely affected by industrial waste products and municipal sewage of Vladivostok, as well as by terrigenous runoff and agricultural sewage that are transported to the sea by the Razdolnaya River. The qualitative and quantitative composition of the phytoplankton of the coastal waters off Vladivostok during the period 1992-2007 was analyzed. The following trends in phytoplankton community were revealed: changes in the dominant species, total density and biomass increased, the density of the non-diatom component of the phytoplankton increased during the summer bloom. Long-term data set analysis showed that a peak of HABs was observed at the beginning and in the mid 90s. The appearance and extensive bloom development of new and uncommon, for this area, raphidophytes and dinoflagellates of the genera *Karenia* and *Prorocentrum* were observed during this period. Recurrent blooms of potentially toxic *Pseudo-nitzschia* species at concentrations above a million cells per liter were registered during the summer-autumn period. The relative decrease in the intensity of HABs since the late 90s does not coincide with any positive change in antropogenic influence on the coastal ecosystem.

28 October, 11:35 (S3-5458)

GEOHAB Core Research Project – Species succession of harmful algal blooms in upwelling systems

Raphael Kudela[1], Vera L. **Trainer**[2], Grant Pitcher[3], Teresa Moita[4], P. Figueiras[5], Trevor Probyn[6] and Theodore J. Smayda[7]

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Eastern boundary current upwelling systems are increasingly susceptible to the negative effects of harmful algae ranging from illness and death due to direct toxic effects, environmental degradation due to increased biological oxygen demand, impacts on fisheries, “nuisance” effects such as discoloration of the water, and more subtle changes to the ecology of these systems. Seasonal succession of microplankton in upwelling systems follows the general pattern of coastal temperate seas, with diatom dominance in spring, a progressive contribution of heterotrophic components during summer and a major contribution of dinoflagellates in late summer and early fall. This assemblage structure will expand and contract in response to pulses of upwelling and relaxation. Consequently, phytoplankton succession in upwelling systems can be partially re-set in a fairly unique way, with intermittent interruptions, returning to earlier stages. Physical features along the coastline, such as capes and embayments, particular topographic features of the slope and continental shelf such as canyons and steep variations in the isobaths, the presence of buoyant freshwater plumes, and the dynamics of oceanic margins, can provide sources of new cells to the biological community during these upwelling/relaxation events. This talk highlights one of the focus areas of the GEOHAB Upwelling Core Research Project, developed to allow scientists to coordinate their research using the same measurement protocols, share data, and contribute to model development. Three major eastern boundary current upwelling systems are represented - the Benguela Current, Iberian Current, and the California Current.

28 October, 11:55 (S3-5438)

The review of shellfish poisoning toxins in China

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We present a review of the distribution of phytoplankton species producing shellfish poisoning toxins and toxic shellfishes in Chinese waters, the analytical approaches to measuring shellfish toxins, and a profile of shellfish poisoning toxins in China. To date, the toxins of paralytic shellfish poisoning (PSP) and diarrhetic shellfish poisoning (DSP) have been detected in some marine shellfish on the Chinese coast. The toxin composition in Chinese waters encompasses STX, neoSTX, dcSTX, GTX4, GTX1, GTX3, GTX2, GTX5, C1, C2. Phytoplankton species producing PSP in Chinese coastal waters include *Alexandrium catenella, Alexandrium tamarense, Alexandrium minutum, Gymnodinium catenatum, Gonyaulax polygramma, Gonyaulax polyedra*. The occurrence of PSP has been reported for scallops, mussels, oysters, and clams. The toxin composition of DSP in Chinese bivalves has included okadaic acid (OA), dinophysistoxin-1 (DTX-1), gymnodimine, yessotoxin (YTX), homo-YTX, 45-OH-HOMO-YTX. Microalga producing DSP toxin in Chinese coastal waters frequently include *Dinophysis acuta, Dinophysis acuminate, Dinophysis fortii, Prorocentrum lima, Dinophysis caudate*, and the producer of YTXs *Protoceratium reticulatum (Gonyaulax grindleyi*), *Lingulodinium polyedrum, Gonyaulax spinifera*. DSP-type toxicity has been detected in Chinese scallops, mussels, oysters, and clams. The source organisms of Amnesic Shellfish Poisoning (ASP), *Pseudo-nitschia pungens,* Neurotoxic Shellfish Poisoning (NSP), *Karenia brevis,* and Ciguatera Fish Poisoning (CFP) *Gambierdiscus toxicus* also have been observed in Chinese coastal waters. The PSP toxins have been analyzed by using mouse bioassay and HPLC-FLD; the DSP toxins have been analyzed by using mouse bioassay, HPLC-FLD, HPLC-MS/MS, idc-ELISA, and a competitive gold immunochromatography test strip.

28 October, 12:15 (S3-5069)

The historical and present situation of the red tide and its characteristics in the Bohai Sea of China

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The temporal and spatial distributions of red tides in the Bohai Sea have been studied, and the dominant red tide species and their development characterized. The findings show that red tides occur predominantly in Bohai Bay, Laizhou Bay, along the west coast of Liaodong Bay, in the coastal region of central Liaodong Bay, and in the waters near Yingkou Bayuquan. The annual red tide blooms are most intense from June through August, with the main causative species being Noctiluca scintillans, Phaeocystis globosa, Ceratium furca, Mesodinium rubrum, and Skeletonema costatum. A total of 80 red tide events encompassing a summed area of about 19,800 km^2 were recorded between 2000 and 2006. The average number and size of the annual red tide averages were 4.2 times and 1.6 times lower, respectively, in the 1990s. Moreover the occurrence of red tides in the Bohai Sea in recent years have continued to increase in number, duration and affected areas, in a clear trend of expansion of these HAB events.

S3 Posters

Poster S3-5071

Taxonomic diversity and ecophysiology of bacteria of the phylum *Bacteroidetes*, isolated from five algal species inhabited the Sea of Japan

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The taxonomic composition of heterotrophic, Gram-negative, rod-shaped, pigmented and motile (gliding) bacteria was studied. The strains were isolated from five algal species including *Acrosiphonia sonderi*, *Chorda filum*, *Laminaria japonica*, *Polisiphonia japonica* and *Ulva fenestrata* inhabiting coastal areas of Sea of Japan. Phylogenetic analysis based on sequencing of 16S rRNA gene revealed that all of 180 strains belonged to the phylum *Bacteroidetes*. The majority was affiliated with the 15 genera of the family *Flavobacteriaceae* (175 or 97.2%), the class *Flavobacteria*, and 5 strains, or 2.8%, were identified as representatives of two genera of the families *Cyclobacteriaceae* and *Flammeovirgaceae* of the class *Sphingobacteria*. Within the family *Flavobacteriaceae* members of the genera *Zobellia* and *Maribacter* were predominant (45 and 41 strains or 25.7 and 23.4%, respectively), composing 49.1% of total. Bacteria belonging to the genera *Cellulophaga*, *Formosa* and *Winogradskyella* constituted 23, 18 and 16 strains or 13.1, 10.3 and 9.1%, respectively. Taxonomic composition of these epibionts varied with the alga species. *Zobellia* spp. dominated among *A. sonderi* epiphytes while *Maribacter* spp. and *Cellulophaga* spp. were the most numerous bacteria of *P. japonica* and *L. japonica*, respectively. These genera were the predominant taxa among associates of *U. fenestrata* while *Winogradskyella* spp. were the prevalent epiphytes of *C. filum*. These findings indicate that cultivable bacteria of the phylum *Bacteroidetes* isolated from microbial communities of the different species of coastal algae are considered to be a taxonomically heterogenous group. Ecophysiological parameters including growth conditions and nutrient requirement of the isolates are considered.

Poster S3-5101

Ecological restoration of an artificial lagoon in the Hangzhou Bay, Shanghai

Yaqu **Chen**, Liyan Shi and Weimin Quan

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An artificial lagoon was constructed in the Hangzhou Bay of Shanghai City for the goals of entertainment and erosion control in March 2006. Field investigation had shown that high concentrations of inorganic nitrogen and phosphorus were among the most conspicuous characteristics of the artificial lagoon. In August 2006, a systematic ecological restoration project has been carried out to control the red tide and manipulate the structure of the aquatic food web. The main ecological restoration measures included marine macroalgae aquaculture, the breeding of macrobenthos and nektons and construction of artificial wetland. After the ecological restoration project, a long term monitoring effort of water quality, sediment quality and biological communities has been carried out to understand the dynamics of water quality, to determine the community succession of plankton and nektons, and to assess the effectiveness of restoration. The field investigation showed that the water quality had obviously improved from the fourth-grade to the second-grade of the national seawater standard. Most of environmental factors (DIN, DIP, trace metals and oils) showed a rapidly decline trend, while the abundance, biomass and diversity of macrobenthos, plankton and nektons have significantly increased.

Poster S3-5384

Data integration to help identify and monitor harmful algal blooms along the west coast of North America

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The environmental data providers who support resource managers along the west coast of North America place a high priority on the development of remote sensing methods to identify and track harmful algal blooms (HABs). HABs in this region are caused by a variety of plankton (*e.g.*, *Alexandrium spp*. and *Pseudonitzchia australis*) and toxins (*e.g.*, saxitoxin and demoic acid), with distinct regional differences in physical, chemical, and ecological forcing mechanisms. While satellite-based measurements of water-leaving radiances, and products derived thereof, cannot be effectively used to distinguish between these phytoplankton, they can be helpful in the identification and tracking of such, particularly when integrated into a suite of measurements that include in situ samples, and ocean currents from coastal radar and regional circulation models. However, it is unusual to find all of the relevant information in one easily accessed place. A distributed data system dedicated to serve regional data pertaining to HABs has been established to assist the efforts of State and Municipal agencies charged with monitoring these blooms. The site allows for the simple merging of toxicology standards with elements of environmental forcing, including such forecasts that might be available to predict likely trajectories and biogeochemical processes. In addition to near real time data, the web site also provides access via a single portal to time series and anomalies, which allows the non-expert data user to place contemporary measurements within the context of regional dynamics.

Poster S3-5451

Study on growth of macro green algae *Enteromorpha prolifera*

Mingyuan **Zhu**, Ruixiang Li and Zongling Wang

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A large floating macro algae mass of *Enteromorpha prolifera* was observed in the western Yellow Sea at the end of May, 2008. Driven by both surface current and wind, the macro algae moved towards the coastal water of Qingdao where it formed a large-scale green tide in the middle of June. This algae is a eurytherm, euryhaline and eurytopic species. The growth of this algae was studied at lab and mesocosm esperiments. The results showed that the average growth rate was 5-10% per day under lab conditions and 12% in a mesocosm experiment at sea. The maximum growth rate could reach 40% per day.

Poster S3-5504

Research on the characteristics of red tides in Qingdao

Aijun Zhang, Hong-Liang Zhang and Zijun Xu

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We studied the characteristics of 16 red tides monitored in Qingdao between 1999 and 2007. While a total of 78 red tide species have been observed in this region, we monitored the 7 species closely, including 4 species of Bacillariophyta, 1 species of Pyrrophyta, 1 species of Xanthophyta, and 1 species of Protozoa. The major species were *Mesodinium rubrum*, *Noctiluca scintillans*, S*keletonema costatum* and *Heterosigma akashiwo*, *etc.* Red tides took place quite often in the southern area of Jiaozhou Bay and the area along the coast of Qingdao. Red tides always started in the area of Fushan Bay and the entrance of Jiaozhou Bay between June and August. The scales of red tides were different. Most red tides took place with small areas, while in July 2003 the red tide of *Mesodinium rubrum* exceeded 450 km^2.

S4 FIS Topic Session
Institutions and ecosystem-based approaches for sustainable fisheries under fluctuating marine resources

Co-Convenors: *David L. Fluharty (U.S.A.), Xianshi Jin (China), Mitsutaku Makino (Japan), Vladimir I. Radchenko (Russia), Laura Richards (Canada) and Chang-Ik Zhang (Korea)*

In PICES member countries, some fisheries resources are in high abundance and healthy, but others are decreasing or already depleted. Most causes of stock declines can be ascribed to climate changes and overfishing. Stocks in declining or depleted conditions require prompt management actions based on sound science. This session will provide opportunities to address such questions as: (1) How do current fishery institutions address sustainable fisheries and what institutional changes may be necessary to fully implement an ecosystem-based approach to fisheries management? (2) What are the roles of fishers and government concerning sustainable fisheries under fluctuating resources? (3) How should fishery management strategies recognize and address changes in productivity prior to, during and after regime shifts? and (4) What kind of information and research activities are needed to support sustainable fisheries management in an ecosystem context, given regime shifts? This session encourages papers addressing institutions, management strategies, and research supporting sustainable fisheries management of fluctuating marine resources using ecosystem-based approaches. Lessons from other marine ecosystems are invited for comparison to the PICES region. A publication in a special issue of a primary journal or in the PICES Scientific Report Series is intended as an outcome of the session.

Wednesday, October 29, 2008 09:00 – 15:40

09:00 ***Introduction by convenors***

09:05 **Keith R. Criddle (Invited)**
Management of linked nonstationary dynamic bioeconomic systems (S4-5465)

09:30 **Jake Rice**
The role of marine science in promoting policy coherence across marine management and conservation institutions (S4-5474)

09:50 **Takaomi Kaneko, Takashi Yamakawa and Ichiro Aoki**
Fisheries management by a non-cooperative income pooling system as a remedy for the “tragedy of the commons” (S4-5127)

10:10 **Inja Yeon, Chang-Ik Zhang, Jae Bong Lee, Hak-Jin Hwang, Jong-Bin Kim, Myoung-Ho Sohn, Mi-Young Song, Heeyong Kim and Yi-Un Kim**
Korean institutional and ecosystem-based approaches for sustainable fisheries under fluctuating marine resources (S4-5445)

10:30 ***Coffee / tea break***

10:50 **Akihiko Yatsu** (Invited)
Fisheries management and ecosystem regime shifts: Lessons learned from the Kuroshio/Oyashio current system (S4-5169)

11:15 **Minling Pan and Shichao Li**
Fisheries policy designs in response to climate changes – A case study of the Hawaii-based longline swordfish fishery (S4-5119)

11:35 **Jie Zheng, Gordon H. Kruse and M.S.M. Siddeek**
Could the collapse of the Bristol Bay red king crab stock in the early 1980s have been avoided? – A case study for ecosystem-based management (S4-5052)

11:55 **John K. Keesing, Fred E. Wells and Tennille R. Irvine**
Long-term stability of coastal molluscan fisheries resources and biodiversity aided by effective spatial and temporal management intervention (S4-5478)

12:15 **Weimin Quan, Liyan Shi and Yaqu Chen**
Faunal utilization of created intertidal oyster (*Crassostrea rivularis*) reef in the Yangtze River estuary, China (S4-5100)

12:35 ***Lunch***

14:00 **Masahide Kaeriyama, Hyunju Seo and Shigehiko Urawa**
Situation and perspective on production trends of Pacific salmon in the North Pacific (S4-5207)

14:20 **Vladimir I. Radchenko**
New principles of Pacific salmon fishery management on the Russian Far East (S4-5491)

14:40 **Hee Won Park and Chang-Ik Zhang**
Ecosystem-based fisheries resource assessment and management system in Jeonnam marine ranching in Korea (S4-5172)

15:00 **Chang-Ik Zhang, Anne B. Hollowed, Jennifer Boldt, Pat Livingston and Jim Ianelli**
An ecosystem-based risk assessment for the eastern Bering Sea trawl fishery (S4-5137)

15:20 **Chih-hao Hsieh, Christian N.K. Anderson, Stuart A. Sandin, Roger Hewitt, Anne B. Hollowed, John Beddington, Robert M. May and George Sugihara**
Fishing effects enhanced variability and sensitivity of exploited fish populations (S4-4997)

S4 Posters

S4-5070 **Yongjun Tian, Hideaki Kidokoro and Tadanori Fujino**
Long-term variability of demersal fish community in the Japan Sea: Impacts of the climatic regime shifts and trawl fishing with recommendations for management

S4-5173 **Jae Bong Lee, Hee Won Park and Chang-Ik Zhang**
Relative states of exploited Korean coastal marine ecosystems using multiple ecological indicators

S4-5243 **Chieko Kato, Takashi Yamakawa and Ichiro Aoki**
Construction of spatial distribution model for an appropriate estimation of fisheries resources abundance in the East China Sea and the Yellow Sea

S4-5397 **Young Il Seo, Joo Il Kim, Taeg Yun Oh, Sun Kil Lee and Seung Jong Lee**
Ecosystem approaches to fisheries resources rebuilding assessment for *Octopus minor* in Korea

S4-5405 **Hyunju Seo, Hideaki Kudo, Sukyung Kang and Masahide Kaeriyama**
Spatiotemporal change in growth pattern of Japanese and Korean chum salmon

S4 Oral Presentations

29 October, 9:05 (S4-5465) Invited

Management of linked nonstationary dynamic bioeconomic systems

Keith R. **Criddle**

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Management objectives for living marine resources are often couched in terms of reference values that are based on observations of past levels of abundance and geographic extent, and historic patterns of use. Satisfying static reference points may not be feasible or desirable when rapidly evolving environmental conditions affect growth, recruitment, or carrying capacity. Moreover, governance systems and management strategies designed to enshrine an Elysian status quo may not only fail in their objective, but they may add to instability. The problem is that the current management paradigm is predicated on a false assumption that linked biological, environmental and social systems are stationary, where in fact it is well known that they are not. Nonstationary systems are inherently different from stationary systems and management of living marine resources governed by nonstationary dynamics is inherently different from management of living marine resources governed by stationary dynamics. This paper explores differences in the behavior of stationary and nonstationary dynamic systems and examines how these differences affect the feasibility and desirability of reference points and resource management strategies.

29 October, 9:30 (S4-5474)

The role of marine science in promoting policy coherence across marine management and conservation institutions

Jake **Rice**

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There are two types of institutions with interests in ecosystem approaches to management, including fisheries management. One type has direct or indirect authority to regulate enterprises in the sea. In fisheries FAO (through Flag States and RFMOs) is such an institution. A second type has direct or indirect authority to conserve components of ecosystems. IUCN and CBD are examples. Regulatory institutions can become more ecosystem oriented through increased accountability for all impacts of the activity they regulate. Conservation institutions can consider increasing numbers of threats to their ecosystem components. Although the two classes of institutions are readily delineated in waters beyond national jurisdictions, national governance systems tend to have similar parallel institutional structures. There is growing awareness of the importance of coherence in policies between the two types of institutions, if implementation of ecosystem-based management is to be sustainable. This coherence has proven hard to develop. However, both types of institutions rely fundamentally on science advice for their policies and programs. This gives science a crucial opportunity to facilitate institutional coherence on conservation and sustainable use of marine biodiversity, through fully integrated management within an ecosystem approach. The talk will explain the institutional problem more fully, focusing on the unique role for science in providing the framework for institutional coherence. It will also explain why providing the science advice for integration of policy and management across different industry sectors, including fishing, is at least as important as accommodating natural variation in the resources being used by each sector.

29 October, 9:50 (S4-5127)

Fisheries management by a non-cooperative income pooling system as a remedy for the "tragedy of the commons"

Takaomi **Kaneko**, Takashi Yamakawa and Ichiro Aoki

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We propose the concept of a non-cooperative pooling system as a new fisheries management system to remedy the "tragedy of the commons" and evaluate its management performance by applying a game theoretic approach. In this system, fishermen share a pooled income according to a certain sharing rule which reflects some competitive mechanisms. It is intended to achieve a desirable Nash equilibrium for the pre-agreed objectives, such as the conservation of depleted stocks or the enhancement of fishermen's income. By using such a framework, we can modify the payoff function in the fishing game and internalize the external diseconomy of the fishery into its own system. We evaluate its robustness and flexibility by comparing the performances with three other fisheries (a fixed-effort fishery, a fishery under a normal pooling system, and a general competitive fishery), changing the factors such as price conditions or the number of target species. In almost all cases, the non-cooperative pooling system enhances the long-term income and conserves the spawning stock biomass. It can readily respond to a variety of factors by changing the value of the tuning parameters in the sharing rule. Although there remains much scope for improvement for practical use, the concept of this system has the potential to contribute to an internalization of the external diseconomy of the fishery and the attainment of sustainable fisheries management.

29 October, 10:10 (S4-5445)

Korean institutional and ecosystem-based approaches for sustainable fisheries under fluctuating marine resources

Inja **Yeon**[1], Chang-Ik Zhang[2], Jae Bong Lee[3], Hak-Jin Hwang[1], Jong-Bin Kim[1], Myoung-Ho Sohn[1], Mi-Young Song[1], Heeyong Kim[1] and Yi-Un Kim[1]

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Desirable consequences of ecosystem-based management (EBM) may be sustainability of yields, maintenance of biodiversity, protection from the effects of pollution and habitat degradation and various socio-economic benefits. To achieve these results, Korea has established 14 Acts and 15 presidential and ministerial orders. Most of these Korean Acts are focused on the maintenance of biodiversity and/or the minimization of pollution. Current initiatives in Korea include TAC-based fishery management for nine species, closed fishing season/areas for 24 species during the spawning period, fish size limits or sex-controls for 27 species, fishing gear restriction such as mesh size limits for nineteen fisheries, prohibited fishing areas to conserve spawning and juvenile stocks and their habitats for eighteen fisheries, buy-back program, community self regulation and a licensing system for fishing boats. Management of threatened protected species and communities, habitat management, management of contaminants and pollutants and aquaculture control have been also established. The basic objective of all of these Acts is mitigation and restoration of ecosystems. In Korean waters it is recently recognized that the population has increased slightly and habitats have been restored especially in the coastal areas with low pollutants.

29 October, 10:50 (S4-5169) Invited

Fisheries management and ecosystem regime shifts: Lessons learned from the Kuroshio/Oyashio current system

Akihiko **Yatsu**

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The Kurohio/Oyashio current system provides rich habitats for many marine animals and fishing grounds. This system is greatly affected by climatic regime shifts. Two examples of Japanese fishery management will be presented in order to highlight the importance of the "regime concept" and adaptive management based on incentives of fishers. The first example shows how the 1988/89 climatic regime shift affected the Japanese sardine, and subsequently prevented recovery of chub mackerel through the growth of excess fishing capacity due to extremely reduced sardine productivity. The "regime concept" of fishery management includes 1) regime-dependent fishing rates with a time-lag after the year of regime shift, 2) target switching, 3) conservation of biodiversity and 4) precautionary approach. The second example is the co-management of a local stock of sandeel based on adaptive management with real-time monitoring on the stock and economics. These examples may be viewed within the framework of Ecosystem Approach to Fisheries or Ecosystem-based Management. However, they pose a problem to the Japanese "right-based" fisheries management system. Uncertainties in science and climatic effects on fish stocks frequently cause doubts as to the effectiveness of management measures, particularly when fishers face adverse economic situations due to overcapitalization. To overcome this situation, communication is needed among stakeholders with the best-available scientific knowledge on ecosystems and continuous monitoring. The precautionary approach to control fishing capacity should continue even after arrival of a productive regime because a mismatch is likely between life-span of fleets and length of a regime.

29 October, 11:15 (S4-5119)

Fisheries policy designs in response to climate changes – A case study of the Hawaii-based longline swordfish fishery

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Like many global pelagic fisheries, the Hawaii-based longline fishery continues to face increased pressure to reduce the incidental catch of endangered sea turtles and/or other protected species. Aggregation and movement of both sea turtles and fish are directly associated with climatic variations and oceanographic conditions. As a result, catch rates of both targeted species and protected species vary spatially and temporally. Accordingly, successful policy designs of fishery management in terms of effectiveness in turtle avoidance and commercial viability need to consider and adopt the spatial and temporal variations of oceanographic and climate conditions. A spatial bio-economic model was developed to incorporate sea surface temperature (SST), lunar phase, and other variables with temporal and spatial variations. Through the application of this model, this study explores the trade-offs between reduction in the incidental catch of turtles and economic return in the Hawaii-based swordfish fishery in relation to climate variation and fishing behavior changes. Hence, the model can be used to evaluate impacts of management choices on fishing opportunity and sea turtle interactions.

29 October, 11:35 (S4-5052)

Could the collapse of the Bristol Bay red king crab stock in the early 1980s have been avoided? – A case study for ecosystem-based management

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The Bristol Bay red king crab (*Paralithodes camtschaticus*) stock supports one of the most valuable fisheries in the United States. The fishery peaked in 1980 with a catch of 58,943 t, and due to a stock collapse, the catch declined sharply in the early 1980s with the fishery being closed in 1983. The catch has stayed at relatively low levels during the last two decades. In this study, we applied a length-based model to the trawl survey and commercial fisheries data from 1968 to 2008 to assess stock abundance and to examine different hypotheses for explaining the stock collapse in the early 1980s. These hypotheses include (1) high natural mortality due to shifts of spatial distributions owning to the 1976/77 regime shift, disease, predation and senescence, (2) high harvest rates in the directed pot fishery, (3) unobserved crab bycatch in groundfish trawl fisheries, and (4) high red king crab bycatch in the Tanner crab (*Chionoecetes bairdi*) pot fishery. All four factors had likely contributed to the decline of the stock abundance. Yet due to lack of data, we are unable to quantify the extent to which each factor contributed to the stock decline. We discuss ecosystem-based management measures that might have prevented or softened the stock collapse in the early 1980s.

29 October, 11:55 (S4-5478)

Long-term stability of coastal molluscan fisheries resources and biodiversity aided by effective spatial and temporal management intervention

John K. **Keesing**[1], Fred E. Wells[2] and Tennille R. Irvine[1]

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We conducted detailed surveys of molluscs on six intertidal reefs adjacent to a major population centre in south-west of Australia during 1982-1986 and again in 2007. The original surveys were due to concern about over-collecting of molluscs, particularly the abalone *Haliotis roei* by recreational fishermen and of other edible molluscs as well as those collected for their shells. Our examination of mollusc populations on reefs with historically different regimes of fishing pressure established a baseline on the status of mollusc populations in this area and formed the basis for further management actions having both fisheries management and biodiversity protection objectives. As human population grew in the region and a resultant increase in fishing pressure ensued, temporal closures were intensified to increase the level of abalone resource protection and a new spatial closure was implemented for habitat and conservation purposes. Using the same methods and personnel, we repeated the surveys of the same six reefs again in 2007. We found 47 species of molluscs indicating that levels of mollusc biodiversity were similar after more than two decades. Abalone densities at the six reefs in 2007 varied between 14 and 106 abalone per m^2 and we found that while some reefs had experienced declines in total abalone abundance since the 1980's, the proportion of animals above the legal sze limit had increased at all reefs. Size structure of abalone at some reefs and increases in density at others were consistent with the interpretation that the adaptive management measures implemented had been effective in maintaining the abalone resource.

29 October, 12:15 (S4-5100)

Faunal utilization of created intertidal oyster (*Crassostrea rivularis*) reef in the Yangtze River estuary, China

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An intertidal oyster reef (~260 hm^2) was created by adding hatchery-reared seed oysters (*Crassostrea rivularis*) to artificial concrete dikes and groins in the Deepwater Navigation Channel Regulation Project of the Yangtze River estuary, China. We examined the development of the reef community (oyster, barnacle and motile epibenthic macrofauna) and characterized nekton use of the created intertidal oyster reef for assessing habitat value. Since oyster reef restoration, the oyster *Crassostrea rivularis* population increased rapidly, and reached apex density (3410 ± 241 ind./m^2) and biomass (3175 ± 532 g/m^2) after 1 yr. High densities of the barnacle *Balanus albicostatus* were also found on the created oyster reef, and it had significantly greater abundances in the higher intertidal than in the lower intertidal ($p < 0.05$). The created intertidal oyster reef also supported diverse motile epibenthic macrofauna (28 species), including mollusks (11 species), crustaceans (11 species), annelids (4 species) and fishes (2 species). The communities were numerically dominated by *Neanthes japonica*, *Perinereis aibuhitensis*, *Nerita yoldi* and *Littorinopsis intermedia*. A total of 50 nekton species (31 fishes, 9 shrimps and 10 crabs) were found to utilize the created intertidal oyster reef habitat. The dominant taxonomic groups included gobies, mullet, sea bass, spot, mud crab, grass shrimp and white prawn. Grass shrimp *Palaemon* spp., which were more abundant than fishes, accounted for the nekton communities on the created oyster reef. Since the created intertidal oyster reef supported a diverse reef community and abundant nekton species, it should be recognized as critical fish habitat in the Yangtze River estuary, China.

29 October, 14:00 (S4-5207)

Situation and perspective on production trends of Pacific salmon in the North Pacific

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Pacific salmon (*Oncorhynchus* spp.) play an important role as keystone species and provide ecosystem services in North Pacific ecosystems. Abundance of Pacific salmon has declined since the end of twenty century despite being numerically healthy. In the early 21st century, chum (*O. keta*) and pink salmon (*O. gorbuscha*) stayed at high abundance through a sharp increase in hatchery-released populations. However, sockeye salmon (*O. nerka*) declined since the late 1990s. Abundance of coho (*O. kisutch*) and Chinook salmon (*O. tshawytscha*), and masu salmon (*O. masou*), which live in freshwater for one year, sharply declined since the 1990s and the 1980s, respectively, due to different causes such as environmental conditions in freshwater (*e.g.*, habitat loss, urbanization, and river channelization). A significant positive correlation (r=0.838***) between carrying capacity of three species (sockeye, chum, and pink salmon) and the Aleutian Low Pressure Index (ALPI) indicates that their carrying capacity could be synchronized with long-term climate change. Residual carrying capacity (RCC) of Hokkaido chum salmon was positively correlated with mean fork length (r=0.979***) and negatively correlated with mean age at maturity (r=-0.879***). This reduction in somatic growth with increase in population size is caused by the population density-dependent effect. The growth pattern of Ishikari River chum salmon in 1946-2004 determined using back-calculation and scale analyses suggests that global warming has positively affected their growth and survival in the Sea of Okhotsk. Specifically, their growth in the first year and survival was negatively correlated with sea ice concentration in winter, and positively correlated with sea surface temperature (SST) during summer and fall seasons, despite the lack of a relationship between SST and zooplankton biomass in the Sea of Okhotsk. Predictions of the global warming effect on chum salmon based on the SRES-A1B scenario of the IPCC and their optimal temperature suggested that (1) the global warming will decrease their carrying capacity by reducing distribution area, (2) strong density-dependent effects will occur in populations, and (3) Hokkaido chum salmon will lose their migration route to the Sea of Okhotsk. Therefore, Pacific salmon should be protected by a framework of sustainable conservation management based on the ecosystem approach, including adaptive management and the precautionary principle.

29 October, 14:20 (S4-5491)

New principles of Pacific salmon fishery management on the Russian Far East

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Fisheries branch in the Russian Far East relies on Pacific salmon catch, which yields 15% of the total taxable income. In December 2007, new principles of Pacific salmon fishery management were established by federal law. The main ones are: 1) only fishery lot holders could be admitted to the Pacific salmon fishery; 2) regional Commissions on fisheries regulation of anadromous fish species were established in the coastal administrative divisions. These principles signify some progress in fishery management with the introduction of multisectoral cooperation, and salmon harvest restrictions at traditional fishery sites. Pacific salmon stock abundance is sensitive to climate change and can fluctuate significantly. Salmon fishery management does not adapt well to sharp changes in salmon stock abundance, especially to declines. Fishery effort can be limited by the number and size of beach traps set, and by the number of days-without-fishery. The first is preferable since it has less impact on the environment. Up-to-date legislation covers the conduct of the Pacific salmon fishery although there is a need for additional legal documentation. The following issues need to be defined: how to manage salmon escapement and harvesting of excessive salmon spawners in river mouths, how to set the priority between fishery lots in the case of gear limitation. Distance from fishery sites to the main spawning river mouths, spawning potential (area and quality of spawning grounds), and presence of hatcheries in the river basin can be considered as the basic parameters for such priority definition.

29 October, 14:40 (S4-5172)

Ecosystem-based fisheries resource assessment and management system in Jeonnam marine ranching in Korea

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A practical and pragmatic method is employed for assessing fishery resources at the ecosystem level in Korea. It makes use of objectives, indicators, and reference points for assessing a marine ecosystem. At Jeonnam marine ranch, black seabream (*Acanthopagrus schlegeli*) is one of the target species of pole and line fisheries. A tier2 analysis was conducted for bycatch species such as Jacopever rockfish, black rockfish, red seabream, common seabass, rock bream, yellowtail, and common conger. In this study, we compared the status of marine ecosystems between pre-construction and post construction of marine ranching programs. Fisheries management decisions made at this level of understanding can prevent significant and potentially irreversible changes in marine ecosystems caused by fishing and other anthropogenic activities.

29 October, 15:00 (S4-5137)

An ecosystem-based risk assessment for the eastern Bering Sea trawl fishery

Chang-Ik **Zhang**[1], Anne B. Hollowed[2], Jennifer Boldt[3], Pat Livingston[2] and Jim Ianelli[2]

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A comprehensive ecosystem-based approach is required to holistically assess and manage fisheries resources and their associated habitat ecosystems, by considering ecological interactions of target species with predators, competitors, and prey species, bycatch species, interactions between fishes and their habitat environments, and the effects of fishing on fish stocks and their ecosystems. A pragmatic ecosystem-based approach, which was developed by Zhang *et al.* (in press), was employed for the assessment of the eastern Bering Sea bottom trawl fishery. For three management objectives, *i.e.*, sustainability, biodiversity, and habitat quality, a number of indicators for Tier 1 and Tier 2 assessments were selected. Both target and limit reference points were chosen for each indicator to assess the status of species and the fishery. Nested risk indices such as objectives risk index

(ORI), species risk index (SRI), and fishery risk index (FRI) were estimated to assess the ecosystem status at the management unit level. A risk assessment diagram was constructed to quickly understand the results of risk indices. A management status index (MSI) was also estimated to evaluate any changes in species and the fishery between two time periods.

29 October, 15:20 (S4-4997)

Fishing effects enhanced variability and sensitivity of exploited fish populations

Chih-hao **Hsieh**[1], Christian N.K. Anderson[2], Stuart A. Sandin[2], Roger Hewitt[3], Anne B. Hollowed[4], John Beddington[5], Robert M. May[6] and George Sugihara[2]

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Separating the effects of environmental variability from the impacts of fishing on the dynamics of fish populations is essential for sound fisheries management. Using the 50-year-long larval fish time series from the California Cooperative Oceanic Fisheries Investigations, we regard fishing as a treatment effect in a long-term ecological experiment. We investigate fishing effects by comparing temporal and spatial dynamics of exploited fish species *versus* unexploited ones living in the same environment. Our spatial analyses indicate that exploited species show a clearer distributional shift in response to environmental change than unexploited species, even after accounting for life history and ecological traits, and phylogeny. The enhanced response (improved signal/noise ratio) to environmental change in exploited species may be a consequence of reduced spatial heterogeneity caused by fishery-induced age (size) truncation and the constriction of geographic distribution that accompanies fishing pressure. We also show clearly that fished populations tend to fluctuate more than unharvested stocks in time. The elevated temporal variability in the abundance of exploited fishes is caused by fishing-selective age-truncation effects. The age-truncated or juvenescent populations have increasingly unstable population dynamics due to changing demographic parameters such as intrinsic growth rates. This finding has implications for resource management as an empirical example of how selective harvesting can alter the basic dynamics of exploited fishes. Accumulating evidence indicates that age-truncation is widespread in commercial fisheries.

S4 Posters

Poster S3-5070

Long-term variability of demersal fish community in the Japan Sea: Impacts of the climatic regime shifts and trawl fishing with recommendations for management

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A climatic regime shift as indicated as an abrupt change from cooling to warming in the Tsushima Warm Current (TWC) was identified in the late 1980s in the Japan Sea (JS). Principal component analysis (PCA) applied to two fishery catch datasets, coastal pair trawlers and offshore single trawlers data in the JS, showed decadal variability patterns in the catches of trawl target species with step changes around the late 1980s and mid-1990s. The first and second principal components (PC1 and PC2) for both datasets correspond well with winter and summer water temperatures in the JS. Detailed analysis of the demersal fish assemblage composition, abundance and distribution indicated an evident shift in the late 1980s. Cold water species decreased (increased) both abundance and distribution during warm (cold) regime. However, warm-water species increased in abundance and/or distribution during the warm 1990s. These results suggested that demersal fish community structure in the JS was largely affected by climatic regime shifts. Impacts of trawl fishing and management of the trawl fishery under the current warm regime were also discussed.

Poster S4-5173

Relative states of exploited Korean coastal marine ecosystems using multiple ecological indicators

Jae Bong Lee[1], Hee Won **Park**[2] and Chang-Ik Zhang[2]

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Comparative analyses of fishing impacts and ecosystem degradations among marine ecosystems have been undertaken using synthetic, model-derived ecosystem indicators, and ranking ecosystems in terms of their exploitation levels. Along similar lines but using geographically different ecosystems and drawing from a pre-agreed set of simple, data-based, readily available ecological indicators, ranking was undertaken while management objectives addressing key ecosystem issues were borne in mind. In this study, we ranked or scored a set of coastal ecosystems according to the extent of fishing impacts by testing different methods, and evaluated this ranking when a set of conservation goals are considered and accounting for redundancy of indicators. Finally we compared the ranking of ecosystems on a multivariate basis, including selected indicators and other possible explanatory factors. Similarities and differences among three Korean coastal ecosystems were further explored using multivariate analyses and testing explanatory factors.

Poster S4-5243

Construction of spatial distribution model for an appropriate estimation of fisheries resources abundance in the East China Sea and the Yellow Sea

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For appropriate fisheries management, it is necessary to estimate annual increasing or decreasing trends in fisheries resources. An abundance index based on CPUE can be used to achieve this purpose. This conventional method, however, doesn’t incorporate changes in fisheries operations and/or distribution of the resources, so there is a possibility that serious estimation errors can arise. Moreover, there are often areas and/or periods where data are lacking in the time-series. In the present study, we developed a model to analyze spatial time-series catch-effort data based on its spatial rank in CPUE to derive an estimate of the shift in abundance. This model assumes exponential distribution for the spatial rank in CPUE and can interpolate missing observations caused by periodical changes in the spatial extent of fisheries operations. It also incorporates any contraction or expansion of the distributional areas of resources according to shifts in abundance. We applied the model to spatial catch-effort data grid in a 0.5 mesh for the bottom trawl fishery in the East China Sea and the Yellow Sea from 1970 to 2003. The results showed that the trend in the abundance estimated by our model differed from those estimated by conventional VPA, especially after the latter half of the 1990s, after which the spatial extent of fishery operation has greatly contracted. This result demonstrates the importance of incorporating spatial information in the model.

Poster S4-5397

Ecosystem approaches to fisheries resources rebuilding assessment for *Octopus minor* in Korea

Young Il **Seo**, Joo Il Kim, Taeg Yun Oh, Sun Kil Lee and Seung Jong Lee

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Stock rebuilding programs in Korea aim to reform the structure of fishery production, prevent harmful fishing activities and improve the quality of marine environments. One of stock rebuilding programs targeted species, *Octopus minor* in the southern tidal-flat of Korea, has been carried out since 2006. This species is usually caught by longline and no-gear fishing when it is migrating to spawning grounds in deeper water during May-June. In this study, ecosystem approaches to fisheries resource assessment are described and applied to the designated area and target species for rebuilding the stock. A two-tier system is used to accommodate the quantity and quality of available data according to objectives, indicators, and reference points. The rebuilding assessment showed the effectiveness of habitat and fishery management by comparing the status of marine ecosystems between pre- and post- rebuilding programs. For rebuilding *Octopus minor*, we primarily recommend that a marine protected area needs to be established around the spawning ground and that fishing intensity should be reduced by 25% in the southern tidal-flat of Korea.

Poster S4-5405

Spatiotemporal change in growth pattern of Japanese and Korean chum salmon

Hyunju **Seo**[1], Hideaki Kudo[1], Sukyung Kang[2] and Masahide Kaeriyama[1]

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To clarify the relationship between population dynamics and the growth pattern of chum salmon *Oncorhynchus keta*, we evaluated spatiotemporal changes in the growth pattern of Ishikari River (Japanese) and Namdae River (Korean) chum salmon during their life history. We analyzed the growth pattern of 2,630 female adult chum salmon at age-4 collected in natal rivers during the 1984-1998 period, using scale analysis and back-calculation from fork length. Korean (Kang, unpublished) and Japanese juvenile chum salmon (Kaeriyama 1986; Mayama and Ishida 2003) migrated offshore after the spring season at a size of over 80 mm fork length. After leaving the coastal area, Korean salmon reared in the Japan Sea before migrating to the Okhotsk Sea, while Japanese juvenile migrated directly into the Okhotsk Sea and reared there. On the other hand, there were no significant differences in annual growth between populations at age-1, -2, and -4. At age-3, Korea chum salmon grew significantly larger than the Japanese population (ANOVA, $p<0.05$). And, mean fork length of adults in the Korean population was also significantly larger than in Japanese salmon ($p<0.001$). Japanese and Korean chum salmon populations showed density-dependent effects at age-3 in the Bering Sea, although the effect differed between populations.

S5 MEQ/FIS Topic Session
Mariculture technology and husbandry for alternate and developing culture species

Co-Convenors: Ingrid Burgetz (Canada), Shuanglin Dong (China), Toyomitsu Horii (Japan) and Hyun-Jeong Lim (Korea)

After considering the recommendations of the Study Group on *Marine Aquaculture and Ranching in the PICES region*, PICES representatives have agreed that they share a common interest in the development of a highly efficient, environmentally friendly and diverse aquaculture industry. The diversification of aquaculture operations through the culture of new species and the use of innovative grow out technologies is of world-wide interest to both industry investors and the agencies responsible for ecosystem protection. New species and technologies may offer economic opportunities while providing solutions to the perception that current aquaculture practices threaten natural habitat and wild stocks. In many Pacific Rim countries recent developments of effective and efficient fish feed, development of animal husbandry protocols to ensure fish health and welfare, use of biotelemetry procedures to evaluate grow out facilities from the perspective of the fish, and advances in reproductive physiology using state-of-the-art molecular techniques show promise for enabling the socio-economic acceptance of aquaculture operations while preventing or mitigating environmental impacts. A variety of tools presently exist that permit the modeling of environmental risk from these developments and the subsequent incorporation of risk into an ecosystem management scheme. We encourage presentations that highlight scientific developments in the field of mariculture, particularly those that support the diversification of the industry and enable sustainable development while serving to protect natural ecosystems and wild stocks.

Wednesday, October 29, 2008 09:00 – 15:30

09:00 ***Introduction by convenors***

09:05 **Shigenori Suzuki, Maria Del Mar Ortega-Villaizan Romo, Takashi Ichikawa, Tadashi Andoh, Naoto Murakami, Taizou Morioka, Kyouhei Fukunaga, Takahiro Matsubara, Sachio Sekiya, Takuma Sugaya and Nobuhiko Taniguchi (Invited)**
Current situation in stock enhancement of barfin flounder *Verasper moseri* in Japan (S5-5350)

09:30 **Kwang Hoon Kim and Chang-Ik Zhang**
Growth of cultured and wild black seabream in the coastal water of Yeosu, Korea (S5-5197)

09:50 **Nikolina P. Kovatcheva, Roman M. Vasilyev, Ivan A. Zagorsky, Sergey V. Kholodkevitch and Aleksey V. Ivanov**
Monitoring of the physiological state of red king crab (*Paralithodes camtschaticus*) in artificial conditions (S5-5049)

10:10 **Valeria E. Terekhova and Natalya L. Bel'kova**
Struggle against skin ulceration disease of cultivated sea cucumber *Apostichopus japonicus* juveniles (S5-5179)

10:30 ***Coffee / tea break***

10:50 **Moira Galbraith and David L. Mackas**
Distribution of planktonic larval sea lice (*Lepeophtheirus salmonis*) in the Broughton Archipelago, British Columbia, Canada (S5-5433)

11:10 **Xiutang Yuan, Yubo Liang, Mingjun Zhang, Dan Liu and Daoming Guan**
In situ study on self-pollutant loading in suspension aquaculture system of Japanese scallop *Patinopecten yessoensis* from Changhai sea area, North Yellow Sea, China (S5-5038)

11:30 **Katsuyuki Abo, Toshinori Takashi and Hisashi Yokoyama**
Environmental indicators and modeling studies for assessing sustainability of marine aquaculture (S5-5215)

11:50 **Larissa A. Gayko**
Marine climatology – New concept of agricultural meteorology studying interrelation between environment factors and sea farming efficiency (S5-5030)

12:10 ***Lunch***

14:00 **Ingrid Burgetz, Jay Parsons and Steve MacDonald**
Ecosystem-based approaches and environmental interactions of marine aquaculture: Opportunities and priorities from a Canadian perspective (S5-5456)

14:20 **Kevin H. Amos**
Interactions between marine aquaculture and marine ecosystems: Infectious aquatic pathogens and disease (S5-5437)

14:40 Open discussion on objectives and terms of reference for a proposed PICES Working Group on *Environmental Interactions of Marine Aquaculture*

S5 Posters

S5-5011 **Chunjiang Guan, Qing Liu, Peng Li and Donzhi Zhao**
Study on using *Sargassum thunbergii* to purify aquaculture water of sea cucumbers in mesocosm experiment

S5-5024 **Galina S. Gavrilova**
Application of the some mariculture methods in *Apostichopus japonicus* population restoration

S5-5031 **Larissa A. Gayko**
Influence of environmental factors in forecasting mollusks yield on marine farms (for Possyet Bay, Sea of Japan)

S5-5058 **Shu-Xi Liu, Guo-fan Zhang, Xiao Liu and Wen-Xin Yin**
Self-fertilization family establishment and its depression in bay scallop *Argopecten irradians* from different growing areas

S5-5064 **Ludmila S. Dolmatova, Olga A. Zaika and Valeria V. Romashina**
Cytokine production in coelomocytes of the holothurian *Eupentacta fraudatrix* and seastar *Asterias amurensis*

S5-5083 **Yubo Liang, Dongmei Li, Sa Liu, Xingbo Wang, Tao Song, Xing Miao, Guanhua Chen and Guize Liu**
Spatial distribution of *Perkinsus olseni* in the Manila clam *Ruditapes philippinarum* along Chinese coast

S5-5111 **Donghui Xu and Guangxing Liu**
Experiment on the rearing of larval Japanese flounder, *Paralichthys olivaceus* with *Schmackeria poplesia* (Copepoda: Calanoida)

S5-5485 **Jeong Hee Nam, Yun Joon Park and Hyun Do Jeong**
Characterization of the repeating sequence present in the specific genomic ORF region of iridovirus

S5-5486 **Ju Heon Kim and Hyun Do Jeong**
Molecular cDNA cloning and analysis of the organization and expression of immune genes from rock bream (*Oplegnathus fasciatus*) infected by Iridovirus

S5-5487 **Ki Won Shin and Hyun Do Jeong**
Megalocytivirus susceptible for freshwater Pearl gourami (*Trichogaster leeri*) have a risk of transmission to seawater rock bream (*Oplegnathus fasciatus*)

S5-5488 **Kwang Il Kim, Ji Woong Jin and Hyun Do Jeong**
Molecular characterization of Noroviruses in various samples from the southeastern coast of Korea

S5-5489 **Young Jin Kim, Lyu Jin Jun and Hyun Do Jeong**
Quantification of various tet genes in tetracycline resistant bacteria from microflora in fish

S5 Oral Presentations

29 October, 9:05 (S5-5350) Invited

Current situation in stock enhancement of barfin flounder *Verasper moseri* in Japan

Shigenori **Suzuki**[1], Maria Del Mar Ortega-Villaizan Romo[2], Takashi Ichikawa[3], Tadashi Andoh[3], Naoto Murakami[3], Taizou Morioka[3], Kyouhei Fukunaga[3], Takahiro Matsubara[3], Sachio Sekiya[4], Takuma Sugaya[5] and Nobuhiko Taniguchi[6]

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The barfin flounder *Verasper moseri* is distributed around northern Japan. This fish has a high commercial value in the Japanese market. However, the wild stock has decreased to a critically low level. The Japanese government has listed it as a potentially endangered species. The stock enhancement programs for barfin flounder have been carried out since 1981. Recently, the hatchery production technologies for this fish have been developed to high level. Over 1 million juveniles have been released annually since 2006. This practice has brought about an increase in landings around the release area. On the other hand, biodiversity and genetic diversity are important considerations for sustainable fisheries and stock enhancement. Genetic considerations for artificial juveniles released in coastal seas are indispensable to avoid loss of genetic diversity in the wild stock. Therefore, we have developed the basis of a mating technique to maintain the genetic diversity of juveniles concurrently with inbreeding avoidance. This presentation will present the recent progress in stock enhancement for barfin flounder in Japan and describe the process used to produce juveniles that are rich in genetic variation.

29 October, 9:30 (S5-5197)

Growth of cultured and wild black seabream in the coastal water of Yeosu, Korea

Kwang Hoon **Kim** and Chang-Ik Zhang

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The purpose of this study was to compare the growth of cultured and wild black seabream (*Acanthopagrus schlegeli*) from the coastal waters of Yeosu, Korea. Wild black seabream were randomly sampled monthly in the fish markets, and cultured black seabream were sampled from cages in the Junnam marine ranch in 2007 and 2008. Total length and body weight of sampled seabream were measured, and scales and otoliths taken from the fish were read by a binocular stereoscope using reflected light and dark background. The distance from the otolith nucleus to the maximum radius and the length of the radius of each annulus were measured using an image analysis processing system. There was a significant difference in growth rate between cultured black seabream and wild black seabream. The difference in growth rate was associated with environmental factors of the habitat.

29 October, 9:50 (S5-5049)

Monitoring of the physiological state of red king crab (*Paralithodes camtschaticus)* in artificial conditions

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Research on the cardiac activity parameters of the red king crab (*Paralithodes camtschaticus)*, kept in artificial conditions, by a new non-invasive method of laser photo-cardiogram registration shows the marked influence of different environmental factors on heart rate. There are statistically significant differences in the range of heart rates which alter under the impact of different external stimulus. The goal of this research was to analyze the physiological characteristics of the cardiovascular system of the red king crab in order to determine its adaptive properties and abilities, and to monitor its reaction to different stress actions. The results showed that the red king crab heart rate in a state of calm is 20-25 beats per minute (water temperature 5-7^{o} C). The adaptive time for crabs to reach the above mentioned heart rate is about 15-20 days in artificial conditions. The experimental treatement of transportation as a stressor showed that for the red king crab, handling is one of the most significant stress factors, which is characterized by very high heart rate level of 45-50 beats per minute. The transportation time was 24-30 hours in an insulated container at a temperature of 8-10^{o}C and 70-80% humidity, during which time the heart rate level was rather low and stable (30-35 beats per minute).

29 October, 10:10 (S5-5179)

Struggle against skin ulceration disease of cultivated sea cucumber *Apostichopus japonicus* juveniles

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Skin ulceration disease of cultivated sea cucumber (*Apostichopus japonicus*) juveniles in 2004 and 2005 has accounted for the loss of 90% of yield in hatchery "Zapovednoe" on the Japan Sea coast near Vladivostok, Russia. The infection is manifested by a lysis of individuals' skin and the formation of white ulcers. The bacteriological analysis and analysis of 16S rRNA gene sequences showed the presence of the following microorganisms in the lesions: *Cobetia marina*, *Ruegeria mobilis*, *Bacillus licheniformis*, *Bacillus* sp., *Pseudomonas* sp., *Vibrio* sp., *Alteromonas* sp. Infection assays have been performed from bacterial cultures but the etiological agent of skin ulceration disease has not been identified.

A search of preparations to decontaminate the ulcers, at the expense of destruction of secondary infectious agents, has been undertaken. They were combined into this group. The sensitivity of fish pathogens (isolated from ulcerated skin tissue) to the antimicrobial preparations was assessed. The antimicrobial activity for all isolates was shown only by fluoroquinolones. The efficiency of the Antiback line fluoroquinolones (Russia) as a prophylactic drug against skin ulceration disease was demonstrated. The safety of fluoroquinolones for *Apostichopus japonicus* was also established. The protocol of antiepizootic measures in case of skin ulceration disease of holothuroids was developed. The antiepizootic measures have been carried out in hatchery "Zapovednoe" from 2006. The indicator of their efficiency is an absence of skin ulceration disease epizooty of *Apostichopus japonicus* juveniles in 2006-2007.

29 October, 10:50 (S5-5433)

Distribution of planktonic larval sea lice (*Lepeophtheirus salmonis*) in the Broughton Archipelago, British Columbia, Canada

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The life cycle of the sea louse *Lepeoptheirus salmonis* includes a brief period (about 15-30 days) during which the three initial juvenile stages (2 naupliar stages and the first copepodite stage) are free-living in the water column. The copepodite stage is the stage at which host infection occurs. Within a few days the juvenile copepod must encounter and attach to a suitable finfish host if it is to survive and progress to subsequent and larger parasitic stages. We have mapped the distribution of planktonic sea lice in the Broughton Archipelago region during the spring season out-migration of wild pink and chum stocks. Data on how the abundance of these planktonic stages varies with date and location provide useful information about when, where, and how severely the lice infect out-migrating wild populations of juvenile salmon. However, the larval abundance patterns are not easy to quantify, primarily because their average density in the water column is much lower (factors of hundreds to tens-of-thousands) than the abundance of other non-parasitic crustacean plankton. The challenge for sampling planktonic sea lice is therefore to develop a sampling method and grid that can reliably discriminate and map the difference between 'low' and 'zero or near-zero' abundance of the sea lice. We were able to do this, using a sampling design consisting of repeated surface-layer net-tow surveys of locations extending along the shorelines of Knight Inlet/Tribune Channel. Our data (covering Feb-March 2007 and Feb-May 2008) show that planktonic louse abundances were consistently low (average <0.01 m^{-3}; peak <1 m^{-3}), but also showed that *L. salmonis* occurrence/abundance rates were higher near active farms (naupliar abundance declining to zero within 10 km, copepodites mostly within 20 km).

29 October, 11:10 (S5-5038)

In situ study on self-pollutant loading in suspension aquaculture system of Japanese scallop *Patinopecten yessoensis* from Changhai sea area, North Yellow Sea, China

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Suspension aquaculture of filter-feeding bivalves produces large amounts of particulate biodeposits (faeces and pseudofaeces) and dissolved metabolic wastes (ammonia and phosphorus) that may impact the aquaculture environment. In this study, biodeposition rates and ammonia and phosphorus excretion rates by suspension-cultured Japanese scallop *Patinopecten yessoensis* from the Changhai sea area, North Yellow Sea, China were investigated *in situ* using a sediment trap and a closed respirator, respectively, from January to December, 2007, in order to evaluate the self-pollutant loading from suspension aquaculture system. Results showed that the range of biodeposition rates for *P. yessoensis* was 0.08-2.47g.ind^{-1}.d^{-1} (dry weight) with an average value of 0.71 g.ind^{-1}.d^{-1} depending on body size and season. *P. yessoensis* could release considerable amounts of dissolved N (0.96-2044.08 μg.ind^{-1}.d^{-1}, mean 694.80 μg.ind^{-1}.d^{-1}) and P (9.36-1848.96 μg.ind^{-1}.d^{-1}, mean 585.6 μg.ind^{-1}.d^{-1}). An extrapolation of the results showed that the annual biodeposit production could reach 3.84×10^6t dry matter, or 9.62×10^4t POC, 1.36×10^4t PON with annual NH_4^+-N and PO_4^{3-}-P production of 3.75×10^3t and 3.17×10^3t respectively, by all of the suspension-cultivated scallops in Changhai sea area. The results indicated that the impact of filter-feeding bivalves on the environment should not be underestimated given the large scale and high density of bivalves' culture along the coasts of China. An integrated model of filter-feeding bivalves, nutrient-absorbing seaweed and deposit-feeding holothurian are recommended to minimize these impacts and benefit the economy.

29 October, 11:30 (S5-5215)

Environmental indicators and modeling studies for assessing sustainability of marine aquaculture

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In Japan, the "Law to Ensure Sustainable Aquaculture Production" was enacted in 1999 in order to prevent deterioration of aquaculture environments. To promote improvements of the environmental quality in the vicinity of aquaculture activities, the Law established environmental criteria and indicators. These criteria and indicators should now be revised to more appropriate criteria on the basis of more recent scientific data. In order to examine the applicability of the environmental criteria of sediments to fish farms, and to specify new criteria for assessment of the environments, surveys of the bottom environments and the macrobenthos were conducted in fish farming areas. In addition, we have developed numerical models to estimate the impact of aquaculture to the environments and to predict the change of the environmental quality around fish farms. In general there are various models from one-dimensional to three-dimensional, from low resolution to high resolution, and from steady state models to non stationary time series models. In Japan, several models have been developed to assess the environmental quality of marine aquaculture. As aquaculture is conducted in various topographical areas in various ways, we are trying to develop appropriate models considering specific aquaculture situations.

29 October, 11:50 (S5-5030)

Marine climatology – New concept of agricultural meteorology studying interrelation between environment factors and sea farming efficiency

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This study considered the problems originating from a new concept of agricultural meteorology – marine climatology aimed at informational support of sea farming activities. It is ascertained that existing techniques of forecasting spawning productivity are empirical in nature, andt he time has come for a paradigm shift - empirical approaches should be replaced by methodologies that are based on models of cause-and-effect relationships between hydrometeorological conditions and sea-farming efficiency. Theoretical approaches of agricultural meteorology, with reference to sea-farming, were considered. The conclusion is made that an important area of focus for applied sea agricultural meteorology is the creation of systems to support sea-farming information at various levels, through the development of hydrometeorological-technological block diagrams for economic decisions and hydrometeorological long-term forecasts which are necessary for their acceptance, as well as recommendations of options for economic decisions related to manufacture of Japanese scallop *Mizuhopecten yessoensis.*

29 October, 14:00 (S5-5456)

Ecosystem-based approaches and environmental interactions of marine aquaculture: Opportunities and priorities from a Canadian perspective

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The incorporation of ecosystem-based approaches for managing natural resources is increasingly being discussed. How these approaches are developed for different sectors and ecosystems continues to challenge regulators, policy makers and industry. In Canada there is a commitment within the federal government responsible for the management of fisheries and aquaculture to move towards an ecosystem approach. Recently, a new program for enhancing the harmonization of regulations for aquaculture in Canada has been launched, and this includes the development and scientific validation of models of pathways of effects for aquaculture. In addition, there continues to be scientific research focusing on questions related to environmental interactions, including examining and optimizing integrated multi-trophic aquaculture, transmission of sea lice between wild and cultured salmon, wild-cultured fish interactions, near-field and far-field effects and model development and validation. The Canadian mariculture industry is actively working on approaches to minimize interactions and to understand the environmental interactions such as the relationship between changing climate conditions and the stress responses of cultured organisms.

29 October, 14:20 (S5-5437)

Interactions between marine aquaculture and marine ecosystems: Infectious aquatic pathogens and disease

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In the North Pacific region, marine aquaculture is an important economic, cultural, and environmental activity that provides food, employment, stock enhancement and rehabilitation, and recreation. The potential exists for interactions, both positive and negative, between cultured and wild aquatic animals and their habitats. A PICES working group (Working Group on the Environmental Interactions of Marine Aquaculture: WG-EIMA) is being proposed to consider these interactions. One aspect being considered for the WG-EIMA is the interactions of infectious pathogens between wild and cultured animals. Information will be presented on the proposed activities of this sub-group to include: development of standardized methods to evaluate and report infectious disease events and interactions between wild and farmed marine animals; methods to document new and emerging infectious diseases in the PICES region; methods for their detection and assessing potential impacts of emerging diseases endemic to wild and farmed species; and, consideration of the development of information on said interactions. Some functions of the proposed WG-EIMA are similar to those of the ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO).

S5 Posters

Poster S5-5011

Study on using *Sargassum thunbergii* to purify aquaculture water of sea cucumbers in mesocosm experiment

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Pond aquaculture for sea cucumbers in Northern China may cause many environmental problems such as eutrophication. *Sargassum thunbergii* is a good sea cucumbers feed, and was selected for a mesocosm experiment to measure nitrogen and phosphorus uptake in aquaculture ponds. The experiment was conducted in winter. At the beginning of the experiment, concentrations of N and P were 77.58μmol/L and 2.81μmol/L, respectively. Phytoplankton and zooplankton in the enclosure bags might uptake or release N and P during the process of growth and death. The concentration of P from the control group increased from 0.43μmol/L (on the 14th day) to 2.76μmol/L (on the 30th day). The average uptake rate of P by *Sargassum thunbergii* was calculated according to the value difference between control group and experiment groups. The average concentration of P and the average uptake rate for groups 1, 3 and 4 (506.3g in average weight) were 0.55μmol/L and 0.15μmol/[g(dw)·d]; group 2 were 0.67μmol/L and 0.19μmol/ [g(dw)·d], respectively; and the high-density groups 5 and 6 (820.5g in average weight) were 0.66μmol/L and 0.09μmol/ [g(dw)·d], respectively. The average assimilation rate of N in 23days was calculated using the same method as for P. The average N uptake rate for groups 1, 3 and 4 was 2.50μmol/[g(dw)·d], group 2 was 3.65μmol/[g(dw)·d], and the high-density groups 5 and 6 was 1.47μmol/[g(dw)·d]. The results indicate that *Sargassum thunbergii* had better absorption of N and P during the cooling process (9.9~0°C) than during hypothermal period. The high-density groups (5 and 6) had relatively low in assimilation rates, likely because the higher density had limited the growth rate.

Poster S5-5024

Application of the some mariculture methods in *Apostichopus japonicus* population restoration

Galina S. **Gavrilova**

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Sea cucumber *Apostichopus japonicus* is one of the most important coastal fishery resources in the Peter the Great Bay (Japan Sea). The sea cucumber stock size has decreased rapidly since 1990s. The main cause of the decline was overexploitation.

The Sukhodol Bight is one of the greatest juvenile sea cucumber production areas, and the stock size was approximately 64 tons until the 1980s, but declined dramatically in the late 1990s. In general, the hydrological conditions in Sukhodol Bight are typical of many bights within Peter the Great Bay, with a voluminous continental runoff: the interaction of the coastal waters in the open part of the bay and estuarine waters determine the hydrological situation. Water temperature in the shallow bight varies from -1.8^{o}C in January-February to 25^o-27^{o}C in August. Considerable differences between the surface and bottom layer temperatures are evident.

Recently, we have developed approaches that exploit extensive and intensive mariculture methods and introduction of larval phase for *A. japonicus* population restoration. During the last 8 years, the density of the rebuilding population has increased 10 times. Stock abundance is now around 170 000 individuals, with a biomass of 14 t, and specific biomass of 14-70 g/m^2. The maximum stable yield (MSY) may be limited as a protective standard (6%) to 1 ton.

Poster S5-5031

Influence of environmental factors in forecasting mollusks yield on marine farms (for Possyet Bay, Sea of Japan)

Larissa A. **Gayko**

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In order to develop scientific methods for long-term prediction of mollusk productivity, the first stage necessary is to study the effects of the hydrological parameters on the Japanese scallop and on the cultivation technologies used. Initial observational data were collected from a scallop *Mizuhopecten yessoensis* sea farm in Possyet Bay (1970-2005), where all operations, from obtaining spat on artificial substrata (collectors) until commercialization are performed under natural conditions in the semi-closed Minonosok Bay, on floating industrial installations. From the data analysis, it was seen that all of the measured parameters undergo considerable inter-annual variability.

Poster S5-5058

Self-fertilization family establishment and its depression in bay scallop *Argopecten irradians* from different growing areas

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The method of self-fertilization was adopted to compare and research the self-fertilizing effect of two different populations of bay scallops *Argopecten irradians* Lamarck. For self-fertilized population A of *Argopecten irradians*, the range of self-fertilization rate is from 97.54% to 100%, the range of hatching rate is 0.81% to 59.18%, and the average hatching rate is 23.55%. For self-fertilized populations of *Argopecten irradians* are obviously slowly than those of controls and the self-fertilization depression rate of the veliger of the two populations has an obvious tendency to increase.

Poster S5-5064

Cytokine production in coelomocytes of the holothurian *Eupentacta fraudatrix* and seastar *Asterias amurensis*

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Interleukin-1 (IL-1) is considered to be the most ancient cytokine. This immunoregulatory protein has been found in many types of animals. However, little is known about cytokines in immune cells of Echinodermata. Comparative studies on levels of IL-1 and tumor necrosis factor (TNF) in coelomocytes of holothurian *Eupentacta fraudatrix* (Holothuroidea, Dendrochirota) and seastar *Asterias amurensis* (Asterioidea) using assay kits ("Cytokine", Russia) for human IL-1α and TNFα revealed relatively high concentrations of cytokine-like substances. The level of IL-1α-like cytokines in coelomocytes of the seastar was 4.66 ± 0.12 ($M \pm \sigma$) ng/mg protein which was about 3-fold higher than that of the holothurian. Nevertheless, no TNFα-like substance was found in coelomocytes of seastar, while TNFα-like cytokines were detected in the holothurian (311 ± 152 pg/mg). It was also shown that a 30 min–incubation of phagocytes (92% of purity) of *E. fraudatrix* with supernatants of morula cells (52% of purity) which were preincubated for 24 h at 17^{o}C (control supernatants) resulted in 12-fold-increase in TNFα-like cytokine level, and a 6-fold reduction in the level of IL-1α-like cytokine compared to those of control phagocytes. If morula cells were preincubated with dexamethasone (10^{-4}-10^{-2} M), production of TNFα-like cytokines by phagocytes decreased, and IL-1α-like cytokines increased in a concentration-dependent manner compared to control supernatants. The data obtained indicate that the coelomocytes of the two species studied differed in their capacity to produce cytokines.

Poster S5-5083

Spatial distribution of *Perkinsus olseni* in the Manila clam *Ruditapes philippinarum* along Chinese coast

Yubo **Liang**, Dongmei Li, Sa Liu, Xingbo Wang, Tao Song, Xing Miao, Guanhua Chen and Guize Liu

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This is the first report of the spatial distribution of *Perkinsus olseni* in the Manila clam *Ruditapes philippinarum* off the coast of China. Histological observations revealed Perkinsus-like organisms in the mantle, gills, digestive tubules, and gonad. Hypnospore formation of the *Perkinsus*-like organism was confirmed with Ray's fluid thioglycollate medium assay (RFTM). Genus- and species-specific polymerase chain reaction (PCR) assays and the DNA sequences of the internal transcribed spacer region (ITS) of the *Perkinsus* sp. isolated from the Manila clam were identical to *Perkinsus olseni*. Samples were collected from 33 clam populations along the Chinese coast in Yellow Sea, Bohai Sea, Eastern Sea and Southern China Sea, and the prevalence and infection intensity was determined using RFTM and a 2M NaOH digestion technique. The infection intensity averaged 466,532 *Perkinsus* cells per gram of tissue for the whole coastal water areas, and was 567,659 *Perkinsus* cells/g tissue in the Bohai Sea; 165,671 *Perkinsus* cells/g tissue in the Yellow Sea; 516,038 *Perkinsus* cells/g tissue in the East Sea and 878,385 *Perkinsus* cells/g tissue in the South China Sea, while the prevalence of *Perkinsus* ranged from 5.0 to 100.0%.

Poster S5-5111

Experiment on the rearing of larval Japanese flounder, *Paralichthys olivaceus* with *Schmackeria poplesia* (Copepoda: Calanoida)

Donghui Xu and Guangxing **Liu**

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Zooplankton constitutes a major part of the diet for fish larvae in the marine food web, and it is generally believed that copepods can meet the nutritional requirements of fish larvae. In this experiment, the calanoid copepod *Schmackeria poplesi,* the rotifer *Brachionus plicatilis* and Anostraca crustacean *Artemia* sp. were analysed for fatty acids contents, and were used as living food for the rearing of larval Japanese flounder, *Paralichthys olivaceus*. The total contents of the three kind of HUFAs (DHA, EPA and ARA) in *S. poplesia* were significantly higher than that in the others ($P<0.01$). The three organisms were used for raising the larvae and juvenile of *Paralichthys olivaceus* for 15 and 10 days, respectively, and then the growth, survival and fatty acids composition of the larvae and juvenile were investigated. The results showed that the larvae and juvenile fed with copepods (*S. poplesia*) had significantly higher growth than the others ($P<0.01$). The survival of the larvae fed with copepods was significantly higher than the others ($P<0.01$), and the survival of the juveniles fed with copepods was higher than that of those raised on *Artemia* ($P<0.05$). The contents of the three HUFAs (DHA, EPA and ARA) and the DHA/EPA ratio in larvae and juvenile of *P. olivaceus* fed with *S. poplesia* were higher than the other feeds, and the EPA/ARA ratio in larvae and juvenile of *P. olivaceus* fed with *S. poplesia* was lower than the other feeds.

Poster S5-5485

Characterization of the repeating sequence present in the specific genomic ORF region of iridovirus

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Iridoviruses have caused serious constraints on finfish aquaculture and have emerged over the last two decades to become important pathogens in intensively raised finfish. Recently, iridoviruses such as Murray cod iridovirus (MCIV), Dwarf gourami iridovirus (DGIV), Pearl gourami iridovirus (PGIV) have caused serious systemic diseases with high morbidity and mortality of freshwater and marine fishes. These iridoviruses share

remarkable similarities with infectious spleen and kidney necrosis virus (ISKNV), and have been called ISKNV-like viruses. Such ISKNV-like viruses are starting to be found everywhere owing to the movement of ornamental fish by international trade, which may help the spread of these diseases.

In the present study, the presence of ISKNV-like viruses in freshwater ornaental fish and marine fish species was examined. We studied the ORF 2 region that belongs to a special genomic region in iridovirus, called the K1 region, and investigated the intergenic region located between the ORF 2 and the RNRS region. The ORF 2 and intergenic region, named IRN in this study, contained many repeating sequences. The PCR analysis of the ORF 2 region in the iridovirus genome showed variable lengths of amplicons from a single infected fish. However, the IRN region PCR was targeted to an intergenic region which carryies the highest frequency of repeating sequence in the genome of individuals, while we obtained only a single length of amplicon. Multi-sized amplicons appearing in ORF 2 region were derived from the deletion/ addition of a repeating fragment of 156bp, which came out as a much longer repeating sequence when compared to that found in the IRN region. In other words, in terms of the polymorphism length of the ORF 2 region, lthe onger amplicon contained higher numbers of 156bp's repeating sequence. The length of the ORF 2 polymorphism, even after cross infection to the seawater fish, rock bream, was not influenced by the pathogenicity of iridovirus from ornamental fish.

From quantitative PCR targeted to the MCP region, viral concentration in the infected tissue by an iridovirus carrying a single length of K1 region was higher than that by an iridovirus carrying multiple lengths of the K1 region.

Poster S5-5486

Molecular cDNA cloning and analysis of the organization and expression of immune genes from rock bream (*Oplegnathus fasciatus*) infected by Iridovirus

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The innate immune response in fish represents an early, rapid defense against pathogens. Myxovirus resistant (Mx) proteins comprise a class of interferon (IFN)-inducible proteins responsible for virus resistance in vertebrate cells. Cyclooxygenase-2 (Cox-2) is expressed in response to various inflammatory signals, including growth factors cytokines. Iridovirus is an increasingly important pathogen for several marine fish species, causing mortalities mainly in juveniles and adults. Despite many species being affected by this disease, little is known about the interactions between iridovirus and the fish immune system.

The full-length Mx and Cox-2 cDNA sequences from rock bream were determined using PCR primers designed from known fish immune genes sequences followed by elongation of the 5′ and 3′ ends using Rapid Amplification of cDNA Ends (RACE). For *in vivo* experiments, total RNA were isolated from the head kidney cells stimulated for different lengths of time with iridovirus. We have also compared the innate immune response of head kidney cells to dsRNA and lipopolysaccharides (LPS).

In the rock bream Mx cDNA coding sequence, characteristic features of Mx proteins were found, such as a tripartite guanosine-5′-triphosphate (GTP)-binding motif, the signature of the dynamin family, and a sequence that codes for a leucine zipper at the C-terminal region of the protein. Rock bream Cox-2 cDNA contains multiple copies of a typical inflammatory molecule instability motif (ATTTA) and a polyadenylation signal (AATAAA) 27bp upstream of the poly (A) tail 3`UTR. When rock bream were injected with 100$\mu\ell^{-1}$ml LPS, 500$\mu\ell^{-1}$ml poly I:C, we observed the up-regulation of immune genes in response to the injected factors. Interestingly, the expression pattern of Mx gene was different between the dsRNA and LPS-treated groups. Fish infected with iridovirus showed the highest level of Mx gene on day 3 post-infection and decayed over time until reaching background levels by day 7.

Poster S5-5487

Megalocytivirus susceptible for freshwater Pearl gourami (*Trichogaster leeri*) have a risk of transmission to seawater rock bream (*Oplegnathus fasciatus*)

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Two iridovirus isolates of Meglaocytivirus, IVS-1 and PGIV-SP were obtained from rock bream (*Oplegnathus fasciatus*) and pearl gourami (*Trichogaster leeri*) respectively, from fish farms in Korea. Freshwater pearl gourami *Trichogaster leeri* and seawater rock bream *Oplegnathus fasciatus* infected by the iridoviruses PGIV-SP and IVS-1 carried similar numbers of viral particles (2.52×10^8 and 2.46×10^8 viral genome copies/mg spleen tissue, respectively). The viral genome copy number for both iridoviruses decreased much faster in seawater than in freshwater, reaching a concentration of less than 0.5% after 4 days of incubation at 25°C *vs.* 26 to 54% in freshwater. The decrease in copy number altered the infectivity of the viruses, as reflected by the decreased cumulative mortality of rock bream injected intraperitoneally with the incubated iridoviruses.

Furthermore, a cohabitation experiment suggested that uninfected rock bream cohabitated with PGIV-SP challenged rock bream were infected by PGIV-SP and showed 100% cumulative mortality, similar to an experiment with IVS-1.

In addition, of 58 outwardly healthy marine fish groups collected from various markets, two rock bream and one sea perch *Lateolabrax* sp. tested positive for PGIV-SP using a two-step polymerase chain reaction (PCR) method. Thus, PGIV-SP from freshwater ornamental fish may have crossed both environmental and species barriers to infect marine fish such as rock bream.

In this study, we performed a stability test and a cohabitation test to investigate the cross transmissibility between PGIV-SP and IVS-1. As a result, PGIV-SP isolated from freshwater pearl gourami was stable in the seawater, similar to IVS-1 isolated from seawater rock bream, and seawater rock bream were highly susceptible to PGIV-SP. This data imply the potential for iridoviral transmission originating from imported freshwater ornamental fish, to marine fish, even in a marine environment.

Poster S5-5488

Molecular characterization of Noroviruses in various samples from the southeastern coast of Korea

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Noroviruses (NVs), a member of the *Calicivirus* family, are the causative agent of gastroenteritis in humans. Noroviruses detected from patients of gastroenteritis, sewage, river water and cultivated oyster, can be divided into five separate genogroups (GI- GV). It has been reported that most of the isolates can be included GI and GII. In this study, environmental samples, influent and effluents of sewage treatment water, estuarine water, and cultivated oysters from the southeastern coast of Korea were analyzed. Molecular comparison of the detected NVs was also performed after DNA sequencing and phylogenetic analysis of the major capsid protein (ORF2) gene. Due to the genetic diversity among NVs, we designed new primer sets KG1F/KG1R and KG2F/KG2R for GI and GII types of Norovirus respectively after DNA sequence alignments of the major capsid gene from the detected NVs and phylogenetic analysis. Nested PCR using the newly designed primer sets from our laboratory showed improved detection of both types of Noroviruses present in the samples from the southeastern coast of Korea compared with those reported in other laboratories.

The proportion of oyster samples obtained between December 2006 and June 2008 that were positive fo GI and GII types of Norovirus were 30 of 33(90%) and 24 of 33(72%) respectfully. Both influent and effluents of sewage water from the sewage plant were not treated sufficiently to remove the contaminated Noroviruses from the living waste water. Detected strain types of Norovirus from influent and effluents of sewage water appeared to be similar to each other, as we expected. Strains found in oysters collected from the southeastern coast of

Korea appeared to be similar to each other and the reference strain reported from those in Japan. In contrast, wild oyster of more than 3 years old, collected from the area very close to a public swimming beach which may be contaminated by human waste contained different strains of Noroviruses from those found in cultured oysters.

These results suggested that NVs obtained from water and those obtained from oysters in the Southeastern part of Korea have a relationship to the NVs of other Asia countries, but the influence of environment on the strains of Noroviruses in each different sample also cannot be excluded.

Poster S5-5489

Quantification of various *tet* genes in tetracycline resistant bacteria from microflora in fish

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Tetracycline (Tc) is a broad-spectrum antibiotic and one of the most popular antibiotics used in the aquatic industry in order to treat bacterial diseases in marine fish and ornamental fish. Usage of tetracycline has caused the appearance of Tc resistance bacteria through the acquisition of tetracycline resistance genes (*tet* genes).

In this study, we investigated the proportion of tetracycline (Tc) resistant bacteria in the microflora of fish through the identification of various tetracycline resistance genes (*tet*). We report the development, validation and use of real-time PCR (qPCR) for both detection and quantification of various efflux *tet* genes, *tet*(A), *tet*(B), *tet*(C), *tet*(D), *tet*(E) and *tet*(G), that are common in the microflora of fish from different aquatic environments. The proportion of antibiotic resistant bacteria in natural marine fishes in Korea (0-10%) appeared to be the lowest level compared to these found in imported ornamental fish from other Asian countries (65-80%) and cultured marine fish in Korea (30-50%). Distribution of *tet* genes in Tc resistant bacteria determined using multiplex PCR with one degenerated sense primer and 6 specific different antisense primers showed diverse *tet* genes in ornamental fish which is different from marine fish that show predominantly the *tet*(B) gene. In qPCR for the quantification of each different *tet* gene, *tet*A and *tet*B appeared to have the highest level in the microflora from ornamental fish and marine fish respectively. In terms of the relationship between the proportion of Tc resistant bacteria and the copy numbers of *tet* genes, we found that microflora containing higher copy numbers of all of the 6 different *tet* genes showed a higher proportion of Tc resistant bacteria by multiplex real-time PCR. This relationship was confirmed using different measuring methods for bacterial numbers, colony counting on TSA plate and through comparison with the amount of 16s rDNA by real-time PCR with a eubacterial 16s rDNA primer set.

This study demonstrated that qPCR can be not only a rapid diagnostic testl for detecting the diverse *tet* genes in the ecosystem but also an accurate and sensitive method for comparing the abundances of *tet* genes with the proportion of Tc resistant bacteria.

S6 POC Topic Session
Coastal upwelling processes and their ecological effects

Co-Convenors: Tal Ezer (U.S.A.), Vyacheslav Lobanov (Russia) and Xingang Lü (China)

Upwelling is a key process in marine ecosystems linking physical oceanography, chemistry, and marine ecology. It brings rich nutrient water to the upper ocean so it has great impacts upon fisheries in these regions and on the ecological environment, and may also provide a suitable environment for harmful algal blooms. This session will focus on three aspects of upwelling: (1) observations, numerical modeling and mechanism analysis of upwelling and related processes; (2) the quantitative evaluation of upwelling on marine ecology (biological production, diversity, *etc.*); and (3) changes in upwelling systems as a result of climate change. The session should be helpful for the ecosystem-based management of the marine environment.

Wednesday, October 29, 2008 09:00 – 15:30

09:00 ***Introduction by convenors***

09:05 **Jianping Gan, Anson Cheung, L. Li, L. Liang, X. Guo and D. Wang (Invited)**
Alongshore variability of upwelling induced by variable shelf topography and river plume in the northeastern South China Sea (S6-5156)

09:30 **Pifu Cong, Dongzhi Zhao, Limei Qu and Changan Liu**
Analysis of coastal upwelling and its ecological impacts in the China Sea using remote sensing (S6-5047)

09:50 **Xingang Lü, Fangli Qiao and Changshui Xia**
Numerical simulation of the summertime surface cold patches and upwelling in the Yellow Sea (S6-5296)

10:10 **Elena A. Schtraikhert, Sergey P. Zakharkov and Tatyana N. Gordeychuk**
Chlorophyll-*a* concentration at wind-induced upwelling regions in Peter the Great Bay in 2003-2007 (S6-5080)

10:30 ***Coffee / tea break***

10:50 **Tal Ezer, Digna T. Rueda-Roa and Frank Muller-Karger (Invited)**
Unusual mechanisms for driving coastal upwelling and near-shore currents: Examples from the Caribbean Sea and biological consequences (S6-5004)

11:15 **John A. Barth, F. Chan, Stephen D. Pierce, R. Kipp Shearman, Anatoli Y. Erofeev, Laura Rubiano-Gomez and Justin Brodersen**
Interannual variability and modeling of upwelling-driven shelf hypoxia off the central Oregon coast (S6-5375)

11:35 **Michael G. Foreman, Wendy Callendar, Amy MacFadyen and Barbara Hickey**
Present and future upwelling off the entrance to Juan de Fuca Strait (S6-5088)

11:55 **Albert J. Hermann, Sarah Hinckley, Elizabeth L. Dobbins, Dale B. Haidvogel, Nicholas A. Bond, Phyllis J. Stabeno and Calvin Mordy**
Significance of curl-driven upwelling to production in the Coastal Gulf of Alaska (S6-5372)

12:15 **Zhongyong Gao and Liqi Chen**
The different water masses of the Bering Strait throughflow and their mixing on the way to the Arctic Ocean (S6-5198)

12:35 ***Lunch***

14:00 **Steven J. Bograd, Isaac Schroeder, Nandita Sarkar, William J. Sydeman and Franklin B. Schwing (Invited)**
The phenology of coastal upwelling in the California Current: Interannual variability and ecosystem consequences (S6-5163)

14:25 **Che Sun**
Upwelling of the subsurface Kuroshio water and its path on the East China Sea shelf (S6-5280)

14:45 **Hee Dong Jeong, Yang Ho Choi and Chang Su Jeong**
Cold water appearance in the southwestern coast of Korea in summer (S6-5332)

15:05 **Vyacheslav Lobanov, Vladimir Zvalinsky, Pavel Tishchenko, Anatoly Salyuk, Svetlana Y. Ladychenko and Aleksandr F. Sergeev**
Coastal upwelling and its ecological effects in the northwestern Japan Sea (S6-5348)

15:25 **Closing remarks**

S6 Posters

S6-4982 **Elena Vilyanskaya and Gennady Yurasov**
The peculiarities of the coastal upwelling in Peter the Great Bay

S6-4985 **Li-Feng Lu and John Z. Shi**
The dispersion, mixing, stratification and de-stratification within the plume of the Changjiang River estuary, East China Sea: Under the action of combined tidal constituent and steady winds in the flood and dry seasons

S6-5010 **Huasheng Hong, Xin Liu and Bangqin Huang**
Seasonal and interannual variations of phytoplankton in the southern Taiwan Strait

S6-5060 **Victor Kuzin, Elena Golubeva and Gennady Platov**
Simulation of the Bering Sea water propagation to the Arctic-North Atlantic

S6-5072 **Fedor F. Khrapchenkov**
The upwelling effect on the north shelf area of Sakhalin Island based on hydrological measurements and satellite imaging data (2005-2007)

S6-5073 **Fedor F. Khrapchenkov and Nadezda M. Dulova**
Seasonal variability of water currents and temperature in Peter the Great Bay of the Sea of Japan in 2004 - 2007

S6-5091 **Svetlana Y. Ladychenko, Vyacheslav B. Lobanov and Olga O. Trusenkova**
Mesoscale eddy dynamics off Peter the Great Bay, northwestern Japan Sea

S6-5133 **Georgy Shevchenko, Valery Chastikov and Elena Vilyanskaya**
Wind-induced autumn upwelling near western coast of Sakhalin Island

S6-5204 **Xueen Chen and Yunwei Yan**
Numerical simulation of Lagrangian residual currents in the Changjiang Estuary, Hangzhou Bay and their adjacent sea

S6-5206 **K. Muni Krishna**
Coastal upwelling activity along the Central East coast of India in a warming environment

S6-5227 **Alexander Romanov, Alexander Tsoy and Georgy Shevchenko**
Eddies determination in the North Kuril area from satellite altimetry, SST and chlorophyll-*a* data

S6-5315 **Zhiliang Liu**
Effects of tidal-induced upwelling on coastal circulations of the southern Yellow Sea: A model study

S6 Oral Presentations

29 October, 9:05 (S6-5156) Invited

Alongshore variability of upwelling induced by variable shelf topography and river plume in the northeastern South China Sea

Jianping **Gan**[1], Anson Cheung[1], L. Li[2], L. Liang[1], X. Guo[2] and D. Wang[3]

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Observational and modeling studies are utilized to investigate the processes and forcing mechanisms governing alongshore variability of upwelling over the shelf in the northeastern South China Sea (NSCS) during the summer. Analyses reveal that an Intensification of Upwelling (IOU) in the NSCS occurs over a distinctly eastward widened shelf as a result of intensified upslope advection of dense deep waters that crosses the mid shelf toward the inner shelf. Cross-shelf transport is amplified at the head of the widened shelf over the mid shelf and at the lee of the coastal cape over the inner shelf. The strong shoreward cross-isobath transport over the widened shelf is formed by a westward along-isobath pressure gradient force as a result of the net rate of the momentum influx over the diverging isobaths of the widened shelf, and by an intensified bottom frictional transport. Enhanced stratification by the rive plume enhances the cross-shelf circulation in the upper water column such that the surface Ekman current and compensating flow beneath the plume are amplified. Yet, the plume over the shelf has little effect on the intensity of the shoaling of the deep dense water. The plume considerably speeds up the wind-driven current along the inshore edge of the plume, but retards it along the offshore edge. The upwelling current is adjusted to a new dynamic balance invoked by the plume-induced changes of vertical viscosity and horizontal pressure gradient.

29 October, 9:30 (S6-5047)

Analysis of coastal upwelling and its ecological impacts in the China Sea using remote sensing

Pifu **Cong**, Dongzhi Zhao, Limei Qu and Changan Liu

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The seasonal and interannual variability of coastal upwelling in the China Sea area has been investigated using remote sensing data of sea surface temperatures (SST) and wind data. Sea Surface Temperature (SST) / MODIS data from 2003 to 2007 were analyzed for the recognition of upwelling phenomena with emphasis on the summer months. Upwellings show a strong variability in the different regions of the China Sea. The result shows that Fujian-Guangdong coasts, the coast outside the Yangze River Estuary, as well as the southern waters of Shandong Peninsula are the regions with frequent upwelling events. The pattern of the upwelling areas is highly affected by mesoscale processes in the shelf zone, which are related with the "rim" current. In the rim current upwelling can be generated by jets, and eddies as can be demonstrated on SST images of the China Sea especially during summer month. The coastal current and upwelling are the main physical processes of nutrient transport in the waters of the China Sea. The impacts of upwelling on the ecological environment were also analyzed. Chlorophyll a (chl-*a*) / MODIS data from 2003 to 2007 were retrieved and analyzed. The concentration of chl-*a* increase obviously where they are greatly affected by these processes. Mutual analysis of data shows that upwelling can decrease, but also increase the chlorophyll concentration in the surface water layer. The processes responsible for these observations are discussed.

29 October, 9:50 (S6-5296)

Numerical simulation of the summertime surface cold patches and upwelling in the Yellow Sea

Xingang **Lü**, Fangli Qiao and Changshui Xia

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Several isolated cold surface patches are often observed in boreal summer in the Yellow Sea (YS), and these cold waters are particularly striking in the background of nearly homogenous warm water. We numerically simulate the summertime circulation in the YS by using MASNUM wave-tide-circulation coupled model (based on the Princeton Ocean Model), and try to explore the mechanisms of these cold patches through numerical experiments. The modeled cold waters agree with observation in pattern: they are located in five spots, *i.e.*, the marginal area off Subei Bank, the water off Shandong Peninsula eastern tip, and the waters near the three tips along the west coastlines of Korean Peninsula. Numerical experiments show that these isolated patches of low sea surface temperature (SST) are associated with upwelling and tidal mixing, and the upwelling can be explained in two aspects: tidal mixing front (TMF), and tidal currents past the convex coastline. On the one hand, the large horizontal density gradient across the TMF elicits a secondary circulation clinging to the front, and upwelling appears as a branch. On the other hand, according to Garrett *et al.* (1976), the centrifugal effect related with strong tidal currents past convex coastline also produces upwelling, and this mechanism partially accounts for the site-selective feature of the low SST off the “peninsula tips”. In general, the very strong tidal movement in YS is suggested to be the most important inducement of the cold patches and relevant upwelling.

29 October, 10:10 (S6-5080)

Chlorophyll-*a* concentration at wind-induced upwelling regions in Peter the Great Bay in 2003-2007

Elena A. **Schtraikhert**, Sergey P. Zakharkov and Tatyana N. Gordeychuk

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High biological productivity is observed in the areas of upwelling. Chlorophyll-*a* concentration is one of the basic parameters of water bioproductivity. Autumn period is more favorable for development of upwelling in Peter the Great Bay. To determine the period at which the chlorophyll-*a* concentration in Peter the Great Bay is significantly increasing we used the satellite data of SeaWiFS scanner for 2003-2004. These data are for 1 day and averaged for 8 days. Investigations have shown that the appreciable chlorophyll-*a* concentration increase takes place at the beginning-middle of October. Therefore, during this period the chlorophyll-*a* concentration, sea surface temperature and sea-surface wind distribution data for 2003-2007 from the Aqua, NOAA and QuikScat satellites were analyzed. The chlorophyll-*a* concentration, sea surface temperature distribution data were obtained by from the NOWPAP (North West Pacific Action Plan) website. We have chosen the distribution data before the beginning of upwelling and after it. We have revealed, that the wind upwelling and chlorophyll-*a* concentration increase occur mainly along the north-eastern coast of the bay. Upwelling characteristics were more strongly pronounced in 2003 and 2007.

29 October, 10:50 (S6-5004) Invited

Unusual mechanisms for driving coastal upwelling and near-shore currents: Examples from the Caribbean Sea and biological consequences

Tal **Ezer**[1], Digna T. Rueda-Roa[2] and Frank Muller-Karger[3]

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The conventional forcing mechanism for driving coastal currents and upwelling processes is the along-shore wind. However, in some regions, less common forcing sources, such as offshore processes and eddies, can also

be significant and impact biological activities. In the southeastern Caribbean Sea, for example, the primary coastal upwelling is driven by the trade winds and occurs every year between December and May, but a secondary, short-lived (~5 weeks), coastal upwelling occurs also between June and August every year, when the coastal along-shore winds are relatively weak. Examination of various satellite-derived and hydrographic data suggests that the offshore winds are intensified during the summer while the coastal winds are weakening, creating wind-stress curl pattern favorable for upwelling. The location and timing of the seasonal intensification of the offshore winds coincide with the most intense Caribbean eddy activities, suggesting possible impact of the eddies on the wind stress curl through air-sea interactions. Another region with a significant impact of meso-scale eddies on biological-physical interactions is the western Caribbean Sea along the Meso-American Barrier Reef System, where numerous spawning fish aggregations are found. Coastal currents along the reef are unpredictable and often uncorrelated with the local wind. Observations and numerical models show haw the Caribbean eddies influence the flow near the reefs and how they may impact the larval dispersion.

29 October, 11:15 (S6-5375)

Interannual variability and modeling of upwelling-driven shelf hypoxia off the central Oregon coast

John A. **Barth**, F. Chan, Stephen D. Pierce, R. Kipp Shearman, Anatoli Y. Erofeev, Laura Rubiano-Gomez and Justin Brodersen

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Near-bottom waters over the inner shelf (< 50 m water depth) off central Oregon have been increasingly hypoxic (dissolved oxygen < 1.4 ml/l) over the last 8 years, including the appearance of anoxia in summer 2006. Through a combination of ship sampling, moorings and autonomous underwater vehicle gliders, we have been measuring dissolved oxygen with increasing temporal and spatial coverage. For longer term context, we use historical observations along the Newport Hydrographic Line sampled since the 1960s. The appearance of near-bottom, inner-shelf hypoxia is driven by upwelling of low-oxygen and nutrient-rich sourcewater onto the continental shelf, followed by the decay of organic matter raining down from surface phytoplankton blooms. Hypoxia in this region is not driven by input of nutrients from freshwater runoff. The severity of inner-shelf hypoxia varies year-to-year due to changes in upwelling sourcewater properties and the characteristics of wind-driven upwelling. We use a regression model to link observed inner-shelf, near-bottom oxygen levels with offshore sourcewater dissolved oxygen levels and two measures of wind forcing. Wind forcing is represented as both the cumulative seasonal upwelling and an exponentially weighted sum of winds over the last 30 days. The model shows that 94% of the variability of inner-shelf, near-bottom dissolved oxygen levels is explained by a nearly equal combination of changes in sourcewater dissolved oxygen and wind forcing. Long-term records of dissolved oxygen in upwelling source waters off central Oregon show a decrease consistent with other recent estimates of oxygen declines in the eastern North Pacific.

29 October, 11:35 (S6-5088)

Present and future upwelling off the entrance to Juan de Fuca Strait

Michael G. **Foreman**[1], Wendy Callendar[1,2], Amy MacFadyen[3] and Barbara Hickey[3]

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The upwelled and nutrient-rich waters comprising the Juan de Fuca Eddy are the primary reason why the southwestern Vancouver Island and northern Washington continental shelves are among the most productive fisheries regions in the northeast Pacific Ocean. Recent model simulations have shown that dynamics underlying this upwelling system depend not only on winds, but also tides and the estuarine flow in Juan de Fuca Strait. In this presentation, we will summarize these dynamics and use downscaled climate model projections to speculate on the future productivity of the ecosystem.

29 October, 11:55 (S6-5372)

Significance of curl-driven upwelling to production in the Coastal Gulf of Alaska

Albert J. **Hermann**[1], Sarah Hinckley[2], Elizabeth L. Dobbins[1], Dale B. Haidvogel[3], Nicholas A. Bond[1], Phyllis J. Stabeno[4] and Calvin Mordy[1]

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The Coastal Gulf of Alaska (CGOA) is productive, with large populations of fish, seabirds, and marine mammals, yet it is subject to downwelling favorable coastal winds. Downwelling regions in other parts of the world are typically much less productive than their upwelling counterparts. Alternate sources of nutrients to feed primary production in the topographically complex CGOA are poorly known and difficult to quantify. Here we diagnose the output from a spatially nested, coupled hydrodynamic and lower trophic level model of the CGOA, to quantify both horizontal and vertical nutrient fluxes into the euphotic zone. Our nested model includes both nitrogen and iron limitation of phytoplankton, and is driven by a fine-scale atmospheric model which resolves the effects of local orography on the coastal winds. Results indicate significant "rivers" of cross-shelf nitrogen flux due to horizontal advection, as well as "fountains" of vertical transport over shallow banks due to tidal mixing. Using these results, we have constructed a provisional budget of nutrient transport among subregions of the CGOA. Contrary to expectations, this budget reveals substantial *upwelling* of nutrients over major portions of the shelf, driven by local wind stress curl. These effects are large enough to overwhelm the smaller downwelling flux at the coast throughout the growing season. Vertical mixing by winds and tides, and horizontal flux from the deep basin, are other substantial contributors to the total budget for nutrients above the 15m horizon. These findings help to explain the productivity of this coastal ecosystem.

29 October, 12:15 (S6-5198)

The different water masses of the Bering Strait throughflow and their mixing on the way to the Arctic Ocean

Zhongyong **Gao** and Liqi Chen

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The characteristics of the water masses of the Bering Strait throughflow were distinguished from each other by using underway pCO_2 (partial pressure of CO_2) observation, together with the measurements of CO_2 system parameters and hydrographic parameters in the Bering Strait during the 1st and 2nd Chinese National Arctic Research Expedition. Great differences of water masses were revealed by analyzing those chemical signals. Based on these differences, different water masses were distinguished from each other, and their mixing on the way to the Arctic Ocean were revealed as well. Water masses in the Bering Strait were highly stratified from July to August. The Anadyr Current and the Alaska Coastal Current were almost overlaid the local water masses when pouring into the Arctic Ocean. Meanwhile, other water masses in the middle of the Bering Strait could mix vertically with each other and provide enriched nutrient waters. The winter residual water was distinguished when analyzed the abnormality of pCO_2, nutrients, temperature, salinity *etc.* Such important information is significant to the nutrients import and supply to the Arctic Ocean.

29 October, 14:00 (S6-5163) Invited

The phenology of coastal upwelling in the California Current: Interannual variability and ecosystem consequences

Steven J. **Bograd**[1], Isaac Schroeder[1], Nandita Sarkar[1], William J. Sydeman[2] and Franklin B. Schwing[1]

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Changes in the amplitude and phasing of seasonal events (*i.e.*, phenology) can significantly affect the productivity and structure of marine ecosystems. Phenology plays a particularly critical role in eastern boundary ecosystems, which are driven largely by the seasonal cycle of coastal upwelling. Here we develop and describe a set of physical indicators that quantify the timing, evolution, intensity, and duration of coastal upwelling in the California Current large marine ecosystem (CCLME). There is significant interannual variability in upwelling characteristics over the period 1967-2007, with extended periods of strong (1970s, 1998-2004) and weak upwelling (1980-1995) and a trend towards a later and shorter upwelling season in the northern CCLME. Additionally, years of El Niño events were characterized by delayed and generally weak upwelling in the central CCLME. We relate these intra-seasonal and interannual variations in upwelling to responses at several trophic levels, focusing on the reproductive success of one planktivorous and one pisciverous seabird species. Understanding the causes and ecosystem consequences of phenological changes in coastal upwelling is critical, as climate models project significant variability in both the timing and magnitude of coastal upwelling under varying climate change scenarios.

29 October, 14:25 (S6-5280)

Upwelling of the subsurface Kuroshio water and its path on the East China Sea shelf

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Previous studies have shown that the Kuroshio intermediate water constitutes the major source of nutrients on the East China Sea (ECS) continental shelf, and the shelf break region northeast of Taiwan is the primary location for the exchange of Kuroshio and shelf waters. Upwelling at the shelf break has been observed in both hydrographic surveys and satellite remote sensing data, but the temporal-spatial variations of this upwelling process as well as its physical mechanism remain unclear. There is also an open question on the intrusion path of the upwelled Kuroshio water on the shelf and its relation to the Taiwan Warm Current to the west. To investigate this and other related oceanographic issues, a multi-institutional project has recently been started within the frame of the Major Basic Research Plan of China. The progress and scientific goal of the project are reported here.

29 October, 14:45 (S6-5332)

Cold water appearance in the southwestern coast of Korea in summer

Hee Dong **Jeong**, Yang Ho Choi and Chang Su Jeong

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The appearance and variation of cold water area and its influence on the oceanographic condition in the southwestern coast of Korea in summer are studied on the basis of oceanographic data and IR imagery from NOAA. Cold water in the study area is generated in early June and disappears in mid October. Core of cold water appearance is located in the southwestern direction of Jindo, about 15 miles, and within a radius of 3 miles of 34.28°N ~ 125.86°E. Its influence range was from Goheung peninsula, Heuksan island groups to Anma Island. Based on the analysis we concluded that the mechanism of cold water appearance in south western field of Jindo is the vertical mixing by strong tidal current. Moreover, it is estimated that the southwestward expansion of cold water region is derived from the southwestward tide-induced residual currents with speed more than 10 cm/s. The tidal front whose horizontal gradients of water temperature is more than 0.3°C/km

parallel to contours of H/U^3 parameter ranged 2.0~2.5 and the outer boundary of cold water region corresponds with contours of the parameter ranged 2.0~3.0 in the southwestern sea of Korea. On the other hand, we found that the heavy period of sea fog occurrence corresponds with cold water appearance in the southwestern coast of Korea Especially, sea fog in Jukdo close by cold core occurred frequently when the temperature difference between air and dew point is within 5°C, the value of dew point temperature minus water temperature is larger than 2°C and wind speed is within 5m/s in summer.

29 October, 15:05 (S6-5348)

Coastal upwelling and its ecological effects in the northwestern Japan Sea

Vyacheslav **Lobanov**, Vladimir Zvalinsky, Pavel Tishchenko, Anatoly Salyuk, Svetlana Y. Ladychenko and Aleksandr F. Sergeev

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Fast changes of physical, chemical and biological regime along Primorye coast in the northwestern Japan Sea occur in the transition period of monsoon winds (September-November) and are associated with intensification of coastal upwelling and beginning of sea surface cooling and convection. Three cruises with hydrographic, chemical and biological observations were implemented in October 2000, November 2003 and October 2005 to investigate this process. Satellite data on SST and ocean color were also analyzed. Moorings data of bottom water temperature at coastal area since 2003 also analyzed. On the background of SST cooling during fall period a drastic change in circulation pattern, formation of mesoscale eddies and wind induced upwelling event were revealed. These processes enhanced cross-shelf water transport and ventilation of shelf area by nutrient rich deep sea water which leads to increase of primary production (PP). It was found however that increase in PP was not observed in the cold upwelled water tongues, while it was found in the areas where subsurface horizontal advection induced by mesoscale eddies had happened. This could be explained by decreasing of stratification and deepening of upper mixed layer in the upwelling tongues that decreased PP. In opposite, subsurface intrusion of cold, saline and nutrient rich deep sea waters onto the shelf increased stratification and uplifted picnocline that creates favorable conditions for plankton. Thus horizontal advection associated with eddy dynamics is most effective mechanism of fall plankton bloom in the coastal area of Primorye. With the progress of termohaline convection the depth of picnolcine exceeds the critical one by middle of November and then PP gradually decreases. This began first in the area of cyclonic gyre off the Peter the Great Bay. Another important consequence of upwelling is advection of high salinity water onto the shelf thus creating favorable preconditions for dense water formation during coming winter and intense slope convection that can ventilate bottom waters of the deep Japan Basin. Prominent inter-annual variability of spatial and temporal structure of upwelling associated water dynamic and properties distribution is observed.

S6 Posters

Poster S6-4982

The peculiarities of the coastal upwelling in Peter the Great Bay

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The coastal upwelling is the dynamic system formed under the external influence (here is the influence of the wind) and characterized by intensive ascending water movements from deep layers to surface in the narrow zone between the coast and alongshore jet. Coastal upwelling, having thermal stratification, forms zone of lower temperature waters on the surface of the sea by rising colder deep waters. The significant amount of nutrients is rising from deep waters generating hyperactivity of biological processes in upwelling zone. Peter the Great Bay is the most developed offshore area in the Sea of Japan. The favorable conditions for upwelling development in Peter the Great Bay are created during winter monsoon winds, since October. During this time strong winds of the northwest direction in the top of the gulf are considerably amplified under the influence of the coast's surrounding relief. While coming to the water area of the gulf the winds start to weaken and get alongshore direction to stimulate upwelling development. Stratification starts to weaken on the initial stage of its development, so the phenomenon of the colder deep water's appearing is well seen on the hydrographic section made in the waters of the gulf. Under the data of the repeated hydrological section along 132°E an upwelling zone of intermediate water was found in November and December, 1999 in the waters of Peter the Great Bay, the Sea of Japan. The main characteristics of the two-layer field's density are estimated by upwelling model. Upwelling width is 5.5 km, stratification erosion is 11.8 hours and vertical velocity is 4.8·10-2 cm/s.

Poster S6-4985

The dispersion, mixing, stratification and de-stratification within the plume of the Changjiang River estuary, East China Sea: Under the action of combined tidal constituent and steady winds in the flood and dry seasons

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An improved COHERENS model in orthogonal curvilinear coordinates is used to model the dispersal and mixing processes within the Changjiang River plume under the action of combined tidal constituent and steady winds in the flood and dry seasons. (i) Under 6 m/s of south-southeasterly steady winds, a part of the surface Changjiang River plume expands eastwards in the form of cloudy patches during the spring tide in the flood season, while the Changjiang River plume expands east-northeastwards as a whole during the neap tide. Under 4 m/s of northwestly steady winds, the seaward dispersion of the Changjiang River plume is suppressed in the dry season, and it expands southeastwards in the form of a fresh water tongue. (ii) Under 6 m/s of south-southeasterly steady winds, the thickness of the upper buoyant plume within the Changjiang River plume increases in the flood season. Under 4 m/s of northwesterly steady winds, the vertical salinity gradient within the upper and lower layers of the Changjiang River plume is small, and thus the plume is nearly vertically homogeneous, except at the maximum flood tide during the neap tide in the dry season. (iii) Under 6 m/s of south-southeasterly steady winds, the stratification within the Changjiang River plume is enhanced. Vertical stratification was estimated by using Simpson's stratification parameter (ϕ). The stratification parameter increases about 20-80% more than without wind in the flood season. Under 4 m/s of northwesterly steady winds, the stratification at the upwind side of the Changjiang River plume is enhanced, while destratification occurs in other parts of the plume in the dry season. It is suggested that the stratification or destratification within the Changjiang River plume appears to be controlled by the direction of the wind. Furthermore, the upwelling-favourable wind drives the plume to disperse seawards and tends to enhance the stratification, while the downwelling-favourable wind drives the plume to move landwards and causes destratification within the Changjiang River plume.

Poster S6-5010

Seasonal and interannual variations of phytoplankton in the southern Taiwan Strait

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Remote sensing, Chl-*a*, phytoplankton abundance, size-fractionated and species composition were studied during 17 cruises from 1987 to 2007 in the southern Taiwan Strait. Seasonal variations of phytoplankton biomass and community was dramatically changed by the coastal upwelling and Taiwan Bank upwelling. The results showed phytoplankton abundance varied between 0.16 and 845.6×10^3 cells/L, with the highest in July, 1988 (109×10^3 cells/L) when strong coastal upwelling occurred, while the lowest in November, 1988 (5.66×10^3cells/L). In summer, the size-fraction of Chl-*a* is dominantly by microphytoplankton (up to 70%), while substituted by nanophytoplankton in winter. During upwelling season phytoplankton concentrated in depth of 20-30m, and the dominant species (wide-temperature) were *Thalassiothrix frauenfeldii, Thalassionema nitzschioides, Nitzschia delicatissima* and *Skeletonema costatum* in coastal waters, while *Thalassiosira subtilis* and *Trichodesmium thiebautii* of oceanic species in out-shelf waters, and *Hemiaulus hauckii* and *Bellerochea malleus* of warm-water species in the Taiwan Bank upwelling waters.

Interannual variability of Chl-*a in situ*, which was conform by the remote sensing data, in different warter mass, was changed dramatically, Furthermore, the percentage of microphytoplankton was increased gradually from 2004-2007 in summer, followed the Chl-*a* increased tendency. And we can also found the percentage of diatoms was also increased, using the HPLC-pigment analyse. However, the interannual variability of this two upwelling system is also not the same. We think this was beacuse the mechanisms of this two upwelling systems were different. And we guess this seasonal and interannual variation were closely relates to the East Asian monsoon system, Kuroshio and EI Niño events.

Poster S6-5060

Simulation of the Bering Sea water propagation to the Arctic-North Atlantic

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The fresh water flow through the Arctic Ocean plays a key role not only in the water masses distribution in the basin, but in the global water cycle. Model experiments carried out using the reanalysis data are aimed at reproducing the general circulation and the fresh water propagation in the region, covering the Arctic Ocean coupled with the North Atlantic. The paper is focused on the propagation of the Pacific and the Siberian rivers waters beyond the Arctic basin and on the influence it has on the generating of the deep water in the Atlantic. The inflow from the Bering Strait was taken as time dependent with the seasonal cycle. The discharge of the main Siberian Rivers are taken from the multiyear hydrological measurements. The results of the numerical simulation are analyzed in the paper.

Poster S6-5072

The upwelling effect on the north shelf area of Sakhalin Island based on hydrological measurements and satellite imaging data (2005-2007)

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The continental shelf has a large extent in the north and north-west parts of Okhotsk Sea, but the oceanic circulation is not researched well with instrumental measurement and there is only schematic description based on water mass, ice and boat drift distribution analysis and only some short-term measurement. The cyclonic circulation dominates in the sea and the main boundary current – East-Sakhalin current is located to the east of

Sakhalin Island according to these schemes. The current measurement with different current meters and drifters in 1996-2000 showed that East-Sakhalin current was south directed and had considerable seasonal variation. However, summertime south winds domination leads to the almost complete absence of East-Sakhalin current from June till September (current velocity in the area of shelf boundary is about 5-10 cm/s). Barotropic model simulation and current measurement indicate water mass transfer to the north and zonal direction of barotropic currents in Chaivo and Piltun bays. The upwelling effect is discovered in the north-east shelf area of Sakhalin Island with instrumental measurement and satellite imaging data in the 90-s of last century. The upwelling effect was supposed to appear along the entire coast from Nabil bay to Levenshtern cape in summer. There is specific broad sand bar in this part of the shelf and reverse tidal currents are dominating on it along the coast (current velocity exceed 1m/s, estimated as the boat drift during calm and measured in July-September 2007).

The spatial-temporal properties of the upwelling effect in the north-east Sakhalin shelf area in July-September are examined in the article according to the hydrological observations and satellite imaging data in 2005-2007.

Poster S6-5073

Seasonal variability of water currents and temperature in Peter the Great Bay of the Sea of Japan in 2004 - 2007

Fedor F. **Khrapchenkov** and Nadezda M. Dulova

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In 2004-2007 there have been put 18 independent buoy stations in Peter the Great Bay of the Sea of Japan. The duration of continuous measurements of water currents and temperature on two depth levels reaches one year. The data analysis of these observations has shown, that character of currents on water area of a gulf is, particularly in Amur bay, is determined basically by a wind mode, and characterized by significant variability. The maximum speeds of currents were observed in the summer and reached values from 0.4 up to 1 m/s according to measurements in Amur bay. It is shown, that spectra of variability of the module of speed of current in a synoptic range had almost identical structure with maxima on the periods: 3, 4, (5-6) and 9 days and also are similar to spectra of the module of speed of a wind and atmospheric pressure above a gulf.

Poster S6-5091

Mesoscale eddy dynamics off Peter the Great Bay, northwestern Japan Sea

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Peter the Great Bay is located on extended shelf in the northwestern Japan Sea. The oceanographic conditions in the Bay are controlled by the wind-driven circulation and the cold southwestward Primorye Current flowing over the slope. One can expect substantial mesoscale dynamics in this area, related to the coastline/ topography and wind variability. Flow instabilities resulting in current meandering and eddy formation are observed to intensify in the transition period from summer to winter monsoon (September – October), with the general strengthening and frequent events of very strong wind. NOAA infrared AVHRR images are analyzed for July – October 2000-2004. A large (80-110 km) single anticyclonic (AC) eddy or several smaller eddies were detected in the Bay. Typical AC eddy diameters vary from 15-110 km. Eddie's lifetime changes from several days to some months. Fresh coastal water is transported across the shelf-break at the eddy eastern side and deep sea water is advected onto the shelf along its western side. Northeastward current can flow over the slope in the direction opposite to the Primorye Current. Numerical simulations with an oceanic model show that even under the smoothed monthly forcing AC wind stress curl prevailing over this area in summer – autumn induces AC eddy formation. However, if the model is forced by the large-scale cyclonic curl in summer, the Primorye Current simulated at the northwestern edge of the sea cyclonic gyre is so strong that the formation of AC eddies is suppressed, despite the AC wind stress curl in autumn.

Poster S6-5133

Wind-induced autumn upwelling near western coast of Sakhalin Island

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Observations on standard oceanological sections give us the excellent data for investigating of seasonal and interannual variations of fish and other types of marine biota habitat because of regular surveying. Our knowledge of oceanological conditions in the northern part of Tatar Strait and their seasonal changes are very limited. This fact induced us to analyze multiyear CTD data which were collected on the four standard cross-sections which are crossing this area. The cross-section Cape Korsakov – Cape Surkum (KS) which is orient along 50ºN is the most informative among sections of northwestern Sakhalin shelf. In spring time we found significant difference between water temperatures in the western end eastern parts of KS cross-section. Water on the Sakhalin shelf is greatly warmer than on the Asia shelf. This picture corresponds to north-directed flow along Sakhalin coast which is shown on the all known schemes of Tatar Strait circulation. In summer time water temperature difference became smaller. In fall season water on the Sakhalin shelf is significantly colder as result of upwelling event induced by northwesterly wind (so-called winter monsoon). Upwelling of cold and salt water corresponds to south-directed flow along Sakhalin coast which absents on the schemes of Tatar Strait circulation. Low salinity water (less then 31‰) was found in western part of KS section in November.

Poster S6-5204

Numerical simulation of Lagrangian residual currents in the Changjiang Estuary, Hangzhou Bay and their adjacent sea

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The Lagrangian circulation in Changjiang Estuary, Hangzhou Bay and their adjacent sea area is simulated. The riverine flow, East China Sea Current, wind, and the major tidal components (*i.e.* M_2, S_2, O_1 and K_1) are taken into account. By Splitting Current Method, the four components for the Lagrangian circulation, *i.e.* the barotropic gradient current, wind-driven current, tidal induced current and nonlinear coupling of zero-order circulation, are obtained. This study focuses on the barotropic current field and its seasonal variation. The model output is consistent with observations and with the theoretical analysis results. It is indicated that the zero-order circulation is mainly controlled by the East China Sea Current, that tidal induced current is important, and the barotropic circulations in Hangzhou Bay are mainly driven by the wind stresses and the tidal force.

Poster S6-5206

Coastal upwelling activity along the Central East coast of India in a warming environment

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Coastal upwelling along the Central East coast of India (CEI) supports one of the most productive areas of the global ocean. The oceanography of the CEI is dominated by the reversal of winds between the southwest and northeast monsoons. The southwest monsoon normally reaches the CEI in June, spreads northward and continues to blow through September. Between November and March or April, the region is under the influence of lighter, drier northeast winds. Variations in the coupled ocean-atmospheric system impact upwelling patterns and other climatic elements in CEI. Changes in the upwelling system in turn modify sea surface temperatures, sea level heights, and coastal climate. This study examines upwelling patterns from 1945 – the present along the CEI, and ties these patterns to variations in air-sea interactions. While upwelling is controlled daily mostly by local characteristics of winds, coastal topography and bathymetry, large atmospheric feature such as El Niño/La

Niña episodes dominate local conditions. Results from this indicate that air-sea interactions on a large-scale do explain trends and variability of upwelling along the CEI. CEI waters show a trend of increasing temperature over the past several decades. It is triggered by a prolonged regional positive sea surface temperature (SST) anomaly greater than ~1°C that developed offshore during the time of annual summer temperature maximum. Additionally, these findings also point to the possible influences of global warming. Furthermore, local climatic records reveal the influence of coastal atmospheric/oceanic variations on CEI climate.

Poster S6-5227

Eddies determination in the North Kuril area from satellite altimetry, SST and chlorophyll-*a* data

Alexander Romanov[1], Alexander Tsoy[2] and Georgy **Shevchenko**[3]

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A unified satellite altimetry database Topex/Poseidon (2002-2005), Envisat (2002-2007) and Jason-1 (2002-2007) containing about 15000 spots, was created for the Okhotsk Sea and adjacent areas. Amplitudes and phases of main tidal waves were calculated for each spot, and predicted tides were subtracted from initial sea level datasets. Root mean square amplitudes of residual series were considered as characteristics of non-tidal sea level oscillation. Areas with their highest values were considered as energetic ocean zones. They have been found near North Kuril Islands - southeastern Kamchatka coast where mesoscale eddies are observed often. Because our database includes three satellites, spatial resolution was enough for correct determination eddy's parameters and trajectories. Several well-expressed eddies (more often anti-cyclonic eddies) were determined in the area adjacent to North Kuril Islands during 2003-2005. Satellite SST and chlorophyll-*a* concentration data were analyzed also. However anti-cyclonic eddies were relatively weak expressed in SST distributions. High chlorophyll-*a* concentration were observed usually at the eddy's periphery.

Poster S6-5315

Effects of tidal-induced upwelling on coastal circulations of the southern Yellow Sea: A model study

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Based on results of a three dimensional ocean model, the effects of tidal-induced upwelling on coastal circulations were studied in the southern Yellow sea. The results showed that the tidal-induced upwelling could inhibit the coastal circulations from the thermal-driven currents associated with the cold water mass of the Yellow Sea along the tidal fronts. This may suppress the thermal-driven currents in the coastal areas and intensify the wind-driven signals among the sub-tidal currents.

S7 CCCC/POC Topic Session
Marine system forecast models: Moving forward to the FUTURE

Co-Convenors: Michael G. Foreman (Canada), Thomas C. Wainwright (U.S.A.), Hao Wei (China), Yasuhiro Yamanaka (Japan), Sinjae Yoo (Korea) and Yury I. Zuenko (Russia)

As marine system models mature, they are increasingly used to forecast future conditions, both for understanding potential effects of climate change and for projecting system responses to management activities. In particular, the PICES FUTURE Program is focused on forecasting and understanding the responses of North Pacific marine systems to climate change and human activities. This work will reach beyond the models currently used by the PICES community to include models that provide system forecasts, assess uncertainty, and link together multiple levels of system organization. Achieving meaningful forecasts that are useful for management of marine resources will require cross-disciplinary approaches that link processes ranging from atmospheric and ocean physics, through biology to socio-economic systems. This session will focus on multidisciplinary coupled models designed to forecast marine systems in the PICES region, including both strategic (long-term) and tactical (short-term) forecasts linking across two or more disciplines (such as physical oceanography, climate, ecosystem dynamics, marine resource management, or socio-economic systems). Presentations describing approaches to assessing and communicating the reliability (or uncertainty) of coupled marine system forecasts are particularly encouraged.

Friday, Oct. 31, 2008 09:00 – 17:30

09:00 ***Introduction by convenors***

09:05 **Kenneth F. <u>Drinkwater</u> (Invited)**
Requirements for forecasting marine systems – A non-modeller's view (S7-5461)

09:30 **Caihong <u>Fu</u>, Yunne Shin and Angelica Peña**
Towards end-to-end modeling for investigating the effects of climate and fishing in the Strait of Georgia ecosystem, Canada (S7-5087)

09:50 **Maria Rebecca A. <u>Campos</u>**
Moving forward to the future: Bioeconomic modelling of fishery conservation policies in the Philippines (S7-4983)

10:10 **Liang Zhao, Hao Wei, Zhenyong Wang and Yuheng <u>Wang</u>**
Simulation on ecosystem evolution of Jiaozhou Bay for recent 40 years (S7-5023)

10:30 ***Coffee / tea break***

10:50 **Hao <u>Wei</u> and Liang Zhao**
Ecosystem modeling studies in the coastal water of China (S7-4994)

11:10 **Xueen Chen and Jia <u>Gao</u>**
The hydrometeorology and the biological environment of Bohai (S7-5115)

11:30 **Albert J. <u>Hermann</u> and Bernard A. Megrey**
Examining the predictability limits of NPZ-fish dynamics in the Coastal Gulf of Alaska and the Bering Sea using a numerical model (S7-5371)

11:50 **Yury I. <u>Zuenko</u>, Natalia T. Dolganova and Victoria V. Nadtochy**
Forecasting of climate change influence on zooplankton in the Japan/East Sea (S7-5230)

12:10 **Hiroshi <u>Sumata</u>, Taketo Hashioka, Takashi T. Sakamoto and Yasuhiro Yamanaka**
Application of 3-D NEMURO to an eddy-permitting general circulation model for the global domain (S7-5167)

12:30 ***Lunch***

14:00 **Sinjae Yoo, Ig-Chan Pang, Sung-Jun Pang and Jisoo Park**
Wind-driven coastal upwelling and offshore summer phytoplankton blooms on the East China Sea shelf (S7-5266)

14:20 **Shiliang Shan, Huaming Yu, Xueen Chen and Jinrui Chen**
Three-dimensional high-resolution numerical study of the tide and tidal current in the Jiaozhou Bay and Olympic sailing site (S7-5265)

14:40 **Liying Wan, Jiang Zhu, Laurent Bertino and Hui Wang**
Initial ensemble generation and validation for ocean data assimilation using HYCOM in the Pacific (S7-5092)

15:00 **Zhenya Song and Fangli Qiao**
The improvement of the simulated sea surface temperature seasonal cycle in the equatorial eastern Pacific by surface wave-induced vertical mixing (S7-5125)

15:20 **Qi Shu, Fangli Qiao, Zhenya Song, Changshui Xia and Yongzeng Yang**
The improvement of MOM4 by adding wave-induced mixing (S7-5290)

15:40 **Kentang Le, Peng Qi and Qinzheng Liu**
A project for Fine Technology of 4-D Assimilation of Temperature and Salinity (S7-5144)

16:00 ***Coffee / tea break***

16:20 **Xunqiang Yin, Fangli Qiao, Yongzeng Yang and Changshui Xia**
Ensemble adjustment Kalman filter study for Argo data (S7-5283)

16:40 **Thomas C. Wainwright, Jim J. Colbert and Bernard A. Megrey**
Integrating ocean system models using a software framework (S7-5159)

17:00 **Discussion**

S7 Posters

S7-5002 **Evgeniya A. Tikhomirova and Vladimir I. Dulepov**
Model for estimation of primary production

S7-5013 **Svetlana P. Shkorba**
Probabilistic forecast for the ice cover evolution in the Sea of Japan

S7-5170 **Yasumasa Miyazawa, Yoshikazu Sasai and Kazuo Nadaoka**
Toward a data-assimilation system for marginal seas in the SEA-WP region

S7-5176 **Nadezda M. Vakulskaya**
Technology of a large-scale mathematical model of ice spatio-temporal dynamics for the Bering Sea

S7-5205 **Maki Noguchi Aita, S. Lan Smith, Michio J. Kishi and Yasuhiro Yamanaka**
Effects of iron on spatial and temporal phytoplankton distribution using a global 3-D ecosystem model (Fe-NEMURO)

S7-5293 **Xiuhua Yan**
A modeling study of phytoplankton dynamics in Xiamen Bay

S7 Oral Presentations

31 October, 9:05 (S7-5461) Invited

Requirements for forecasting marine systems – A non-modeller's view

Kenneth F. **Drinkwater**

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Marine system models have made large strides over the last number of years. This has resulted in increasing pressure to use them to forecast what will happen in the future. This ranges from predicting the ecosystem response to anthropogenic-induced climate change to assessing shorter-term management actions, *e.g.* fishing strategies. Many of the predictions made will undoubtedly be wrong but assessing what went wrong will only help to improve the models. In this talk I will discuss some of the progress that has been made but concentrate more on where and what future improvements are needed. This includes the requirements for clear indices of uncertainty so that non-modelers can better assess how useful the models are. More emphasis is required on the underlying processes and mechanisms linking climate to ecosystem responses. Closer two-way communication between modelers and observationalists is required for the latter to learn which areas are critical to sample as well as the frequency of sampling and to keep the former on track. More research is needed to assess the non-linear interactions between climate and fishing that makes separation of variability in fish abundance all but impossible to assign to one cause or the other. In regards to future climate change there are still few good regional models available. Why this is so and how we may overcome the difficulties will also be addressed.

31 October, 9:30 (S7-5087)

Towards end-to-end modeling for investigating the effects of climate and fishing in the Strait of Georgia ecosystem, Canada

Caihong **Fu**[1], Yunne Shin[2] and Angelica Peña[3]

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2 Institute de recherché pour le développement, Centre de recherché halieutique, Avenue Jean Monnet 34203 Sète Cedex, BP 171, France
3 Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, 9860 West Saanich Rd., Sidney, BC, V8L 4B2, Canada

Marine ecosystem models should progressively integrate food web dynamics with environmental forcing of marine ecosystem to improve our capacity to understand potential effects of climate change and to forecast system responses to management activities, particularly in the form of fishing. Developing this type of holistic end-to-end modeling approach requires the coupling of physical models with models describing lower trophic levels (*i.e.* plankton) and higher trophic levels (*i.e.* fishes, marine mammals, birds). In this study, we intend to couple a higher trophic level model OSMOSE (a model that is individual- and size-based with flexible structure allowing for the study of the spatial dynamics and of a great number of species that interact) with a lower trophic level model of ROMS-NPZD. As an initial step towards the coupling, we focus on the application of OSMOSE to the fish communities in the Strait of Georgia, Canada, with forcing from observed density distributions of planktons in the Strait. Through simulations under two climate regimes (cold and warm) and six historical fishing scenarios (with/without seal harvesting, with/without Pacific herring fishing, and with/without groundfish trawling), we demonstrate how climate changes and fishing activities affect the dynamics of the Strait of Georgia ecosystem.

31 October, 9:50 (S7-4983)

Moving forward to the future: Bioeconomic modelling of fishery conservation policies in the Philippines

Maria Rebecca A. **Campos**[1]

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The Philippines is surrounded with many fishing grounds. In spite of this, most fishermen in the area live in poverty, and their plight is getting worse, not better. Current fisheries policies for the area have failed to improve the situation but no research has been done to find out why. This report uses a bioeconomic model to simulate the effects of changes in the enforcement levels of current policies. Investments of the government on different levels of enforcement were assessed using benefit cost analysis. The report assesses the effects of enforcing current fisheries policies more stringently. The situation would be transformed into one in which large and perhaps increasing numbers of people would continue to fish, expending larger amounts of effort to comply with various gear restrictions but, in all likelihood, harvesting no fewer fish. Because the bay is already overfished, catch per unit effort and marginal productivity would decrease. Any additional fishing effort in the bay will result in a decrease in the average catch of all fishermen. Enforcement of current policies will not address the underlying problems of open access and the overfishing it leads to. One policy to deal with the problems of open access and overfishing is to set a limit on the total number of fish that can be caught and divide this quota among Lamon Bay's fishermen. Over time, the total allowable catch might be reduced. To allow flexibility, the quotas allocated to individual fishers might be tradeable.

31 October, 10:10 (S7-5023)

Simulation on ecosystem evolution of Jiaozhou Bay for recent 40 years

Liang Zhao, Hao Wei, Zhenyong Wang and Yuheng **Wang**

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Based on the PICES NEMURO model, we created a 0-dimensional pelagic ecosystem model of Jiaozhou Bay, by introducing energy cycling of phosphorus, nutrients from riverine input, atmospheric deposition and exchange with the Yellow Sea, and then simulated the evolutionary trend of the ecosystem for 40 years from 1961 to 2000. The result shows that from the 1960s to 1990s phytoplankton of Jiaozhou Bay change in size, becoming smaller. However, the biomass does not decline. The main reason for this size change is the increase of nitrogen and phosphorus and decrease of silicon from riverine input, and the limiting factor has changed from nitrogen to silicon. The biomass of phytoplankton, especially the small phytoplankton (non-silicous phytoplankton such as flagellates), rises with increasing PAR (photosynthetic active radiation) while the change of temperature has little impact on the biomass of phytoplankton.

31 October, 10:50 (S7-4994)

Ecosystem modeling studies in the coastal water of China

Hao **Wei** and Liang Zhao

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Physical and biological coupled NPZ-like ecosystem modelings are developed in the Bohai Sea, Yellow Sea, and Jiaozhou Bay. The annual cycle of phytoplankton biomass, nutrient concentration and new production are simulated reasonably. Their distribution and seasonal variations are reproduced by three dimensional studies. Numerical experiments show that vertical mixing can both affect the vertical transportation of nutrients and the horizontal distribution of primary production. The weaker the mixing, the higher the primary production when the nutrients and temperature adequate. Suspended particulate material concentration strongly affects the underwater light. Change in transparency can dramatically affect both the occurrence time and the amplitude of the phytoplankton bloom. Horizontal advection affects the relative magnitude of the phytoplankton bloom and

convergence along tidal fronts could induce high biomass and new production. A 40-year simulation in Jiaozhou Bay shows the small phytoplankton biomass increases while the large phytoplankton biomass decreases. The migration of anchovy in the Yellow Sea is also modeled using an Individual-Based Model (IBM). Swimming speed was determined by food and temperature conditions fit for their living. Two production peaks in a year were found. This model can be used to study the effects of climate change on anchovy biomass variation and on best usage of the other biological resources for sustainable development. An IBM for *Calanus sinica* (zooplankton) is in construction now. Twelve life stages are included and the influence of tidal front, Yellow Sea cold water mass and Yellow Sea warm water on zooplankton growth will be tested with this model.

31 October, 11:10 (S7-5115)

The hydrometeorology and the biological environment of Bohai

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In the past 30 years, the hydrometeorology of Bohai has changed remarkably, and this is likely to have an effect on the environment. This paper simulates the tides and tidal currents of the Bohai Sea and North Huanghai based on a Finite Volume Coastal Ocean circulation Model (FVCOM), and the grids in the area near Yellow River Estuary and Bohai Strait are of special high resolution. In order to simulate the tides and tidal currents in the study sea region, the σ-coordinate transformation is applied in the vertical and water level is used in the open boundary in order to drive the model. The computational results are compared with the observed values. The cotidal charts of M2, S2, K1, O1 are presented by means of harmonic analysis, and the charts of surface current field at the high water stand moment, the low water stand moment, the fastest flood moment and the fastest ebb moment are also shown in this paper. This study is mainly in the area near Huanghe Estuary, so the structure of the surface current fields in the area near Huanghe Estuary and Bohai Strait is carefully analyzed. The results with discharge is compared with the results without discharge to show the influence of Huanghe discharge, and a primary mechanism of the area under the influence of Huanghe discharge is discussed in this paper. This is followed by a simulation of the biological environment near the Huanghe Estuary using the Biological Module of FVCOM. High phytoplankton biomass appeared in the upwelling region. Numerical experiments based on the barotropic model and baroclinic model with no wind were also conducted. Differences in the results by the baroclinic model and the barotropic model were significant: more patches appeared in the baroclinic model comparing with the barotropic model, and in the baroclinic model, the subsurface maximum phytoplankton biomass patches formed in the stratified water.

31 October, 11:30 (S7-5371)

Examining the predictability limits of NPZ-fish dynamics in the Coastal Gulf of Alaska and the Bering Sea using a numerical model

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Considerable research has been directed towards capturing the dynamics of marine ecosystems using numerical models, with the eventual goal of predicting the future states of those systems. An important question to ask of such models is what they say about the fundamental predictability of such states - that is, what are the fundamental limits beyond which no model (even a “perfect” one) can forecast a particular aspect of the system with any significant skill. “Predictability” in this context is directly related to the sensitivity of the modeled system to uncertainties in the initial and forcing conditions, which we can never know precisely. In some ways this problem is analogous to that of weather prediction, where spatial/temporal averages of temperature and rainfall are fundamentally more predictable (*i.e.* less sensitive to initial and boundary conditions) than the fine-scale details of those quantities. The predictability of some features in a biological model will be far greater than others; indeed, there may be compensating mechanisms that render some aspects of the biology more predictable than some aspects of the physics. Here, we examine the predictability on multiyear timescales of 1D NPZ dynamics in the Coastal Gulf of Alaska and the Bering Sea, using the NEMURO lower trophic level model

(with and without a fish component) within the Regional Ocean Modeling System (ROMS). We conduct these model experiments using an ensemble of initial and projected forcing data appropriate to each region, based on IPCC scenarios. We contrast the predictability of the physical and biological state variables (mixing, stratification, currents, nutrients, and biomass of various classes of phytoplankton and zooplankton), and examine the predictability of single variables at a single depth in the water column, as compared with that of vertically, temporally, and trophically averaged quantities.

31 October, 11:50 (S7-5230)

Forecasting of climate change influence on zooplankton in the Japan/East Sea

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Different aspects of environmental impact on zooplankton populations in both deep water and shelf areas of the Japan/East Sea are investigated and formalized by statistical methods, such as primary production dependence on water stratification, copepods fecundity dependence on water temperature, wind-induced deep-shelf exchange and terrestrial fresh water discharge influence on neritic communities. The driving mechanisms are considered and linked with climatic indices. A conceptual model of climate change influence on zooplankton abundance and species structure is created and tested on the climate shifts in the late 1980s and late 1990s (the first one caused the zooplankton abundance heightening, but the second one – slight lowering). An empirical multiple correlation model of year-to-year fluctuations of zooplankton abundance and composition is developed on this foundation. The model includes asynchronous links that allow its use to forecast the state of zooplankton communities with a lead time up to 5 years. The model results could be used for definition of environmentally sensible parameters in ecosystem models.

31 October, 12:10 (S7-5167)

Application of 3-D NEMURO to an eddy-permitting general circulation model for the global domain

Hiroshi **Sumata**[1], Taketo Hashioka[2,3], Takashi T. Sakamoto[2] and Yasuhiro Yamanaka[1,2,3]

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A 3-D ecosystem-biogeochemical model based on NEMURO (North Pacific Ecosystem Model Used for Regional Oceanography) for the global domain is presented. The model has a horizontal resolution of 1/4 times 1/6 degrees and 48 vertical levels, covering the entire domain of the world ocean. The ecosystem model NEMURO is extended to 15 compartments of ecosystem-biogeochemical properties, and is coupled with an eddy-permitting general circulation model by an offline technique. The physical model reasonably simulates the realistic separation of western boundary currents and the distribution of the deep mixed layer. These properties of the physical model with its eddying field enable us to reproduce the realistic distributions of nutrients, phytoplankton and other geochemical tracers by the ecosystem model. One of the remarkable results is that the model clearly exhibits horizontal variation of dominant plankton group in the respective basins. The habitat segregation of diatoms and other groups of phytoplankton is strongly correlated to the mixed layer depth in the mid-latitude of the North Pacific and the Southern Hemisphere, while that is weakly correlated in the North Atlantic Ocean. In the former regions, a dilution effect by winter mixing significantly decreases grazing pressure for diatoms, leading to spring bloom of diatoms faster than other group of phytoplankton. As for the North Atlantic, early blooming of diatoms is suppressed by nutrient limitations. These properties of habitat segregation exhibits pattern of patches by effects of mesoscale eddies.

31 October, 14:00 (S7-5266)

Wind-driven coastal upwelling and offshore summer phytoplankton blooms on the East China Sea shelf

Sinjae **Yoo**[1], Ig-Chan Pang[2], Sung-Jun Pang[2] and Jisoo Park[1]

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Recurrent summer phytoplankton blooms far offshore along the shelf of the East China Sea have been observed from satellites. The timing (early July-early September) and magnitude (~1 to > 2 mg m^{-3}) of the blooms have varied during the 1998-2006 period. It is difficult to explain these blooms by Changjiang River discharge alone because the temporal variability of the blooms does not show a clear relationship with this discharge. We conducted numerical experiments using a 2-dimensional nutrient-phytoplankton-zooplankton (NPZ) model with 2 nutrient compartments. The current field was provided by a Regional Ocean Modeling System (ROMS) model with 1/8 degree horizontal resolution and 30 terrain-following coordinate levels. The results of our model experiments using specific conditions of wind and freshwater fluxes in 2006 indicate that the wind-driven upwelling along the Chinese coast may be an important factor in inducing the blooms.

31 October, 14:20 (S7-5265)

Three-dimensional high-resolution numerical study of the tide and tidal current in the Jiaozhou Bay and Olympic sailing site

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Based on the finite-volume method, with an unstructured triangular grid which can more exactly represent the complex coastline and irregular topography, a three-dimensional high-resolution model is constructed in the Jiaozhou Bay. It is a coastal ocean model simulating the tides and tidal currents in Jiaozhou Bay and the Olympic sailing site, using real coastline and bathymetry, a refined grid at harbors and Qingdao Olympic Sailing Center, and is tidal-driven and includes river flows. At the inter-tidal zone, it treated by wet/dry method.

The results of that model give us a high resolution tides and tidal currents and more realistic variation of tides and tidal currents in the inter-tidal zone. The results show that Jiaozhou Bay's tide is semidiurnal. Outward from the Jiaozhou Bay, tidal waves propagate from the northeast to southwest, it is an anti-clockwise system. When tidal waves approach the mouth of Jiaozhou Bay, the waves start to bifurcate: one still propagates to southwest along the coastline, the other one propagates into the inward Jiaozhou Bay with increasing amplitude, tidal waves are mainly standing waves. The characteristic of tidal currents is reversing currents. Near the mouth of Jiaozhou Bay, Eulerian residual currents show a multi-vortex structure, surface residual tidal currents greater than the bottom currents. Tide energy propagates from the northeast to southwest at outward of Jiaozhou Bay; near the mouth of Jiaozhou Bay part of energy continue spread to southwest along the coastline, the other part of energy converges at mouth of Jiaozhou Bay, and then diverges to the inward Bay. Because of the special topography at the mouth of the Bay, the tidal energy is higher than in other areas. In the inner Jiaozhou Bay, only near the Dagu Estuary can the impact of the runoff of Dagu River be felt. Dye release tests showed that the mouth of Jiaozhou Bay is a relatively active zone of water exchange; water flow out the inner Bay parallel to coastline and water exchange is not obvious between east and west zones. Construction of Qingdao Olympic Sailing Centre only affects its near sea area considering the pattern of tidal current. The Qingdao Olympic Sailing Centre and the Maidao shoreline produces a vortex into the field of play for 2008 Olympic Sailing Competition, so the surface currents pattern are more complex and variable. That model also predicts the spatial distribution and temporal variation of tidal currents during the 2008 Olympic game period in the sailing site in Qingdao.

31 October, 14:40 (S7-5092)

Initial ensemble generation and validation for ocean data assimilation using HYCOM in the Pacific

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A method to initialize an ensemble, introduced by Evensen (1994, 2003), was applied to the Ocean General Circulation Model (OGCM) HYCOM (HYbrid Coordinate Ocean Model) for the Pacific Ocean. Taking advantage of the hybrid coordinates, an initial ensemble is created by first perturbing the layer interfaces and then running the model for a spin-up period of one month forced by randomly perturbed atmospheric forcing fields. In addition to the perturbations of layer interfaces, we implemented perturbations of the mixed layer temperatures.

In this paper we investigate the quality of the initial ensemble generated by this scheme, and the influence of the horizontal decorrelation scale and vertical correlation on the statistics of the resulting ensemble. We performed four ensemble generation experiments with different combinations of horizontal decorrelation scales with and without perturbations in the mixed layer. The resulting four sets of initial ensembles are then analyzed in terms of sustainability of the ensemble spread and realism of correlation patterns. The ensemble spreads are validated against the difference between model and observations after 20 years of free run. The correlation patterns of four sets of ensemble are compared to each other.

This study shows that the ensemble generation scheme can effectively generate an initial ensemble whose spread is consistent with observed errors. The correlation pattern of the ensemble also exhibits realistic features. The addition of mixed layer perturbations improves both the spread and correlation. Some limitations of the ensemble generation scheme are also discussed. We found that the vertical shift of isopycnal coordinates provokes unrealistically large deviations in shallow layers near the islands of the west Pacific. A simple correction circumvents the problem.

31 October, 15:00 (S7-5125)

The improvement of the simulated sea surface temperature seasonal cycle in the equatorial eastern Pacific by surface wave-induced vertical mixing

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One problem of the simulation by CCSM3 is the semi-annual sea surface temperature (SST) cycle in the eastern Pacific that does not occur in the observations. Based on the surface wave-circulation coupled theory, an atmosphere-wave-ocean coupled model was developed, which incorporates the MASNUM wave number spectral model and the coupled general circulation model (CGCMs), CCSM3. The model is applied to simulate the SST seasonal cycle in the equatorial eastern Pacific. Compared with CCSM3 simulation, the atmosphere-wave-ocean coupled model reasonably produces a fair SST annual cycle with an April warm peak and August cold peak. The correlation coefficients between model results and observation are improved form 0.66 to 0.93. The ocean surface layer heat budget analysis indicates that the wave-induced vertical mixing is the most important process for improving the SST seasonal cycle in the equatorial eastern Pacific.

31 October, 15:20 (S7-5290)

The improvement of MOM4 by adding wave-induced mixing

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Based on the latest wave-induced mixing theory established by MASNUM, wave-induced mixing is added to the Modular Ocean Model (MOM4). The results show that wave-induced mixing has made significant improvement in simulating the upper ocean. In the upper ocean (20~100m), the probability of the temperature error falling between - 1ºC and 1ºC is enhanced from 64% to 76% in the southern hemisphere (60°S - 10°S) January, and from 66% to 75% in the northern hemisphere (10ºN - 60ºN) July. In summer, because of wave-induced mixing, the model ocean mixed layer depth (MLD) is deepened 12.4 m in the southern hemisphere and 6.3 m in the northern hemisphere, and the results are closer to the observations. In the upper ocean (0-100m), the global averaged correlation coefficient between model temperature and Levitus climatology is enhanced from 0.60 to 0.67. All the results suggest that wave-induced mixing can improve MOM4 significantly.

31 October, 15:40 (S7-5144)

A project for Fine Technology of 4-D Assimilation of Temperature and Salinity

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In order to improve the numerical forecast model used in the present operational system in China, a project entitled “Fine Technology of 4-D Assimilation of Temperature and Salinity” has been suggested by IOCAS and NCEMF. It is planned that vertical coordinates in the new numerical forecast model will be designed as consisting of terrain-following σ-coordinate in shallow water regions, isopycnic coordinates in the open stratified ocean and z coordinates in the weakly-stratified upper-ocean mixed layer. The model’s horizontal resolution will be up to 1′×1′ or less and its vertical layers will not be less than 20 in the China seas and their adjacent oceans. The errors of the sea surface temperature forecasted for one day and for 3 days are designed to be less than 0.8°C and 1.2°C, respectively, as the fine 4-D assimilation products. As a key environmental variable, ocean salinity should be included in the new 4-D assimilation dataset. It is well known that ESA’s SMOS (Soil Moisture and Ocean Salinity) mission has been designed to observe salinity over the oceans, which is scheduled for launch in 2009. Also, Aquarius is a focused satellite mission to measure global Sea Surface Salinity (SSS) and is planning to launch in 2010. It is necessary to develop a new salinity retrieval algorithm so as to obtain the SSS data from the above remote sensing brightness temperature fields. From this, the designed precision of retrieval salinity is 0.4 psu under normal conditions in the project.

31 October, 16:20 (S7-5283)

Ensemble adjustment Kalman filter study for Argo data

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An ensemble adjustment Kalman filter system is developed to assimilate Argo data into the North-West Pacific MASNUM wave-circulation coupled model which is based on the Princeton Ocean Model (POM). This model was recoded in FORTRAN-90 style and some new data types were defined to improve the efficiency of system designing and execution. This system is arranged for parallel computing by using UNIX shell scripts, and is easier for a single model running separately with the required information exchanged through input/output files.

Two experiments are carried out to check the performance of the system: one assimilates the simulated ‘Argo’ data and the other one assimilates the real Argo data in 2005. The first experiment shows that the assimilation system performs well. The comparison with the satellite-derived sea surface temperature (SST) shows that

modeled SST errors are reduced after assimilating; at the same time, the spatial correlation between the simulated SST anomalies and the satellite data is improved because of Argo assimilation. Furthermore, the temporal evolution/trend of SST becomes much better than those results without data assimilation. All these results suggest that this system is potentially capable of reconstructing oceanic data sets which are of high quality, and temporally and spatially continuous.

31 October, 16:40 (S7-5159)

Integrating ocean system models using a software framework

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The success of the IPCC climate assessments has proven the value of ensemble analyses that use multiple model formulations. Two major efforts are underway to provide software tools to ease integration of earth system models for such analyses: PRISM (Partnership for Research Infrastructures in earth System Modelling) in Europe and ESMF (Earth Systems Modeling Framework) in the United States. We have conducted a pilot project to test ESMF for linking the PICES NEMURO models with various ocean circulation models. ESMF provides a library of superstructure (application drivers, gridded model components, and model coupling tools) and infrastructure (structured fields, grids, distributed-processing support, calendars and clocks) for either developing new gridded models or linking existing models. We have developed two simple demonstration applications using ESMF with NEMURO: a 1-dimensional model mimicking the published NEMURO simulation for Ocean Station A7, and a 3-dimensional demonstration linking NEMURO with a simple ROMS ocean circulation grid. Our experience indicates that ESMF has a number of advantages for linking ocean system models: it has a strongly modular design, it is very portable across computer architectures, and it is being widely adopted by U.S. government agencies and university programs. It also has some disadvantages: the libraries are quite complex resulting in a difficult learning curve, there are some restrictions in the supported distributed processing schemes, and not all common grid types are supported at this time. Overall, we conclude that ESMF is a useful tool for supporting "plug-and-play" ocean system models.

S7 Posters

Poster S7-5002

Model for estimation of primary production

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In spite of the availability of a significant information database on plankton, phytoplankton – the major component of the ocean biota, producing primary organic substance - has been insufficiently studied. Lack of on-site data on the existenting distribution of phytoplankton is a valid argument for use of modelling. V.V. Menshutkin's scheme (1993) serves a basis for a model constructed on principles of imitating modelling with attraction of new additions. It is open for expansion and improvement in the process of information accumulation, and can be applied to concrete bays and gulfs. In the present model, besides previously used data on temperature of water, concentration of biogenic substances, irradiance and dependence of photosynthesis intensity on depth, absorption of light by ice in winter months is also considered. In addition, the influence of water temperature on formation of primary production is specified - S.E. Jorgensen's (1985) empirical dependence is applied, and also dependence of primary production on irradiance under the equation of W.L. Webb *et al.* (1974) is used. The estimates of primary production obtained by the model can be utilized for studying production processes, forecasting of stocks and dynamics of trade objects, and also for development of recommendations on their rational use. Estimates of primary production for some areas of the Peter the Great Bay (Sea of Japan), obtained on the basis of the present model, show the results, comparable with other models and on-site data.

Poster S7-5013

Probabilistic forecast for the ice cover evolution in the Sea of Japan

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Probabilistic modeling of the ice cover evolution in the Sea of Japan is based on the notion on the interaction of ocean, ice cover, and atmosphere as a uniform thermodynamic system. Probabilistic forecasting allows us to raise the efficiency of forecasting recommendations. This research is directed at estimating the probabilistic forecast of the decadal ice cover in the Sea of Japan with the help of: 1) algorithms of aprioristic conditional probabilities, 2) Markov chains of the first order, and 3) the Bayes approach. Approbation shows that the most informative parameter for prediction is Il'inskiy index of large-scale atmospheric circulation. The optimum lead time is one month. The Girs indices of atmospheric circulation and parameters of water thermal regime are less important but have larger lead time (3 and 9 months accordingly). The Markov model showed worse results for the lead time > 1 month but was satisfactory for shorter lead time.

Considering that the existing long-term forecasts are far from perfect, and probabilistic forecasts are practically absent, it is possible to recommend the offered scheme of the long-term probabilistic forecast of ice characteristics for practical use.

Poster S7-5170

Toward a data-assimilation system for marginal seas in the SEA-WP region

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The South East Asia and West Pacific (SEA-WP) region is a significant reservoir of the world's richest marine biodiversity, but is deteriorating in its coastal ecosystems owing to various environmental threats. To provide a proper conservation strategy, we have started a study that aims at clarifying regional reef connectivity in the SEA-WP region and thereby identifying important candidate areas to be properly managed as Marine Protected Areas (MPAs), on the basis of numerical simulations on larval dispersal, molecular biological analysis on meta-population dynamics and others. To provide realistic ocean currents for the simulation of larval dispersal, we have developed high-resolution ocean general circulation models in the SEA-WP region. The data assimilation has potentials for farther improvement of the model skills by combination of both the model and observation. Since the SEA-WP region includes shallow marginal-seas, it is important to modify the traditional data assimilation technique that has been developed mainly for use in deep open ocean. We conducted sensitivity experiments of adjustable parameters included in a data assimilation system, JCOPE2 (Miyazawa *et al.*, 2008), in the marginal sea (the East China Sea) and open ocean (Kuroshio Extension and Kuroshio-Oyashio Mixed Water region). We found that the assimilation of sea surface height anomaly is effective in the Kuroshio Extension but not so in the East China Sea. We also found that use of sea surface temperature is useful in the East China Sea.

Poster S7-5176

Technology of a large-scale mathematical model of ice spatio-temporal dynamics for the Bering Sea

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The estimation of ice spatio-temporal variability regime characteristics, the decision of ice forecast problem, the construction and use of ice cover evolution models has scientific and practical importance. At model construction it is supposed that the sea ice floes set corresponds to an ensemble of interacting particles of various areas and thickness, which are in identical macroscopical conditions. Jointly accounting for processes of thermal and wind external atmospheric influence on an ice cover, aggregation, crushing and ice hummocking is possible using such an approach. Open sea ice areas transformations in fast ices at the autumn ice cover formation, and also return transformations at the spring ice melting are considered in coastal areas. The ice cover variability of the Bering Sea is considered within the Chetyrbotskii A.N. large-scale model of sea ice evolution. Durations of processes of formation, mature condition and ice cover destruction are revealed on the basis of this simulation. Absence of the correlation dependence between concentration and ice thickness, presence of the statistical importance of communication between concentration and ice form are shown. The statistically significant agreement of air temperatures at a 2-metre level above ice is revealed at the initial ice occurrence moment and at the initial ice melting instant on the water area of the Bering Sea. The degree of the model adequacy to sampling distributions is defined. The statistical consistency of model parameter estimations is shown.

Poster S7-5205

Effects of iron on spatial and temporal phytoplankton distribution using a global 3-D ecosystem model (Fe-NEMURO)

Maki Noguchi **Aita**[1], S. Lan Smith[1], Michio J. Kishi[1,3] and Yasuhiro Yamanaka[1,2,3]

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Interannual to interdecadal scale oscillations in atmosphere-ocean systems affect marine ecosystems by altering nutrient supply across the thermocline and horizontal advection. Trace metals such as iron, supplied by atmospheric dust and other sources, are important for limiting primary production. To investigate effects of iron on marine ecosystems, we used NEMURO (North pacific Ecosystem Model for Understanding Regional Oceanography), developed by the MODEL Task Team of PICES (North Pacific Marine Science Organization) embedded into a global three-dimensional physical-biogeochemical coupled model, '3D-NEMURO'. We simulated changes in the lower trophic level of the ecosystem caused by climate variability, using a monthly climatological average of the NCEP 6-hourly dataset as a surface forcing to drive the coupled model. The dust flux data used in the model is from the daily output of a global aerosol transport-radiation model, SPRINTARS (Spectral Radiation-Transport Model for Aerosol Species). We compare the standard version of NEMURO to our newly developed version including the iron cycle 'Fe-NEMURO', focusing on the effect of iron on primary production and distribution of phytoplankton. We will also present preliminary results of decadal scale comparisons of historical simulations with each respective version.

Poster S7-5293

A modeling study of phytoplankton dynamics in Xiamen Bay

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Xiamen Bay is a firth with the discharge of Jiulong River, lots of islands and shoals. The variation of its phytoplankton biomass, phosphate and zooplankton in time and space are affected by the hydrological, physical and bio-chemical processes together. Based on historical data from 1990, a nutrient-phytoplankton-zooplankton (NPZ) model which is suitable for this area is established to simulate the variation and distribution of the phytoplankton biomass, phosphate and zooplankton in four seasons. The Princeton Ocean Model (POM) is used as the hydrodynamic model to provide the background field for the NPZ model.

The results show that phosphorus is the main limiting factor to the increase of phytoplankton in Xiamen Bay. The concentration of phosphate decreases from spring to summer and increases from autumn to winter in all the areas. The variation is a response to the consumption of the phytoplankton. In spring, the phytoplankton biomass increases as the temperature increasing and reaches the highest peak in summer. The concentration of nutrients drops to the lowest level during the same period. After the summer phytoplankton bloom, the nutrients increase gradually in August and accumulate in winter.

Sensitivity analysis indicates that the variation of the phytoplankton biomass is sensitive to phytoplankton maximum growth rate, half-saturation constant of phosphorus, phytoplankton mortality rate, and zooplankton grazing rate.

S8 MEQ Topic Session
Consequences of non-indigenous species introductions

Co-Convenors: Blake Feist (U.S.A.) and Mingyuan Zhu (China)

Non-indigenous species (NIS) are ubiquitous throughout the world's marine, coastal and estuarine waters. There is little doubt that human-mediated dispersal of NIS and subsequent establishment of NIS has altered biodiversity, species assemblages, food web dynamics, and trophic structure and interactions in marine ecosystems. These alterations have ecological, biological, evolutionary and economic consequences, especially in coastal and estuarine systems. It is ironic that mariculture and the global shipping trade have been identified as the most affected economically, given that these two activities are often identified as the primary vectors of marine NIS introductions. This session will address the impacts of marine NIS on the ecosystems in which they have invaded. Examples of impacts include, but are not limited to, biological, ecological, evolutionary, and economic. While abstracts addressing any type of economic impact will be considered, preference will be given to research projects focusing on ballast water and bio-fouling diagnostic and treatment technologies.

Tuesday, October 28, 2008 09:00 – 18:00

09:00 ***Introduction by convenors***

09:10 **Edwin Grosholz (Invited)**
A new agenda for addressing the impacts and management of coastal invasions (S8-5326)

09:50 **Henry Lee II, Deborah Reusser, Walter Nelson and Janet Lamberson**
Changes in latitude, changes in attitude – Emerging biogeographic patterns of invasion in the Northeast Pacific (S8-5258)

10:10 **Vasily I. Radashevsky**
Unknown vector of organism transportation with ballast water between the Northwest Pacific and Southwest Atlantic (S8-5297)

10:30 ***Coffee / tea break***

10:50 **Takeaki Hanyuda, Shinya Uwai, Judie Broom, Wendy Nelson and Hiroshi Kawai**
Origin and dynamics of two non-indigenous algal populations (*Undaria pinnatifida*, Phaeophyceae; and *Ulva pertusa*, Ulvophyceae) using molecular markers (S8-5493)

11:10 **Graham E. Gillespie, Thomas W. Therriault and Glen S. Jamieson**
Marine non-indigenous species on the Pacific coast of Canada: Distribution, origin and vectors (S8-5301)

11:30 **Soo-Jung Chang, Won-Duk Yoon and Yoon Lee**
Spatio-temporal variability in the abundance and size of *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) in Korean waters (S8-5481)

11:50 **Jinhui Wang, Yanqing Wu, Yutao Qin and Yihong Li**
The threat of potential alien species in the East China Sea and a mitigation strategy (S8-5272)

12:10 **Lijun Wang**
Species introduced for marine aquaculture and their impacts in China (S8-5093)

12:30 ***Lunch***

14:00 **Graham E. Gillespie and Thomas W. Therriault**
Biology and ecological impacts of the European green crab, *Carcinus maenas*, on the Pacific coast of Canada (S8-5300)

14:20 **Steven S. Rumrill**
Interactions with non-indigenous aquatic species pose an impediment to recovery of native Olympia oyster (*Ostrea conchaphila*) populations within Coos Bay, Oregon, USA (S8-5234)

14:40 **Thomas W. Therriault, Graham E. Gillespie and Glen S. Jamieson**
Looking for non-indigenous species in Canada: Preliminary results from a multi-year, multi-discipline program (S8-5282)

15:00 **Jinho Chae, Dong-Hyun Lim, Taeho Chang Hyungzin Ahn, Il-hoi Kim and Yoon Lee**
Monitoring non-indigenous species in southeastern and eastern Korean trade-ports (S8-5480)

15:20 **Judith Pederson, Victor Polidoro, James Morash, Justin G. Eskesen, Dylan Owens, Franz Hover and Chrys Chryssostomidis**
Advancing technologies to identify marine invaders in support of fisheries management (S8-5452)

15:40 **Paul Heimowitz**
Rapid response plans for aquatic invasive species (S8-5470)

16:00 ***Coffee / tea break***

16:20 **Blake E. Feist, Kevin See, Carolina Parada and Jennifer Ruesink**
Predicting the northward range expansion of non-indigenous European green crab (*Carcinus maenas*) along the west coast of North America (S8-5494)

16:40 **Darlene Smith**
Introduction of a PICES project on marine non-indigeous species supported by the Ministry of Agriculture, Forestry and Fisheries of Japan

16:50 **Thomas W. Therriault**
Rapid Assessment Surveys: PICES WG-21's approach (S8-5471)

17:10 **Deborah Reusser and Henry Lee II**
Evolution of biogeography in the 21st Century – Development of a North Pacific non-indigenous species database (S8-5476)

17:30 **Open Discussion**

S8 Poster

S8-5399 **Xuezheng Lin and Xiaohang Huang**
Introduced marine organisms in China from Japan and their impacts

S8 Oral Presentations

28 October, 9:10 (S8-5326) Invited

A new agenda for addressing the impacts and management of coastal invasions

Edwin **Grosholz**

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Invasive, non-indigenous species are widely acknowledged to be one of the primary threats to coastal marine ecosystems. I synthesize the evidence documenting impacts of invasive non-indigenous in coastal systems from the population to the ecosystem level. Using examples from both benthic and pelagic systems, I discuss the circumstance under which invaders may affect coastal food webs on both short and long time scales and small and larger spatial scales. I also discuss future changes brought about by invasive species in the context of a changing climate. Finally, I summarize what we don't know about invasions and their future impacts and highlight the substantial gaps that persist at the intersection of science and policy, which complicate the management of invasive non-indigenous species. I highlight some of the issues that have either facilitated or impeded the successful union of the science and management of non-indigenous species and draw on recent examples of eradication attempts in coastal estuaries to underscore these points. I close by suggesting a research agenda that focuses on science that can move invasive non-indigenous management forward. I emphasize issues such as early detection and rapid response, population connectivity, the potential for rapid evolution, responses to climate change, and decision support that will improve efforts to manage ongoing coastal invasions and will prevent invasions in the future.

28 October, 9:50 (S8-5258)

Changes in latitude, changes in attitude – Emerging biogeographic patterns of invasion in the Northeast Pacific

Henry **Lee II**[1], Deborah Reusser[2], Walter Nelson[1] and Janet Lamberson[1]

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Biogeographic patterns of invasion of near-coastal and estuarine communities in the Northeastern Pacific (NEP) are beginning to emerge based on surveys by U.S. EPA's Environmental Monitoring and Assessment Program (EMAP) and the EPA/USGS synthesis of native and non-native species in the "Pacific Coast Ecosystem Information System" (*PCEIS*) database. One pattern is the large number of non-indigenous species (NIS), with over 70 non-indigenous fishes and 450 non-indigenous invertebrates reported from southern California to Alaska. In terms of latitudinal patterns, the mid-latitude Northern California Ecoregion was more invaded than the Southern California Bight Ecoregion or the ecoregions encompassing Oregon, Washington, and Puget Sound. The high number of invaders in the Northern California Ecoregion is primarily due to the large number of NIS in the San Francisco Estuary. Puget Sound was the second most invaded waterbody with the extent of invasion decreasing below 30 meters. Though less information is available, the three northern ecoregions spanning up into to the Aleutian Islands appear to be substantially less invaded. While the larger estuaries and waterbodies were the most invaded, the smaller "pristine" estuaries without international ports or oyster aquaculture were also moderately invaded by a subset of the invaders found in the larger systems. As a group, estuarine NIS tend to be more widely distributed along the coast than the native species, resulting in a trend toward homogenization of the estuaries within the NEP. In comparison, the offshore continental shelf (30-120 m) contained very few NIS and does not show a trend toward homogenization.

28 October, 10:10 (S8-5297)

Unknown vector of organism transportation with ballast water between the Northwest Pacific and Southwest Atlantic

Vasily I. **Radashevsky**

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Based on taxonomic surveys of polychaetes (Annelida) in estuarine port areas, we found a series of species in common for Russia, Taiwan and Vietnam in the Northwest Pacific, and Brazil in the Southwest Atlantic. Species we observed include: *Dipolydora socialis* (Schmarda, 1861), *Poecilochaetus paratropicus* Gallardo, 1968, *Polydora cornuta* Bosc, 1802, *Polydora nuchalis* Woodwick, 1953, *Pseudopolydora achaeta* Radashevsky & Hsieh, 2000, *Pseudopolydora antennata* (Claparède, 1868), *Pseudopolydora diopatra* Hsieh, 1992, and *Pseudopolydora paucibranchiata* (Okuda, 1937). All species observed were tube dwellers, found on muddy bottoms, and possessing an extended pelagic phase (larvae) in ontogenesis. Maps of worldwide records of these species are presented and possible dispersal via ballast water is suggested. However, the exact vectors of these introductions remain unknown. The two areas, Northwest Pacific and Southwest Atlantic, are discussed as possible source for one species and recipient for others.

28 October, 10:50 (S8-5493)

Origin and dynamics of two non-indigenous algal populations (*Undaria pinnatifida*, Phaeophyceae; and *Ulva pertusa*, Ulvophyceae) using molecular markers

Takeaki **Hanyuda**[1], Shinya Uwai[2], Judie Broom[3], Wendy Nelson[4] and Hiroshi Kawai[1]

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Artificial trans-oceanic introduction of macroalgae is a considerable threat to local ecosystems, but the origin, expansion, and fate of introduced populations is difficult to determine. Genetic diversity of *Undaria pinnatifisa* and *Ulva pertusa* populations (from East Asia including Japan, Oceania, North America, *etc.*) were analyzed and their origins and population dynamics inferred. Based on the analysis of haplotypes using mitochondrial *cox3* gene sequences, native Northeast Asian populations of *Undaria pinnatifida* (a typical edible macroalga) were classified into four major clades: 1) Korea and China, 2) Northern Japan, 3) Pacific coast of central Japan, and 4) Japan Sea. Based on comparisons between the clades, origins of introduced populations in Europe, North America, South America, and Oceania were predicted. In addition, more detailed analysis of the New Zealand samples (including old dry specimens) suggested that the dominant haplotypes have changed since their initial introduction. In addition, analyses of haplotypes using mitochondrial and chloroplast genome sequences and genotypes using microsatellite marker were performed for *Ulva pertusa* (presumably Eastern Asian origin). Genetic diversity outside Far East Asia (Oceania, North and South America, and Europe) was conspicuously low in all analyses, compared to Far East Asia itself. Moreover, one specific haplotype or genotype was found in about 90% of the populations. These results strongly suggest that populations found outside Far East Asia have their origins in Far East Asia and likely were dispersed via anthropogenic means, and the founder populations in these areas outside Far East Asia were the source of much of genetic material that we see today.

28 October, 11:10 (S8-5301)

Marine non-indigenous species on the Pacific coast of Canada: Distribution, origin and vectors

Graham E. **Gillespie**, Thomas W. Therriault and Glen S. Jamieson

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The occurrence and impacts of non-indigenous species (NIS) continues to be a major concern worldwide. Beginning in 2005, monitoring programs funded by the Department of Fisheries and Oceans Canada (DFO) and the Canadian Aquatic Invasive Species Network (CAISN) were undertaken to document distribution and dispersal of NIS in the marine waters of British Columbia. The Georgia Basin, historically the cradle of aquaculture in British Columbia (BC), and currently the area receiving the majority of international shipping traffic, displayed the highest diversity of NIS in BC, followed by the west coast of Vancouver Island, with diversity decreasing with increasing latitude. It is likely that NIS initially arrived in BC on the hulls of wooden ships or in the solid ballast they carried. Many species were introduced with oysters for aquaculture, first *Crassostrea virginica* from the east coast of North America, then *C. gigas* from Japan. Some species dispersed into BC following establishment on the Pacific Coast of the United States (*e.g.*, *Mya arenaria*, *Carcinus maenas*). In recent times, new NIS have arrived due to international shipping (*Nuttallia obscurata*) and other vectors.

28 October, 11:30 (S8-5481)

Spatio-temporal variability in the abundance and size of *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) in Korean waters

Soo-Jung Chang, Won-Duk Yoon and Yoon **Lee**

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Nemopilema nomurai (Scyphozoa: Rhizostomeae), which inhabits Northeast Asian Seas, is one of the largest of all jellyfish species. Alarmingly, biomass of the jellyfish has increased in the Yellow, East, and East China Sea in the 21st century. An offshore jellyfish monitoring program, focusing on *N. nomurai,* began circa 2005 in the waters surrounding the Korean Peninsula, in coordination with the National Fisheries Research and Development Institute oceanographic monitoring program. Bimonthly surveys occurred in the East, Yellow, South and Northeast China Sea. *Nemopilema nomurai* were first detected in the Northeast China Sea from May to June, and in Korean waters starting in June or July. Since then, *N. nomurai* have expanded their range and abundance and are found throughout Korean waters. In most areas, the abundance of *N. nomurai* is relatively constant. However, the abundance *N. nomurai* in the Northeast China Sea decreased over time. The abundance of *N. nomurai* was the highest in 2005 and the lowest in 2006. At its first appearance in the Northeast China Sea, we found only one cohort, even though the number of cohorts increased to around five or six in the Yellow and South Seas from August to October. Therefore, we concluded that there were differences in recruitment and mortality rates at the various survey sites. The bell diameter of *N. nomurai* was the largest in East Sea and smallest in the Northeast China Sea, which is consistent with the number of cohorts and the distribution pattern or drifting of *N. nomurai*. Consequently, analysis of the size frequency and of the distribution pattern could provide valuable information on population dynamics of the jellyfish. Our analysis could be used to identify potential vectors and population sources of jellyfish as well.

28 October, 11:50 (S8-5272)

The threat of potential alien species in the East China Sea and a mitigation strategy

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The number of harmful algal blooms (HAB) in the East China Sea has doubled since the 1990s. Recently, changes in the biogeography of harmful dinoflagellates (*Heterocapsa circularisquama, Prorocentrum dentatum*) and raphidophytes (*Heterosigma akashiwo, Chattonella marina)* have been detected along the Chinese coast. Strong northward shifts in the spatial distribution of *Phaeocystis globosa* and *Karenia mikimotoi* blooms have been documented. Based on 51 samples taken from ships' ballast tanks in Ningbo Harbor (August 2002 and July 2003), *Dinophysis miles* has been detected, despite the fact that it has was never been observed in surrounding marine environs. However, the other 50 species of phytoplankton and 18 species of zooplankton found in the ballast water samples are also found in nearby marine waters. During 2007 and 2008 additional ballast water samples from international vessels in Shanghai harbor were analyzed. Non-indigenous algae such as *Heterocapsa circularisquama, Pseudo-nitzschia multiseries* and *Pseudo-nitzschia multistriata* were discovered. While *P. multiseries* and *P. multistriata* produce domoic acid (which can cause Amnesic Shellfish Poisoning in humans), there have not been any reports of HABs with this species. However, *Heterocapsa circularisquama* blooms have been observed with subsequent detrimental effects on marine ecology. Another NIS, *Spartina alterniflora*, introduced intentionally for erosion control and marsh reclamation, is competitively superior to the native grass species, *Phragmites australis* and *Scirpus mariqueter*. Consequently, benthic community structure and diversity has declined in the wetlands of the Changjiang Estuary. The total biomass and diversity of macro benthos within *Spartina alterniflora* patches is lower than reference sites with native wetlands plants. Clearly, non-indigenous *Spartina alterniflora* threatens the native species of wetlands where it has invaded.

28 October, 12:10 (S8-5093)

Species introduced for marine aquaculture and their impacts in China

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Currently, there are 41 non-indigenous species (NIS) that have been introduced for marine aquaculture in China, consisting of algae (6 species), shellfish (13 species), crustaceans (7 species), and fishes (15 species). The origins of these NIS range from temperate to tropical zone regions. All 41 of these NIS are important to the development of marine aquaculture, which have improved the quality of their resulting products in China. While none of these NIS have become invasive, there have been some unanticipated consequences, such as non-indigenous pathogens and genetic introgression. Specifically, the marine pathogen *Perkinsus.* sp., unintentionally introduced with cultured *Ruditapes philippinarum* has caused nearly 44 million USD in economic damages along the coast of the north Yellow Sea in China. Reports indicate that *Perkinsus* sp. was brought into China from the Korean Peninsula with *Ruditapes philippinarum* seed. Further, non-indigenous *Argopectens irradias* can hybridize with native *Chlamys* (Azumapecten) *farreri*, and another NIS, *Strongylocentratus intermedius*, can hybridize with native *Strongylocentrolus nudus*. These results demonstrate that the negative consequences of economically important NIS should not be ignored.

28 October, 14:00 (S8-5300)

Biology and ecological impacts of the European green crab, *Carcinus maenas*, on the Pacific coast of Canada

Graham E. **Gillespie** and Thomas W. Therriault

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The European green crab, *Carcinus maenas*, is well-documented as a global invader in Australia, Tasmania, Japan, Patagonia and both coasts of North America. Green crab invaded British Columbia in the winter of 1998/99 as larvae were transported from populations on the Pacific coast of the United States. *Carcinus* has since established local populations throughout the west coast of Vancouver Island; extensive monitoring in other areas of the coast did not produce records of green crab. Tagging programs were undertaken at one site in 2007 and 2008 to estimate abundance and collect growth information. Comparison of catches of native species in areas with and without green crabs was examined to estimate potential impacts of *Carcinus* on native crab species. Ocean circulation models predict that larvae from Vancouver Island could seed new populations in the North coast area of British Columbia and in southeast Alaska.

28 October, 14:20 (S8-5234)

Interactions with non-indigenous aquatic species pose an impediment to recovery of native Olympia oyster (*Ostrea conchaphila*) populations within Coos Bay, Oregon, USA

Steven S. **Rumrill**

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Native Olympia oysters (*Ostrea conchaphila*) were once abundant and ecologically important components of estuarine communities throughout the Pacific Northwest (British Columbia to northern California). Beds of Olympia oysters occurred in the lower intertidal and shallow subtidal zone where they provided key ecosystem services including formation of heterogeneous benthic habitat, biofiltration of phytoplankton and suspended sediments, pelagic-benthic coupling, increased biodiversity, and foraging areas for invertebrates, fish, and shorebirds. Dense beds of Olympia oysters also provided local indigenous people with an important source of food, and larger-scale harvests of *O. conchaphila* once constituted an economically valuable industry. Popularity of the native oysters as a targeted shellfish species lead to over-harvests and massive removal of shell habitat from some estuaries (*i.e.*, San Francisco Bay), and beds of *O. conchaphila* became locally extinct in Coos Bay (Oregon) prior to written history, due to burial and basin-wide changes in the input of fine sediments. Over the past 30+ years, small populations of *O. conchaphila* have become re-established within Coos Bay. However, widespread recovery has not occurred due to several potentially limiting factors including predation, competition, and ecological interactions with indigenous and non- indigenous species. In particular, the larvae of *O. conchaphila* frequently settle and complete metamorphosis on the shells of living Pacific oysters (*Crassostrea gigas*; a non-indigenous species) which are cultured extensively in commercial mariculture plots throughout the tideflats of Coos Bay. The Pacific oysters are harvested after grow-out periods of 2-3 years, resulting in an important source of incidental mortality for the native Olympia oysters.

28 October, 14:40 (S8-5282)

Looking for non-indigenous species in Canada: Preliminary results from a multi-year, multi-discipline program

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Non-indigenous Species (NIS) by definition are not native to the ecosystem in which they are found and can have biological and economic impacts. However, identifying, tracking and understanding NIS can be problematic, especially for countries with extensive marine waters such as Canada. Thus, focused monitoring programs to characterize and track the distribution of known NIS and to identify new NIS and complementary research programs to characterize the potential risks and impacts of NIS are critical. To this end, various programs have been launched in Canada, including programs funded by the Department of Fisheries & Oceans Canada (DFO) and the Canadian Aquatic Invasive Species Network (CAISN). Together these programs have significantly advanced our understanding of NIS in Canadian waters. Systematic intertidal and subtidal surveys were launched by DFO within the Strait of Georgia, British Columbia starting in 2005 and these surveys provided guidance to additional coast wide programs that were launched in subsequent years. In 2006 CAISN, a national research network for NIS was launched focusing on three themes: vectors and pathways, factors affecting establishment, and risk assessment. The findings from these multi-year, multi-discipline programs are being used on a variety of fronts to provide scientific advice to policy makers and managers. For example, distribution data has been used recently to inform risk assessments of five non-indigenous tunicate species and two non-indigenous crab species in Canadian waters. Also, these surveys provide a baseline against which new invasions can be tracked. The methodology and preliminary results from these programs will be discussed.

28 October, 15:00 (S8-5480)

Monitoring non-indigenous species in southeastern and eastern Korean trade-ports

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Quantitative quadrate clearings were made on submerged walls of piers in two heavily trafficked trading ports, the Ports of Ulsan and Onsan, and at a local fishery port in Guryongpo, from 27 – 30 August, 2007. The trading ports are used primarily for international shipping, while the latter experiences mostly local vessel traffic. Samples were sorted by taxonomic group, subsampled and examined by taxonomic experts. About 60 species of annelids, crustaceans, mollusks and urochordates were found from the surface to bottom depths of pier walls. Several established non-indigenous species were found even in the predominant animal groups, such as *Crassostrea gigas, Mytilus galloprovincialis* and *Ciona intestinalis*. Many species of barnacles and polychaetes, *Balanus Amphitrite, B. improvisus, Harmothoe imbricata, Hydroides ezoensis, Myxicola infundibulum, Pomatoleios kraussii, etc.*, were also non-indigenous, but their introduction pathways and affects on habitat are unknown. However, with regard to community structure, Bray-Curtis similarity analyses showed little difference between the trade ports and the local fishery pier. We hypothesize that estuarine ecosystems that do not experience international shipping may not be safe from invasion of well-known, established alien species, even though newly invading non-indigenous species were not found in this study. This is a pioneer effort to document and understand the occurrence of indigenous and non-indigenous species in areas near trade ports, which provides essential information necessary for managing non-indigenous species in Korea. The Korean national plan on frameworks for research, monitoring and management of non-indigenous species is also presented.

28 October, 15:20 (S8-5452)

Advancing technologies to identify marine invaders in support of fisheries management

Judith **Pederson**[1], Victor Polidoro[2], James Morash[3], Justin G. Eskesen[1], Dylan Owens[4], Franz Hover[4] and Chrys Chryssostomidis[1]

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Didemnum, a non-indigenous tunicate is found on gravel beds in Georges Bank, which is a prime Northwest Atlantic fishing ground for scallops and groundfish. Because there are no known predators of *Didemnum*, there is concern that the sea squirt will prevent and/or compete with juvenile scallops for food and space, prevent juvenile fish from feeding on benthic organisms, and possibly interfere with herring spawning.

Surveys of the area have relied heavily on towed or drifting remotely operating vehicles (ROV) with optical imagers, which is a relatively slow process with inadequate technology to cover the potential *Didemnum* habitat. In order to understand the impact of the sea squirt on offshore, deeper subtidal habitats, an inexpensive, reliable method of surveying large areas in relatively short periods of time is needed. We are using an autonomous underwater vehicle (AUV) that is not tethered to a ship and is equipped with a scientific payload of a digital camera and a high frequency acoustic imager (which can survey areas more quickly than optical equipment) to explore the potential for the acoustically identifying *Didemnum.* This paper describes the early results from the AUV deployment in Georges Bank and discusses the potential of an acoustic imager for identifying the sea squirt. Knowing the spatial coverage of the area, along with other research studies on *Didemnum* and its impacts would benefit fisheries management of the area.

28 October, 15: 40 (S8-5470)

Rapid response plans for aquatic invasive species

Paul **Heimowitz**

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Halting new introductions of invasive non-indigenous species is the best approach to avoiding impacts, but no prevention method is fool-proof. Rapid response, with intent to eradicate, is an important second-line of defense. As with fires and oil spills, emergency response to a new aquatic invasive species (AIS) can benefit greatly by advance planning and preparation. This presentation will describe applications of basic contingency planning principles to AIS rapid response plans, drawing on examples from the Northwest region of the United States. It will discuss application of the Incident Command System and associated response organization structures. Core plan topics will be reviewed, ranging from report verification to media relations. Finally, the author will discuss use of mock exercises as a valuable tool to evaluate response plans and build responder readiness, emphasizing challenging response decisions such as vessel traffic restrictions and chemical treatment proposals. Although rapid response plans can not anticipate every scenario, they significantly increase the potential to reduce the impacts of a new introduction.

28 October, 16:20 (S8-5494)

Predicting the northward range expansion of non-indigenous European green crab (*Carcinus maenas*) along the west coast of North America

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European green crab (*Carcinus maenas*), were unintentionally introduced from the east coast of the United States to San Francisco Bay, CA. 1989. Green crab are native to the northeastern Atlantic, but are considered invasive and a great ecological threat to the marine and estuarine ecosystems of the United States. Green crabs have been documented in nearly every major estuary along the west coast of the lower 48 and as far north as the southwest coast of Vancouver Island, British Columbia. There is great concern that green crab populations will continue expanding northward along coastal British Columbia and southeast Alaska. Green crab expand their range to new estuaries and embayments via larval transport, and it is commonly held that this transport mechanism is vastly accelerated northward during El Niño years. We coupled National Oceanic and Atmospheric Administration (NOAA) Regional Ocean Modeling System (ROMS) output with larval green crab life history parameters to create an individual based model (IBM) that predicted where larvae could be transported along the west coast of North America. Larvae were released from 13 sites ranging from San Francisco Bay, California up to Riou Bay, Alaska, at various times of the year from 1994 – 2004. We found that year of release had the most profound affect on northward larval dispersal patterns and that the warmer temperatures associated with El Niño years did not offset the effect of decreased time for larval settlement. It appears that San Francisco Bay is an unlikely source for current populations of green crab found on Vancouver Island in British Columbia. Finally, the model predicted that currently un-colonized areas along the coast of British Columbia and Southeast Alaska could be susceptible to invasion in the future.

28 October, 16:50 (S8-5471)

Rapid Assessment Surveys: PICES WG-21's approach

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Non-indigenous species (NIS) can be found in marine, brackish and freshwaters around the globe with no country immune to their potential impacts. By definition, NIS are not native to the ecosystem in which they are found and can have significant biological and economic impacts. However, many countries with extensive marine waters, such as PICES member countries, are just starting to systematically look for and characterize the distribution of NIS. One approach commonly used to characterize the distribution of a number of NIS simultaneously is to conduct rapid assessment surveys (RAS). These surveys make use of a variety of taxonomic experts that come together as a team to quickly characterize the native, non-indigenous, and cryptogenic species encountered at a number of sites in a specific area of concern. One such area of concern for PICES member countries is commercial ports as a number of studies have shown that commercial shipping continues to redistribute species around the globe either via ballast water, ballast sediment or hull fouling. In order to identify the complement of NIS in ports of PICES member countries, WG-21 has devised an RAS that capitalizes on the PICES annual meeting to bring experts together while drawing on local taxonomic experts to provide training to the larger group. The WG-21 RAS includes sampling both intertidal and subtidal habitats using a variety of techniques to qualitatively determine the species composition of each port surveyed. The overall RAS project and the field methodologies employed will be discussed.

28 October, 17:10 (S8-5476)

Evolution of biogeography in the 21st Century - Development of a North Pacific non-indigenous species database

Deborah **Reusser**[1] and Henry Lee II[2]

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Aquatic invasive species are one of the major ecological threats to the ecological integrity of estuarine and near-coastal waters. However, lack of systematic inventories of non-indigenous species across the North Pacific countries limits our ability to assess how the extent of invasion varies by region, identify potential new invaders, or conduct invasive species risk assessments as described in the draft IMO ballast water treaty. To address this limitation, PICES Working Group 21 is supporting the development of a North Pacific Non-indigenous Species Database that will allow each country to list their non-indigenous species. To reduce language barriers, a graphical interface is used to the extent possible. Species distributions are being captured hierarchically using the global "Marine Ecosystems of the World" schema which divides near-coastal waters into 12 realms, 62 provinces, and 232 ecoregions. A world-wide gazetteer of harbors, bays, and estuaries is being developed to allow input by water body as well as by biogeographic region. The second component of the database is the development of a hierarchical natural history typology that allows users to capture information on species' habitat and physiological requirements and life history characteristics. The objectives are to develop queriable natural history that allows users to extract information on multiple species and locations and to couple natural history with species' distributions to better predict potential risks (*e.g.*, all established infaunal estuarine invaders with pelagic larvae within an ecoregion). A demonstration of the prototype database will be presented on Thursday at the E-Poster session.

S8 Poster

Poster S8-5399

Introduced marine organisms in China from Japan and their impacts

Xuezheng **Lin**[1,2] and Xiaohang Huang[1,2]

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With the rapid development of mariculture in China, more and more marine non-indigenous species (NIS) are introduced in the absence of detailed socioeconomic and ecological cost-benefit assessments. More than 14 non-indigenous mariculture species have been introduced from Japan and most of them are popular in China today. However, their impacts on biodiversity of local marine ecosystem and survival of local species are poorly understood. A management system is required to assess the risks of different NIS, especially for those species likely to become invasive.

S9 BIO Topic Session
End-to-end food webs: Impacts of a changing ocean

Co-sponsored by IMBER
Co-Convenors: George Hunt, Jr. (U.S.A.), Hiroaki Saito (Japan) and Sinjae Yoo (Korea)

A holistic end-to-end approach is needed to study the impacts of global change in marine food webs, including the influences on biogeochemistry and feedbacks to climate. This approach is encapsulated by the term "end-to-end food webs", which is defined as "feeding interactions, nutrient flows and feedbacks in an end-to-end food web of primary producers, consumers and decomposers." This food web approach retains the energy transfer and nutrient cycles of traditional food webs, but emphasizes the importance of understanding food web dynamics simultaneously at all levels and scales. To achieve an integrated understanding of end-to-end food web dynamics requires a merging of knowledge from many marine-related disciplines, including those concerned with global climate, marine food webs, marine ecosystems, marine biogeochemistry and biodiversity.

Tuesday, October 28, 2008 14:00 – 17:50

14:00 ***Introduction by convenors***

14:05 **Angelica Peña (Invited)**
Modelling food web dynamics and biogeochemical cycles on the continental shelf: An example from the Pacific coast of Canada (S9-5426)

14:35 **Mitsuhide Sato, Shigenobu Takeda and Ken Furuya**
Temporal variation in the cellular labile iron pool of phytoplankton during an *in situ* iron enrichment experiment as measured by flow cytometry (S9-5312)

14:55 **Sarah-Jeanne Royer, Martine Lizotte, Maurice Levasseur, Michael Arychuk, Michael Scarratt, Keith Johnson, C.S. Wong, Connie Lovejoy, Marie Robert, Sonia Michaud and Ronald P. Kiene**
DMSP microbial dynamics along a natural iron gradient in the Northeast Pacific (S9-5117)

15:15 **Hongbin Liu, Bingzhang Chen, Mianrun Chen, Xihan Chen, Loklun Shek, Hongmei Jing and Thomas Wong**
Planktonic microbial food web dynamics in Hong Kong coastal waters (S9-5390)

15:35 **JiHo Seo, Seok Hyun Youn, Jeong Kyu Yoo and Joong Ki Choi**
The variation in zooplankton abundance related to sea water temperature changes in Incheon coastal waters, Gyeonggi Bay from 2000 to 2007 (S9-5253)

15:55 ***Coffee / tea break***

16:20 **Chang-Keun Kang (Invited)**
Food web structure in the continental shelf and slope waters of the Korean peninsula: Stable isotope approach and prospects for future research (S9-5342)

16:50 **Eun-Jin Yang, Sinjae Yoo, Jung-Ho Hyun, Jae-Hoon Noh, Hyung-Ku Kang, Dongseon Kim and Chang-Woong Shin**
Structure and dynamics of the planktonic food web during spring and summer in the Ulleung Basin, East Sea/Japan Sea (S9-5360)

17:10 **Jeffrey M. Napp, Christine T. Baier and Suzanne L. Strom**
Mesozooplankton grazing and egg production in the coastal Gulf of Alaska (S9-5400)

17:30 **Hiroaki Saito, Keiichiro Ide, Masatoshi Moku, Hiroya Sugisaki and Kazutaka Takahashi**
The end-to-end food web of the subarctic Pacific from the viewpoint of *Neocalanus* copepods (S9-5358)

Thursday, October 30, 2008 09:00 – 17:30

09:00 **Orio Yamamura (Invited)**
Inside and outside the food web: Factors affecting dynamics of walleye pollock (S9-5417)

09:30 **Hye Eun Lee, Won Duk Yoon and Suam Kim**
Feeding biology of *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) and its ecological implication (S9-5330)

09:50 **George L. Hunt, Jr., Kenneth O. Coyle and Jeffrey M. Napp**
Does a warming climate aid pollock recruitment in the eastern Bering Sea? A new look at assumptions behind the Oscillating Control Hypothesis (S9-5368)

10:10 **Franz Mueter and Ken Coyle**
From physics to humans: Climate effects on Bering Sea food webs and fisheries (S9-5443)

10:30 ***Coffee / tea break***

10:50 **Chung-Youl Park and Woo-Seok Gwak**
Stomach contents of Pacific cod (*Gadus macrocephalus*) in Korean coastal waters (S9-5338)

11:10 **Vjacheslav S. Labay and Yuri R. Kochnev**
Long-term changes in the *Nuculana pernula* community of the southern Okhotsk Sea as an indicator of global benthic change (S9-5107)

11:30 **Olga Yu. Tyurneva, Valery. I. Fadeev, Yuri M. Yakovlev and Vladimir V. Vertyankin**
Changes in the movement and distribution of western gray whales between known feeding areas in 2002-2007 (S9-5099)

11:50 **Jung Hyun Lim, Zang Geun Kim, Kyung-Jun Song, Hyeok Chan Kwon, Seok Gwan Choi, Yong-Rock An and Chang-Ik Zhang**
Feeding habits of minke whales in Korean waters (S9-5241)

12:10 **Hongsheng Bi, William T. Peterson, Jesse Lamb and Cheryl Morgan**
Couplings between multi-scale physical processes and copepod communities along the Washington and Oregon coast (S9-5199)

12:30 ***Lunch***

14:00 **William J. Sydeman, Nandita Sarkar, Isaac D. Schroeder, Kyra L. Mills, Jarrod A. Santora, Sarah Ann Thompson, Robert M. Suryan and Steven J. Bograd (Invited)**
Seabirds as environmental indicators: Climate variability, phenology, prey availability and tests of the "integrator" hypothesis (S9-5447)

14:30 **Jaime Jahncke, Meredith L. Elliott, Benjamin L. Saenz, Jennifer E. Roth and Christine L. Abraham**
Planktivorous seabird responses to variability in coastal upwelling in Central California (S9-5408)

14:50 **Jarrod A. Santora, William J. Sydeman and Steve Ralston**
Do seabirds at sea in the California Current reflect krill distribution, abundance and patch structure? (S9-5160)

15:10 **Jennifer E. Roth, Russell W. Bradley, Peter Warzybok, Christine L. Abraham and Jaime Jahncke**
Ocean processes driving the phenology and productivity of marine birds in the California Current System (S9-5418)

15:30 **Katarzyna Zmudczyńska, Lech Stempniewicz, Adrian Zwolicki, Lech Iliszko, Bronisław Wojtuń and Jan Matuła**
The influence of plankton- and fish-eating seabird colonies on the Arctic tundra ecosystem of Spitsbergen (S9-5116)

15:50 ***Coffee / tea break***

16:10 **Hiroko Sasaki, Hiroshi Kiwada, Koji Matsuoka and Sei-Ichi Saitoh**
The relationship between cetacean distributions and oceanographic conditions in the western North Pacific (S9-5429)

16:30 **Rei Yamashita, Masa-aki Fukuwaka and Yutaka Watanuki**
Ingestion of plastic debris by seabirds in the North Pacific Ocean (S9-5340)

16:50 **Kazuaki Tadokoro, Takashige Sugimoto and Michio J. Kishi**
The effects of anthropogenic global warming on the marine ecosystem (S9-5345)

17:10 ***Summary and wrap up***

S9 Posters

S9-4990 **Guoping Zhu, Liuxiong Xu, Xiaojie Dai, Yingqi Zhou and Wei Liu**
Comparative study of the feeding habits of bigeye *T. obesus* and yellowfin tuna *T. albacares* in the east-central tropical Pacific Ocean

S9-5112 **Xiuning Du and Guangxing Liu**
Species composition and abundance of phytoplankton in the Northern Yellow Sea in the winter of 2006

S9-5131 **Sang Chul Yoon, Hyung Kee Cha, Sung Il Lee, Dae Soo Chang, Sergey Solomatov, Pavel Kalchugin and Jae Hyeong Yang**
Biomass, density, and community structure of fish collected by bottom trawl in the northwestern and southwestern East Sea during 2006-2007

S9-5155 **Marta Gluchowska, Slawomir Kwasniewski, Katarzyna Wojczulanis-Jakubas, Dariusz Jakubas, Katarzyna Blachowiak-Samolyk and Lech Stempniewicz**
Still enough Arctic zooplankton for Little Auks on Spitsbergen, but for how long?

S9-5238 **Kyung-Jun Song, Zang Geun Kim, Seok Gwan Choi, Yong-Rock An, Suk-Jae Kim and Moon-Kab Park**
Occurrence of cetaceans on the fast ferry route between Korea and Japan

S9-5277 **Hyun Woo Kim, Seok-Gwan Choi and Zang Geun Kim**
Seabird distribution patterns in the East/Japan Sea in spring 2007

S9-5344 **Yashu Bai**
Food web structure in the Xiamen Harbour marine ecosystem: Changes during the past 30 years

S9-5362 **Kyum Joon Park, Seok Gwan Choi, Yong Rock An, Zang Geun Kim, Hyun Woo Kim, Ji Eun Park, Tae-Geon Park, Zhiquang Ma and Zhichuang Lu**
Abundance and distribution of minke whales (*Balanoptera acutorostrata*) in the Yellow Sea in 2008

S9-5395 **Jung Hwa Choi, Wongyu Park, Jung Nyun Kim, Sung Tae Kim and Young Min Choi**
Understanding the relationship between zooplankton and shrimp biomass as driven by climate changes in the Yellow Sea, western part of Korean peninsula during 1968-2007

S9-5435 **Peter Warzybok, Russell W. Bradley, Meredith L. Elliott, Benjamin L. Saenz, Nina J. Karnovsky and Jaime Jahncke**
How effective are Cassin's auklets as environmental monitors in Central California?

S9 Oral Presentations

28 October, 14:05 (S9-5426) Invited

Modelling food web dynamics and biogeochemical cycles on the continental shelf: An example from the Pacific coast of Canada

Angelica **Peña**

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The development of a quantitative understanding of the interactions between physical, chemical and biological processes is critical for predicting marine ecosystem responses to climate change. Mechanistic ecosystem models coupled to circulation models are important tools for understanding ecosystem dynamics, to generalize discrete observations, and to predict plausible ecosystem changes. In this study, results from coupled plankton/circulation models (ROMS), developed to study factors influencing bloom dynamics on the continental shelf off Vancouver Island, will be presented. Model results show the influence of the Juan de Fuca eddy, located off the mouth of the Strait of Juan de Fuca, on the growth and retention of phytoplankton. The importance of different sources of nutrients (*i.e.* wind-driven upwelling, topographically controlled upwelling, and the outflow from Juan de Fuca Strait) on primary production and biogeochemical cycles is evaluated. The usefulness of this type of model to assess the potential responses of the marine ecosystem to climate change scenarios will be discussed as well as the limitations of present biogeochemical models to predict future climate change.

28 October, 14:35 (S9-5312)

Temporal variation in the cellular labile iron pool of phytoplankton during an *in situ* iron enrichment experiment as measured by flow cytometry

Mitsuhide **Sato**, Shigenobu Takeda and Ken Furuya

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The cellular labile iron pool (cLIP) of phytoplankton is the free or weakly complexed ferrous ion within cytosol. We developed a method for estimating cLIP by flow cytometry using a fluorescent probe and Phen Green SK to diagnose the iron nutritional status of phytoplankton. The measurement protocol was established using a culture of the diatom *Thalassiosira weissflogii* grown under iron-starved conditions. We applied the method to natural phytoplankton assemblages during SEEDS II, a mesoscale iron enrichment experiment in the western subarctic Pacific. Iron was infused twice on days 0 and 6, and field observations were conducted from day 0 to 12 and from day 23 to 25. After the first iron infusion, the cLIP of both pico- and nanophytoplankton assemblages gradually increased but sharply decreased after the second iron infusion. On day 11, although surface dissolved iron concentration remained as low as ~0.1 nM, the cLIP started to increase again, coinciding with a steep increase in pico- and nanophytoplankton abundance. The variation in both cLIP and cell abundance was much greater for picophytoplankton than for nanophytoplankton. On day 25, the iron-induced algal bloom was in a decline phase, and the cLIP of both assemblages had decreased to a pre-infusion level. These results demonstrate that the cLIP of phytoplankton fluctuates according to changes in ambient dissolved iron concentration and other unknown factors. Iron incorporated by phytoplankton was transferred between a cLIP and a non-cLIP fraction, and the cLIP likely supported phytoplankton growth under low-iron conditions.

28 October, 14:55 (S9-5117)

DMSP microbial dynamics along a natural iron gradient in the Northeast Pacific

Sarah-Jeanne Royer[1], Martine Lizotte[1], Maurice **Levasseur**[1], Michael Arychuk[3], Michael Scarratt[2], Keith Johnson[3], C.S. Wong[3], Connie Lovejoy[1], Marie Robert[3], Sonia Michaud[2] and Ronald P. Kiene[4]

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4 University of South Alabama, Department of Marine Sciences, Mobile, AL, USA

The Alaskan Gyre is a HNLC region characterized by high concentrations of dimethylsulfide (DMS), a biogenic gas with a potential cooling effect on climate. In the North Pacific, both aeolian deposition and vertical mixing may contribute to the replenishment of iron in the surface mixed layer and the stimulation of algal growth. During the 2002 SERIES experiment at Ocean Station P (OSP), the artificial fertilization of a 10 x 10 km^2 surface with iron (mimicking an aeolian deposition) resulted in an increase in dimethylsulfoniopropionate (DMSP), the precursor of DMS, but no change in DMS levels. In the present study, we wanted to assess if iron delivered through vertical mixing would generate a similar response. To do so, we measured ambient concentrations of DMS(P) and the bacterial metabolism of DMSP along a natural iron gradient between OSP and Canadian coastal waters as part of the May 2007 Line P cruise. Our results revealed a stimulation of the growth of DMSP-rich algal species and bacteria as iron increased, but no significant changes in the bacterial metabolism of DMSP and production of DMS. However, DMS microbial yields and DMS levels were higher in the iron-depleted-HNLC waters than in the iron-rich coastal waters, showing that iron limitation resulted in high net microbial DMS production.

28 October, 15:15 (S9-5390)

Planktonic microbial food web dynamics in Hong Kong coastal waters

Hongbin **Liu**, Bingzhang Chen, Mianrun Chen, Xihan Chen, Loklun Shek, Hongmei Jing and Thomas Wong

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We conducted monthly surveys and process studies to investigate microbial food web structure and trophic dynamics in Hong Kong coastal waters at two contrasting sites, one that is strongly influenced by the Pearl River discharge on the west side, and the other in the more oligotrophic eastern waters. Food web components, from virus to mesozooplankton were quantified. Phytoplankton at both sites was mainly composed of microphytoplankton, especially diatoms, though picophytoplankton contributed more to total phytoplankton biomass in the less eutrophic eastern waters. PE-rich *Synechococcus,* the dominant type of marine picocyanobacteria, could rarely be observed at the estuarine site, but was abundant at the eastern site, especially in summer. PC-containing *Synechococcus*, common in freshwater and brackish water, were detected in the estuarine water, especially during wet season. Microzooplankton consumed a great proportion (~60%) of phytoplankton production, whereas mesozooplankton consumption averaged only a few percent. Viral-induced phytoplankton mortality was small, although viruses played an important role in regulating bacterial abundance. Taxon-specific growth and mortality rates were investigated using HPLC-pigment analysis and molecular approaches. Seasonal variation in the composition and dynamics of the planktonic food web can be related to the nutrient-rich freshwater discharge from the Pearl River and the intrusion of various water masses modulated by monsoonal winds.

28 October, 15:35 (S9-5253)

The variation in zooplankton abundance related to sea water temperature changes in Incheon coastal waters, Gyeonggi Bay from 2000 to 2007

JiHo **Seo**[1], Seok Hyun Youn[2], Jeong Kyu Yoo[3] and Joong Ki Choi[1]

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The main objective of this study was to understand the dynamic variation of the abundance of zooplankton in Incheon coastal waters from 2000 to 2007. Incheon coastal waters are influenced by substantial exchange because of tidal action. Zooplankton sampling was conducted bimonthly at 6 stations located in Incheon coastal waters with a conical-type net from 2000 to 2007. Thirty-nine taxa of zooplankton were identified in Incheon waters, which consisted of 1 Dinoflagellate, 2 Chaetognatha, 3 Cladocera, 24 Copepods, 1 Appendicularia and 11 other kinds of zooplankton including meroplankton. Total abundances of zooplankton were highly variable, ranging from 588 inds./m^3 to 61,658 inds./m^3. The maximum value of total abundance appeared in June from 2000 to 2002. After 2003, the maximum value of total abundance appeared in April. During the study period, the copepod *Acartia hongi* was the most abundant species overall. However, during summer, the dinoflagellate *Noctiluca scintillans* was the dominant species and abundance of the genera *Oithona* and *Paracalanus* increased with water temperature. The proportion of meroplankton increased during the warm season throughout study period. We suggest that the seasonal succession and the variation of zooplankton communities were influenced by seasonal variations in water temperature and by the variation of phytoplankton abundance in the study area.

28 October, 16:20 (S9-5342) Invited

Food web structure in the continental shelf and slope waters of the Korean peninsula: Stable isotope approach and prospects for future research

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A changing ocean leads to modifications in the structure of marine food webs through various physical, chemical and biological changes. How can we detect effectually the impacts of global change in marine food webs? The potential of carbon and nitrogen stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) as powerful tools for estimating the organic matter flow and trophic structures of marine food webs has been increasingly realized. We have investigated $\delta^{13}C$ and $\delta^{15}N$ of primary producers, consumers and decomposers in various habitats of Korean waters, and revealed different trophic pathways of organic matter leading to an organism in different marine habitats. In general, while the $\delta^{13}C$ signatures of organisms separated between pelagic and benthic/littoral food webs, the $\delta^{15}N$ signatures of consumers reflected the trophic position of consumers and food-chain length of communities. In this presentation, I will introduce our existing knowledge on end-to-end food web dynamics in coastal waters, and in continental shelf and slope waters using isotopic data sets for various ecological communities. Is this also valid for understanding food web dynamics concerning the changing ocean? If yes, we need to review various questions requiring future research. Investigations should target long-term monitoring of biodiversity, trophic pathways and nutrient fluxes. Furthermore, isotopic characteristics, including trophic fractionation effect of each isotope, as well as changes in trophic interactions, require specific approaches for impact assessments. The time has come to strengthen research efforts on this changing ecosystem.

28 October, 16:50 (S9-5360)

Structure and dynamics of the planktonic food web during spring and summer in the Ulleung Basin, East Sea/Japan Sea

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The community structure and dynamics of the planktonic food web were studied in the Ulleung Basin, East Sea/Japan Sea in the summer of 2005 and the spring of 2006. Biomass of plankton components as well as bacterial and phytoplankton production, and grazing impacts of microzooplankton and copepods on phytoplankton were quantified in relation to the water column condition. The anticyclonic Ulleung Warm Eddy, which has been known in the southwestern East Sea/Japan Sea, was present in the center of the Ulleung Basin in summer and spring. In summer, the eddy was stratified with a seasonal thermocline, and in the center of the eddy, a strong subsurface chlorophyll maximum was developed at 30-40m depth. The biomass and production of plankton components were consistently higher at the center than at the outside of the eddy. Grazing impacts of microzooplankton and copepods on the phytoplankton were similar at the center of the eddy, although that of microzooplankton was higher at the outside than at center of the eddy. In spring, the water column stratification showed a different pattern between the stations. The biomass and production of plankton components were consistently higher at the weakly stratified outside of the eddy than at the vertically well-mixed center of the eddy. Copepods had a relatively low grazing impact on phytoplankton compared with microzooplankton at both sites, and the grazing impact of microzooplankton was considerably higher at the center than the outside of the eddy. However, the microbial food web was dominant in the outside of the eddy in the summer and at the center of the eddy in spring, whereas a multivorous food web seemed to prevail in the center of the eddy in the summer. Our results suggest that the function and structure of the planktonic food web in the Ulleung Basin is primarily governed by water column condition.

28 October, 17:10 (S9-5400)

Mesozooplankton grazing and egg production in the coastal Gulf of Alaska

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The coastal Gulf of Alaska is a unique downwelling ecosystem with strong, buoyancy-driven currents. Cross-shelf and along-shelf variability are important in this system and create different habitats for higher trophic levels. In spring and summer of 2001 and 2003, GLOBEC Process cruises examined the lower trophic levels in four distinct areas: Prince William Sound; the inner shelf (Alaska Coastal Current); the large, but spatially-varied middle shelf; and the iron-depleted outer shelf / oceanic area. Cruises represented different phases of the seasonal dynamics: early-mid phytoplankton bloom (April 2001); fully developed bloom (April-May 2003); mid-late bloom (May 2001); and post-bloom, stratified water column (July 2001 and July-August 2003). We conducted shipboard dilution experiments to estimate microplankton growth and grazing rates, grazing experiments for two species of copepods using natural food assemblages, and incubations to estimate copepod egg production. Late summer cruises always found at least one station with high concentrations of food for particle grazers. The ratio of microzooplankton to total carbon declined as total carbon increased. *Pseudocalanus* and *Calanus* included microzooplankton in their diets, and their grazing tended to be on the largest microzooplankton size classes (> 40 µm). Egg production rates by *Pseudocalanus* and *Calanus* were most concordant with food availability when food was expressed as > 20 µm chlorophyll or > 20 µm chlorophyll plus total microzooplankton, not total chlorophyll or microzooplankton alone. *Calanus* egg viability was highest in spring (82 – 97%) and lowest in summer (31 – 72%).

28 October, 17:30 (S9-5358)

The end-to-end food web of the subarctic Pacific from the viewpoint of *Neocalanus* copepods

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Neocalanus spp. are a dominant component among the mesozooplankton community in the North Pacific. In the subarctic Pacific and its adjacent seas (Sea of Okhotsk, Japan Sea, and Bering Sea), three species of *Neocalanus* occur, which are *N. cristatus, N. plumchrus and N. flemingeri. Neocalanus* is a typical opportunistic feeder, preying on not only phytoplankton, but also microzooplankton especially at low phytoplankton concentrations. This feeding characteristic is one of the reasons for the Pan-Pacific distribution of *Neocalanus* from the coastal regions with phytoplankton blooms to the oceanic HNLC region. Because of the large size (3-7 mm in prosome length) and high abundance, *Neocalanus* plays an important role in transferring primary production to the higher trophic levels. *Neocalanus* is preyed by various organisms, such as pelagic and demersal fish, sea birds, whales, *etc.* The other role of *Neocalanus* is transport of organic matter from the epipelagic ecosystem to the mesopelagic ecosystem. *Neocalanus* grows in the epipelagic layer, accumulates lipids and migrates down to 400-2000 m for mating and spawning. During the period of residence in the mesopelagic zone, *Neocalanus* respires, excretes and is preyed upon by mesopelagic predators, and thus a large amount of carbon is transferred to the mesopelagic layer. The end-to-end food web of the subarctic Pacific, centered around *Neocalanus,* will be presented.

30 October, 9:00 (S9-5417) Invited

Inside and outside the food web: Factors affecting dynamics of walleye pollock

Orio **Yamamura**

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In the coastal area of southeastern Hokkaido Island (Doto area), the diatom-based classical food web encompasses walleye pollock. Its structure is rather complicated, reflecting the trophic cascade due to the cannibalistic behavior of walleye pollock. In this area, the density of walleye pollock sometimes exceeds 100g wwt m^{-2} (*i.e.* 100 t km^{-2}), resulting in the ‘top-heavy’ structure of the food-web. In this ecosystem, the grazing pressure extremely outstrips the secondary production; a model analysis suggests that mesozooplankton is grazed down in ~10 days when one assumes no advective supply. To elucidate the mechanism supporting the fish production, tidal currents were measured using an ADCP along the shelf-edge of the area. The variance of the cross-shelf flow (*i.e.* tidal component) exceeded 50 cm s^{-1} at the bottom layer. This velocity is comparable to the along-shelf component of the Coastal Oyashio Current, indicating that the tidal movement plays an important role in transporting mesozooplankton, phytoplankton, and nutrients to the shelf ecosystem (outside factor).

In the Doto area, pollock diet has been analyzed for 20 yrs to monitor the ecosystem response of walleye pollock. The diet differed chiefly before and after 2001. Before 2001, small-sized fish preyed mainly on copepods and euphausiids, whereas appendicularia (*Oikopleura* sp.) also became important after 2001. For middle- and large-sized pollock, the contribution of myctophids in the early years was replaced with appendicularia in the late years. Juvenile and immature pollock showed better condition factor in the earlier years, suggesting that the difference in prey field affected fish condition and growth performance. Better condition is advantageous in predator avoidance and winter survival, so it is also concluded that the change in prey environment affects pollock dynamics directly and indirectly (inside factor).

30 October, 9:30 (S9-5330)

Feeding biology of *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) and its ecological implication

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Feeding apparatus, the feeding mechanism, and the stomach contents of *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) were investigated. *N. nomurai* medusae, which have no central mouth, have developed a complicated canal system connecting the tip of the tentacle and oral arm to the gut cavity. The number of junctions in the canal system increases with the bell diameter. *N. nomurai* possess a huge number of tiny pores which are properly sized for feeding on micro- and mesozooplankton. Prey are engulfed into the terminal pore located on the oral arms and scapulets, and then transported to the gut cavity via the canal system. The diameter of the terminal pore is always about 1 mm implying that they could not eat prey lager than that pore size. In the Yellow Sea, *N. nomurai* mainly eats copepods in the size range of 0.2 to 0.93mm in width. Exploitation of these prey by *N. nomurai* implies that *N. nomurai* can affect the whole food web by ingesting massive amounts of micro- and mesozooplankton, thus cutting energy transfer to higher-level carnivores.

30 October, 9:50 (S9-5368)

Does a warming climate aid pollock recruitment in the eastern Bering Sea? A new look at assumptions behind the Oscillating Control Hypothesis

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The Oscillating Control Hypothesis (OCH), as originally formulated, assumed that walleye pollock (*Theragra chalcogramma*) recruitment would be favored by early ice retreat and a spring bloom in warm water because there should be more shelf zooplankton to support growth and survival of larval pollock. Recent years with early ice retreat, blooms in warm water, and strong summer stratification have failed to produce the strong year classes predicted by the OCH. In these warm years, the summer abundance of the large shelf copepod, *Calanus marshallae*, was extremely low, as was the abundance of the shelf euphausiid, *Thysanoessa raschii*. In the warm summer of 2004, age-0 pollock were eating small shelf copepods and were heavier in August 2004 than in the cold year of 1999. We suggest that the lack of *C. marshallae* and *T. raschii* in 2004 had the potential to impact both age-0 and age-1 pre-recruit year classes. The lack of adequate prey may affect the growth and preparation of age-0 for their first winter, and it may also result in above average cannibalism on juveniles by larger pollock (when they co-occur) because of the lack of large zooplankton prey for larger pollock in summer and fall. Though increased temperatures are supportive of increased growth rates in pollock as predicted in the OCH, warming and its concomitant affects on prey availability may result in poorer recruitment of more than one year class of pollock.

30 October, 10:10 (S9-5443)

From physics to humans: Climate effects on Bering Sea food webs and fisheries

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To improve understanding of the potential impacts of climate changes on the eastern Bering Sea shelf, we examine links between climate variability, ice conditions, and productivity at several trophic levels. Recent warm years have been characterized by unusually low abundances of large zooplankton and juvenile fishes that

depend on pelagic prey, such as walleye pollock and Pacific cod. While this suggests reduced overall productivity, warmer temperatures do not appear to reduce primary productivity estimated from production models based on satellite-derived surface chlorophyll-*a* concentrations. We explore several alternative explanations for reduced pelagic productivity, in particular (1) the redirection of energy from pelagic to benthic organisms and (2) reduced overall water column productivity associated with increased stratification during warm years. Potential effects of changes in lower trophic level productivity on upper trophic levels will be explored through an analysis of available time series of productivity and the abundance of fish, seabirds, and marine mammals.

30 October, 10:50 (S9-5338)

Stomach contents of Pacific cod (*Gadus macrocephalus*) in Korean coastal waters

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The diets of Pacific cod (*Gadus macrocephalus*) in the East Sea, Yellow Sea and Jinhae Bay were studied by analysis of stomach contents. A Total of 268 individuals were analyzed and the size of Pacific cod ranged from 15.5 to 77.0cm fork length (FL). Prey organisms of the East Sea Pacific cod consisted of caridea, cephalopoda and fish. In the Yellow Sea, the prey composition of Pacific cod was similar to that of eastern Pacific cod, except for cephalopoda. Interestingly, stomach contents of Pacific cod in Jinhae Bay consisted mainly of fish, which is in contrast to those of cod from the East Sea and Yellow Sea. Although various species of food were eaten by smaller Pacific cod, both caridea and fish were chiefly taken by larger Pacific cod. We suggest that the diet of Pacific cod within a certain size is mainly influenced by prey abundance and prey size spectrum in its habitat.

30 October, 11:10 (S9-5107)

Long-term changes in the *Nuculana pernula* community of the southern Okhotsk Sea as an indicator of global benthic change

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Changes in the benthic communities of the southern Okhotsk Sea in the last half of the 20th century are described on scientific, archival and our own data. We documented a decrease in an average benthos biomass in Aniva Bay from 100–300 g/m^2 in 1949 to 38 g/m^2 in 2005. The most important of these changes was migration and variability of the *Nuculana pernula* community in Aniva Bay and Terpenya Bay. The migration of this community involved a reduction in depth distribution and was accompanied by a break area occupied. The biomass biomass of *Nuculana pernula* declined by almost 21 times in Aniva Bay and by 16 times in Terpenya Bay. These changes were not the result of a change in the hydrological regime of the bottom layer. Other reasons may be a reduction of food resources because of either a decrease of a receipt of organic substance from pelagic realm or because of the presence of an infaunal suspension feeder that competes with the mollusks for detritus.

1) A decrease in the average phytoplankton biomass was observed during the spring maximum from 4–6 g/m^3 in1989–1990, to 0.04–1 g/m^3 in 2003–2005. In the Okhotsk Sea the basic determinants of productivity are availability of nutrients (summer) and water temperature (spring and autumn maxima of flowering). In the last half of 20th century, there has been a decrease in the sea surface temperature drop, the most significant of which occurred between 1950 and 1980.

2) The consumption of detritus by an infaunal suspension feeder results in change from a community dominated by bivalve mollusks to one dominated by polychaeta and sipuncula. This phenomenon causes a redistribution of communities.

30 October, 11:30 (S9-5099)

Changes in the movement and distribution of western gray whales between known feeding areas in 2002-2007

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There are two primary gray whale feeding areas off Sakhalin Island in the Sea of Okhotsk. A shallow-water feeding area (5-15 m) is located along the coast adjacent to Piltun Bay. The second, deeper water “Offshore” feeding area is located about 30-40 km off of Chayvo Bay, in waters of 35-60 m deep. Both areas have abundant potential prey for gray whales. Photo-ID studies of gray whales in the Offshore area in 2002-2007 confirmed the exchange of individuals between the two feeding areas; inter- and intra-year interchange of whales between feeding areas was also confirmed. During the six years of photo-ID effort, use of the Offshore feeding area by gray whales varied in intensity. Over the past few decades, researchers have become aware of the presence of gray whales in coastal waters off SE Kamchatka during the summer-autumn and early winter months and photo-ID studies conducted off Kamchatka in 2004, 2006 and 2007 have shown that the western gray whale population during the feeding season is not confined to offshore Sakhalin alone. Shifts in the distribution of feeding gray whales within and between feeding seasons are considered to be at least partly a reaction to seasonal changes in the distribution and abundance of prey. Individual whales move between these areas both during the feeding season and between years. The authors believe that changes in the extent and consolidation of sea ice in the Sea of Okhotsk may affect the seasonal distribution and geographic boundaries of habitats and migration paths.

30 October, 11:50 (S9-5241)

Feeding habits of minke whales in Korean waters

Jung Hyun **Lim**[1], Zang Geun Kim[2], Kyung-Jun Song[1], Hyeok Chan Kwon[1], Seok Gwan Choi[2], Yong-Rock An[2] and Chang-Ik Zhang[1]

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The stomach contents of 39 minke whales (*Balaenoptera acutorostrata*), sampled in Korean waters between 2000 and 2007, were analyzed to study their feeding habits in this area. The body length of the minke whales ranged from 4.2 to 8.5 m with a mean of 5.36 m (SD=1.06). A total of 9 prey species (3 crustaceans, 4 fishes and 2 cephalopodas) were identified. Relative importance of prey species was estimated by a CRI (Combined Rank Index) value, and euphausiid (*Euphausia pacifica*) was found to be the most important prey species in this area, occurring in 76.9% of the stomachs. Pacific anchovy (*Engraulis japonicus*) was the second most important prey species, occurring in 15.4% of the stomachs. Most minke whales fed on one single prey species (74.4%). This result suggests that minke whales in this area tended to feed on single prey species aggregations. On the other hand, most minke whales fed on euphausiid in all age stages, and the result suggests that there were no significant changes in prey species according to the growth condition. In terms of temporal patterns of prey species consumption, euphausiids were the dominant prey species in all months, suggesting no significant changes in prey species by month.

30 October, 12:10 (S9-5199)

Couplings between multi-scale physical processes and copepod communities along the Washington and Oregon coast

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Zooplankton samples were taken along the Washington and Oregon coast in June 1998–2006. The spatial distribution patterns for two copepod groups were examined: cold neritic species and warm oceanic species. Directional Moran's I (inshore-offshore or zonal: 0–50 km and north-south or latitudinal: 200–500km) was calculated to measure the spatial distribution patterns. Positive values indicate a high degree of clustering of samples and negative values indicate negative correlations. We tested the hypothesis that the north-south distribution patterns for two copepod groups were related to large scale transports as indicated by Pacific Decadal Oscillation (PDO) indices and the inshore-offshore distributions were related to coastal upwelling. Results showed that cold neritic species including *Calanus marshallae* and *Acartia longiremis*were more abundant inshore to the north and showed negative spatial autocorrelation in north-south direction when PDO was positive (warm ocean conditions in 1998, 2005, and 2006). There was no significant north-south spatial autocorrelation when PDO was negative (cold conditions). Positive zonal autocorrelation occurred (*i.e.*, animals were clustered nearshore) in most years, but did not show a clear relationship with the strength of coastal upwelling. Warm oceanic copepod species displayed positive spatial autocorrelation in inshore-offshore direction in most years, but no clear patterns in north-south direction. The difference in spatial distribution between two copepod groups is likely to be a result of variation in large scale physical transports and regional physical processes such as coastal upwelling, as well as the interaction between large scale and regional scale physical processes.

30 October, 14:00 (S9-5447) Invited

Seabirds as environmental indicators: Climate variability, phenology, prey availability and tests of the "integrator" hypothesis

William J. **Sydeman**[1], Nandita Sarkar[2], Isaac D. Schroeder[2], Kyra L. Mills[1], Jarrod A. Santora[1], Sarah Ann Thompson[1], Robert M. Suryan[3] and Steven J. Bograd[2]

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Seabirds have been proposed to be reliable, accurate, and near-real-time indicators of marine ecosystem variability and change. Starting with pioneering work describing seabirds as indicators of contaminants (primarily DDT) in coastal food webs, the field has grown to encompass dozens of ways in which seabird physiological, life history, distributional, and demographic attributes can be used as environmental indicators, and in some cases predictors for fish and fisheries. Underlying essentially all of these arguments is an assumption that seabirds "integrate" environmental, ecological, and human-induced factors to provide clear signals of ecosystem change in time and space. We review aspects of this extensive and developing field and investigate scales of integration in time and space using newly analyzed information on ocean climate, primary productivity, phenology, and prey availability from the California Current. We conclude with recommendations to the PICES community on application of the concept of seabirds as environmental indicators in regards to FUTURE.

30 October, 14:30 (S9-5408)

Planktivorous seabird responses to variability in coastal upwelling in Central California

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We examined planktivorous seabird responses to oceanographic conditions in the Gulf of the Farallones, Central California, at multiple time scales. We tested the hypothesis that oceanographic processes influence the ecology of planktivorous auklets *Ptychoramphus aleuticus* by means of changes in their habitat and/or prey availability. At short time scales (2004-2007), we found that delayed and reduced upwelling can lead to remarkable changes in the zooplankton community and result in declines in the abundance of major zooplankton taxa in the water column. Most upper-trophic level predators satisfy their energy demands consuming crustacean zooplankton, particularly copepods and krill. Reduced availability of these prey species can have significant effects on timing of breeding, productivity, and overall abundance and distribution, as demonstrated by recent auklet breeding failures on the Farallon Islands and low returns of Chinook salmon *Oncorhynchus tshawytscha* to the Central Valley. At inter-decadal scales (1972 to 2006), we found that timing of nesting on the Farallon Islands was associated with local sea surface temperatures (winter and spring), and chick productivity was associated with local upwelling strength and influenced by basin-scale climate variability captured by the North Pacific Gyre Oscillation. This study illustrates the importance of upwelling for the local food webs in Central California and provides examples of shifts in biology due to marine climate on several species, exploring the trophic and ecological interactions behind these changes. Climate change may have unexpected consequences because different species show unique responses to changes in their environment.

30 October, 14:50 (S9-5160)

Do seabirds at sea in the California Current reflect krill distribution, abundance and patch structure?

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Krill are keystone species in the epi-pelagic food webs of many marine ecosystems worldwide. Globally, krill biomass exceeds the biomass of any other marine taxa. In the California Current Large Marine Ecosystem, two primary species of krill, *Thysanoessa spinifera*, and *Euphausia pacifica* form key trophic linkages between lower and upper trophic levels. In recent time, obligate krill predators in the California Current, Cassin's Auklet (*Ptychoramphus aleuticus*) and Blue Whales (*Balaenoptera musculus*) have shown signs of severe food stress. Thus, action is needed to understand how changes in ecosystem function (*e.g.* climatic forcing) influence trophic dynamics from krill to top predators. We examined the spatial distribution of seabirds and krill patches over 5-years (2002-2006) during May-June within the California Current. Our objective was to develop a strategy for predicting when and where krill patches occur on seasonal and annual scales to test whether changes in the abundance and patchiness of krill influences where seabirds aggregate. We used hydro-acoustics to map krill patches while observer's simultaneously mapped seabird distribution during the annual NOAA juvenile Rockfish survey. We found distinctive changes in patch distribution of krill and seabirds during the study period. For example, in recent years the distribution of krill patches showed a marked shift from northern to southern latitudes. Our study provides a basis for examining the factors that govern where krill patches and foraging seabirds are found throughout the California Current ecosystem.

30 October, 15:10 (S9-5418)

Ocean processes driving the phenology and productivity of marine birds in the California Current System

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We examined the effects of local ocean conditions and basin-scale patterns of climate variability on phenology and productivity of five species of marine birds to assess how long-term changes in ocean conditions currently affect marine bird populations, and to provide insight into how populations may respond to predicted changes in the marine environment under various climate change scenarios. We included Cassin's Auklets, Common Murres, Pigeon Guillemots, Brandt's Cormorants, and Pelagic Cormorants in the analyses. We used upwelling strength and sea surface temperature as measures of local ocean conditions, and the Southern Oscillation Index, the Pacific Decadal Oscillation, and the North Pacific Gyre Oscillation as basin-scale measures of climate variability. We conducted the analyses using an Akaike's Information Criterion approach to model selection. Sea surface temperature just prior to and during the egg-laying phase of the breeding cycle was related to timing of breeding for all species. Upwelling strength during the egg-laying and chick-rearing phases was important to the productivity of four of the five species. The Southern Oscillation Index and the Pacific Decadal Oscillation, indices that reflect sea surface temperature, were important for timing of breeding and / or productivity of Pigeon Guillemots, Brandt's Cormorants, and Pelagic Cormorants. The North Pacific Gyre Oscillation, reflecting upwelling strength and horizontal advection, was related to timing of breeding and / or productivity of Cassin's Auklets and Common Murres. These results demonstrate the close association between ocean processes and top predator populations in the California Current System.

30 October, 15:30 (S9-5116)

The influence of plankton- and fish-eating seabird colonies on the Arctic tundra ecosystem of Spitsbergen

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Many arctic terrestrial ecosystems suffer from a permanent deficiency of nutrients. Marine birds that forage at sea and breed on land can transport organic matter from the sea to the land, helping to sustain terrestrial ecosystems. This organic matter, mainly in the form of guano but also as lost prey items, eggs, dead chicks and adults, initiates the emergence of local tundra communities, increasing primary and secondary production and heterogeneity of plant communities. Moreover, the chemical composition of guano depends on seabird diets and may influence soil properties in a different way near planktivorous and piscivorous birds colonies.

Testing this hypothesis, we studied tundra plots in the vicinity of two big colonies of seabirds in Hornsund, SW Spitsbergen – a colony of plankton-eating little auks *Alle alle* and a mixed colony of fish-eating Brünnich's guillemots *Uria lomvia* and black-legged kittiwakes *Rissa tridactyla*. We found:

- higher guano deposition, higher ion content (NO_3^-, NH_4^+, PO_4^{3-}, K^+) and lower value of soil pH close to both colonies compared with the control areas;
- gradual decrease of nutrient contents in the soil along the colony-sea axis (no such gradient was found in control areas);
- significantly higher heterogeneity of ornithogenic tundra plant communities in comparison with control areas, which decreased with distance from a colony;
- much higher content of phosphates and the dominance of *Cochlearia groenlandica* near fish-eaters compared with plankton-eaters' colony;
- higher biomass of vascular plants, particularly grasses, in direct proximity of planktivorous little auks in comparison with piscivores' colony.

30 October, 16:10 (S9-5429)

The relationship between cetacean distributions and oceanographic conditions in the western North Pacific

Hiroko **Sasaki**[1], Hiroshi Kiwada[2], Koji Matsuoka[2] and Sei-Ichi Saitoh[1]

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In the western North Pacific, sei (*Balaenoptera borealis*) and Bryde's (*Balaenoptera edeni*) whales are common species that feed on pelagic fish. Little is known about the preferences of the two species for different habitats and marine environments. The objectives of this study are to investigate the pattern of distribution of these two species with regard oceanographic conditions in the western North Pacific (30-45°N and 145-170°E), and to estimate areas of suitable habitat using satellite remote sensing. Whale distribution data were collected during surveys of the Japanese Whale Research Programme under Special Permit for the North Pacific (JARPN II). To understand spatial and temporal oceanographic characteristics of the whale habitats, sea surface temperature (SST), chlorophyll-*a* concentration (Chl-*a*), sea surface height anomaly data (SSHA), and bathymetry data were analyzed. First, oceanographic data for the areas where whales distributed were extracted from each type of satellite data. Then we clustered and overlayed each type of data to clarify the whales' preferred habitats using ArcGIS9.2. As a result, distribution areas were was clearly differentiated, with sei whales having a more northern distribution compared to Bryde's whales. The sei whale distribution area was characterized by lower SST (average 15.3°C) and a narrow SSHA range (-3.0 – 3.6 cm), while the Bryde's whale distribution area was characterized by higher SST (average 21.3°C) and a wide SSHA range (-12.2 – 18.9cm). In August, 70% of sei whales were located within 15 km of thermal front. Finally a generalized linear model (GLM) was used to clarify which variables contribute to define areas of suitable habitat for the whales. The results of the GLM suggested that the SST was a primary factor, with SSHA being of secondary importance.

30 October, 16:30 (S9-5340)

Ingestion of plastic debris by seabirds in the North Pacific Ocean

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Plastic debris is widely distributed in the world's oceans, though information about its distribution and abundance has been limited. The plastics are ingested by various marine organisms, especially seabirds. We investigated the plastics ingested by seabirds, which were accidentally caught by fishing gears in the North Pacific in 2003, and the abundance and distribution of the plastics in the sea surface by ship-survey in the North Pacific in 1993-1996 and 2000-2005. Of the 137 individual seabirds inspected, 105 were found to have ingested plastics. Mean number and mass of plastics found in the stomach of short-tailed shearwater *Puffinus tenuirostris*, which is the most abundant species in the sample, were 15.1 pieces per bird and 0.29 g per bird, respectively. The comparison of historical data and recent data shows an increase in the frequency of the shearwaters with ingested plastics between 1970 and 2003, which reflects the increase of the density of plastics in the sea surface, especially in the Subtropical region. Plastic fragments were the most numerous component of the plastics found in the shearwater's stomachs (59%), reflecting the composition of plastics in the sea surface in the North Pacific (50-60%). However, the occurrence of resin pellets in the stomachs of shearwaters (26%) was much higher than that (1-2%) in the plastics in the North Pacific; indicating that the birds ingested these in the Southern Hemisphere where they breed. We did not find direct evidence suggesting that the amount of plastic in the stomach affected the body condition of the shearwaters.

30 October, 16:50 (S9-5345)

The effects of anthropogenic global warming on the marine ecosystem

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The increase in atmospheric carbon dioxide concentrations caused by anthropogenic activity is affecting the world's oceans, increasing temperature, decreasing sea ice, and causing acidification. Recent studies have revealed that changes in oceanographic conditions affect marine ecosystems. It has been suggested that enhanced stratification, caused by increases in the temperature of the surface layer, is decreasing the nutrient supply from the subsurface layer, and hence primary productivity, over a large area of the North Pacific Ocean. It has also been reported that some plankton communities have advanced their seasonal pattern in accordance with the temperature increase in the surface layer of the North Sea. This phenological change may decrease fisheries' resources, inducing a mismatch between trophic levels, because the seasonal variation of diatoms is not altered by increased temperature. It is thought that decreases in the extent of sea ice resulting from global warming will decrease the food resources of ice algae, and hence the productivity of Antarctic krill (*Euphausia superba*). Moreover, it is expected that an increase in the partial pressure of carbon dioxide in the ocean will increase acidification, damaging calcareous organisms and affecting the reproduction of fishes and copepods. However, in other cases global warming may increase biological productivity, because upwelling is enhanced by thermal low-pressure regions in some coastal upwelling systems. Recent research has revealed ecosystem changes caused by global warming in some waters, but the changes in many other regions remain a mystery. Observations of changes on a global scale will be needed to evaluate the influence of global warming on the marine ecosystem in future.

S9 Posters

Poster S9-4990

Comparative study of the feeding habits of bigeye *T. obesus* and yellowfin tuna *T. albacares* in the east-central tropical Pacific Ocean

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Based on data collected in the East-central Tropical Pacific Ocean during February to November 2006, we analyzed and compared diet compositions and feeding habits of yellowfin *Thunnus albacares* and bigeye *Thunnus obesus*. The diet of bigeye included 2 crustacean, 1 cephalopod and 22 fish species and the foods of yellowfin included 3 crustacean, 1 cephalopoda and 18 fish species. Squid]=[were the most frequently observed prey of bigeye and yellowfin, followed by shrimp for bigeye and harvestfish (*Scomber scomber*) for yellowfin. A high within-phenotype component (WPC) was detected for both fish species from the feeding strategy analysis. Stomach fullness stage of bigeye had a significant monthly variation (χ^2=88.18, df=45, $p < 0.001$) and a remarkably strong relation to fork length (χ^2=156.80, df=110, $p < 0.005$). Stomach fullness stage of yellowfin showed no significant differences among months (χ^2=39.10, df=45, $p > 0.1$) or fork length classes (χ^2=55.20, df=70, $p > 0.1$). For bigeye, diet composition was more similar in April to June and October, whereas for yellowfin, diets were most similar in February to June. For bigeye, diet composition was more similar for fish of fork length 91-140 cm, whereas for yellowfin, diets were most similar for fish of fork length 101-170 cm. In the ECTP, high overlap between the diets of the bigeye and yellowfin were found.

Poster S9-5112

Species composition and abundance of phytoplankton in the Northern Yellow Sea in the winter of 2006

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We investigated the species composition, dominant species, and abundance of phytoplankton in the Northern Yellow Sea between Dec.30, 2006 ~ Jan.17, 2007. We identified 131 species, of which 86.3% were Bacillariophyta and 12.2% were Phyrrhophyta. A majority of species were neritic and cosmopolitan in temperate coastal seas, with small proportion of warm water species present due to the impacts of the Yellow Sea Warm Current in winter. The average quantity of phytoplankton was 88.89×10^4cells/ m^3, of which Bacllariophyta and Phyrrhophyta were 86.58×10^4 cells/ m^3 and 2.28×10^4 cells/ m^3, respectively. The dominant species included *Eucampia zodiacus* Ehrenberg, *Paralia sulcata* (Ehr.) Cleve, *Pseudo-nitzschia pungens* (Grunow ex Cleve) Hasle, *Chaetoceros densus* Cleve, *Chaetoceros debilis* Cleve, *Rhizosolenia setigera* Brightwell. We found that the southern coast of Liaoning Province was the area of highest phytoplankton abundance, followed by the northern coast of Shandong Province and the central area of the Northern Yellow Sea. In comparison with the investigation of Jan.1959, the abundance of phytoplankton was reduced nearly 41% (from 150×10^4 cells/m^3 to 89×10^4cells/m^3), among which the abundance of diatoms reduced from 148×10^4 cells/m^3 to 87×10^4 cells/m^3. In contrast, the abundance of dinoflagellates increased from 1.25×10^4 cells/m^3 to 2.25×10^4cells/m^3. The dominant community pattern, in relation to diatoms as the dominant group followed by dinoflagellates, has not significantly changed irrespective of the above differences. Based on contemporary data of physical-chemical parameters and zooplankton, interactions are discussed. The preliminary results demonstrate that the abundance distribution of phytoplankton was spatially consistent with the distribution of the main nutrients (nitrate, phosphate and silicate). Stepwise regression analysis identified that the surface salinity the most significant influence on the abundance distribution. The overlap of densest areas for phytoplankton and zooplankton indicated they had an ecologically balanced relationship.

Poster S9-5131

Biomass, density, and community structure of fish collected by bottom trawl in the northwestern and southwestern East Sea during 2006-2007

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We conducted a trawl survey to study the distribution of fish, and their species composition and biomass in the coastal of the northwestern and southwestern East Sea in August during 2006-2007. From the survey, a total 55 species and 37 species were collected, respectively, in the northwestern East Sea and in the southwestern East Sea during the survey. Number of individuals was relatively high in the northwestern East Sea, whereas biomass was high in the southwestern East Sea. We analyzed the changes in biomass density (kg/km^2). The species composition showed a large difference between the northwestern and the southwestern East Sea. The dominant species in the northwestern East Sea were *Eleginus gracilis*, *Myoxocephalus jaok* and *Limanda herzenstein;* whereas the dominant species in the southwestern East Sea were *Dasycottus setiger*, *Icelus cataphractus* and *Gadus macrocephalus*. We estimated species diversity and the evenness indices by area, and developed a dendrogram of the clustering by species. The community structure of fish between the northwestern East Sea and southwestern East Sea were analyzed based on the Self-Organizing Map (SOM) model.

Poster S9-5155

Still enough Arctic zooplankton for Little Auks on Spitsbergen, but for how long?

Marta **Gluchowska**[1], Slawomir Kwasniewski[1], Katarzyna Wojczulanis-Jakubas[2], Dariusz Jakubas[2], Katarzyna Blachowiak-Samolyk[1] and Lech Stempniewicz[2]

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The Arctic is considered a very susceptible region for climate change [1]. It is hypothesized that the true Arctic animals, such as Little Auks (*Alle alle*), will be affected the most, due to deteriorating feeding conditions. Climate-induced changes in the Arctic seabird populations will result in serious consequences for the terrestrial ecosystem as well [2]. Little Auk colonies on Spitsbergen are spread on the west coast and are naturally exposed to various oceanographic conditions and, as a consequence, different feeding conditions. Here we present the results of research in 2007 and compare hydrological conditions, zooplankton species composition and Little Auks diets in two distant areas of Spitsbergen where large breeding colonies of Little Auk occur, Magdalenefjorden, in the NW and Hornsund, in the SW. In spite of prevailing Atlantic conditions on the shelf W off Magdalenefjorden, there were still similar numbers of the Arctic *Calanus glacialis* in the plankton as in Arctic water that dominated the Hornsund shelf. However, the proportion of Arctic to Atlantic food items in zooplankton off Magdalenefjorden was 1:10, while it was 1:3 off Hornsund. At the same time, Little Auks from the colony in Magdalenefjorden continued feeding their chicks mainly with cold water *C. glacialis.* The present study suggests that Little Auks breeding on Spitsbergen may be influenced by climate change, but most probably in a longer perspective. For the present, in spite of the observed increasing impact of warm Atlantic water on the Spitsbergen shelf, well-established colonies of Little Auks appear to be safe.

Poster S9-5238

Occurrence of cetaceans on the fast ferry route between Korea and Japan

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Although in recent years collisions between whales and fast ferries have frequently occurred on the fast ferry route between Korea and Japan, little has been done to identify the nature of the collisions. Generally, the risk of collisions tends to increase in certain areas where the habitat of cetaceans overlaps with fast ferry routes. Data on sighting surveys and reports of incidental sightings were analyzed to understand cetacean distribution on the fast ferry route between Korea and Japan. Six sighting surveys were conducted from 1999 to 2006 around the fast ferry route between Korea and Japan, and a total of 7 species (minke whale, common dolphin, finless porpoise, Pacific white-sided dolphin, Risso's dolphin, bottlenose dolphin and false killer whale) were sighted. Among the 7 species, minke whale, common dolphin and finless porpoise were commonly sighted in this area. A total of 14 and 34 sightings of cetaceans from the fast ferries were reported in 2005 and 2006, respectively. There was a significant difference in the frequency and rate of cetacean occurrence among years ($p<0.01$). Also, significant differences among months ($p<0.01$) and among seasons ($p<0.01$) were identified. Most of sightings in 2005 occurred around Tsushima Island; however, sightings occurred uniformly along the fast ferry route in 2006. It will be necessary to prepare measures for the prevention of collisions between whales and fast ferries, not only for the conservation of cetaceans, but also for the safety of passengers and mariners.

Poster S9-5277

Seabird distribution patterns in the East/Japan Sea in spring 2007

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The distribution of seabirds in the East/Japan Sea is poorly known because of a paucity of data. Previously, only limited information was available from land-based seabird surveys. Seabird distribution in the East/Japan Sea was studied from April to May 2007 using line transect counts. We observed a total of 1,383 individuals of 23 species including 16 species of seabird. The overall seabird density was 2.5 birds km^{-2}. The streaked shearwater (*Calonectris leucomelas*) (74.5%) was the numerically dominant species. Ancient murrelets (*Synthliboramphus antiquus*) (8.3%), red-throated divers (*Gavia stellata*) (5.0%), common terns (*Sterna hirundo*) (2.1%), Pacific divers (*Gavia pacifica*) (2.0%), and black-tailed gulls (*Larus crassirostris*) (1.1%) were also frequently observed. The density of seabirds was highest between 36°N and 37°N of the coastal area of the Korean peninsular. However, the index of species diversity (*H*') was higher between 35°N and 36°N. The densities of most observed species decreased with distance from the coastline. The distribution patterns of Streaked shearwater were linked to the variation in the distribution pattern of minke whales. Also, spatial segregation was found in the distributions of the two species of divers (*Gavia* spp.).

Poster S9-5344

Food web structure in the Xiamen Harbour marine ecosystem: Changes during the past 30 years

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Xiamen Harbour is a typical marine ecosystem that accommodates diverse species including Chinese White Dolphin, Little Egret, and mangrove. A series of environmental issues, such as overfishing, pollution, and sea reclamation, had largely changed the structure of, and thus compromised the health of, this ecosystem. Using the *Ecopath with Ecosim* method, the present study reconstructs the food web structure of this marine ecosystem for the past 30 years based on observational data collected during this period,. We then discuss the possible mechanisms underlying the changes of food web structure over time, and predict the future changes. We hope that this study may help reveal the consequences of human activities and global changes for marine ecosystems, and provide useful information for conservation practices.

Poster S9-5362

Abundance and distribution of minke whales (*Balanoptera acutorostrata*) in the Yellow Sea in 2008

Kyum Joon **Park**[1], Seok Gwan Choi[1], Yong Rock An[1], Zang Geun Kim[1], Hyun Woo Kim[1], Ji Eun Park[1], Tae-Geon Park[1], Zhiquang Ma[2] and Zhichuang Lu[2]

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A shipboard sighting survey was conducted along transect lines in the Yellow Sea (33°00’-37°30’ N, 123°40’-126°00’ E) from April to May 2008. The top barrel and the top bridge of the research vessel were used as observation sites. There were 18 sightings of minke whales (*Balanoptera acutorostrata*) during 1,407 nautical miles of survey effort. Distance and angle of sighted animals from the transect line were recorded to calculate perpendicular distance. Three models (Uniform, Half-normal and Hazard-rate) were used to fit probability density to perpendicular distance of observed animals in this survey. The uniform model was selected as the most fitable by the criterion of AIC (Akaike Information Criterion). The density of minke whales in the Yellow Sea was estimated to be 0.027/n.m. (95% CI = 0.012-0.061/n.m.). Abundance was estimated to be 733

individuals (95% CI = 327-1,646). We also conducted preliminary studies of the distribution of this animal in relation to water temperature and salinity using a CTD (Conductictivity, Temperature, Depth) sensor.

Poster S9-5395

Understanding the relationship between zooplankton and shrimp biomass as driven by climate changes in the Yellow Sea, western part of Korean peninsula during 1968-2007

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Spatial and temporal variations of zooplankton biomass and temporal variations of shrimp biomass (Acetes and Penaeids shrimp) were investigated in the Yellow Sea, western part of the Korean peninsula. Zooplankton was collected at 63 stations arrayed in six transects (124º00´ - 126º30´ E 34º00´ - 37º00´ N) in February, April, June, August, October, and December, and shrimp biomass was collected monthly during 1968 to 2007. In general, shrimp biomass increased during the summer and decreased during the winter with one peak in June for Penaeid shrimp and one in October for Acetes shimp. The seasonal abundance patterns of shrimp biomass generally coincided with the seasonal pattern of zooplankton biomass variation in temperate latitudes. At most sampling stations during past four decades, copepoda and chaetognatha have two peaks in June and October. SST at the outermost station was approximately 0.7-3.8ºC higher than that at the innermost station on the same transect. The general pattern of interannual variations of SST is similar to those of the East Sea of Korea (Japan Sea) and the South Sea of Korea, and followed the global pattern, which has been increasing. Temporal variations of zooplankton biomass were not significantly correlated with those of shrimp biomass. We discuss possible reasons for zooplankton fluctuations over the past four decades and the relationship between zooplankton biomass variation and shrimp biomass in our research area.

Poster S9-5435

How effective are Cassin's auklets as environmental monitors in Central California?

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Cassin's Auklets *Ptychoramphus aleuticus* are small wing-propelled diving seabirds (Family: Alcidae) of the California Current which forage on macrozooplankton, primarily large euphaussids. For 38 years, PRBO Conservation Science (formerly Point Reyes Bird Observatory) has maintained a continuous annual time series on auklet demography and diet on Southeast Farallon Island, CA, as part of long-term ecological studies of breeding seabirds. During the past 3 years, auklets have suffered unprecedented breeding failure and large declines in breeding population. While it appears that timing of euphaussid availability may be the driving mechanism, causality is still uncertain. There is a strong need to link long-term colony-based studies of marine wildlife to their at-sea foraging behavior to improve understanding of their potential use as monitors of ecosystem status and 'health'. Using a pilot study with Time Depth Recorders (CEFAS Technology, UK), we examined Cassin's Auklet foraging behavior to investigate linkages between breeding biology and foraging in the spring/summer of 2008. We assessed foraging effort, depth and duration of diving, physical ocean conditions at foraging sites, and diet of marked birds. We also assessed the effects of auklets carrying TDRs, and dummy devices, by comparing reproductive performance and diet of TDR birds to unmarked birds. TDR deployment was conducted simultaneously with local oceanographic cruises to assess auklet and euphausiid abundance and distribution, to sample physical ocean conditions, and to determine abundance and species composition of zooplankton at predetermined locations.

S11 FIS Topic Session
Effects of fisheries bycatch and discards on marine ecosystems and methods to mitigate the effects

Co-Convenors: Hui Chun An (Korea) and Patricia Livingston (U.S.A.)

Commercial fisheries using gears, such as bottom trawling, capture both target and non-target species. In some instances, bycatch mortality is sufficiently high to adversely affect the stock status and productivity of non-target species. To minimize unintended impacts on the environment, commercial fisheries should strive to increase their selectivity by reducing the bycatch of birds, mammals, turtles and other non-target species, as well as by reducing the catch and discard of undersized commercial species. This session will examine the magnitude of bycatch of non-target species, effects of bycatch mortality on the health of non-target stocks, and recent research on methodology to reduce bycatch and discards in the PICES region. Particular emphasis will be placed on studies that have resulted in changes in commercial fishing practices.

Thursday, October 30, 2008 14:00 – 17:20

14:00 ***Introduction by convenors***

14:05 **Steven J. Kennelly (Invited)**
Reducing bycatch in the world's fisheries (S11-5462)

14:45 **Heui Chun An, Chang-Doo Park, Jong Keun Shin and Kyoung-Hoon Lee**
Bycatch reduction in the snow crab gillnet fishery of Korea (S11-5359)

15:05 **Kyung-Jun Song, Zang Geun Kim, Seok Gwan Choi, Yong-Rock An and Chang-Ik Zhang**
Fishing gears involved in entanglements of minke whales in the southwestern East/Japan Sea (S11-5221)

15:25 **Larisa P. Nikolenko**
How big are the losses of Greenland turbot (*Reinhardtius hippoglossoides*) and crabs (*Lithodes aequispina* and *Chionoecetes angulatus*) during deep-sea bottom net and long-line fishing in the Okhotsk Sea? (S11-5319)

15:45 **Evan A. Howell, Jeffrey J. Polovina, Donald R. Kobayashi, George H. Balazs, Denise M. Parker and Peter Dutton**
A new dimension to the problem of loggerhead turtle (*Caretta caretta*) bycatch in the Hawaii-based longline fishery (S11-5263)

16:05 ***Coffee / tea break***

16:25 **Stephani G. Zador, Julia K. Parrish, André E. Punt, Jennifer L. Burke and Shannon M. Fitzgerald**
Determining spatial and temporal overlap of an endangered seabird with a large commercial trawl fishery (S11-5192)

16:45 **Patricia A. Livingston, Jennifer Boldt, Shannon M. Fitzgerald, William Karp and David Witherell**
Assessing and reducing the amounts and impacts of fisheries bycatch in Alaska marine ecosystems (S11-5257)

17:05 ***Discussion***

S11 Poster

S11-5364 **Hyoung Chul Shin, Doonam Kim and Kyu Jin Seok**
To monitor and mitigate the incidental mortality and discards from fisheries; Lessons from the Southern Ocean, a test bed of ideal management

S11 Oral Presentations

30 October, 14:05 (S11-5462) Invited

Reducing bycatch in the world's fisheries

Steven J. **Kennelly**

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Humans have been harvesting fish for at least 90,000 years using technologies that have developed from simple harpoons through to huge factory trawlers. For most of this history, developments in fishing technology have focussed on methods that catch ever-greater quantities of fish of an ever-increasing diversity. This direction changed dramatically in the last few decades in the light of one of the world's most serious and controversial fishing issues – the waste associated with the incidental capture, mortality and discarding of unwanted bycatch. In response, fishing technology altered its focus to more selective fishing techniques, so that targeted species (and targeted sizes of species) are caught whilst unwanted bycatches are not. In more recent times, this field has expanded to address problems associated with fishing gears (especially dredges and trawls) impacting on the benthos and seabed ecosystems. The successful resolution of bycatch problems has usually adhered to a framework that involves the particular fishing industry and scientists each applying their respective expertise to the problem. This framework comprises five key steps: (1) quantifying bycatches (mostly via observer programs) to identify the main bycatch species and their sizes, (2) developing alterations to existing fishing gears and practices that minimize the mortality of these species, (3) testing these alternatives in appropriately-designed field experiments, (4) gaining acceptance of the new technology throughout the particular fishery and, most importantly, (5) publicizing the solution to the interest groups who first raised the issue as a concern. This presentation will summarize some of these successes, including the all-important methods used to ensure the uptake of newly developed techniques by fishers.

30 October, 14:45 (S11-5359)

Bycatch reduction in the snow crab gillnet fishery of Korea

Heui Chun **An**, Chang-Doo Park, Jong Keun Shin and Kyoung-Hoon Lee

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The snow crab (*Chionoecetes opilio*) fishery in Korea is one of the most valuable fisheries in Korea. Various methods such as TAC, minimum landing size and closed season from June to October have been applied for years to sustain stock abundance of snow crab. Catch is prohibited of male crab smaller than 90mm carapace length and any female snow crab. The main fishing gear for snow crab in Korean is gillnet. Bycatch of snow crab under the minimum legal size frequently appeared in gillnets.A series of fishing experiments on mesh selectivity of gill net for male snow crab was carried out using different mesh sizes to determine the size selectivity of the gear. The mesh size selectivity curve was estimated and showed that the number of small male crab caught decreased with increasing mesh size. Based on these results, mesh size of snow crab gillnets was changed from 180mm to 240mm for sustainable utilization of the snow crab resource. Biodegradable material has also been developed and used for the commercial fishing operation from 2008 to reduce ghost fishing by lost gear. As a result, the snow crab resource has showed stable abundance in recent years due to various management efforts.

30 October, 15:05 (S11-5221)

Fishing gears involved in entanglements of minke whales in the southwestern East/Japan Sea

Kyung-Jun **Song**[1], Zang Geun Kim[2], Seok Gwan Choi[2], Yong-Rock An[2] and Chang-Ik Zhang[1]

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A total of 214 entanglements of minke whales in the southwestern East/Japan Sea, particularly around the waters of Pohang, Donghae and Sokcho between 2004 and 2007, were analyzed to investigate the types and parts of fishing gear involved. Entanglement outcome was considered as negative in all cases because all entangled minke whales had died. All gear types were identified (n=214; 100%), and the majority were entangled by three fishing gears: set nets, pots and gill nets (n=207; 96.7%). Other entanglements were associated with bottom trawls, purse seines and trawls. A total of 65 entanglements (31.4%) were attributed to main line/branch line of fishing gear. The most common body part of minke whale which attached to fishing gear was the mouth (n=63; 30.4%). On the other hand, most entanglements took place within 10 nautical miles from the land (n=179; 86.5%), and between 10 and 220 m water depth. The body length of minke whales ranged from 2.44 to 9.00 m with a mean of 5.09 m. There was a significant difference in the body length distributions of minke whales that entangled in set net and other fishing gears such as pot and gill net ($p<0.01$). Also, there was a significant difference in the mean body lengths of entangled minke whales depending on distance from land in the southwestern East/Japan Sea ($p<0.05$). There was a significant difference in the mean body length distributions of entangled minke whales by water depth ($p<0.05$).

30 October, 15:25 (S11-5319)

How big are the losses of Greenland turbot (*Reinhardtius hippoglossoides*) and crabs (*Lithodes aequispina* and *Chionoecetes angulatus*) during deep-sea bottom net and long-line fishing in the Okhotsk Sea?

Larisa P. **Nikolenko**

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The losses of Greenland turbot (*Reinhardtius hippoglossoides*) were assessed as the amount of discarded fish (in weight relative to the total amount of catch) during deep-sea fishing using bottom nets and long-lines in the Okhotsk Sea. It was shown that, due to various reasons, annual losses amounted to approximately 37% during the bottom net fishery and 13% during the long-line fishery. These losses should be considered in support of the Total Allowable Catch estimates for Greenland turbot. Significant losses were also encountered even during the most selective bottom net fisheries for equal-spined crab (*Lithodes aequispina*) and deep-sea Tanner crab (*Chionoecetes angulatus*). The losses of each crab species reached 20-25%.

30 October, 15:45 (S11-5263)

A new dimension to the problem of loggerhead turtle (*Caretta caretta*) bycatch in the Hawaii-based longline fishery

Evan A. **Howell**[1], Jeffrey J. Polovina[1], Donald R. Kobayashi[1], George H. Balazs[1], Denise M. Parker[1,2] and Peter Dutton[3]

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Interactions between loggerhead turtles (*Caretta caretta*) and pelagic fisheries such as the Hawaii-based longline fishery are a global concern, with fisheries bycatch implicated as one of several factors in the population decline of this species. Previous research on loggerheads in the North Pacific using telemetry tags has provided insights into the surface habitat of these animals, yet little information on vertical dive behavior

has been published for loggerheads in this region. Variability in this third dimension may have a large impact on the susceptibility of these animals to being caught by longline fisheries based on the amount of time spent in close vertical proximity to longlines. To better understand dive behavior in the central North Pacific, 16 loggerheads caught by the longline fishery during 2002-2004 were equipped with Wildlife Computers ARGOS-linked dive recorders. These telemetric tags provided dive information as well as high quality geolocation positions. To investigate possible explanations for observed variability in dive behavior we will apply a state-space model to quantitatively differentiate between movement behaviors including a foraging and search state. We will then incorporate these results to assess whether dive variability is related to these states, changes in oceanography, or a combination of factors. A better understanding of the variability in dive behavior may allow for the prediction of probable bycatch by the longline fishery based on the predicted dive patterns and ultimately work towards decreasing the bycatch of this threatened species. The incorporation of these results to improve the PIFSC TurtleWatch product will be discussed.

30 October, 16:25 (S11-5192)

Determining spatial and temporal overlap of an endangered seabird with a large commercial trawl fishery

Stephani G. **Zador**[1,2], Julia K. Parrish[2], André E. Punt[2], Jennifer L. Burke[2] and Shannon M. Fitzgerald[1]

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Overlap between short-tailed albatross (*Phoebastria albatrus*), an endangered species, and the Alaskan groundfish trawl fleet is of concern because of the potential for incidental mortality. Due to the small size of this albatross population (ca. 2 000 birds) and their wide-ranging foraging behavior, opportunistic sightings contribute the majority of the data on their distribution. Two methods were used to predict spatial distributions of albatross: (1) bounded interpolation of sightings and (2) distance to the 1 000 m isobath. The fishery was grouped into five sectors based on fish processing mode and predominant product type. Locations and durations of observed trawls were associated with the predicted albatross densities. Spatial and temporal overlap of the albatross and trawl fleet was influenced by the assumptions used to infer albatross distribution and differed among trawl sectors. Establishing spatial overlap of albatross and fisheries lays the groundwork for research that would elucidate the factors responsible for interactions where overlap is known to occur and target mitigation of bycatch in a more efficacious manner. However, accurate assessment of bycatch requires knowledge of the nested interactions that lead from overlap to incidental mortalities.

30 October, 16:45 (S11-5257)

Assessing and reducing the amounts and impacts of fisheries bycatch in Alaska marine ecosystems

Patricia A. **Livingston**[1], Jennifer Boldt[2], Shannon M. Fitzgerald[1], William Karp[1] and David Witherell[3]

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Research and management of Alaska's groundfish fisheries have been based on an ecosystem approach. This approach involves not only conservative single-species management of the targets of fisheries but also protection of non-target species through policy making and research that provides bycatch estimation and reduction. We will review US fisheries management policies with respect to bycatch and how those policies have been implemented in Alaska through a variety of management approaches. We will highlight the importance of in-season fisheries monitoring systems and gear research in providing effective bycatch controls. Examples of bycatch reduction policies currently in place will be provided along with a description of the methods used to evaluate ecosystem impacts.

S11 Poster

Poster S11-5364

To monitor and mitigate the incidental mortality and discards from fisheries; Lessons from the Southern Ocean, a test bed of ideal management

Hyoung Chul **Shin**[1], Doonam Kim[2] and Kyu Jin Seok[2]

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[2] National Fisheries Research and Development Institute, Busan, R Korea

The Southern Ocean supports only limited fisheries, but the ecosystem based management practiced in the area is setting an example for fisheries in the rest of the world. Animals impacted by unintended mortality and bycatch in Southern Ocean fisheries are comprised of seabirds often in vulnerable conditions, a number of fish species including skates and rays, and a variety of invertebrates sometimes occurring in critical habitats. Fisheries ranging from mid-water trawl to demersal longline are taking untargeted organisms in varying degrees in the Southern Ocean and diverse measures are in place to monitor and mitigate these mortalities. The measures include employing mitigation devices of a particular design together with fishing gears, area closures, or the application of move-on rules after a pre-set level of bycatch is exceeded. These are often combination products of customary practices, field studies, and subsequent trials that aim for improvements. These measures are continuing to evolve and contribute to the minimization of negative impacts on those species, as well as the preservation of poorly understood critical habitats with potential conservation values. Scientific observers commissioned by CCAMLR, the inter-governmental management body responsible for the area, are deployed onboard fishing vessels and record and report the removal of these non-target species along with the causes and nature of mortalities. They also monitor the efficacy of the mitigation measures. Examples from recent observations will be illustrated and discussed.

S12 MEQ Topic Session
Connecting the human and natural dimensions of marine ecosystems and marine management in the PICES context

Co-Convenors: David L. Fluharty (USA), Mitsutaku Makino (Japan), R. Ian Perry (Canada) and Chang-Ik Zhang (Korea)

A complete definition of marine ecosystems includes the human components. Consideration of ecosystem-based management, at least within the natural sciences, usually leaves out the human dimensions, or includes it only as fishing effort. For ecosystem-based management to succeed, however, humans need to be included. This session builds on the Science Board Symposium of 2003 titled *"Human dimensions of ecosystem variability"*. Human relationships and how humans interact with the ocean have been changing in nature and strength over time. Natural variability in marine systems can be large, but so are socio-economic pressures and considerations relating to marine environments. Determining appropriate socio-economic indicators to complement indicators of natural climate variability, *e.g.* for ecosystem-based management, is an ongoing challenge. This session will address these interactions between natural and socio-economic issues in the context of ecosystem-based management. Specifically, it will consider: (1) What are the criteria to determine relevant socio-economic indicators of human well-being related to marine issues for PICES member countries? (2) What are appropriate indicators to monitor changes in management objectives and human well-being relevant to changing ecosystem structure and production? (3) How might decisions that are made to enhance human well-being likely to impact (positively or negatively) the nature and functions of marine ecosystems? This session theme will continue to explore the many ways that humans interact with marine ecosystems and the scientific efforts to quantify and predict human impacts on the dynamics of such systems.

Thursday, October 30, 2008 09:00 – 13:20

09:00 ***Introduction by convenors***

09:05 **Mitsutaku Makino and Hiroshi Horikawa**
Social-ecological conditions of fisheries and management by ITQs: A global review (S12-5460)

09:25 **Lawrence C. Hamilton (Invited)**
Ecosystem, fishery and social changes in western Alaska (S12-5406)

09:50 **Chang Seung and Chang-Ik Zhang**
Socio-economic indicators used in ecosystem-based assessment for the eastern Bering Sea trawl fishery (S12-5259)

10:10 **Peter S. Ross, T. Child and N. Turner**
Caught in the crossfire: Environmental contaminants in Pacific food webs and implications for coastal First Nations (S12-5466)

10:30 ***Coffee / tea break***

10:50 **David L. Fluharty**
Developing and using social science information in marine management processes in the United States (S12-5479)

11:10 **Hee Won Park, Chang-Ik Zhang and Jae Bong Lee**
A comparative study on the structure and function of Korean marine ranching ecosystems (S12-5174)

11:30 **Shang Chen, Jian Liu, Tao Xia and Qixiang Wang**
Change of ecosystem services of the Yellow River Delta Wetland, China (S12-5158)

11:50 **Olga N. Lukyanova and Ludmila V. Nigmatulina**
The value of ecosystem services of Peter the Great Bay (Japan/East Sea) (S12-5151)

12:10 **Samuel G. Pooley, Ian Perry and Mitsutaku Makino**
Socio-economic considerations of ecosystem approaches to fisheries management (S12-5490)

12:30 **Zhifeng Zhang**
Effects of dredging on internal release of phosphate from marine sediments in Dalian Bay (S12-5157)

12:50 ***Discussion***

S12 Posters

S12-5068 **Jingfeng Fan, Hongxia Ming, Lijun Wu, Yubo Liang and Jiping Chen**
Detection of human enteric viruses in shellfish in China

S12-5097 **Peter M. Zhadan and Marina A. Vaschenko**
Does pollution change the reproductive strategy of the sea urchin?

S12-5098 **Svetlana A. Ireykina, Olga N. Lukyanova and Andrey P. Chernyaev**
An integrated approach to pollution assessment of estuarine ecosystems of Peter the Great Bay (Japan/East Sea)

S12-5153 **Natalia M. Aminina and Lidia T. Kovekovdova**
Brown algae metabolism in polluted environments

S12-5164 **Zhen Wang, Xindong Ma, Zhongsheng Lin, Guangshui Na, Qiang Wang and Ziwei Yao**
Occurrence and congener specific distribution of polybrominated diphenyl ethers in sediments and mussels from the Bo Sea, China

S12-5224 **Andrey P. Chernyaev**
Persistent organic pollutants in Amursky Bay (Japan/East Sea): Risk assessment

S12-5235 **Galina V. Moyseychenko and Alla A. Ogorodnikova**
Nature-conservative measures to decrease the negative impacts of waterside construction on marine biological resources in the Japan/East Sea

S12-5236 **Alla A. Ogorodnikova**
Evaluation of the coastal ecosystem services of Peter the Great Bay

S12-5239 **Guangshui Na, Qiang Wang, Zhen Wang, Hongxia Li, Shilan Zhao, Tong Chen, Zhongsheng Lin and Ziwei Yao**
Pharmaceuticals and Cersonal Care Products (PPCPs) in some river and sewage water of Dalian, China

S12-5302 **Li Zheng, Xuezheng Lin, Zhisong Cui, Frank S.C. Lee and Xiaoru Wang**
Phylogenetic analysis of indigenous marine bacteria with the ability to degrade oil pollutants in Bohai Bay

S12-5304 **Liping Jiao, Liqi Chen, Yuanhui Zhang, Gene J. Zheng, Tu Binh Minh and Paul K.S. Lam**
Polycyclic aromatic hydrocarbons in remote lake and coastal sediments from Svalbard, Norway: Levels, sources and fluxes

S12-5324 **Qixiang Wang, Shang Chen and Xuexi Tang**
Preliminary assessment of ecosystem services of the Yellow Sea

S12-5353 **Petr V. Lushvin**
The impact of anthropogenic activity (regime of hydroelectric power stations and technological explosions) on behaviour and reproduction of fish and crustaceans

S12-5386 **Galina Borisenko and Galina Moyseychenko**
Level assessment of natural and artificial radionuclides in Cosimino Bay’s bottom sediments (Nakhodka Bay, Japan Sea)

S12-5501 **Zhang Hongliang, Leng Yu, Xu Zijun and Li Jiye**
Research on the generating and vanishing process of *Enteromorpha* bloom and the environmental controlling factors

S12-5502 **Zhou Yan-Rong Zhang Wei Tang Wei Zhao Bei andYang Dong-Fang**
Analysis of nutrients and organic pollution in Shuangdao Bay

S12-5503 **Ji-Ye Li, Xiu-Qin Sun, Feng-Rong Zheng and Lin-Hua Hao**
Screen and effect analysis of immunostimulants for sea cucumber, *Apostichopus japonicus*

S12-5505 **Wang Xinping, Sun Peiyan, Zhou Qing, Li Mei, Cao Lixin and Zhao Yuhui**
Compounds concentration analysis of oil and its application in oil spill identification

S12 Oral Presentations

30 October, 9:05 (S12-5460)

Social-ecological conditions of fisheries and management by ITQs: A global review

Mitsutaku **Makino** and Hiroshi Horikawa

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Fisheries are an industry which uses fish resources as one part of the services from ecosystems. In order to devise fisheries management measures in certain nations or areas, both the natural conditions based on the characteristic features of surrounding ecosystems, and social conditions based on the position of fisheries in the human societies, must be considered. Based on the UN Food and Agricultural Organization and other statistical information, this study derived several indicators representing the social and ecological conditions of fisheries. Then, using these indicators, appropriate fisheries management measures were compared on a country-by-country basis, and the applicability of using ITQs (Individual Transferable Quotas) as a management measure was considered. We found that there are considerable differences among countries, for example, in the relative importance of seafood as the source of animal protein, social position of the fisheries sector as a source of jobs, importance of small scale fishers within the industry, *etc*. Also, the diversity of fisheries resources decreases monotonically with latitude. We conclude that the social-ecological conditions in Iceland and New Zealand, where ITQs are the central management tool, are considerably different from PICES countries. Although an ITQs system has great potential as an efficient policy tool, careful examination of its applicability is required.

30 October, 9:25 (S12-5406) Invited

Ecosystem, fishery and social changes in western Alaska

Lawrence C. **Hamilton**

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As the Bering Sea experiences substantial ecological and climate-related changes, western Alaska coastal communities have been changing as well, and partly for interconnected reasons. These coastal communities include some commercial fishing towns, but also many small, subsistence-oriented Alaska Native settlements. Alaska's Community Development Quota (CDQ) system transfers commercial fisheries rents to resource-poor coastal communities. The CDQ system has brought new income to these communities, while also affecting their views regarding quota management and catches of different species, including commercial–subsistence conflicts. The CDQ program also requires that investments be fisheries related, which does not always make economic or ecological sense. Meanwhile, coastal communities face other pressures for change, as well. Time series of ecological, fisheries and social indicators highlight ways in which these interconnected systems are changing.

30 October, 9:50 (S12-5259)

Socio-economic indicators used in ecosystem-based assessment for the eastern Bering Sea trawl fishery

Chang Seung[1] and Chang-Ik **Zhang**[2]

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Four major objectives in ecosystem-based management of fisheries are sustainability, biodiversity, habitat quality, and socio-economic status. Scientists have already paid attention to the first three objectives (*i.e.*, sustainability, biodiversity, and habitat quality), and to the development of their indicators. For example, in Zhang *et al.* (in press), a comprehensive pragmatic ecosystem-based approach was developed to holistically

assess and manage fisheries resources and their associated habitat ecosystems. However, less attention has been paid to the fourth objective – socio-economic status and the development of its indicators. This study is the first attempt to fill this gap, and develops several socio-economic indicators to conduct an ecosystem-based assessment of the eastern Bering Sea bottom trawl fishery. Some socio-economic factors are considered to develop appropriate indicators for ecosystem-based fishery assessment. These factors include the socio-economic sustainability of species, fishery and ecosystem, employment and earnings of fishery participants, vessel capacity, ease and expense of implementing fishery management actions, profits using the relationship between revenue and cost, socio-economic impacts in terms of biodiversity and habitat quality, *etc*. Both target and limit reference points are developed for each indicator to assess the status of species and the fishery.

30 October, 10:10 (S12-5466)

Caught in the crossfire: Environmental contaminants in Pacific food webs and implications for coastal First Nations

Peter S. **Ross**, T. Child and N. Turner

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For the 70,000 members of coastal First Nations in British Columbia (BC), Canada, seafoods represent a vital resource: we estimate from dietary surveys that the average individual consumes 61 kg of seafood per year, which is approximately 15 times that of the average Canadian. Among the many anthropogenic impacts on fisheries resources, environmental contaminants can affect the quality, quantity and desirability of different seafoods. Over 25% of respondents to our survey indicated that they have reduced their intake of seafoods because of concern about contaminants. In an attempt to better characterize the nature of risks and benefits associated with the consumption of traditional seafoods, we have been working collaboratively with Health Canada and five First Nations partners to 1) document the importance of seafoods by conducting over 300 individual-based surveys; 2) measure the concentrations of three priority classes of contaminants (polychlorinated biphenyls or PCBs, polybrominated diphenyl ethers or PBDEs, and metals) in four sentinel species (Dungeness crab, butter clams, sockeye salmon and harbour seals) from each of five communities; and 3) conduct a risk-benefit analysis which combines 1 and 2. Our preliminary results underscore the importance of seafoods to these communities, and document the extent of PCB, PBDE and metal contamination in a selection of traditional foods. While we faced significant socio-political challenges in achieving our goals, we achieved success by adapting traditional scientific methods. The success of our project can be attributed to our extensive consultations with First Nations Band Councils, heavy investment in stakeholder outreach, incorporation of traditional ecological knowledge into our science-based study design, and multidisciplinary approach to research. In conducting research on contaminants in aquatic food webs, we are delivering science in support of ecosystem-based management as well as chemical regulation.

30 October, 10:50 (S12-5479)

Developing and using social science information in marine management processes in the United States

David L. **Fluharty**

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While not new to the management of resources and areas in the ocean, the social sciences are less mature than the natural sciences in their application. However, we are increasingly coming to the understanding that the management of marine resources and space is really about managing people and their use of these resources and spaces. In what ways can we prioritize and accelerate the development of the social sciences in this regard. Further, it is imperative that we contemplate what processes of communication and decision making facilitate the use of social science information in moving towards ecosystem based management approaches. Examples from the Gulf of Alaska and the Bering Sea with respect to fisheries, coastal zone management and marine pollution control are examined and lessons learned are presented.

30 October, 11:10 (S12-5174)

A comparative study on the structure and function of Korean marine ranching ecosystems

Hee Won **Park**[1], Chang-Ik Zhang[1] and Jae Bong Lee[2]

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Comparative analyses are a powerful way to evaluate similarities and differences in ecosystem structure and function. We identified key areas of differences and similarities in the structure and function of Korean marine ranching ecosystems (MaRE), that is, Tongyeong Marine Ranch and Jeonnam Marine Ranch, located in the eastern and western parts of the East China Sea of Korea, respectively. Common modeling approaches, such as Ecopath models of the Korean MaREs were applied including important commercial fisheries and sets of macrodescriptor metrics from systems ecology were used to examine large scale ecological characteristics for the two coastal ecosystems. Macrodescriptor metrics were calculated with Ecopath diet matrices, which were provided from food web information in the two marine ecosystems. Food web connectance showed that the average number of trophic steps from primary producers to apex predators was longer in the Jeonnam MaRE, and that trophic pathways were more linear in the Tongyeong MaRE. Jeonnam MaRE had pelagic and benthic foodwebs, while the foodwebs in Tongyeong MaRE were mainly pelagic. Other macrodescriptor metrics, such as linked pathways starting from a group and returning to it, were described to compare ecological attributes of the two marine ecosystems.

30 October, 11:30 (S12-5158)

Change of ecosystem services of the Yellow River Delta Wetland, China

Shang **Chen**, Jian Liu, Tao Xia and Qixiang Wang

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The Yellow River Delta Wetland (YRDW), a coastal reed wetland located in the western Yellow Sea, provides 14 kinds of ecosystem services belonging to 4 groups. Nine of these were evaluated in this study. The YRDW provided ecosystem services worth 2,866 million CNY and 764,900 CNY per km^2 in 2006. Among these services, food supply and climate regulation ranked the highest at 633 million CNY each. Second were oxygen production and wastewater purification at 596 and 558 million CNY, respectively. Biodiversity maintenance and raw material supply were third at 230 and 131 million CNY, respectively. Leisure-entertainment, scientific services and disturbance regulation were lowest at 35, 35 and 14 million CNY, respectively. Based on the landscape changes of YRDW from 1992 to 2006, the ecosystem services of YRDW in each year were valuated. The total service value of the YRDW ecosystem was 2,585 million CNY in 1992, 2,136 million CNY in 1996, 2,353 million CNY in 2000, and 2,866 million CNY in 2006. Spatial distribution maps of the YRDW show the service values of the YRDW ecosystem increased in the direction from land to seawater; reed grasslands of 8 landscapes had the highest values of ecosystem services in the 4 single years.

30 October, 11:50 (S12-5151)

The value of ecosystem services of Peter the Great Bay (Japan/East Sea)

Olga N. **Lukyanova** and Ludmila V. Nigmatulina

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Ecosystem valuation represents the process of expressing a value for ecosystem goods or services, for example, biodiversity, recreation opportunity, food production, *etc*. The value of any service is measured by its contribution to maintaining the health and integrity of the ecosystem. Ecosystem analysis is based on a mix of intrinsic and instrumental value methods. We estimated the value of ecosystem services of Peter the Great Bay, located in the north-western part of the Japan/East Sea. The Bay is important as a commercial fishing, marine culture and recreation area. We referred to the articles of Costanza *et al*., 1997, and used their classification and

average of global values of annual ecosystem services for the shelf zone of Peter the Great Bay. We evaluated the value of food production and other services separately. The value of fish, algae and invertebrate production is about USD885x10^6 or USD160 per ha per year. Invertebrates contribute the majority to food production value. The total value of ecosystem services including disturbance regulation, nutrient cycling, biological control, raw materials, and recreation is about USD857x10^7 per year. Thus, the value of food production comprises only 1/10 of the value of the remaining services of this ecosystem. Based on these data, we have shown that the total value of the ecosystem services considerably exceeds the value of food production. Maintaining the stability of entire ecosystems is a necessary condition for the retention of its natural capital.

30 October, 12:10 (S12-5490)

Socio-economic considerations of ecosystem approaches to fisheries management

Samuel G. **Pooley**[1], Ian Perry[2] and Mitsutaku Makino[3]

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Substantial progress has been made over the past several years on developing socio-economic information and applications for ecosystem approaches to fisheries management (EAM). The Food and Agricultural Organization of the United Nations held a conference this summer on the topic, chaired by Dr. Ian Perry of PICES, and we will report on that conference as well as other developments. Critical to these approaches is an understanding of the cross-jurisdictional nature of EAM, as well as the importance of multi-disciplinary research. We will also discuss how ecosystem indicators can include social indicators of marine ecosystem status and health, in particular those that might connect with the natural science indicators.

30 October, 12:30 (S12-5157)

Effects of dredging on internal release of phosphate from marine sediments in Dalian Bay

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I show by time-series monitoring results that the concentration of phosphate has abnormally increased in Dalian Bay in the last two years, and that the ratio of N:P decreased to less than 10:1. This phenomenon was ascribed to the much more intensive dredging activities in Dalian Bay and the adjacent Dayao Bay and Xiaoyao Bay in recent years than previously, because no obvious changes have been monitored for other possible sources of nutrients in this area. An algae bloom event was found by remote sensing and on-site investigation in late February in Dalian Bay, and was the earliest algae bloom event ever reported in this area. The concentration of phosphate decreased to normal levels after the algae bloom event, but increased to a high level in July, indicating that the intensive dredging activities in the three adjacent bays would cause continuous release of phosphate from marine sediments. In situ monitoring and simulation experiments in the laboratory are to be carried out to study the process of internal release of phosphate from dredging-disturbed sediments.

S12 Posters

Poster S12-5068

Detection of human enteric viruses in shellfish in China

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Coastal discharges constantly release human viruses into the marine environment. Bivalve shellfish, in the process of filter feeding, concentrate and retain human pathogenic viruses derived from sewage contamination in shellfish-growing waters. Epidemiological evidence suggests that human enteric viruses are the most common etiological agents transmitted by bivalve shellfish. Human enteric viruses cause a wide range of diseases, such as hepatitis A (HAV), Norovirus (NV), Rotavirus (RV), Adenovirus (AdV), Astrovirus (AsV) and enterovirus (EV). In this study, viruses were detected by reverse transcription-PCR (RT-PCR) in shellfish from fifty-seven sites countrywide, in July, 2007. One hundred and sixty-two shellfish samples and 30 species including clam, scallop, oyster, mussel, *etc*., were collected from coastal areas. At least 50 samples of each species were included. Viruses were concentrated from processing shellfish by homogenization and centrifugation. Positive samples detected by RT-PCR were HAV(5%), AsV(6%), RV(7%), AdV(9%), NV(12%), EV(15%). Pathogenic human enteric viruses in wastewater that contaminate shellfish harvesting waters pose a significant public health threat.

Poster S12-5097

Does pollution change the reproductive strategy of the sea urchin?

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The reproductive cycle of marine invertebrates has evolved in the course of the biological evolution of the Earth associated with climatic changes. The sequence of the stages of the reproductive cycle in a population is controlled and synchronized by ecological factors including temperature and photoperiod. Environmental pollution is one of the most important factors affecting living systems that has appeared with industrial society. We studied the effects of marine pollution on the reproductive function of some benthic invertebrates and showed that the most pollution-sensitive stage in their life cycle is the formation of sexual cells (gametogenesis). Disturbances in gametogenesis appeared as pathological changes in the gonads and abnormalities in the offspring. Changes in temporal characteristics of the reproductive cycle of the sea urchin *Strongylocentrotus intermedius* in polluted areas were revealed. In particular, the species' mass spawning was shifted from autumn to early summer. In female urchins from polluted areas, the resting stage was omitted from the reproductive cycle so that new gametes were formed immediately after spawning. The gonads of male urchins were highly mature throughout the year. The observed spawning shift was probably caused by the species' phenotypic plasticity (variability), *i.e.*, its ability to change the parameters of the reproductive cycle in response to environmental changes. A method based on estimating the proportion of sea urchins that display abnormal spawning events may be used to assess the environmental quality of the marine coastal zone. It requires minimal material and time costs and may be implemented by a variety of people including those without special education.

Poster S12-5098

An integrated approach to pollution assessment of estuarine ecosystems of Peter the Great Bay (Japan/East Sea)

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Estuarine ecosystems with high productivity offer important habitats for many species, so these zones have important ecological significance and also attract economic interest. Anthropogenic pressure usually includes intensive agriculture and waste disposal. Bottom sediments are often the most polluted part of estuarine ecosystems, and therefore could act as secondary sources of persistent contaminants. We examined the petroleum hydrocarbon (PH) pollution in estuaries of two rivers - Sukhodol and Razdol'naya, inflowing into Peter the Great Bay (Japan/East Sea). The total PH concentration in sediments varied from 9 to 62 mkg/g dry weight and was higher in river sites of the estuaries than in marine sites. Whole sediment toxicity assays were chosen for evaluation of the potential toxicological impact on biota. Survival rates of mysid shrimps *Paracanthomysis* sp. exposed to bottom sediments from the polluted estuaries were lower compared with reference sites, 50% and 70%, respectively. The edible crab *Eriocheir japonica* was used to measure the metabolic alterations in benthic organisms from polluted estuaries. There were differences in the activity of glutathione-S-transferase and oxidative stress biomarkers in the crab gills at different sites. These results confirm that the environmental quality of estuarine zones is strongly influenced by intense economic activity. It is necessary to include measurements of biological damage and animal health as well as analysis of chemical contaminants in the assessment of environmental conditions of coastal and estuarine ecosystems.

Poster S12-5153

Brown algae metabolism in polluted environments

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Significant changes in physiology and morphology of brown algae are observed under chronic toxic metal pollution. Anthropogenic pollution influences the algae microelement composition. Elemental analysis of algae from different polluted regions showed considerable differences in metal content. It was established that *Laminaria japonica* and *Costaria costata* growing in the polluted area (Rudnaya Bay) contained more univalent metals (especially potassium) but less bivalent metals (calcium and magnesium) in comparison with algae from conditionally non-polluted areas. *Laminaria japonica* from Rudnaya Bay contained more zinc and copper, but less manganese and iron. The content of iodine in algae from the polluted regions was less than that in algae from the pollution-free regions. This was particularly noticeable in the case of *Laminaria japonica*, which usually accumulates up to 0.2% of iodine. *Laminaria japonica* from Rudnaya Bay had 2 times less iodine than *Laminaria japonica* from Kamenka Bay. Growing in polluted areas considerably influences the metabolism of young algae. A one year old *Laminaria japonica* has 16% more mineral matter, 4 times more lipids and 6.5 times less iodine than a two year old. The composition of different age groups of algae from clean water areas differed only slightly.

Poster S12-5164

Occurrence and congener specific distribution of polybrominated diphenyl ethers in sediments and mussels from the Bo Sea, China

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Congener specific levels of polybrominated diphenyl ethers (PBDEs) were determined in sediment and mussel tissues collected from coastal locations of Bo Sea, China. The median values of BDE-209 and ΣPBDEs (including BDE-17, -28, -47, -66, -71, -85, -99, -100, -138, -153, -154, -183 and -190) were 2.29 and 0.16 ng/g

dry weight in sediment, and 2.43 and 0.69 ng/g dry weight in mussel tissue, respectively. PBDE concentrations were comparable to or lower than those reported from other regions. Congener compositions were dominated by BDE-209 (61 to 99% in mussel and 75-99% in sediment except for one sample with 17%). Different congener patterns (excluding BDE-209) were observed between sediment and mussel tissue. The four most abundant congeners were BDE-47 (40.3%), -99 (22.5%), -71 (8.9%) and -28 (5.8%) in sediment, and -47 (36.4%), -28 (14.5%), -154 (8.6%) and -71 (8.6%) in mussel tissue. The different patterns between sediment and biota were attributed to individual congeners' bioaccumulation potential or the ability to metabolize, such as BDE-99 and -183, which also can be confirmed by the different congener ratios between sediment and mussels. The biota-sediment accumulation factor (BSAF) of individual PBDE congeners declined with the increase of their logarithm of octanol-water partition coefficients (logK_{OW}) except for BDE-154, reflecting a high affinity of highly brominated congeners for carbonaceous geosorbents in sediment, and the effects of steric hindrance that limits large, very hydrophobic compounds from penetrating the cellular membranes.

Poster S12-5224

Persistent organic pollutants in Amursky Bay (Japan/East Sea): Risk assessment

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A major problem worldwide for human health and the environment is marine pollution. It is impossible to develop ecosystems and plan nature protective actions without chemical monitoring. Monitoring the state of the environment is an integral part of risk assessment for persistent organic pollutants (POPs) and their influence on human health. The list of POPs is constantly expanding. It consists of phenols, phthalates, chlorinated organic compounds, polyaromatic hydrocarbons and others. Phthalates are the most dangerous pollutants because of their high toxicity, ability to accumulate in the environment and high concentration in polluted waters. In this study, sources and levels of pollution of Amursky Bay by phthalates were determined. Among organic pollutants are dibutyl phthalate, diisobutyl phthalate, benzilbutyl phthalate. Its high toxicity has been demonstrated, but a maximal permissible concentration has not been established in Russia and monitoring of its concentration in abiotic components of marine ecosystems has not been conducted. It is shown that the concentration of phthalates in surface waters increased from estuarine zones to the inner part of the bay. This concentration of phthalates is likely to accumulate in marine organisms and eventually in humans via the trophic chain. It can cause serious problems with human health, such as delay in increase in weight, change in kidneys and liver, change in the function of liver enzymes, and degeneration of the sexual system.

Poster S12-5235

Nature-conservative measures to decrease the negative impacts of waterside construction on marine biological resources in the Japan/East Sea

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Negative impacts from waterside construction should be estimated to allow proper management and recovery of environments and marine biological resources. The most dangerous technologies are dredging and dumping. In addition, prospecting seismology and ship-building can have significant damage to marine plankton. These activities remove areas from fisheries exploitation, and affect plankton, benthos, and fish larvae by increasing suspended sediments and secondary pollutants. Recently, the annual damage to biological resources from waterside construction in the coastal zone of Peter the Great Bay was estimated to be in the hundreds of tons, and the compensation for this damage has cost several million USD. This compensation has been allocated to the to development of high-technology aquaculture, so that the farming of sea cucumbers, scallops, other fish species, and kelp helps to replace the lost volumes.

Poster S12-5236

Evaluation of the coastal ecosystem services of Peter the Great Bay

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Integrated Coastal Management is the dynamic and continuous management of stable coastal development in order to balance anthropogenic use, and protecting, preserving and restoring properties of coastal systems. For ICM, ecosystem function for human purposes should be studied. Ecosystem functions are biological, chemical and physical manifestations of human – nature interrelations. Decisions concerning ecosystems are inseparable from multifactual ecosystem evaluations. Indicators of only ecological conditions, such as pollutants in water sources, do not assist policy-makers to choose between contradictory interrelations within their limited budgets. The final nature product, bringing welfare to humans, is determined as "ecosystem services". Fishery productivity of Peter the Great Bay is 6.56 ton/ km^2, Amursky Bay – 16.33 ton/ km^2, Slavyanka Bay – 28.78 ton/ km^2. Ecosystem services values of Vladivostok and other settlements show that their value for Peter the Great Bay is 16.99 mln. $/year. Water treatment specific value services are about 6.9 – 17.78 $/ha per year. According to Constanza *et al.* (1997), ecosystem service ranges of water treatment are 6.696 – 58 $/ha per year. Evaluation has been made basing waste treatment value on waste treatment plants. Ecosystem service comparisons of food production and ecosystem service functions have shown that the ecosystem capacity to provide services and goods (recreation, aesthetic, *etc*.) is more significant than waste treatment, not only socially, but also economically.

Poster S12-5239

Pharmaceuticals and Cersonal Care Products (PPCPs) in some river and sewage water of Dalian, China

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Pharmaceuticals and personal care products (PPCPs) are present in aquatic environments, raising concerns amongst chemists and toxicologists who have examined the potential environmental fates and effects of PPCPs. Some typical pharmaceuticals, such as Terramycin (TA), chloramphenicol (CAP) and Sulfonamides (SAs) which are widely used for human and veterinary medicine, are excreted unchanged or as active metabolites in high percentages. We collected water samples from rivers and sewage outlets around Dalian City, Liaoning Province, to show the occurrence of some PPCPs in Northeast China, and to find the main antibiotics and compare the results with other regions. The results show that there are high concentrations of antibiotics in some samples, especially TA, CAP and SAs. Maximum concentrations were up to 1168 ng L^{-1}, 14.60 ng $L^{-1}$and 685 ng L^{-1}, respectively. On the other hand, it is remarkable that TA and quinolones (QNs) were detected in all the samples. The concentrations of antibiotics are a little higher than those reported in Canada and Switzerland. With so many antibiotics being introduced into the sea continuously, the environment, especially the aquaculture environment, will be impacted greatly, which will influence the safety of eating seafood. Therefore, it is necessary to strengthen the monitoring of antibiotics in sewage water and aquiculture environments.

Poster S12-5302

Phylogenetic analysis of indigenous marine bacteria with the ability to degrade oil pollutants in Bohai Bay

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Shenli oilfield is the biggest oilfield near the seashore of Bohai Bay in China, and the occurrence of oil spills in this area is a severe marine environmental problem. It is generally agreed that biodegradation of crude oil by indigenous bacteria is one of the primary mechanisms through which petroleum and other hydrocarbon contaminants are removed from the marine environment. Although some work related to indigenous oil degrading bacteria has been done in Bohai Bay, including the screening of bacteria along with their degradation capacity, their phylogenetic analysis is seldom researched up to now. In this study, we have isolated different species of marine bacteria from the sea water and sediment near Shenli oilfield. Their abilities to degrade crude oil and low molecular weight polycyclic aromatic hydrocarbons has been studied in batch cultures under typical conditions containing crude oil and PAHs as sole carbon source in shake flasks. The degree of oil and PAH biodegradation was determined by the total extractable material (TEM) weighing method followed by GC-MS. Phylogenetic characterization of these bacteria was analyzed based on their 16S rRNA gene sequence. The results show five marine bacteria could degrade crud oil with good degradation rate from 40.1% to 52.4% within 7 days, and another five marine bacteria displayed different degradation capacity for four PAHs within 14 days. Through molecular identification, these bacteria belong to 8 genus including *Halomonas, Vibrio, Microbulbifer*, *Bacillus*, *Psychroserpens*, *Idiomarina*, *Exiguobacterium* and *Pseudoalteromonas*. This implies the biodiversity of bacteria which degrade oil pollutants is high.

Poster S12-5304

Polycyclic aromatic hydrocarbons in remote lake and coastal sediments from Svalbard, Norway: Levels, sources and fluxes

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In the framework of the Chinese Yellow River Station research monitoring program conducted in summer 2005, surface and core sediments from six lakes and two locations on the west coast of Spitsbergen near Ny-Ålesund, Svalbard, the Norwegian Arctic were collected and concentrations of 15 polycyclic aromatic hydrocarbons (PAHs) were measured. Total PAH concentrations in lake sediments (mean: 260, range: 11 - 1100 ng/g dry wt) were higher than those previously reported in surface sediments collected from various lakes in Svalbard in 1995, suggesting that significant PAH contamination is occurring due to long-term atmospheric transport and the influence of local coal mining and fossil fuel sources in the region of Ny-Ålesund. Interestingly, relatively high levels of PAHs were encountered from several lakes from Ny-Ålesund, which were within the range of levels reported for high-altitude mountain lakes in Western and Central Europe and South America, as well as some urban/industrialized areas in the world, pointing to the role of remote Arctic lakes as potential reservoirs of semivolatile organic compounds, including PAHs. Compound-specific analysis revealed different PAH patterns between Ny-Ålesund lakes and European high mountain lakes, showing higher proportions of low molecular weight compounds and lower levels of high molecular weight PAHs in Norwegian Arctic lakes. PAH indicator ratios suggest that the majority of PAHs in lake sediments have pyrogenic origins (coal mining, fossil fuel and biomass combustion), while coastal marine sediments were mainly contaminated by petroleum-derived PAHs (shipping activities in coastal areas, and perhaps as a result of an oil spill in 1986). Sediment fluxes of PAHs in Ny-Ålesund remote lakes were estimated to be 0.2 - 22 ng cm^{-2} yr^{-1}, which were similar to those observed in Western and Central European high mountain lakes. These fluxes account for an accumulation rate of 2.8 g yr^{-1} in the study lake sediments. The current PAH levels in sediments from several lakes exceeded Canadian sediment quality guidelines, suggesting the presence of possible risks for aquatic organisms and the need for further studies.

Poster S12-5324

Preliminary assessment of ecosystem services of the Yellow Sea

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The services provided from marine ecosystems are the essential elements to improve human well-being. The Yellow Sea is an important part of the world ocean. For a long time, the residents in the Yellow Sea coastal zone have relied on ecosystem services provided by the Yellow Sea for their livelihoods and economic development. Based on ecosystem services theory and historical statistical data, we analyzed the status of 8 services from the Yellow Sea ecosystem. In regards to provisioning services, from 1979 to 2005, the production of marine catches increased 431 %. The production of mariculture along the Yellow Sea coast (Jiangsu, Shandong, Liaoning) increased from 7704t in 1958 to 6,565,296 t in 2006. In regards to regulating services, the Yellow Sea ecosystem can absorb 70,414,630 t C and generate 189.16×10^6t O_2 in one year. Phytoplankton play the dominant role. The ecosystem has ability of absorbing N 12,303,057 t, P 1,672,878 t in one year. Phytoplankton also play the dominant role. As to cultural services, coastal tourism of the Yellow Sea is mainly domestic, and lags others areas of the Chinese coast. In regards to supporting services, the average primary production was 490 $mg{\cdot}m^{-2}{\cdot}d^{-1}$ in 1998-2000. The results of this assessment show that the Yellow Sea can provide many ecosystem services, but these services are under heavy pressure. Appropriate management actions should be taken immediately.

Poster S12-5353

The impact of anthropogenic activity (regime of hydroelectric power stations and technological explosions) on behaviour and reproduction of fish and crustaceans

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The technological regulation of river runoff for the purpose of electrical power generation is conducted non-uniformly. These result in daily and weekly variability in runoff, *i.e.* daily raise of level behind dams, and passing of the daily flow increases downstream. On the crests of these flow increases biota are splashed out along the coastal edges and dry. From freshwater deltas, juveniles and yearling of fishes are washed out into the pernicious brackish waters. To minimize technological damage it is necessary to create damping basins after the each dam. Technological developments favor the outputs of lithospheric fluids in volumes which are pernicious for fish. As a result juveniles and older fish die, and for surviving fish their reproductive functions are disturbed (juveniles are not viable), surviving fish migrate from the seismic-pressure aquatories or remain in the remote areas at the seismic-pressure edges of aquatories, or their “liquid” boundaries (thermal, salinity fronts, ice margin or depth). The development of crustacean populations is a good indicator of technological impacts. After seismic events, catches of crustaceans increased temporarily by 2-3 times over the background decline in fish catches during the following 2-3 years. The changes in conditions of spring high water do not result in sharp and unequivocal catches of crustaceans.

Poster S12-5386

Level assessment of natural and artificial radionuclides in Cosimino Bay’s bottom sediments (Nakhodka Bay, Japan Sea)

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We studied background content of natural elements RA-226, Th-232, K-40 and an anthropogenic radionuclide Cs-137 in bottom sediments of Cosimino bay before the start of construction of oil complex included in the “Eastern Siberia – Pacific ocean” project. All types of work on sea bottom are followed with sediment

araisement and dispersion of suspencion on the width of the water. That means increasement of natural radioactive background of marine environment. We consider that studies of natural and artificial radionuclide bejavior very interesting for analyzing the process of radioactive elements coming to humans' body by alimential chain. The most common sediments in Cosimino bay are mixtures of sand and muds. According to the data of spectrometric analysis the content of the natural radioactive elements in bottom sediments samples was about 14-27 Bk/kg of dry mass Ra-226, 27 – 37 Bk/kg Th-232, 770 – 870 Bk/kg K-70. We calculated the natural effective radioactiveness of bottom sediments of Cosimino bay, and found out that natural radioactiveness is less then 130 Bk/kg, and it is 3 times less the normal rate (=< 370 Bk/kg). The content of anthropogenic radionuclide Cs-137 was around 10 – 12 Bk/kg and it was explained with global pollution of hydrosphere because of atmospheric condensation. The data we received is considerably less then norma and the limits of radiation safety will not be superated. We conclude that ground extraction and movement in construction will make the minimum radioactive effect on humans and biota.

Poster S12-5501

Research on the generating and vanishing process of *Enteromorpha* bloom and the environmental controlling factors

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From June to August, 2008, *Enteromorpha* bloom occurred in Qingdao. North China Sea Environmental Monitoring Center performed aerial remote sensing monitoring and field monitoring on vessel. The results showed that in the middle of May, there were lots of *Enteromorpha* floating in the middle of south Yellow Sea. With the southeast monsoon, the *Enteromorpha* flew into the coastal area of Qingdao, where the nutrients were rich in the water body. As these *Enteromorpha* began to grow up quickly, the *Enteromorpha* kept entering into Qingdao from the offshore area, which resulted in the bloom along the coast of Qingdao. The major environmental controlling factors were high transparency, rich nutrients, good illumination and stable shoreward wind. Manual refloatation, deficient sunlight and low density of phosphate caused the declination of the bloom.

Poster S12-5502

Analysis of nutrients and organic pollution in Shuangdao Bay

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According to the data obtained in the Shuangdao Bay in March, 2007, the assessment on the water quality condition in Shuangdao Bay was done with the single factor standard index, the nutrition condition performance figure, the nutrition index, the organic pollution appraisal index. The results show that PH, DO, COD, inorganic nitrogen, phosphate can not satisfy the second water quality standard of “Sea water quality Standard” (GB3097-1997) at partial stations of sampling. The range of *NQI* is between 1.01 and 3.17 and on the average of 2.18. The range of *E* is between 0.45 and 12.35 and on the average of 5.02, and water quality is seriously overnourishous. The range of *A* is between 1.15 and 6.81 and on the average of 4.05, and organically pollutions is to be more serious. In brief, the sea area has been polluted seriously; nutrition and the organic pollution have to been controlled strictly.

Poster S12-5503

Screen and effect analysis of immunostimulants for sea cucumber, *Apostichopus japonicus*

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Immunostimulant may improve disease resistance of aquaculture animals by promoting the nonspecific immunity response of the organisms. By using spectrophotometry, five kinds of saccharides, including chitosan, yeast polysaccharide, burdock oligosaccharide, seaweed polysaccharide and lentinus edodes polysaccharide, were screened for the potent to be used as immunostimulants. The saccharides were injected into *Apostichopus japonicus,* a kind of sea cucumber, and then the lysozyme and superoxide dismutase (SOD) activities of the coelomic fluid and epidermal slime were monitored in six consecutive days. The results showed that the lysozyme activities of the coelomic fluid of *Apostichopus japonicus* are siginificantly stimulated at the second, fourth and sixth day after the injection of the five kinds of saccharides ($P<0.05$). The effects of chitosan and yeast polysaccharide were most notable. The lysozyme activities of the epidermal slime were significantly increased by chitosan, yeast polysaccharide, seaweed polysaccharide and burdock oligosaccharide at the first and second day after injection ($P<0.05$). The SOD activities of the coelomic fluid were significantlypromoted by the five kinds of saccharides at the second and fourth day after injection ($P<0.05$), while the SOD activities of the epidermal slime were increased at the second day.

Poster S12-5505

Compounds concentration analysis of oil and its application in oil spill identification

Wang **<u>Xinping</u>**, Sun Peiyan, Zhou Qing, Li Mei, Cao Lixin and Zhao Yuhui

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The method of concentration analysis of n-alkanes, steranes and terpanes in oil was established. Sample preparation, qualitative and quantitative method were confirmed. The column chromatographic fractionation ability was discussed. As results, all the saturated hydrocarbon were eluted into the first fract, the fractionation ability is satisfactory. N-alkanes, pristane, phytane and 48steranes and terpanes compounds were confirmed, contents of constituent information is enormous, so it's easy to get credible identification result by this method. The precision, recovery and method detection limit were tested. 6 replicates sample were analyzed by this method, the relative standard deviation of 32 n-alkanes and 45 biomarkers compound is 1.25%~7.44% and 2.53%~9.18% respectively, the precision is fine. The recovery of n-alkanes is 73%~116%, that of biomarkers is 84%~106%, which fills the requirements of oil spill identification. The method detection limit of n-alkanes and biomarkers is 7.01μg/g and 0.65μg/g respectively, supplys the requirements of oil analysis. 3 oil sample from different and same platform were analyzed by this method, and distinguished with their concentration value, as a result, the conclusion in accord with the fact.

BIO Contributed Paper Session

Co-Convenors: Michael J. Dagg (U.S.A.) and Michio J. Kishi (Japan)

Oral and poster presentations on biological aspects of the PICES XVII theme (FUTURE) are welcome, as well as papers on all aspects of biological oceanography in the North Pacific and its marginal seas (except those related to the BIO-sponsored Topic Sessions S2 and S9. Early career scientists are especially encouraged to submit papers to this session.

Friday, October 31, 2008 09:00 – 17:20

09:00 **Meibing Jin, Clara Deal, Jia Wang and Peter McRoy**
Response of lower trophic level productivity to long-term climate changes in the southeastern Bering Sea (BIO_P-5118)

09:20 **Hui Liu and William T. Peterson**
A phase shift in the Northern California Current (NCC) ecosystem? (BIO_P-5201)

09:40 **Kohji Iida, Onishi Yuriko and Tohru Mukai**
Regional characteristics of diel vertical migration of the sound scattering layer in the North Pacific (BIO_P-5086)

10:00 **C. Tracy Shaw, Leah R. Feinberg, Hongsheng Bi and William T. Peterson**
Upwelling conditions and cohort analysis of the euphausiid *Euphausia pacifica* off Newport, OR, USA (BIO_P-5089)

10:20 **Zhongming Lu, Jianping Gan, Anson Cheung, Minhan Dai, Hongbin Liu and Paul J. Harrison**
Biological response to wind-driven upwelling and river plume in the northeastern South China Sea (BIO_P-5450)

10:40 ***Coffee / tea break***

11:00 **Atsushi Tsuda and Shinji Shimode**
Distribution and life history of a subtropical copepod, *Neocalanus gracilis*: Implication for the northward intrusion by subarctic species (BIO_P-5046)

11:20 **Soo-Jung Chang, Won-Duk Yoon and Suam Kim**
Molecular phylogeography of *Nemopilema nomurai* (Class: Scyphozoa) in Korean waters (BIO_P-5329)

11:40 **Jing Dong**
Possible origin of *Nemopilema nomurai* in the northern part of the China Sea, and causes of population fluctuations (BIO_P-5442)

12:00 **David L. Mackas**
Scale-dependent spatial correlation of zooplankton time series: Biomass, phenology, and species composition (BIO_P-5434)

12:20 **Sergey P. Zakharkov, Tatyana N. Gordeychuk and Elena A. Shtraikhert**
Variability of satellite primary production in the Sea of Japan from 2003 to 2007 (BIO_P-5240)

12:40 ***Lunch***

14:00 **Pavel A. Salyuk, Oleg A. Bukin, Andrey N. Pavlov, Konstantin A. Shmirko and Denis A. Akmaykin**
Estimation of phytoplankton community response to Asian dust forcing in the northwestern Pacific (BIO_P-5339)

14:20 **Suguru Okamoto, Toru Hirawake and Sei-Ichi Saitoh**
Interannual variability of the spring, column-integrated chlorophyll-*a* content in the Kuroshio Extension region (BIO_P-5189)

14:40 **Qiang Hao, Xiuren Ning, Chenggang Liu and Fengfeng Le**
Primary production in the northern South China Sea – Satellite and *in situ* observations (BIO_P-5473)

15:00 **Pavel Ya. Tishchenko, Vyacheslav B. Lobanov, Alexey M. Koltunov, Anna A. Maryash, Tatyana A. Mikhailik, Galina Yu. Pavlova, Sergey G. Sagalaev, Alexander F. Sergeev, Elena M. Shkirnikova, Mariya G. Shvetsova, Petr P. Tishchenko and Vladimir I. Zvalinsky**
Physical and biological mechanisms of Amurskiy Bay re-oxygenation after deep hypoxia events (BIO_P-5249)

15:20 **Meng Zhou, Di Wu, Yiwu Zhu, Stephen D. Pierce, John A. Barth and Timothy Cowles**
Zooplankton productivity, trophic dynamics and size spectra in the Oregon shelf areas (BIO_P-5106)

15:40 ***Coffee / tea break***

16:00 **Jian Hu, Zhao-Li Xu and De-Di Zhu**
Seasonal changes in the ecological characteristics of pelagic molluscs in the Changjiang Estuary (BIO_P-5020)

16:20 **Juyun Lee, Toshiya Katano and Myung-Soo Han**
Cell cycle of *Heterosigma akashiwo* with special reference to vertical migration behavior (BIO_P-5333)

16:40 **Oleg N. Katugin, Michael A. Zuev and Gennadyi A. Shevtsov**
Distribution patterns, morphology and taxonomy of the gonatid squid *Gonatus tinro* and *Gonatopsis okutanii* in the Sea of Okhotsk and northwestern Pacific Ocean (BIO_P-5298)

17:00 **Hyunjung Kang, Yeonghye Kim, Seongyeon Kim and Dongwoo Lee**
Reproductive ecology of common octopus, *Octopus vulgaris* in the South Sea, Korea (BIO_P-5320)

BIO Contributed Paper Session Posters

BIO_P-4984 **Alexander V. Zavolokin, Elena A. Zavolokina, Igor I. Glebov, Alexander M. Slabinskiy and Alexander Ya. Efimkin**
Food supply of Pacific salmon (*Oncorhynchus* spp.) in the western Bering Sea in 2002-2006

BIO_P-4995 **Jia-Jie Chen, Zhao-Li Xu and De-di Zhu**
Seasonal abundance and distribution of pelagic euphausiids in the Changjiang Estuary, China

BIO_P-4998 **Keiichi Fukushi and Taro Minato**
The potential usefulness of recovered jellyfish as fertilizer

BIO_P-5007 **Shigenobu Takeda and Y. Kondo**
Organic complexation of iron in the Pacific Ocean

BIO_P-5021 **Xiao-Dong Zhou and Zhao-Li Xu**
Ecological characteristics of the pelagic decapods in the Changjiang Estuary

BIO_P-5025 **Hiromichi Ueno, William R. Crawford and Hiroji Onishi**
Impact of Alaskan Stream eddies on chlorophyll distribution in the western and central subarctic North Pacific

BIO_P-5067 **Toru Kobari, Ai Ueda and Yuichiro Nishibe**
Development and growth of ontogenetically migrating copepods during the spring phytoplankton bloom in the Oyashio region

BIO_P-5130 **Wen-Tseng Lo, Meng-Chen Ke and Hao-Hsien Chang**
Effects of temperature and salinity changes on asexual reproduction of *Aurelia aurita* (Cnidaria, Scyphozoan)

BIO_P-5141 **Chaewoo Ma, Wongyu Park and Jung Hwa Choi**
Long-term variations of sea surface temperature and zooplankton biomass driven by climate changes in the Yellow Sea, western part of Korean peninsula during 1968-2007

BIO_P-5148 **Sonia Batten, Dave Mackas and Doug Moore**
Changing size with latitude in *Neocalanus plumchrus* and *N. flemingeri*

BIO_P-5161 **Elena Smirnova and Natalia P. Fadeeva**
Seasonal dynamics of meiofauna community and zonation patterns in (un)disturbed sandy beaches of the Sea of Japan

BIO_P-5162 **Natalia P. Fadeeva and Valery I. Fadeev**
Indicator role of sublittoral meiofauna in monitoring the status of marine environments

BIO_P-5219 **Yuji Okazaki and Kazuaki Tadokoro**
Spatial and seasonal variability of euphausiid distribution and community structure in the Oyashio and the Kuroshio-Oyashio transition region

BIO_P-5223 **Nadezhda E. Struppul, Elena R. Colomeetch and Natalia A. Snopkov**a
Petroleum biodegradation in the presence of marine microorganisms, *Pseudoalteromonas citrea*, *Pseudoalteromonas elyakovii* and *Oceanisphaera litoralis*

BIO_P-5284 **Takumi Nonomura, Jun Nishikawa, Atsushi Tsuda, Ichiro Yasuda and Shuhei Nishida**
Practical identification of three sympatric calanoid copepods, *Calanus sinicus*, *C. jashnovi* and *C. pacificus*, in the western North Pacific

BIO_P-5325 **Miju Kim, Dong-Jin Kang, Kyung-Ryul Kim, Noriko Nakayama, Toshitaka Gamo, Eun Hee Kim and Jae Seong Lee**
Diurnal variation in the concentration and stable isotope composition of dissolved oxygen (O_2) in Lake Shihwa, Korea

BIO_P-5349 **Masaya Toyokawa and Jing Dong**
Salinity tolerance of planula and polyp stages of Nomura's jellyfish, and their possible natural habitat

BIO_P-5499 **Jimin Zhang and Wenzhai Ma**
Nutrient distribution and eutrophication assessment for the adjacent waters of the Yellow River Estuary

BIO Contributed Paper Session Oral Presentations

31 October, 9:00 (BIO_P-5118)

Response of lower trophic level productivity to long-term climate changes in the southeastern Bering Sea

Meibing **Jin**[1], Clara Deal[1], Jia Wang[2] and Peter McRoy[1]

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The ecosystem in the southeastern Bering Sea has undergone various changes in response to climate regime shifts in the past decades. The impacts of reducing ice cover and rising temperature on lower tropic level production were assessed with a vertically 1-D coupled ice-ocean ecosystem model applied at the site of the NOAA/PMEL mooring over the period from 1960 to 2005. The model includes coupled pelagic and sea ice algal components. The physical model is forced by sea surface wind, tide, heat and salt flux and sea ice data from the Hadley Center (monthly) before 1978 and SSM/I (daily) after 1997. Model results compare favorably with the mooring temperature and fluorometer data (1995-2004) and daily SeaWiFS chl-*a* data (1997-2005). While the total primary production is almost unchanged over the past four decades, there are abrupt shifts of the dominant phytoplankton and zooplankton groups and changes in the timing and vertical distribution of lower trophic level production after the Pacific Decadal Oscillation (PDO) index reversal in 1977. Before 1977, primary production was dominated by ice algae in cold water with only light grazing, favoring the benthos community. After 1977, primary production was later and in warmer water, and was dominated by open water species of diatoms and flagellates. Grazing was higher and these conditions contributed more toward the upper ocean pelagic community. Thus since 1977, zooplankton biomass has increased in the surface water but has not changed in the bottom. Several single-year ice algal blooms occurred in the late 1990s and the response of phytoplankton production was similar to that observed prior to 1977. The response of zooplankton production was weaker because a lag time in the upper trophic level production dampened short-time variations in primary production. This could explain why fish catches in the eastern Bering Sea showed dramatic changes in species and harvest after the 1977 climate shift, but smaller changes after the 1998 climate shift.

31 October, 9:20 (BIO_P-5201)

A phase shift in the Northern California Current (NCC) ecosystem?

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In the spring of 2007 and 2008, extraordinarily high abundances of subarctic oceanic copepods, *Neocalanus plumchrus* and *N. cristatus*, were observed in the Northern California Current (NCC) ecosystem off Oregon. Biomass values were 10-fold higher than ever observed in our time series initiated in 1999. This sudden increase in biomass is related in part to the Pacific Decadal Oscillation (PDO) which has been negative since late 2007. Locally, the NCC ecosystem over the past two years has been characterized by cool water temperatures, a strong upwelling index and an early biological spring transition. Cold waters and increased biomass of *Neocalanus* spp. suggest that volume transport of subarctic Pacific waters has increased recently. The Argo monitoring system confirms this notion: large increases in the strength of the California Current have been observed since December 2007. Given these recent changes, we suggest that the NCC has gone through yet another phase shift: the cool phase of 1999-2002 which transitioned to a warm phase in 2003-2006 and now has apparently returned to a cold phase (2007-present). Thus, the decadal signal in the PDO has given way to a 4-year signal. Furthermore, given the anomalously increased biomass of *Neocalanus* spp., this new cool phase appears to be quite different from past cool ecosystem regimes.

31 October, 9:40 (BIO_P-5086)

Regional characteristics of diel vertical migration of the sound scattering layer in the North Pacific

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Sound Scattering Layers (SSL) change their depth and scattering strength throughout the day and night. These changes are due to diel vertical migration of the zooplankton and micronekton in the SSL. To investigate regional characteristics of the SSL in the North Pacific, a multidisciplinary investigation including acoustic observations, biological sampling, CTD casts and illumination measurements was conducted aboard the *Oshoro maru* during the summers of 2001 and 2002. Acoustic data were recorded continuously using the three-frequency SIMRAD EK60 echosounder. Biological samplings were conducted around sunrise and sunset using a frame trawl net (3 m x 3 m), a Motoda (MTD) net (56 cm dia., 3 to 4 nets), and bongo nets (1 m dia., 2 nets). Oceanographic data were collected in CTD casts, and solar illumination was measured simultaneously using a luxmeter. Our results were as follows: (1) at sunset, a layer comprising small zooplankton ascended to the surface earlier than a layer comprising larger zooplankton and fishes, whereas at sunrise the layer comprising small zooplankton descended later than the other layer; (2) the SSL dominated by copepods around Hokkaido showed stronger backscattering at 200 kHz than at 38 kHz, whereas the SSL dominated by euphausiids and fishes in the northwest Pacific (along 145^{o}W and 165^{o}W) showed stronger backscattering at 38 kHz than at 200 kHz; (3) the depth range of vertical migration was shallower north of 50^{o}N than south of this latitude in conjunction with the changing rate of solar illumination was smaller in north than in south.

31 October, 10:00 (BIO_P-5089)

Upwelling conditions and cohort analysis of the euphausiid *Euphausia pacifica* off Newport, OR, USA

C. Tracy **Shaw**[1], Leah R. Feinberg[1], Hongsheng Bi[1] and William T. Peterson[2]

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The euphausiid Euphausia pacifica is widely distributed throughout the Pacific Ocean. It is often the dominant species of euphausiid found throughout a wide range of ocean conditions, from warm inland seas to the cold and food-limited open ocean, and is the most abundant species of euphausiid found off the Oregon Coast. We have sampled euphausiids biweekly off Newport, OR since 2001. Data are available on distribution and abundance of all life history stages (eggs to adults). Spawning by this species can occur from February–October; but there is usually a period of intense spawning during July-August. This intense spawning during a short period of time initiates a cohort that can be followed for many months. We will look at interannual variability in cohort development and growth and in survivorship from egg to adult. We will compare these results to interannual variations in upwelling conditions. Cohorts will be identified using the maximum likelihood fitting proced ure in Matlab. We will compare growth rates obtained from cohort analysis to growth rates obtained from instantaneous growth rate (IGR) experiments that measure the growth of individual live animals.

31 October, 10:20 (BIO_P-5450)

Biological response to wind-driven upwelling and river plume in the northeastern South China Sea

Zhongming **Lu**[1], Jianping Gan[1], Anson Cheung[1], Minhan Dai[2], Hongbin Liu[1] and Paul J. Harrison[1]

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A coupled three-dimensional physical and biological model was utilized to study the ecosystem response to the wind-driven summer upwelling over the continental shelf in the northeastern South China Sea (NSCS). In this study, the circulation is driven by an idealized sustaining upwelling favorable wind field for the purpose of process-oriented study. The nitrogen based NPZD (dissolved inorganic nitrogen (DIN), phytoplankton, zooplankton and detritus) biological model is embedded in the circulation model. In response to the upwelling intensification over a widened shelf in the NSCS and to the nutrient input from Pearl River plume, high surface chlorophyll-a concentration is distinctly formed over the inner and mid shelves within euophotic layer, respectively. A strong SCM (Subsurface Chlorophyll Maximum) is formed at depth of about 40 m offshore owing to the existence of diurnal maximum light penetration. Zooplankton distribution is generally located farther offshore of the phytoplankton as a result of Ekman drift and the time lag in biological response. Both physical and biological responses to the upwelling exhibit strong alongshore variability which is mainly induced by the flow-topography interaction. Higher frequency of DIN variability was found in the upwelling center over the inner shelf as a result of, intensified control of phytoplankton while the variations of phytoplankton and zooplankton offshore were mainly associated with the local physical variability. These results qualitatively resemble to the shipboard measurements and remote sensing data.

31 October, 11:00 (BIO_P-5046)

Distribution and life history of a subtropical copepod, *Neocalanus gracilis*: Implication for the northward intrusion by subarctic species

Atsushi **Tsuda** and Shinji Shimode

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Neocalanus copepods are abundant mesozooplankton and function as the trophic link between small particles and higher trophic organisms in the subarctic Pacific. Although the subarctic *Neocalanus* copepods are endemic to the Pacific, warm-water *Neocalanus* are widely distributed in the subtropical and tropical area of the Pacific, Atlantic and Indian Oceans. Two species of *Neocalanus* (*N. gracilis* and *N. robustior*) are known as warm-water species, but little is known about their vertical distribution and life histories. We collected samples from the western Pacific (15-48^{o}N) using a VMPS net. *N. gracilis* was widely distributed south of 35^{o}N and *N. robustior* was rarely collected in our samplings. *N. gracilis* was mainly distributed in the upper 200 m throughout a day except for the adult stages which had a deeper distribution. We also observed small-scale ontogenetic vertical migration in the early copepodite stages, indicating mating and possibly spawning in the subsurface layer. We observed no seasonal changes in stage composition, and early copepodites such as C1 and C2 were observed throughout the year, indicating continuous reproduction regardless of season. Subsurface spawning, possibly using an accumulated food reserve, is considered as a possible adaptation to an oligotrophic environment. On an the evolutional time-scale, this adaptation to an oligotrophic environment together with an ontogenetic migration is considered to be advantageous for the intrusion of this genus into the subarctic Pacific, which is characterized by a HNLC condition.

31 October, 11:20 (BIO_P-5329)

Molecular phylogeography of *Nemopilema nomurai* (Class: Scyphozoa) in Korean waters

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The giant jellyfish, *Nemopilema nomurai*, lives thoughout North East Asian waters but the location of its seed population is controversial. From a jellyfish survey, it was seen that the youngest jellyfish were first found around Ieo-do in May. Thus, the origin of *N. nomurai* was assumed to be near the Yangtze River. However, based on structure analysis of bell diameter, one of the jellyfish groups around the Bohai Sea was separated from the group around the North East China Sea. In this study, we examined population structure, genetic diversity and differentiation in *N. nomurai* of Korean waters. Genetic diversity of the jellyfish was examined by COI mtDNA region. *N. nomurai* belong to the Rhizostomeae and are monophyletic with *Catostylus mosaicus* but are paraphyletic with the Semaeostomeae within the class Scyphozoa. One hundred and sixty individuals from 7 regions were analyzed and 35 haplotypes were found. Genetic diversity of *N. nomurai* in the East China Sea was the highest at 0.6913, and lowest in Incheon at 0.3860. *N. nomurai* groups in the North East China Sea are continuously transported to the north-east by the Tsushima warm current but the jellyfish in the central Yellow Sea are relatively stagnant because it is an area of weak currents. The genetic structure of those jellyfish populations might be affected by the physical character of the Yellow Sea.

31 October, 11:40 (BIO_P-5442)

Possible origin of *Nemopilema nomurai* in the northern part of the China Sea, and causes of population fluctuations

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Massive aggregations of the giant jellyfish, *Nemopilema nomurai* have occurred in the northern part of the China Sea since the end of the 20th century. They could damage local fisheries. In this paper, we report the mass occurrences of medusae in the northern part of China, in particular in Liaodong Bay. The possible origin of jellyfish, the migration pattern and the mechanisms affecting abundance of *N. nomurai* are described, and possible causes for unusually high mass occurrences will be discussed.

31 October, 12:00 (BIO_P-5434)

Scale-dependent spatial correlation of zooplankton time series: Biomass, phenology, and species composition

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The short life span (weeks to a year) of mesozooplankton allows their population size to respond strongly and rapidly to interannual environmental change. SCOR Working Group 125 recently compiled zooplankton time series from a number of regions worldwide, and converted them to intercomparable time series of annual anomalies. Strong and ecologically important modes of low frequency zooplankton variability include changes of total biomass/biovolume/abundance (3-30x), changes of community composition (amount within individual species or species assemblages, 10-100x), changes of seasonal timing of within year maxima (weeks to months), and changes in size, condition, and chemical composition. All of the longer time series show very strong low frequency variability at multiple time scales (‘ENSO’, decadal regime, and overall trend). However, the correlation among time series locations is local to basin-scale, not global. Pairwise correlations among the

biomass time series typically decay to zero for locations separated by more than ~5000 km. Near-field correlations tend to be stronger in the Pacific than in the Atlantic, and much stronger for species composition and phenology time series, than for anomalies of aggregate biomass or biovolume. Both phenology and community patterns show evidence of poleward displacement in response to long term warming.

31 October, 12:20 (BIO_P-5240)

Variability of satellite primary production in the Sea of Japan from 2003 to 2007

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We examined the spatial and temporal variability of primary production (PP) in the Sea of Japan from 2003 to 2007 in order to predict changes of this characteristic in future. PP was estimated using a satellite PP model. PP derived from MODIS data was compared with PP measured by us in the Japan Sea. MODIS-etimated PP and *in situ* PP showed a good positive correlation. MODIS-estimated PP showed spatial variability. We chose four regions for estimation of annual PP variability: Peter-the-Great Bay (42-43.4°N, 130.5-133.5°E), the middle part of the Japan Basin (42-44°N, 136-138°E), the northern area (40-48°N, 128-140°E) and the southern area (34-40°N, 128-140°E). MODIS-estimated PP was highest in the southern area (284 g C $m^{-2}year^{-1}$) and lowest in the middle part of the Japan Basin (176 g C $m^{-2}year^{-1}$). In Peter-the-Great Bay it was 219 g C $m^{-2}year^{-1}$ and 201 g C $m^{-2}year^{-1}$ in the northern area. Annual primary production levels were about 231, 244, 224, 243 and 242 g C $m^{-2}year^{-1}$ in 2003 - 2007 respectively. Peaks of PP appeared twice a year, in spring and fall, in the southern area whereas a single peak was observed in the northern area in spring, although *in situ* primary production data showed a fall peak. The spring bloom contributed about 31% to the annual primary production in the Sea of Japan.

31 October, 14:00 (BIO_P-5339)

Estimation of phytoplankton community response to Asian dust forcing in the northwestern Pacific

Pavel A. **Salyuk**[1], Oleg A. Bukin[2], Andrey N. Pavlov[2], Konstantin A. Shmirko[2] and Denis A. Akmaykin[3]

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Phytoplankton both responds to and contributes to climate change. Evaluation of these roles requires the development of complex models. Asian dust storms, one of the major climate-forming factors in the North-western Pacific, have increased in recent decades. We will present results of our investigations of dust storm impacts on phytoplanktonin the north-western Pacific during 1997-2008. The impact of dust can be direct – owing to mineral matter entry to the upper ocean, or indirect – through changing of solar radiation spectral characteristics. In order to determine the trajectories and deposition zones of dust aerosols, data from the following sources were used: MODIS and SeaWiFS scanners (aerosol optical thickness and brightness temperature), the RIAM-CFORSE system, a stationary lidar system of POI and IACP (Vladivostok) and mobile ship-borne lidars. The parameters describing phytoplankton functioning were restored from ocean color data and measured by fluorescence methods during ocean expeditions. Ship data generally were used for carrying out ground-truth observations. Typically, deposition of dust aerosols led to an increase in chlorophyll-*a* concentration. To exclude false increases of chlorophyll-*a* concentration, we corrected for variability and errors in atmosphere correction algorithms. The most probably changes of chlorophyll-*a* concentration from dust deposition and the impacts of dust storms on cumulative changes in chlorophyll-*a* concentrations were estimated for the North-western Pacific during 1997-2008.

31 October, 14:20 (BIO_P-5189)

Interannual variability of the spring, column-integrated chlorophyll-*a* content in the Kuroshio Extension region

Suguru **Okamoto**, Toru Hirawake and Sei-Ichi Saitoh

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In the Kuroshio Extension (KE) region, chlorophyll-*a* (chl*a*) concentration is highest during spring, and it probably results in high zooplankton biomass. To consider the food environment for zooplankton and fishes, it is necessary to discuss the column-integrated chl*a* content, not only surface chl*a* concentration, $[\mathrm{chl}a]_{surf}$. We investigated the interannual variability of the spring chl*a* content integrated over the euphotic zone, $\langle \mathrm{chl}a \rangle_{Zeu}$, from 1998 to 2007. First, we used chl*a* data from 142 ship-based stations to validate the equation relating $\langle \mathrm{chl}a \rangle_{Zeu}$ to $[\mathrm{chl}a]_{surf}$ under stratified conditions (Uitz *et al.*, 2006). This underestimated $\langle \mathrm{chl}a \rangle_{Zeu}$ by 8.0%. We tuned this relationship by a weighted scatter plot (nonparametric regression), and the error was improved to only +0.8%. Second, we applied the tuned equation to SeaWiFS ocean color monthly data. The monthly $\langle \mathrm{chl}a \rangle_{Zeu}$ were averaged for the spring season (March to June) and the spatial means in the KE region (30°- 40°N, 140°-180°E) were calculated. The seasonal and spatial means of $\langle \mathrm{chl}a \rangle_{Zeu}$ were highest in 2005 (24.4 mg m^{-2}) and lowest in 1998 (21.9 mg m^{-2}). In 2005, the maximum $\langle \mathrm{chl}a \rangle_{Zeu}$ value on April was larger and high $\langle \mathrm{chl}a \rangle_{Zeu}$ was maintained longer than in 1998. Thus, interannual variability of the spring $\langle \mathrm{chl}a \rangle_{Zeu}$ was caused not only by the magnitude of maximum $\langle \mathrm{chl}a \rangle_{Zeu}$ value but by the duration of the spring bloom.

31 October, 14:40 (BIO_P-5473)

Primary production in the northern South China Sea – Satellite and *in situ* observations

Qiang Hao[2,3], Xiuren **Ning**[1,2,3], Chenggang Liu[1,2,3] and Fengfeng Le[2,3]

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The monthly means of primary production in the northern South China Sea (between 18-24° N and 110-118° E) were measured over 10 years (1998 to 2007). We used an improved VGPM model, based on remote sensing data including Chl *a*, K490 SST, and *etc*, provided by SeaWiFS and AVHRR, and validated by synchronous shipboard-measured data. Errors were estimated as well. Primary production in the studied area gradually decreased from the coastal zone (mean > 400 $mgC\cdot m^{-2}\cdot d^{-1}$) to the deep sea (100 ~ 200 $mgC\cdot m^{-2}\cdot d^{-1}$). With respect to seasonal variation, the daily average primary production in the whole study area was highest in winter (608 $mgC\cdot m^{-2}\cdot d^{-1}$), lowest in summer (292 $mgC\cdot m^{-2}\cdot d^{-1}$), and intermediate in spring and autumn. The main factors affecting the spatial-temporal distribution of primary production are nutrients and PAR, particularly nutrients which are driven by the monsoon-circulation coupling system.

31 October, 15:00 (BIO_P-5249)

Physical and biological mechanisms of Amurskiy Bay re-oxygenation after deep hypoxia events

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Deep hypoxia events with extremely low values of dissolved oxygen in the bottom layer of Amurskiy Bay (northwestern Japan Sea) have become more frequent recently due to the increase of anthropogenic impacts that create a danger for the bay ecosystem. Physical mechanisms of bay ventilation are associated with the upwelling events most frequent in the fall and thermohaline convection in winter. Other mechanisms are associated with biological processes in winter. To understand the re-oxygenation processes taking place in the bay in winter, a

comprehensive oceanographic survey was implemented during February-March 2008 when most of the bay was covered by ice. CTD profiles of temperature, salinity (conductivity), dissolved oxygen, fluorescence and turbidity, and water samples were taken at more than 50 stations. The following parameters were measured: salinity, oxygen, nutrients (ammonium, nitrite, nitrate, phosphates, and silicates), pH, alkalinity, chlorophyll *a* and humic substances. Three distinct sources of eutrophication of Amurskiy Bay were found: the Razdolnaya River, the Shmidtovka River and waste waters from Vladivostok City. High concentrations of chlorophyll *a* anddissolved oxygen, and low values of CO_2 partial pressure for most of the bay strongly suggest that intensive photosynthesis occurred under the ice. Due to high transparency and convection, there is no deoxygenating process in the near-bottom layer in wintertime. Most of the bay can be considered as an autotrophic basin. We believe that winter is the most important re-oxygenation time for Amurskiy Bay.

31 October, 15:40 (BIO_P-5106)

Zooplankton productivity, trophic dynamics and size spectra in the Oregon shelf areas

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Surveys of zooplankton distributions in the California Current and shelf area off Oregon were conducted in spring and fall seasons 2000 and 2002 to assess the abundances and their relationships with coastal upwelling, offshore transport and local retentions. An Optical Plankton Counter (OPC) was mounted on a towed SeaSoar instrument package including temperature, salinity, depth, fluorescence sensors and 2 AC9s. The SeaSoar instrument package was towed at a speed of 6–8 knots while it undulated vertically from the sea surface to a maximum depth of 200 m or 10 m above the bottom. Though the data from these sensors elucidate upwelling, phytoplankton and zooplankton in both horizontal and vertical distributions, interpreting biomass flow in plankton community and productivity is challenged by uncertainties in prey–predator relationships most of which are stochastic. However, the observations of zooplankton abundances as a function of sizes during the surveys show a consistent pattern with linear spectra in offshore stratified areas and nonlinear spectra in nearshore upwelling areas. These differences stimulated us to explore both theoretical and empirical interpretations of shapes of zooplankton size spectra in terms of abundance, trophic dynamics and productivity, and potential indicators of zooplankton community and productivity.

31 October, 16:00 (BIO_P-5020)

Seasonal changes in the ecological characteristics of pelagic molluscs in the Changjiang Estuary

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Based on data from four seasonal investigations in the Changjiang Estuary (between 28°00´~32°00´N, 122°00´~123°30´E) from 2002 to 2003, we determined the distribution pattern, the seasonal changes of total abundance and the species composition of pelagic molluscs. Furthermore, environmental adaptation of the dominant species was estimated by scatter plots of abundance against temperature and salinity. The seasonal abundances were 64.61 ind/m^3 in spring, 191.84 ind/m^3 in summer, 59.11 ind/m^3 in autumn, 1.4 ind/m^3 in winter. There were twenty-four species in our four seasons of sampling. The mollusc species number peaked in summer (21 species), followed by autumn (10 species), spring (8 species) and winter (2 species). Numerically, *Limacina trochiformis* was the dominant species in spring, which we attribute to its low temperature adaptation. *Atlanta peroni* was the dominant species in summer and *Creseis acicula* was the dominant species in autumn. These species are adapted to relatively high temperature. *Agadina stimpsoniji*, adapted to low temperature, was the dominant species in winter. In spring, pelagic molluscs aggregated in waters where the Yellow Sea Coastal Current meets the Changjiang Diluted Water. In autumn, pelagic molluscs were abundant in the warm water side of the mixed water mass where the Taiwan Warm Current meets the Changjiang Diluted Water. Species number was low in winter because most of the pelagic molluscs are warm water species. Abundance and species

number were lower nearshore than offshore in the East China Sea because most pelagic molluscs are offshore species.

31 October, 16:20 (BIO_P-5333)

Cell cycle of *Heterosigma akashiwo* with special reference to vertical migration behavior

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Heterosigma akashiwo frequently causes red tides in coastal waters and negatively impacts fisheries. This harmful alga shows clear diel vertical migration; cells accumulate at the surface during daytime and disperse during nighttime. However, we do not have enough information on their diel growth and migration pattern. In the present study, we investigated the diel cell cycle in relation to vertical migration behavior in both the laboratory and the natural environment. The cell cycle of *H. akashiwo* was analyzed by flow cytometry. In the laboratory, the number of G2+M phase cells increased from 3 hours to 9 hours after the lights were turned off. Division of these G2+M phase cells began 9 hours after the lights were turned off, and continued until 3 hours after the lights were turned on. In 40 cm height cylinders, *H. akashiwo* showed a clear diel vertical migration pattern; *H. akashiwo* cells accumulated at the surface during the light period and the cells accumulated at the bottom during the dark period. These results indicate that cell division and vertical migration to the surface layer occur simultaneously. We also investigated the diel cell cycle of *H. akashiwo* in Masan Bay when they formed a dense bloom in June 2007. The cell density of *H. akashiwo* fluctuated from 2.85 to 133.0 x 10^3 cells l^{-1} and contributed >90% to total phytoplankton abundance. Highest cell densities of *H. akashiwo* were found at the surface during the daytime. The number of G2+M phase cells increased from 3% at sunset to 15% 8 hours after sunset. Then these G2+M phase cells divided until 4 hours after sunrise. Cells began to accumulate at the surface and started to divide 8 hours after sunset. . Both laboratory experiments and field observation clearly demonstrated that the vertical migration to the surface is accompanied by cell division. This tight link between cell division and vertical migration may be related to the cost for the migration to the surface layer.

31 October, 16:40 (BIO_P-5298)

Distribution patterns, morphology and taxonomy of the gonatid squid *Gonatus tinro* and *Gonatopsis okutanii* in the Sea of Okhotsk and northwestern Pacific Ocean

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The occurrence, size structure, sexual maturity and feeding habits of the gonatid squid *Gonatus tinro* and *Gonatopsis okutanii* were analyzed using data collected on 34 research cruises during 1972-2005. Thorough examination of morphological characters of these squid, along with investigation of their geographic, seasonal and vertical distribution patterns in the Sea of Okhotsk and northwestern Pacific Ocean, suggested that these two nominal species are in fact different ontogenetic stages of a single species. It will be shown that small-sized juvenile stages of this squid have usually been identified as *Gonatus tinro* and larger adult stages as *Gonatopsis okutanii*. A hypothetical scheme of the squid life cycle will be suggested.

31 October, 17:00 (BIO_P-5320)

Reproductive ecology of common octopus, *Octopus vulgaris* in the South Sea, Korea

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The common octopus, captured by various methods, is an important species for the fisheries of many countries. . There has been a limited amount of research on the biology and fishery of *Octopus vulgaris* in Korean coastal waters. The aim of the present study was to obtain information on the biology and reproductive cycles of *O. vulgaris* in order to assist fishery management.

Samples were collected monthly in Tongyoung and Sacheon of Gyeongsangnam-do, using traps. A total of 748 individuals were sampled from February 2007 to January 2008. We analyzed monthly changes in maturity stages, the gonadosomatic index (GSI), gonad weight (GW), total weight at 50% group maturity and sex ratio.

Octopus total weight (TW) was between 128.6 and 3381.4g. Females weighed between 129.8 and 3381.4g and males between 128.6 and 2378.4g. The spawning periods were May to June and September. The total weight at 50% group maturity was estimated to be 919.6g. Sex ratio was not significantly different from 1:1 ($P>0.05$).

BIO Contributed Paper Session Posters

Poster BIO_P-4984

Food supply of Pacific salmon (*Oncorhynchus* spp.) in the western Bering Sea in 2002-2006

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We examined the food supply of Pacific salmon in the western Bering Sea using indirect indices such as daily ration, growth rate, diet overlap, and trophic niche breadth. We then determined the potential for feeding competition among salmon and other marine species. High and relatively stable salmon daily rations, few diet items (mainly two or three species), pronounced feeding selectivity, a low percent of dominant plankton items (copepods and chaetognaths) in the salmon diet, a stable diel feeding rhythm and similar growth rate every year, all indirectly testify to a sufficiently high food supply for Pacific salmon in the western Bering Sea in 2002-2006. Diet overlap of salmon and dominant nektonic species (juvenile Atka mackerel, Walleye pollock, Pacific herring, Northern smooth-tongue, myctophids and gonatid squids) was low or intermediate. Some of these species fed mainly at night. Furthermore, all these fish and squids may be prey of salmon. Consequently, we suggest that there was a low potential for feeding competition among salmon and nektonic species in the western Bering Sea in 2002-2006. In addition to fish and squids, the biomass and feeding habits of jellyfish were studied. Most medusae fed on planktonic crustaceans (copepods, euphausiids, amphipods, pteropods, chaetognaths, ostracods, and larvae decapods) although their food consumption per individual was low. However, by taking their high biomass into account (1800-3200 kg per square km in summer and 1900-4200 kg per square km in fall), medusae may considerably affect the forage base of Pacific salmon and other planktivorous fish.

Poster BIO_P-4995

Seasonal abundance and distribution of pelagic euphausiids in the Changjiang Estuary, China

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Pelagic euphausiids of the Changjiang Estuary and its adjacent waters (between 29°00´~32°00´N and 122°00´~123°30´E), were studied from May 2002 to March 2003. Eight species were recorded but three were abundant: *Pseudeuphausia sinica* was abundant in all four sampling seasons (0.41, 0.62, 0.50 and 0.30); *Euphausia pacifica* was abundant in spring, autumn and winter (0.03, 0.08 and 0.10) while *Euphausia nana* was abundant during spring and autumn (0.03 and 0.04). The months in which each species was abundant will be presented. *P. sinica* attained the highest densities with β values in spring (0.87), summer (0.99) and winter (0.78) within the littoral waters of the study area. *E. pacifica* and *E. nana* preferred high salinity warm water. The relationships between the pelagic euphausiids and ecological characteristics were also considered. Abundance peaked in summer (10.46ind/m^3) and was lowest in winter (0.32ind/m^3). These results suggest that the seasonal abundance of euphausiids was influenced by surface temperature while the horizontal distribution was influenced by surface salinity in estuarine waters. The ecological characteristics of the Changjiang River contributed to the spatial and temporal distribution of pelagic euphausiids including *P. sinica.* Physical environmental factors play a major role in determining the abundance and distribution of pelagic Euphausiids and the dynamics of their seasonal cycles.

Poster BIO_P-4998

The potential usefulness of recovered jellyfish as fertilizer

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Jellyfish infestations in coastal waters inflict great damage on fisheries and power plants. The amount of nitrogen in the giant jellyfish population caught in fishing nets in Wakasa Bay was estimated to be similar to that in rivers flowing into the bay. We examined the potential usefulness of recovered jellyfish as a fertilizer for vegetable fields. Concentrations of chromium and cadmium *etc.* in jellyfish were lower than the limit of quantification so a suspension of jellyfish could be suitable for the growth of vegetables. However, it was desirable to decrease the high concentration of Na^+. We investigated the conversion rate of organic nitrogen and organic phosphorus into inorganic forms in jellyfish during storage. After 10-20 days, 60-80% of Total-N and Total-P were contained in the supernatant solution of jellyfish as NH_4^+ and PO_4^{3-}, respectively. We propose a concentration procedure for the supernatant solution that will reduce the amount of Na^+ in order to decrease the possibility of salt injury for plants, and will decrease the cost of transferring fertilized jellyfish to the place of utilization. Chingensai plants were cultivated using the concentrated solution to examine the effect of decreasing Na^+ on their growth. Decreased Na^+ concentrations appeared to reduce the inhibitory effect of Na^+ on the growth of vegetables.

Poster BIO_P-5007

Organic complexation of iron in the Pacific Ocean

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The chemical speciation of iron in seawater is critical for understanding its solubility, distribution and bioavailability. Several studies have provided compelling evidence that, in equilibrium conditions, dissolved iron is principally complexed by organic ligands in oceanic waters. Vertical distributions of dissolved iron and organic iron-complexing ligands were determined over a wide area of the Pacific Ocean to examine the vertical and horizontal gradients of the organic complexation. In surface waters, low concentration of dissolved iron was observed with an excess of strong organic ligands, and most of the dissolved iron was estimated to be complexed with these organic ligands. In the subarctic North Pacific, we found that concentrations of dissolved iron around 1000 m depth were higher than the organic ligand concentrations; excess dissolved iron can exist as colloidal Fe and/or organic/inorganic complexes with weak ligands that were not detectable by our method. The presence of excess dissolved iron for organic ligands was also observed in the deep water at a station east of Fiji in the tropical South Pacific. On the other hand, the concentrations of organic iron-complexing ligands were higher than dissolved iron concentrations throughout the water column in the equatorial Pacific. These results suggest that the extent of organic complexation of iron varies in relation to biogeochemical processes in the ocean interior and is playing a key role in oceanic iron cycling.

Poster BIO_P-5021

Ecological characteristics of the pelagic decapods in the Changjiang Estuary

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Based on seasonal investigations in the Changjiang estuary (between 28°00´~32°00´N and 122°00´~123°30´E) from 2002 to 2003, we will present information on the seasonal changes in abundanceand species composition of pelagic decapods. The influence of water masses, the ecological adaptation of dominant species to environmental conditions, and the contribution of dominant species to total decapod abundance will also be presented. Our results showed that the seasonal abundance of pelagic decapods was mainly determined by water temperature andtheir horizontal distribution was mainly determined by salinity fluctuations. In summer, the abundance of pelagic decapods peaked at 10.42 ind/m^3 in the plume front zone of the Changjiang estuary (122°40′~123°30′ E), while in winter, abundance was the lowest of the year, about 0.004ind/m^3. Only *Lucifer intermedius* and *Leptochela gracilis* were abundant species. In summer, *Lucifer intermedius* contributed 97% to the total variation of decapod abundance, higher than the contribution of 12% provided by *Leptochela gracilis*. The abundances of *Lucifer intermedius* were 0.28 ind/m^3 in spring, 8.93 ind/m^3 in summer, 0.14 ind/m^3 in autumn and 0.005 ind/m^3 in winter. The average abundances of *Leptochela gracili*s were 0.11ind/m3 (spring), 0.67 ind/m^3 (summer), 0.13 ind/m^3 (autumn), and 0.004 ind/m^3 (winter).

Poster BIO_P-5025

Impact of Alaskan Stream eddies on chlorophyll distribution in the western and central subarctic North Pacific

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The impact of the Alaskan Stream eddies on the chlorophyll *a* distribution in the central and western subarctic North Pacific was investigated through analysis of chlorophyll and altimetry data from satellite observations. The Alaskan Stream eddies formed along the Alaskan Stream between 157ºW and 169ºW south of the Alaskan Peninsula and the Aleutian Islands, propagated downstream along the AS, and mostly crossed the 180º meridian, reaching the western subarctic North Pacific. The analysis suggested that chlorophyll *a* concentrations in the central and western subarctic North Pacific were closely related to Alaskan Stream eddies. When Alaskan Stream eddies were located in the Alaskan Stream, they extended high chlorophyll *a* concentrations around the Aleutian Islands to the south. Even after eddy detachment from the Alaskan Stream, the combination of two or three eddies formed a high chlorophyll *a* concentration belt east of the eddies from the Aleutian Islands to the south. After detachment from the Alaskan Stream, one Alaskan Stream eddy had an isolated high chlorophyll *a* concentration near its center, suggesting upwelling of nutrient rich water.

Poster BIO_P-5067

Development and growth of ontogenetically migrating copepods during the spring phytoplankton bloom in the Oyashio region

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In the Oyashio region, there is little information on large calanoid copepods which have similar life cycles to those in the Gulf of Alaska where phytoplankton biomass is low. We report development and growth of ontogenetically migrating copepods from samples collected daily, and from molting rate experiments conducted during the spring phytoplankton bloom, in the Oyashio region. Although the surface water mass changed frequently during the time-series, *Eucalanus bungii* recruited from nauplii to copepodite stage 1 (C1) and the three *Neocalanus* species developed toward late copepodite stages. During the molting rate experiments, newly molted C4s of *N. flemingeri* were heavier than C3s collected at the same time and lighter than older C4s, indicating that animals gained weight (carbon) aftermolting into the next stage. Molting rate experiments showed that mean stage duration was on the order of 12.7 days for C4 of *N. flemingeri*, 14.1 and 18.2 days for C3 and C4 of *N. plumchrus*, and 12.2 days for C2 of *E. bungii*. Instantaneous carbon-specific growth rates of C4s were higher for *N. flemingeri* than *N. plumchrus*. Estimates of their growth rates showed large fluctuations without significant correlation with ambient water temperature and chlorophyll *a*. Age within stage might contribute to this large variability because these copepods have long stage durations and development histories may vary because they originate from different water masses.

Poster BIO_P-5130

Effects of temperature and salinity changes on asexual reproduction of *Aurelia aurita* (Cnidaria, Scyphozoan)

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The proliferation of jellyfish, associated with climate change and other anthropogenic factors, is considered a problem worldwide. By budding and strobilation, the benthic polyps are influential in determining the population size of the swimming medusae, and these asexual reproduction rates might be subject to environmental factors. This study investigated the effect of abrupt temperature and salinity changes on the asexual reproduction rate of polyps of *Aurelia aurita* during 30-day culture experiments. At a salinity of 33, the largest number of accumulative polyps was found at 30ºC, and this decreased at temperatures up to 36 and down to 15 ºC. At a fixed temperature of 25 ºC and the pre-test salinity of 33, the highest polyp proliferation rate was found at a salinity of 27, and this decreased in the higher (36) and lower (15) salinities. Results from both experiments, along with the significant lower polyp proliferation rates during the first three days, indicated a stress response from the abrupt changes of temperature and salinity. However, the polyps soon recovered from stress and exhibited the potential of budding, indicating strong adaptation ability in harsh environmental conditions. This may explain the increase of jellyfish blooms in the changing marine environment. Surprisingly, we observed no strobilation during the experimental period, probably because of the high acclimation temperature (29 ºC) and salinity (33) used. These experiments indicated that the combined effect of temperature and salinity changes on the asexual reproduction of *A. aurita*, and especially on the switch-on of strobilation, might be more complicated than previously thought.

Poster BIO_P-5141

Long-term variations of sea surface temperature and zooplankton biomass driven by climate changes in the Yellow Sea, western part of Korean peninsula during 1968-2007

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The spatial and temporal variations of zooplankton biomass and sea surface temperature (SST) were investigated in the Yellow Sea, western part of Korean peninsula. Zooplankton and SST were collected at 63 stations arrayed in six transects (124º00´ - 126º30´ E 34º00´ - 37º00´ N) in February, April, June, August, October, and December during 1968-2007. In general, zooplankton biomass increased during the summer months and decreased during the winter months with two peaks in June and October. The seasonal abundance patterns of zooplankton biomass generally coincided with the typical pattern of the seasonal variation of zooplankton biomass in temperate latitudes. During most sampling months over the past four decades, SST increased (with exceptions) or decreased in August. SST at outer stations increased more rapidly than at inner stations. SST was coldest in February (approximate mean range 3-7ºC) while it was warmest in August (approximate mean range 20-26ºC). SST at the outermost station was approximately 0.7-3.8ºC higher than at the innermost station at the same transect. The general pattern of interannual variations of SST is similar to those of the East Sea of Korea (Japan Sea) and the South Sea of Korea, and followed the global pattern, which has been increasing. The temporal variations of SST were not significantly correlated with those of zooplankton biomass. We discuss possible reasons for SST increase over the past four decades and the lack of a relationship between SST and zooplankton biomass in our research area.

Poster BIO_P-5148

Changing size with latitude in *Neocalanus plumchrus* and *N. flemingeri*

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Recent publications using CPR data have relied on the difference in size between stage V *Neocalanus flemingeri* and *N. plumchrus* to separate them at the species level and to then discuss changes in development timing of *N. plumchrus*. However, the size categories used did not take into account the wide latitudinal extent of the distributions and that at northern latitudes in particular the smaller of the species, *N. flemingeri,* may be large enough to be mis-identified as *N. plumchrus*. A detailed study spanning the entire transect length (36°N to 60°N) in the NE Pacific was undertaken to accurately identify and measure the prosome length of both species. In fact, the number of mis-identifications was found to be small and unlikely to have any influence on previous studies, however, the data revealed some interesting differences between the species which are presented here; *N. flemingeri* showed a clear increase in size with increasing latitude in both 2001 (a cold year) and 2004 (a warm year included for comparison) at least up until the Alaska shelf. *N. plumchrus* did not show the same linear increase in size with increasing latitude in either year. *N. plumchrus* CV were larger in 2004 than in 2001 over much of their range. Explanations include an advancement in development rate because of warmer temperatures and the changed location of the transect. *N. flemingeri* CV, however, were similar in size, or smaller in 2004 than in 2001. The factors influencing size of CV are operating differently in each species.

Poster BIO_P-5161

Seasonal dynamics of meiofauna community and zonation patterns in (un)disturbed sandy beaches of the Sea of Japan

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The Russian coastline of the Sea of Japan is characterized by fine-medium sand with a high amount of silt. In spite of their rather barren and desert-like appearance, these sandy coastlines harbour a highly diverse fauna and flora. On the other hand these beaches are subjected to strong anthropogenic pressures (*e.g.* oil pollution, eutrophication, coastal fisheries and tourism), which have substantial impacts on the interstitial life and functioning of the sandy beach ecosystem. Seasonal dynamics of the meiobenthic density in the shallow waters of the Bay of Patrokl including the ice-covered area were studied throughout the year. The total number of meiobenthos specimens ranged from 62500–50500 ind./m^2. The maximum of all meiobenthos groups was reached in November. Abundance decreased abruptly in December and was minimum at the beginning of March, before ice formation and after ice melting. Throughout the winter, characterized by water temperature below 0^0C and the presence of ice cover, the number and biomass of meiobenthos increased as compared to those of December. Meiobenthos community abundance was mostly determined by changes in the number of nematode species - *Enololaimus medius.* Nematodes are very suitable for monitoring and are used to compare and evaluate the diversity between ‘disturbed’ and ‘undisturbed’ sandy beaches

Poster BIO_P-5162

Indicator role of sublittoral meiofauna in monitoring the status of marine environments

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Russia is the world’s richest country in terms of oceanic stocks of oil-and-gas. The impact of petroleum hydrocarbons on meiofauna is little studied in comparison with the number of investigations conducted on

macrofauna. A study was conducted in 2007 to investigate meiofauna assemblages from selected inshore and offshore locations around the coast of Vladivostok (Zolotoy Rog, Vladivostok). The main objective was to relate the differences in meiofauna distribution patterns to a number of measured environmental variables and to establish more clearly the sensitivity of meiofauna communities to anthropogenic disturbance. Data analyses show that distinct spatial differences in species distribution patterns exist and that these correlate with the natural physical characteristics and concentrations of petroleum hydrocarbons and trace metals in the sediment. The inclusion of meiofauna in applied monitoring programmes offers the potential for improving the resolution of the spatial extent of anthropogenic impacts over that achievable from macrofauna investigations alone.

Poster BIO_P-5219

Spatial and seasonal variability of euphausiid distribution and community structure in the Oyashio and the Kuroshio-Oyashio transition region

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The distribution and community structure of euphausiids were investigated in the Oyashio and the Kuroshio-Oyashio transition region. We obtained seasonal data (March, May, July and November) at five fixed stations along the A-line transect using a BONGO net (0.33mm mesh size with 0.6m diameter) in 2006. The BONGO net was towed from depth of ca. 500m to the surface. All samplings were conducted in both day and night at each station. Twenty-one species of euphausiids were collected in this study. Species diversity was higher toward the southern stations. *Euphausia pacifica* was the most abundant species in this area. Two major euphausiid groups were identified using cluster analysis. In group I (representing 5 species), *E. pacifica* and *Thysanoessa* spp. were dominant taxa and mainly collected in the Oyashio region (temperature at 100 m ≦5°C). Group II (representing 16 species) was characterized by *E. recurva*, *E. mutica* and *Nematoscelis microps* and these were only collected in the Kuroshio-Oyashio transition region (temperature at 100 m > 5°C). Furthermore, group II was divided into two sub-groups: *Stylocheiron* spp., *Thysanopoda* spp. and *E. brevis* occurred during summer to autumn whereas theother species in group II occurred year round. Results will be discussed in relation to the variability of environmental conditions.

Poster BIO_P-5223

Petroleum biodegradation in the presence of marine microorganisms, *Pseudoalteromonas citrea, Pseudoalteromonas elyakovii* and *Oceanisphaera litoralis*

Nadezhda E. **Struppul**[1], Elena R. Colomeetch[2] and Natalia A. Snopkova[2]

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In 2005 67 pure cultures of microorganisms from the coastal zone of a southern part of Sakhalin were incubated in oil hydrocarbons. Experiments showed *Pseudoalteromonas citrea*, *Pseudoalteromonas elyakovii*, and *Oceanisphaera litoralis* utilizated petroleum hydrocarbons (PH). All studied microorganisms were capable of recycling some naphtha products: ligroin, benzine, kerosene etc. Our studies of the dynamics of different naphtha products (residual fractions of oil, diesel fuel, gasoline) showed that an intermediate degradation stage, aromatic hydrocarbons, resulted from activity of the microorganisms. Degradation dynamics of gasoline hydrocarbons in synthetic sea water by these microorganisms was investigated by static vapour-phase analysis with subsequent gas chromatographic separation. Degradation of gasoline over 20 days averaged 80%, indicating these microorganisms could be used to reduce oil damage. *Pseudoalteromonas citrea* had the greatest oxidizing ability, with an average destruction of 90.6%.

Poster BIO_P-5284

Practical identification of three sympatric calanoid copepods, *Calanus sinicus*, *C. jashnovi* and *C. pacificus*, in the western North Pacific

Takumi **Nonomura**, Jun Nishikawa, Atsushi Tsuda, Ichiro Yasuda and Shuhei Nishida

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During the last 20 years, the distribution and life histories of the copepods *Neocalanus*, *Eucalanus* and *Metridia*, including immature stages, have been described in the western subarctic North Pacific (NP) on the basis of morphology (*e.g.* Miller, 1988; Tsuda *et al.*, 1999). In the western temperate NP and its marginal coastal-shelf waters, *Calanus sinicus*, *C. jashnovi* and *C. pacificus* are among the dominant mesozooplankton in terms of biomass. The three species are not only similar morphologically but also co-occur in the western NP. For these reasons, it is essential to determine practical methods for distinguishing among the three species, particularly the immatures. The aims of this study are: 1) to identify practical distinguishing characteristics of the three species at every copepodite stage and 2) to validate our understanding of their distribution and life histories. Samples were collected from Sagami Bay in central Japan, from the Kuroshio Extension and from transition waters off northeastern Japan. Prosome length was bimodally distributed in copepodite stages IV-VI (CIV-CVI) while it was unimodal in CI-CIII. The smaller CVs ranged from 1440-2250 µm while the larger CVs ranged from 2240-2850 µm. We applied genetic markers to identify CVs of each species. The larger CVs were identified as *C. jashnovi* while the smaller CVs as *C. sinicus* or *C. pacificus*. The CVs of *C. sinicus* were morphologically distinguished from those of *C. pacificus* by the length/width ratio of the urosome in dorsal view, which is larger in *C. pacificus* (range: 2.5-3.2) than in *C. sinicus* (2.0-2.4), with little overlap.

Poster BIO_P-5325

Diurnal variation in the concentration and stable isotope composition of dissolved oxygen (O_2) in Lake Shihwa, Korea

Miju **Kim**[1], Dong-Jin Kang[1], Kyung-Ryul Kim[1], Noriko Nakayama[2], Toshitaka Gamo[2], Eun Hee Kim[3] and Jae Seong Lee[4]

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To understand the diurnal variation of dissolved oxygen and its stable isotopes, they were measured in Lake Shihwa every 3 hours on July 23-24, 2007. Lake Shihwa, located in the western coast of the Korean peninsula, is an artificial seawater lake, made by the construction of the Shihwa dyke in 1994. The observed temperature was 23.5~25.8 °C, and salinity was 25~28 psu, slightly lower than normal seawater due to the inflow of freshwater. The dissolved oxygen varied between 70~300 µmol/kg, which was between 30~130 % saturation. It was highest in daytime and lowest in nighttime, showing clear diurnal variation. The concentration of chlorophyll *a* was 3~14 µg/l, and had a similar variation pattern to dissolved oxygen. Primary production was estimated from surface chlorophyll concentration and light intensity using a Vertically Generalized Production Model. The $\delta^{18}O$ value varied between 13.5~30.5 ‰ (vs. SMOW), and had the opposite pattern to dissolved oxygen, *i.e.* low in the daytime and high in the nighttime. This is because photosynthesis adds O_2 that has a low value of $\delta^{18}O$, and respiration preferentially removes $^{16}O_2$, known as the Dole effect. To quantify the effect of photosynthesis, respiration and air-sea exchange, photosynthetic O_2 is calculated from primary production, and gas exchange flux is estimated from wind speed and oxygen solubility. The relationship between $\delta^{18}O$ and primary production will be discussed.

Poster BIO_P-5349

Salinity tolerance of planula and polyp stages of Nomura's jellyfish, and their possible natural habitat

Masaya **Toyokawa**[1] and Jing Dong[2]

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The salinity tolerance of the planula larva and polyp stages of Nomura's jellyfish, *Nemopilema nomurai*, also known in Japan as "the giant jellyfish", was investigated by experiment. Artificially fertilized planulae survived and formed polyps at salinities from 8-34 psu, while they were immotile at 4-6 psu and died at 0-2 psu. Polyps fed and formed podocysts at salinities from 10-34 psu, and formed ephyrae between 16-28 psu. Their tolerance to low salinity is similar to that of the closely related rhizostome, *Rhopilema esculenta*. Although ephyrae larvae have never found in nature, young medusae of both species were collected near the mouth of a large river in Liaodong Bay. At present, we speculate that their natural habitat is in the estuary or at least not far from it.

Poster BIO_P-5499

Nutrient distribution and eutrophication assessment for the adjacent waters of the Yellow River Estuary

Jimin Zhang and Wenzhai **Ma**

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Based on the nutrient data from two cruises of oceanographic survey including 33 stations carried out in the adjacent waters of the Yellow River estuary (38°02′00″~37°20′00″N, 119°03′24″~119°31′00″E) in May and August of 2005, the distribution and composition of silicate (SiO_3-Si), reactive phosphate (PO_4-P) and dissolved inorganic nitrogen (DIN) were studied, and the degree of eutrophication was evaluated. The results showed that the high nutrient concentration area was located to the south of the Yellow River estuary. SiO_3-Si and PO_4-P concentrations were higher in August than those in May, but DIN concentration was lower in August than that in May. Both SiO_3-Si and DIN concentration in the surface seawater showed significant negative relationship with salinity ($P<0.01$), while DIN in the surface seawater showed significant positive relationship with COD. The ratio of DIN to P was 136 and 54.3 in May and August, respectively, and PO_4-P was the nutrient limiting phytoplankton growth. The average eutrophication index (*EI*) was larger than 1 and the eutrophication area occurred at sea area to the south of the Yellow River estuary, and COD and DIN maybe the primary factor leading to eutrophication.

FIS Contributed Paper Session

Convenor: Gordon H. Kruse (U.S.A.)

Papers addressing general topics in fishery science and fisheries oceanography in the North Pacific and its marginal seas are invited (except S4, S5 and S11 topics).

Friday, October 31, 2000 10:00 – 17:20

09:00 **Anastasia M. Khrustaleva**
Integrated method for sockeye salmon stock differentiation in the West Pacific and the Sea of Okhotsk (FIS_P-5233)

09:20 **Moongeun Yoon, Syuiti Abe and Deuk-Hee Jin**
Population genetic structure of chum salmon in the Pacific Rim inferred from mitochondrial and microsatellite DNA analyses (FIS_P-5109)

09:40 **In Joon Hwang and Hea Ja Baek**
Assessment of ovarian maturation in *Chasmichthys dolichognathus* after exposure to single polycyclic aromatic hydrocarbons, benzo[a]pyrene (FIS_P-5335)

10:00 **Guoping Zhu, Xuefang Wang, Liuxiong Xu, Xuchang Ye and Chunlei Wang**
Comparison on the biological characteristics of skipjack tuna *Katsuwonus pelamis* between the log school and free school caught by purse seine from the Western and Central Pacific Ocean (FIS_P-5231)

10:20 **Alexei M. Orlov, Dmitry V. Pelenev, Vadim F. Savinykh, Natalia V. Klovach and Andrei V. Vinnikov**
Pacific lamprey: Some ecological and biological features during their sea life and relationships with host species (FIS_P-5000)

10:40 ***Coffee / tea break***

11:00 **Hiroshige Tanaka, Chiyuki Sassa, Seiji Ohshimo and Ichiro Aoki**
Feeding habits and diel feeding patterns of two dominant myctophid fishes in the continental shelf region off western Kyushu, Japan (FIS_P-5299)

11:20 **Lei Guo, Robert Foy, Kate Wynne and Lawrence Schaufler**
Combining stomach content and fatty acid analyses to assess forage fish diets (FIS_P-5322)

11:40 **Jung Nyun Kim, Heeyong Kim and Kwang Ho Choi**
Migration and coastal recruitment of jack mackerel *Trachurus japonicus* in Korean waters (FIS_P-5248)

12:00 **Jake Schweigert, Joanna Hirner and Sean Cox**
Predicting Pacific sardine (*Sardinops sagax*) migration into Canadian waters (FIS_P-5261)

12:20 **Jong Hee Lee, Jae Bong Lee and Chang-Ik Zhang**
Long-term fluctuation of commercial fished species and their marine environment in Korean waters (FIS_P-5191)

12:40 ***Lunch***

14:00 **Anatoliy Ya. Velikanov**
Long-term variability of pelagic fish species composition near the eastern Sakhalin (Sea of Okhotsk): Distribution, fluctuations in abundance, fishery (FIS_P-5045)

14:20 **Alexander I. Glubokov and Alexei M. Orlov**
Poachers (Agonidae) of the Russian part of the Bering Sea: Spatial distribution and biology (FIS_P-4999)

14:40 **Jung Jin Kim and Suam Kim**
Recruitment mechanisms of common squid (*Todarodes Pacificus*) in the Yellow Sea (FIS_P-5327)

15:00 **Takeshi Okunishi, Shin-ichi Ito, Naoki Yoshie, Taketo Hashioka, Hiroshi Sumata and Yasuhiro Yamanaka**
The impact of density-dependent processes on growth of Japanese sardine (*Sardinops melanostictus*) (FIS_P-5310)

15:20 **William Peterson, Edmundo Casillas, Hui Liu and Cheryl Morgan**
Forecasting returns of coho and chinook salmon in the northern California Current: A role for high-frequency long-term observations (FIS_P-5373)

15:40 **You-Jung Kwon, Doo-Hae An, Chang-Ik Zhang, Dae-Yeon Moon and Jae Bong Lee**
An ecological risk assessment of the effect of the tuna longline fishery in the Western and Central Pacific Ocean (FIS_P-5186)

16:00 ***Coffee / tea break***

16:20 **Arata Fukaya, Katsuya Saitoh and Sei-Ichi Saitoh**
Estimation of number of Pacific saury fishing vessels using nighttime visible images (FIS_P-5346)

16:40 **Edward J. Gregr and Andrew W. Trites**
Evaluating the effectiveness of fisheries restrictions intended to reduce competition with Steller sea lions (*Eumetopias jubatus*) (FIS_P-5211)

17:00 **Bernard A. Megrey and Chang-Ik Zhang**
Estimating biomass and management parameters from length composition data: A stock assessment method for data-deficient situations (FIS_P-5271)

FIS Contributed Paper Session Posters

FIS_P-4989 **Guoping Zhu, Liuxiong Xu, Yingqi Zhou and Xiaojie Dai**
Age, growth and mortality of bigeye tuna *Thunnus obesus* (Scombridae) in the eastern and central tropical Pacific Ocean

FIS_P-5016 **Chiyuki Sassa, Keisuke Yamamoto, Youichi Tsukamoto and Muneharu Tokimura**
Distribution and biomass of *Benthosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China Sea: Mechanisms of population maintenance

FIS_P-5079 **Nadezhda L. Aseeva**
Changes in populations of flounders at West Kamchatka as the result of fisheries

FIS_P-5149 **Victor F. Bugaev, B.B. Vronsky, L.O. Zavarina and Zh.Kh. Zorbidi**
Correlation analysis of interannual variations of length, weight and condition factor of salmon from the Kamchatka River

FIS_P-5185 **Hyeok Chan Kwon and Chang-Ik Zhang**
Maturation and spawning of black seabream, *Acanthopagrus schlegeli* in the Jeonnam marine ranching area of Korea

FIS_P-5187 **You-Jung Kwon, Sun-Do Hwang, Yeong-Seung Kim and Dae-Yeon Moon**
Recent stock status of fishes on Emperor seamounts in the Pacific Ocean

FIS_P-5188 **You-Jung Kwon, Doo-Hae An, Soon-Song Kim, Dae-Yeon Moon and Seon-Jea Hwang**
Determinants of bigeye and yellowfin tuna catch rates in the tuna longline fishery

FIS_P-5193 **Yukimasa Ishida and Akihiro Yamada**
Salmon distribution in the northern Japan during the Jomon Period

FIS_P-5202 **Elena Dulepova and Evgeny Ovsyannikov**
Productivity of walleye pollock (*Theragra chalcogramma*) in the eastern Okhotsk Sea in 2006-2008

FIS_P-5203 **Goh Onitsuka, Naoki Hirose, Kazutaka Miyahara, Taro Ota, Jun Hatayama, Yasushi Mitsunaga and Tsuneo Goto**
Lagrangian simulation of diamond squid (*Thysanoteuthis rhombus*) in the southwestern Japan Sea from 2003 to 2005

FIS_P-5222 **Nobushige Shimizu, Seiji Oshimo, Ryuji Yukami and Ichiro Aoki**
Growth of larvae and juvenile Japanese anchovy *Engraulis japonicus* off the coast of western Kyusyu, Japan

FIS_P-5232 **Anastasia M. Khrustaleva, Yury V. Fedotov and Elena N. Kuznetsova**
Application of a spectral method of scale-structure analysis for salmon stock differentiation in the Pacific Rim

FIS_P-5262 **Andrei S. Krovnin and George P. Moury**
Changes in the spatio-temporal structure of climatic variations in the North Pacific and North Atlantic during the last 20 years and their relation to fluctuations in fish stocks

FIS_P-5270 **Bernard A. Megrey and Jae Bong Lee**
On the utility of self-organizing maps (SOM) and k-means clustering to characterize and compare marine ecosystems

FIS_P-5275 **Jin Koo Kim, William Watson, John R. Hyde, Nancy C.H. Lo, Jin Yeong Kim and Sung Kim**
Identification of *Ammodytes larvae* using mtDNA COI with morphological descriptions

FIS_P-5278 **Jin Koo Kim, Kyeong Dong Park, Dae Soo Chang and Joo Il Kim**
Age and growth of *Scartelaos gigas* (Gobiidae) from a mud flat in Korea

FIS_P-5279 **Jeong Bae Kim, Jung Hwa Ryu, Sang Yong Lee and Jin Koo Kim**
Effect of eelgrass on fish species composition and growth of young sea bass

FIS_P-5281 **Jung Hwa Ryu, Jin Koo Kim and Jung Youn Park**
Genetic relationship among six horsehead species, *Branchiostegus* (Pisces, Perciformes), and an osteological comparison

FIS_P-5286 **Sukgeun Jung, Dong-woo Lee, Young Shil Kang, Young-Sang Suh, Jin-yeong Kim and Yeong Gong**
Regime shifts indicated in fishery catch statistics (1968-2007) from Korean coastal waters

FIS_P-5306 **Yasunori Sakurai, Mio Osato and Jun Yamamoto**
Does the extent of ice cover affect the fate of walleye pollock?

FIS_P-5307 **Yeong Gong, Young-Sang Suh, In-Seong Han, Ki-Tack Seong, Woo-Jin Go and Suk-Geun Jung**
Year-to-year and inter-decadal fluctuations in abundance of pelagic fish populations in relation to climate-induced oceanic conditions

FIS_P-5328 **Sukgeun Jung, Jae Bong Lee and Gyun Heo**
Relationship between ship tonnage and catch per haul examined to improve the stock assessment of chub mackerel, *Scomber japonicus*, in Korean sea waters

FIS_P-5331 **Woo-Seok Gwak**
Population structure of Pacific cod *Gadus macrocephalus* in Korean waters inferred from mtDNA and msDNA markers

FIS_P-5336 **Tai Jin Kim, Byung Ki Kim, Chung Youl Park, Byung Eon Choi, Hyung Woon Ju, Hwan Sung Ji, Sang Yong Shin, So Gwang Lee and Woo Seok Gwak**
Characteristics of Pacific cod (*Gadus macrocephalus*) during spawning in Jinhae Bay, Korea

FIS_P-5351 **Petr V. Lushvin**
The impact of seismic activity on development of populations and fishery

FIS_P-5396 **Jin Yeong Kim, Jae Bong Lee, Suam Kim, Young Min Choi and Ulf Dieckmann**
Changes in patterns of maturation and growth of sardine in Korean waters in relation to fluctuations in abundance and temperature

FIS_P-5446 **Hak-Jin Hwang, Inja Yeon, Yang-Jae Im, Myoung-Ho Sohn, Mi-Young Song, Jong-Bin Kim and Heeyong Kim**
Spatio-temporal distribution of snailfish, *Liparis tankae* (Gilbert and Burke) in the West Sea of Korea

FIS Contributed Paper Session Oral Presentations

31 October, 9:00 (FIS_P-5233)

Integrated method for sockeye salmon stock differentiation in the West Pacific and the Sea of Okhotsk

Anastasia M. **Khrustaleva**

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Size structure and age-class composition were analyzed for major sockeye salmon populations from the West Pacific and the Sea of Okhotsk. Microsatellite DNA variation at six microsatellite loci was examined in approximately 720 sockeye salmon sampled in 2003-2005 from the nine stocks on the east and west coasts of Kamchatka, Chukotka, North Kuril Islands, and west coast of the Sea of Okhotsk. A well-defined differentiation of the sockeye salmon stocks by the size population structure (mean size and weight of an individual) and mean frequencies of the year classes was revealed. The differentiation could be associated with various time of sea and freshwater periods of life of sockeye individuals from different lakes and rivers. The microsatellite analysis showed well-defined genetic differentiation among the local populations. Significant differences in allele and genotype frequencies were found. The highest divergence was observed between island populations (North Kuril Islands, Shumshu Island, Bettobu Lake) and continental populations and could be caused by sockeye salmon post-glacial recolonization of Asian habitats. Assignment test of simulated mixed-stock samples showed that six highly polymorphic microsatellite loci would enable relatively accurate individual identification. A new method for sockeye salmon stock differentiation that integrates biological and molecular genetic markers and multivariate statistics has been developed to increase accuracy of sockeye population discrimination.

31 October, 9:20 (FIS_P-5109)

Population genetic structure of chum salmon in the Pacific Rim inferred from mitochondrial and microsatellite DNA analyses

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Population genetic structure of chum salmon (*Oncorhynchus keta*) was estimated in the Pacific Rim using mitochondrial (mt) DNA control region sequences and four nuclear microsatellite (ms) DNA loci. Nucleotide sequence variation in the mtDNA control region of chum salmon defined 32 haplotype of three genealogical groups (clade A, B and C) in more than 4000 individuals representing a total of 96 populations. The observed haplotypes were mostly associated with geographic regions, in that clade A and C haplotypes characterized Asian populations and clade B haplotypes distinguished North American populations. The haplotype diversity was highest in the Korean and Japanese populations, suggesting a greater genetic variation in the populations of Korea and Japan than those of Russia and North America. Similar genetic variation was also found using msDNA, although allelic variation was different among the examined loci. Significant structure was detected with both markers among the three geographic groups by AMOVAs. Pairwise F_{ST} with mtDNA and geographical distance in the three regions showed a significant correlation. In contrast, as in the populations from Japan and Russia, there is no indication of any association between genetic and geographic distance in the msDNA analysis. Our data suggest that sequence variation in the mtDNA control region and msDNA can be used to estimate the genetic population structure of chum salmon in the Pacific Rim, which will become useful for construction of the baseline data for genetic stock identification of mixed chum salmon populations capture on the high seas.

31 October, 9:40 (FIS_P-5335)

Assessment of ovarian maturation in *Chasmichthys dolichognathus* after exposure to single polycyclic aromatic hydrocarbons, benzo[a]pyrene

In Joon **Hwang** and Hea Ja Baek

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Oil spill contamination is one of the most important environmental issues. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants derived from crude oil or incomplete combustion. The objective of our study was to investigate whether benzo[a]pyrene (B[a]P), a representative carcinogenic PAHs from oil spills, had agonistic or antagonistic effects on oocyte maturation of the longchin goby, *Chasmichthys dolichognathus*. We tested the effects of B[a]P on *in vitro* sex steroid hormone (testosterone (T), estradiol-17β (E2) and 17α,20β-dihydroxy-4-pregnen-3-one (17α20βOHP)) production by radioimmunoassay (RIA) and germinal vesicle breakdown (GVBD) assay using isolated oocytes of *Chasmichthys dolichognathus*. In steroid hormone production, 100 nM of B[a]P decreased T production in 0.9-1.0 mm diameter oocytes. 10,000 nM of B[a]P increased E2 production and 10 and 100 nM increased 17α20βOHP production in 0.8-0.9 mm diameter oocytes. 1,000 nM of B[a]P increased E2 production and 100 and 1,000 nM increased 17α20βOHP production in 0.9-1.0 mm diameter oocytes. Steroid levels were calculated to E2/T and E2/17α20βOHP as indices for endocrine disruption. In the ratio of E2/T, 100 nM of B[a]P increased E2/T in 0.9-1.0 mm diameter and 10 nM of B[a]P decreased E2/17α20βOHP in 0.9-1.0 mm diameter oocytes. In GVBD assay, 10 nM of B[a]P stimulated GVBD in oocytes of 0.8-0.9 mm diameter and 10,000 nM of B[a]P inhibited GVBD in oocytes of 0.9-1.0 mm diameter. Taken together, these results suggest that B[a]P have agonistic effects at lower concentrations and antagonistic effects at higher concentrations on oocyte maturation in *C. dolichognathus*.

31 October, 10:00 (FIS_P-5231)

Comparison on the biological characteristics of skipjack tuna *Katsuwonus pelamis* between the log school and free school caught by purse seine from the Western and Central Pacific Ocean

Guoping **Zhu**, Xuefang Wang, Liuxiong Xu, Xuchang Ye and Chunlei Wang

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Skipjack (*Katsuwonus pelamis*) is the main target species of the tuna purse seine fishery. Research on its biological characteristics will help to better understanding its population structure. With the cooperation between Shanghai Ocean University and Shanghai Fisheries General Group, specific research was carried out on the tuna purse seine fishery in the Western and Central Pacific Ocean (WCPO). Based on the biological data of 975 (the log school) and 1343 (the free school) skipjack tuna samples collected onboard purse seine vessels operating in the WCPO from October 2006 to February 2007 and October 2007 to January 2008, using statistical (ANCOVA, t-test and chi-square test) and curvilinear regression methods. Also, the biological characteristics of skipjack tuna, such as fork length distribution, relationships between fork length and body weight, sex ratio, sexual maturity stages and size at first maturity were analyzed and compared. Results indicated that fork length ranged from 243 to 733 mm for the log school and 243 to 746 mm for the free school, the dominant fork length was from 302 to 500mm (80.62%) for the log school and 402 to 600 mm (88.24%) for the free school. There were no statistically significant differences in fork length distributions of females and males for both the log school (F=1.271, P >0.05) and the free school (F=1.831, P>0.05). The relationship between fork length and body weight was $W=6.0983\times10^{-6}L^{3.1870}$ (R^2=0.9618) for the log school and $W=6.3905\times10^{-6}L^{3.1938}$ (R^2=0.9443) for the free school; there was no statistically significant difference in the relationship between fork length and body weight among female and male skipjack tuna for both the log school (ANCOVA, F=0.312, P>0.05) and the free school (ANCOVA, F=3.377, P>0.05). The mean male to female ratio was 1:0.83 for the log school and 0.95:1 for the free school, but there were statistically significant differences in the number of male and female skipjack tuna for fork length classes 301-350 mm (χ^2=7.784, P<0.05) and 351-400 mm (χ^2=17.147, P<0.05) for the log school and in fork length classes 501-550mm (χ^2=4.000 P<0.05) and 651-700mm (χ^2=4.17, P<0.05) for the free school. The calculated size at first

maturity of female and male skipjack were 520.62 mm and 527.52 mm for the log school, however the values were lower than 500 mm and were 473.15 mm and 440.78 mm for the free school, respectively.

31 October, 10:20 (FIS_P-5000)

Pacific lamprey: Some ecological and biological features during their sea life and relationships with host species

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Results of long-term research on spatial and vertical distribution of Pacific lamprey *Lampetra tridentata* in the North Pacific and its size composition are provided. Maximum concentrations of Pacific lamprey occur year round occur off the Cape Navarin, Koryak shelf, eastern Aleutian Islands and US west coast, probably related to high abundance of lamprey hosts in these areas. Near the seafloor, Pacific lamprey are most abundant at depths less than 500 m; in the water column they occur most frequently within the upper 100 m layer. Existence of several size classes might indicate that this species spends several years in the sea. A relationship between body length and capture depth was not detected. Relationships between body length and weight and between length and condition factor are provided. Data on interspecific relationships between Pacific lamprey and its host species (walleye polock *Theragra chalcogramma*, Pacific cod *Gadus macrocephalus*, Pacific herring *Clupea pallasii*, arrowtooth *Atheresthes stomias* and Kamchatka *A. evermanni* flounders, Pacific *Hippoglossus stenolepis* and Greenland halibut *Reinhardtius hippoglossoides*, and Pacific salmon *Oncorhynchus* spp.) are considered. The analysis of patterns of spatial and vertical distribution of hosts allows us to conclude that Pacific lamprey are concentrated within the areas with densest aggregations of prey species. Selectivity of lamprey attacks in relation to species, size, sex and body side of hosts and properties of wounds are analyzed. We show that lamprey attacks resulted in decreased condition factor and gonado-somatic index of affected specimens. It is suggested that high level of mortality of hosts might occur in cases of multiple attacks of adult lamprey, very deep injuries, and abscesses of wounds.

31 October, 11:00 (FIS_P-5299)

Feeding habits and diel feeding patterns of two dominant myctophid fishes in the continental shelf region off western Kyushu, Japan

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Mesopelagic fishes, especially myctophid fishes, occur in a large biomass in the East China Sea and adjacent waters. Results of trawling and acoustic surveys showed that *Diaphus chrysorhynchus* and *Diaphus garmani* are dominant species in the continental shelf region off western Kyushu and that they have the same diel vertical migration pattern; migrating upwards at dusk and downwards at dawn. We studied feeding habits of these two species to clarify their trophic niche in spring, summer and winter. *D. chrysorhynchus* fed mainly on crustacean zooplankton, such as copepods (Calanoida, Poecilostomatoida), amphipods, euphausiids and larval stage of decapods. Additionally, larger fish often fed on larval cephalopods and small fish of other species. On the other hand, stomach contents of *D. garmani* were composed of zooplankton such as copepods, euphausiids, amphipods, larval decapods and appendicularians. Differences in prey size were observed between two species; *D. chrysorhynchus* tended to feed on larger prey items than *D. garmani*. Diel feeding periodicity was examined by stomach fullness and the stomach content index (SCI). Most of the stomachs contained prey items; there were few empty stomachs both in the daytime and nighttime. Additionally, full stomachs of *D. chrysorhynchus* were observed both in the daytime and nighttime. On the other hand, stomach fullness of *D. garmani* was higher in the nighttime with high SCI values compared to daytime. These results suggest that these species feed both during the day and at night, although *D. garmani* feed more active in the nighttime.

31 October, 11:20 (FIS_P-5322)

Combining stomach content and fatty acid analyses to assess forage fish diets

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Trophic interactions between forage fish and zooplankton were examined seasonally in three bays of the Kodiak Archipelago (western Gulf of Alaska) from 2004 to 2007. Stomach contents of locally dominant forage fish were analyzed but inferences from these data were limited in terms of temporal and spatial scales, largely because of high gastric evacuation rates and patchy zooplankton prey distributions. Fatty acid analysis was conducted on whole-body homogenates of selected forage fish and zooplankton species in order to provide a broader assessment of diet composition than the snap-shot view from stomach content analysis. In stomach samples, the presence and importance of euphausiids as diets increased with fish size while copepods decreased, regardless of sampling month or location. This size-related preference was not affected by seasonal fluctuations in euphausiid abundance or lipid content. Fatty acid analysis confirmed this relationship for walleye pollock but not for Pacific herring. Although sampled adult herring stomachs contained only euphausiids, fatty acid analysis suggested that calanoid copepods were more likely to be the most important prey. With small sample sizes and a low sampling frequency, the combination of stomach and fatty acid analyses offered a relatively comprehensive view of forage fish diet composition, which is valuable to monitor forage fish and zooplankton interactions at appropriate scales for hypothesis testing related to zooplankton production influences on forage fish abundance.

31 October, 11:40 (FIS_P-5248)

Migration and coastal recruitment of jack mackerel *Trachurus japonicus* in Korean waters

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Jack mackerel, *Trachurus japonicus*, whose main spawning ground is located in frontal regions of the southern East China Sea (ECS), is an important commercially fished species in Korea and Japan. Therefore, the ECS population is a main target of jack mackerel fishery in Korean waters. Its fishing grounds are concentrated between Jeju Island and the Korea Strait, where its main migration path occurs from the ECS to Korean waters. In the present study, their migration and inshore recruitment were investigated using daily catches at set-net stations in the coastal area of Jeju Island, the southern and eastern Korea related to hydrographic conditions. Jack mackerel migrate to the Korean waters east of Jeju Island and then recruit into the coastal waters of the eastern Korea through onshore of Busan. The jack mackerels were mainly age-0, while the catch of jack mackerel in the set-net stations apart from the Tushima Warm Current (TWC) south of Korea is mainly composed of age-1. Based on the variation of sea surface temperature through the coastal stop survey system of NFRDI, Korea suggested that the inshore recruitment of jack mackerel into the Korean waters depends strongly on the change of the TWC. Moreover, properties of jack mackerel offshore catches will be examined from the seasonal-regional relationship between variation of jack mackerel catches by the purse-seine fishery and the change of TWC.

31 October, 12:00 (FIS_P-5261)

Predicting Pacific sardine (*Sardinops sagax*) migration into Canadian waters

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The objective of this study was to explore (1) prediction of the arrival date of sardines to the west coast of Vancouver Island (WCVI) using relationships between arrival timing and environmental and biological data, and (2) predict the biomass of sardines in Canadian waters. We used recent fisheries and environmental data for our analyses. We modeled arrival timing in two steps: (1) predict arrival timing to the Columbia River area as a function of environmental and biological variables; and (2) project arrival timing to WCVI by estimating the days to travel from the Columbia River. Several models gave prediction intervals of one week or less. Projections of arrival date varied between mid-June and late July depending on the index. These dates agree with historical data from the 1920s-1940s as well as with recent information on arrival timing. The arrival of the 12°C isotherm at Amphitrite Point occurs about the same time, but we were unable to predict precisely enough to use for estimating sardine arrival. To forecast biomass in Canadian waters we use estimates of biomass in Canada as a proportion of the total age 2+ coast-wide biomass. Unfortunately, we only had estimates for 1997, 1999, and 2001. For these years, the estimated proportion of the age 2+ biomass that migrated to British Columbia was always less than 10%, with confidence limits around the three biomass estimates ranging between 4 and 12%. These estimates are similar to the proportions estimated by Ware (2001) for the historical fishery.

31 October, 12:20 (FIS_P-5191)

Long-term fluctuation of commercial fished species and their marine environment in Korean waters

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We analyzed long-term data and explored correlations among physical and biological factors in Korean marine ecosystems. Physical data are seawater temperature and salinity from the serial oceanographic database of the National Fisheries Research and Development Institute from 1962 to 2007. Biological data are landings of 33 major fisheries species from the statistic yearbook of the Ministry for Food, Agriculture, Forest and Fisheries from 1969 to 2007. Study areas were divided into eight sub-areas based on variations of water masses in Korean waters, that is, E1, E2 for the East/Japan Sea, W1, W2, W3 for the Yellow Sea, and S1, S2, S3 for the East China Sea. Catches of walleye pollock in the E1-E2 areas were positively correlated with sea surface temperature (SST). In W1-W3 areas, variations of fisheries species were correlated with 50-m seawater temperature and salinity. In the S1-S3 areas, 40% of species catches were statistically correlated with variations in sea surface environments, such as SST and sea surface salinity (SSS). Catches of filefish were correlated with SST as well as SSS in S1, and those of cuttlefish were correlated to sea surface salinity in S1, S2, and S3. Recruitment of jack mackerel showed decadal variations and was positively correlated with zonal wind, 50-m seawater temperature, and zooplankton biomass in S1-S3 areas. Based on long-term patterns, we tested serial regime shifts and developed a decadal indicator which can explain Korean climatic-oceanic-fisheries long-term fluctuations.

31 October, 14:00 (FIS_P-5045)

Long-term variability of pelagic fish species composition near the eastern Sakhalin (Sea of Okhotsk): Distribution, fluctuations in abundance, fishery

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Near the eastern Sakhalin epipelagic fish communities are represented by 50 species from different biogeographical and ecological groups. Long-term investigations show that essential changes of species composition, distribution, abundance and annual catches took place in this region during 1950 – 2007. At the present time walleye pollock, herring and sand-lance are mostly abundant in the northern part of the study area (49 - 54° N), whereas pink salmon, capelin, arabesque greenling and Japanese anchovy are most abundant in the southern part (46 - 49° N). The productivity of the southern spawning grounds of herring, walleye pollock, sand-lance and capelin declined significantly during the last 30 years. In the northern part of the area, the spawning grounds of the same species remain comparatively stable. Since the end of the 1980s Japanese anchovy and arabesque greenling have had a high level of reproduction, but their spawning grounds are situated further south than Sakhalin Island. In the 20th century total maximal annual catches of herring, Far East sardine, sand-lance, walleye pollock and pink salmon reached 1.0 million tons near eastern Sakhalin. Long-term abundance fluctuations of northern and southern boreal species were characterized by comparatively smooth changes, which were observed for a period of 50-60 years. Appearance of subtropical species in high abundance occurred more recently, not more than 10-20 years ago. A new wave of southern latitude fish migrations took place near the eastern Sakhalin in 2000-2007 at which time there were recorded almost 10 new species, including white shark, which was caught for the first time in the Aniva Bay in 2007.

31 October, 14:20 (FIS_P-4999)

Poachers (Agonidae) of the Russian part of the Bering Sea: Spatial distribution and biology

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Seasonal patterns of spatial distributions, size and sex compositions, indices of maturity, and feeding habits of four poachers (dragon poacher *Percis japonica*, sawback poacher *Sarritor frenatus*, longnose poacher *S. leptorhynchus*, and Aleutian alligatorfish *Aspidophoroides bartoni*) in the northwestern Bering Sea are considered based on specimens obtained in 1996-2003. Among poachers considered within the Russian part of the Bering Sea, dragon poacher occurred most frequently (occurrence reached 81.8%); the longnose poacher was the rarest species in the study area (0.7–7.0%). Dragon poacher begin spawning in mid June and spawning of sawback poacher begins in second week of August. Length at maturity (L_{m50}) of female dragon poacher is 29 cm and for male dragon poacher it is 23 cm; respective lengths of sawback poacher are 24-25 and 23 cm. Average individual absolute fecundity of dragon poacher is 6,361 eggs, and the diameter of oocytes is 2.9 mm; for sawback poacher, these values are 2,848 eggs and 1.53 mm, respectively. The bulk of dragon poacher diet consists mainly of polychaete worms followed by gammarids and caprellids. Sawback poacher feeds mostly on gammarids; polychaete worms, isopods, and euphausiids (in decreasing order) also play important role in the diet of this species.

31 October, 14:40 (FIS_P-5327)

Recruitment mechanisms of common squid (*Todarodes Pacificus*) in the Yellow Sea

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Common squid is important ecologically and commercially in Korea and Japan. Annual catches of *Todarodes pacificus* in the Yellow Sea have gradually increased since 2000, though they remained at levels lower than those in the East/Japan Sea. However, recruitment mechanisms to the fisheries in the Yellow Sea of common squid have yet to be clarified. To reveal the transport of squid larvae into the Yellow Sea, we analyzed monthly temperature fields off western Jeju Island from the KODC during 1990-2007. The Yellow Sea Warm Current (YSWC) flows northward along the western coast of the Korean Peninsula in June-October, and the entrainment of common squid larvae into the Yellow Sea mainly occur in summer and early autumn by YSWC. Regional Ocean Modeling System (ROMS), based on reanalyzed data during 1993-2002, was applied to track transport process of eggs and paralarvae into the Yellow Sea. It took about 30-70 days from spawning ground in the East China Sea. The main fishing season in the Yellow Sea is between July and October; annual catches have fluctuated and increased markedly during 2000s. To understand mechanisms of annual fluctuation of common squid catches, we examined the relationship between common squid catches and environmental characteristics, such as water temperature in fishing ground, wind velocities in the northern East China Sea, primary production in the nursery ground.

31 October, 15:00 (FIS_P-5310)

The impact of density-dependent processes on growth of Japanese sardine (*Sardinops melanostictus*)

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We developed a multi-trophic level ecosystem model including Japanese sardine (*Sardinops melanostictus*) by coupling a fish bioenergetics model to a lower trophic level ecosystem model. An oceanic general circulation model (OGCM) developed by the Center for Climate System Research, Univ. of Tokyo, was coupled with a lower trophic level ecosystem model: NEMURO (North pacific Ecosystem Model for Understanding Regional Oceanography) and a Japanese sardine migration model and applied to the western North Pacific. The fish migration model has used individual-based modeling techniques, which have many advantages for spatially explicit modeling of marine fish life history. To investigate the impact of density-dependent processes on growth of Japanese sardine, the coupled models were integrated under scenarios of high and low standing stocks of Japanese sardine with climatological physical fields simulated by the OGCM. An increase in the area occupied by adult sardine at the high stocks was found. This result appears to provide support for the hypothesis of density-dependent habitat selection. Age 0 fish showed slower growth rate under the high stocks in summer because forage density becomes significantly low by high grazing pressures of adult sardine. The effect of density dependence among trophic levels and fish seems to be one of the most important factors which determine the geographical distribution of adult sardine and growth of young sardine.

31 October, 15:20 (FIS_P-5373)

Forecasting returns of coho and chinook salmon in the northern California Current: A role for high-frequency long-term observations

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Successful weather forecasting is based on a basic understanding of the underlying physics and physical mechanisms that determine the weather. Similarly, forecasting of ecological phenomena in the ocean requires a basic understanding of physical and ecological mechanisms that determine the outcomes that one hopes to predict. Successful prediction of fishery yields for example will require at least a modicum of knowledge of where in the ocean the given species lives during all parts of its life cycle, and of processes that determine the key recruitment bottlenecks. Towards this end, we have monitored hydrography, plankton and juvenile salmonid abundance in coastal waters of the northern California Current along eight transects off Washington and Oregon in June and September for the past 11 years. We also monitored hydrography, zooplankton and krill along a single transect off Newport. We have had some success with qualitative forecasts of coho and spring Chinook salmon (*e.g.*, good, fair, or poor returns), with recruitment best predicted by biological oceanographic conditions derived from our monitoring programs: date of biological spring transition, biomass anomalies of northern lipid-rich copepods, copepod community structure, and catches of juvenile Chinooks during June surveys and juvenile coho in September surveys. Our ability to forecast salmon in the future will depend in part on our ability to forecast the impact of global climate change on ocean conditions in coastal waters. Models along with ecosystem observations may become a requirement to understand how variations in physical climate forcing will affect fisheries and marine ecosystem productivity.

31 October, 15:40 (FIS_P-5186)

An ecological risk assessment of the effect of the tuna longline fishery in the Western and Central Pacific Ocean

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Ecological risk assessment (ERA), developed in Australia, can be used to estimate the risk of target, bycatch and protected species from the effects of fishing using limited data for stock assessment. In this study, we employed this ERA approach to estimate risks to tunas, billfishes and other species by the tuna longline fishery in the Pacific Ocean using productivity and susceptibility analyses of the ERA based on low (<1.30), medium (1.30~1.84) and high risk (>1.84). Albacore, bigeye, yellowfin and skipjack tunas were generally evaluated in the medium risk. The susceptibility of tuna species, however, had higher risks than the productivity. Billfishes were also at medium risk, while sharks and other species were at high risk by the tuna longline fishery. The risk of productivity was generally high, because most species fished by the tuna longline fishery have high longevities, *i.e.*, over 25 years, including ovoviviparous sharks species. Susceptibility, which is related with the selection of fishing gear, was also high, because the longline fishery has no gear modifications to prevent bycatch of protected species. Not only target tuna species were influenced by the tuna longline fishery in the Pacific, but also non-target species, such as pomfret, mackerels rays, sea turtle. Ecosystem-based fishery assessment tools, such as PSA, have the ability to provide broad scientific advice to the policy makers and stakeholders.

31 October, 16:20 (FIS_P-5346)

Estimation of number of Pacific saury fishing vessels using nighttime visible images

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Pacific saury, *Cololabis saira*, a commercially important species for multi-national fishing fleets in northwestern Pacific is fished using bright lights to attract schools. The lights are easily monitored using nighttime visible images from the Defense Meteorological Satellite Program/Operational Linescan System (DMSP/OLS). Modeling the relationship between fishing light distribution and numbers of fishing vessels can facilitate near-real time prediction and management of saury fisheries. The objective of this study was to estimate the numbers of fishing vessels from nighttime images and field data in northwestern Pacific coast. Analysis was conducted using ArcGIS. Results show that spatial fishing light coverage is significantly related to numbers of fishing vessels. For instance, in October 1998 and 1999, the number of emitted pixels was significantly correlated to number of fishing vessels ($p<0.001$). We suggest that it is possible to estimate fishing effort from remotely sensed nighttime visible images.

31 October, 16:40 (FIS_P-5211)

Evaluating the effectiveness of fisheries restrictions intended to reduce competition with Steller sea lions (*Eumetopias jubatus*)

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Fishing regulations intended to reduce competition between Steller sea lions (*Eumetopias jubatus*) and commercial fisheries became increasingly restrictive from the time sea lions were listed as endangered (1990) to 2002, when the present management regime was established. We evaluated the efficacy of these regulations using spatially explicit distribution models for commercial fisheries and Steller sea lions. We calculated the spatial overlap between the two distributions for discrete sets of years, delineated by significant changes in fisheries management regulations. We used niche overlap and mean crowding indices for each management period. Changes in these indices over time provided a means of assessing whether increasingly restrictive fishing regulations corresponded with decreased spatial overlap between sea lions and commercial fisheries. Overlap was generally higher in winter than in summer, but was low overall, compared to the predicted sea lion distribution. A reduction in overlap was detected during the late 1990s when management actions imposed the greatest spatial restrictions on fisheries, though regionally, overlap in the Aleutian Islands was as much as 4 times higher than in the Gulf of Alaska or the Bering Sea, while crowding was 50% higher in the Bering Sea. Overlap in the Aleutian Islands also ran counter to the overall trend, showing a steady increase over the time periods. While fishing regulations is only one of the variables that determine the overall distribution of fishing effort, our results show how overlap metrics allow the relative magnitude of human impacts on marine mammal distributions to be assessed.

31 October, 17:00 (FIS_P-5271)

Estimating biomass and management parameters from length composition data: A stock assessment method for data-deficient situations

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We present a new, biomass-based, length cohort analysis requiring only length composition data and estimates of total catch from one year. The model is based on the premise that a biomass-based analysis, which explicitly incorporates growth, can account for changes in population biomass resulting from changes in individual weight in addition to changes in number, and thereby gives better estimates of population biomass. We apply the model to simulated data as well as actual survey data for northern rock sole from the eastern Bering Sea. A comparison of model results to survey and stock assessment estimates for population biomass was conducted to examine the model's performance in estimating total stock biomass. Results showed reasonable correspondence between model and survey estimates of abundance. The model can easily be extended to include calculation of useful and relevant management metrics from length composition data. These include population biomass, instantaneous coefficients of fishing mortality by length, precautionary fishery metrics and management parameters such as acceptable biological catch and yield per recruit information using length structure. The model is especially useful in data deficient situations and should be considered for small-scale fisheries resource assessment.

FIS Contributed Paper Session Posters

Poster FIS_P-4989

Age, growth and mortality of bigeye tuna *Thunnus obesus* (Scombridae) in the eastern and central tropical Pacific Ocean

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Biological parameters such as age, growth, and age (or size) at maturity are vital for accurate stock assessments and management of sustainable fisheries. Despite this, very few validated age studies have been conducted for large tropical pelagic species in the eastern and central tropical Pacific Ocean. Age and growth parameters were estimated for bigeye tuna sampled from Chinese longliners fishing in the eastern and central tropical Pacific Ocean from February to November 2006. Von Bertalanffy growth parameters were estimated to be L_{∞}=207.4 cm fork length, k=0.23 year^{-1}, and theoretical age at zero length is t_0=−0.40 year.

Poster FIS_P-5016

Distribution and biomass of *Benthosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China Sea: Mechanisms of population maintenance

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Benthosema pterotum is a typical pseudoceanic myctophid, widely distributed in the subtropical-tropical slope waters of the Indo-West Pacific. In the East China Sea, they occur in a much shallower shelf region (*ca.* 30–110 m depth), and undergo a unique diel vertical migration, *i.e.*, occurring in the epipelagic layer at night, and shifting

down to the benthopelagic layer during the daytime to form dense aggregations. Therefore, they provide a major prey item for commercially important demersal fishes such as hairtails, croakers, and lizardfishes. Based on data from seasonal bottom trawl surveys during the daytime, dense distributions (>10^5 individuals per km^2) of *B. pterotum* were mainly observed in the area south of Cheju Island throughout the year, where a persistent cyclonic eddy exists. In this area, the bottom sediments are mainly composed of mud, which are resuspended by the strong tidal current producing waters of high turbidity. Since little sunlight penetrates these depths, the dimly lit conditions in the benthopelagic layer enable *B. pterotum* to live in such a shallow area. In the area south of Cheju Island, their larvae mainly occur during summer to autumn and are associated with an eddy, which facilitates recruitment into this area. Assuming that (1) the catch efficiency of the trawl is 0.2–0.4, and (2) daytime distribution of *B. pterotum* is up to 10 m above the bottom, the biomass in the area south of Cheju Island was estimated to range from 8,500 to 40,800 t.

Poster FIS_P-5079

Changes in populations of flounders at West Kamchatka as the result of fisheries

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The annual catch of flounders (mainly *Limanda aspera*, *Hippoglossoides elassodon*, and *Pleuronectes sakhalinensis*) on the shelf off West Kamchatka was about 100,000 tons or 6% of the average Russian catch from the Far-Eastern seas. Recently the flounder populations declined considerably and the annual catch decreased to 36-48 thousand tons. To reveal the reasons and make recommendations for a rational fishery, the data of bottom trawl surveys in the summer of 1997 and 2007 were compared. Relatively young, small-sized fish dominated the yellowfin sole *L. aspera* population in 2007, which concentrated in shallow areas. The most considerable size decrease occurred in the southern part of the shelf (southward from 54°N). The size of the flathead sole *H. elassodon* became 3.5 cm smaller, as well, and the areas of its highest density shifted northward (north of 56°N). The most abundant but less valuable Sakhalin plaice *P. sakhalinensis* had no significant changes in abundance but also redistributed northward. The elimination of large-sized fish and the decline in abundance in the area of an intense fishery indicate that fishery pressure is the main reason for stock decline. To rationalize the fishery for resource preservation by avoiding depletion of young fish, it is recommended to limit the catch area to isobaths > 100 m. Moreover, fishing effort should be directed mostly in the northern part of the Kamchatka shelf to facilitate the recovery of flounder populations in the southern part.

Poster FIS_P-5149

Correlation analysis of interannual variations of length, weight and condition factor of salmon from the Kamchatka River

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Interannual trends in body length and weight of mature individuals in Pacific salmon species in the Kamchatka River, among synchronous (1957-1984) and asynchronous (1985-2002) returns of dominant generations of pink salmon on West and East Kamchatka, in general do not revealed correlations with some exceptions. For example, for the period 1957-1984 there is a positive correlation in the body length between sockeye and chum salmon and between chum and coho salmon. Fulton's condition factor appeared as more informative than body length or weight for interspecies comparisons of interannual trends. There were also positive correlations observed among sockeye, chum and coho salmons during two different periods of pink salmon stock dynamics: 1957-1984 and 1985-2002. The condition factor of Chinook salmon was not correlated with those of the other species with a single exception (coho salmon during 1957-1984). The similarity of variations in condition factor among sockeye, chum and coho salmon leads us to suggest that several principle factors regulate the growth of some salmon species from the Kamchatka River during their oceanic life. The abundance of dominant synchronous and asynchronous generations of pink salmon from West and East Kamchatka are suggested to influence condition factor of salmon of this river. The effects most likely result from food supply during feeding in the ocean. Interannual and interspecies differences in foraging conditions of salmon from the Kamchatka

River are best indexed by condition factors, because the other characteristics (body length and weight) are less informative.

Poster FIS_P-5185

Maturation and spawning of black seabream, *Acanthopagrus schlegeli* in the Jeonnam marine ranching area of Korea

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The maturation and spawning of black seabream, *Acanthopagrus schlegeli* were investigated using samples randomly collected in the Jeonnam marine ranching area of Korea from March 2007 to February 2008. We estimated monthly changes in maturity stages and gonadosomatic index (GSI). The spawning period ranged from March to July, and peak spawning occurred in April and May. The fecundity (F) ranged from 839,596 eggs at 32.2 cm fork length (FL) to 2,894,913 eggs at 42.0 cm FL, and the relationship between F and FL was expressed as $F = 1.126FL^{3.2534}$ (R^2=0.736). The size at 50% maturity was estimated to be 25.8 cm FL for females and 19.0 cm FL for males. The sex ratio was 19.9% for female, 28.7% for female/male, 30.5% for male, 20.9% for male/female.

Poster FIS_P-5187

Recent stock status of fishes on Emperor seamounts in the Pacific Ocean

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Since 1969 Japanese bottom trawl vessels have fished seamounts of the southern Emperor-northern Hawaiian Ridge in the central North Pacific. In Korea, scientific research has been conducted in two trawl and one longline fishery since 2005. The dominant species was splendid alfonsino (Alfonsin) and slender armorhead in the trawl fishery and shark in the longline. Since the commercial trawl fishery began in 2005, total catch was 750 mt (splendid alfonsino 68%, armorheads 16%) in 2005, and 460 mt (splendid alfonsino 63%, armorheads 21%) in 2006. Splendid alfonsino and armorheads were dominant in commercial fisheries on the Emperor Seamounts during 2005-2007. Monthly variation in catch of splendid alfonsino shows monthly increases from April to July during 2005-2007. Biomass was estimated from trawl fishery data obtained from March 2005 through August 2007. The approach consists of fishing area size, catch per unit effort, and catchability. The catchability was assumed to be 0.5. Approximately 10% of biomass was fished. Biomass decreased by year. The risk to each species was estimated using ecological risk assessment which was based on the biological data. The target species, Splendid alfonsino and armorheads, were ranked as medium risk, but bycatch species, such as Skilfish, were ranked as medium or high risk.

Poster FIS_P-5188

Determinants of bigeye and yellowfin tuna catch rates in the tuna longline fishery

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A pelagic tuna longline research cruise was conducted in the eastern and central Pacific Ocean in August of 2007 to compare catch rates associated with different factors, including hook type, bait type and hook number. Traditional tuna hooks (J4) and six circle hook types (C15o, C15s, C16o, C16s, C18o, C18s), along with five bait types (artificial squid (ASQ), chub mackerel (CM), jack mackerel (JM), sardine (SD), and squid (SQ)) and hook number as a proxy for hook depth were evaluated for their effects on bigeye and yellowfin tuna catch rates (fish per 1,000 hooks) using Generalized Linear Models (GLMs). Results from 21 sets indicated significant

differences in bigeye tuna catch rates associated with individual set and hook number and for yellowfin tuna catch rates there were significant effects of hook number and hook type. Hook number (depth) was the paramount operational factor in explaining bigeye tuna catch rates; on the other hand, both hook number and hook type had equal effects on yellowfin tuna catch rates.

Poster FIS_P-5193

Salmon distribution in the northern Japan during the Jomon Period

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In Japan, the present southern limit for chum salmon returns is the Tone River in Chiba Prefecture on the Pacific side and the Tedori River in Ishikawa Prefecture on the Japan Sea side. Salmon distributions along the coast of Tohoku Region from Aomori to Fukushima Prefecture on the Pacific side were examined based on archeological evidence during the Jomon Period, 10,000-2,300 years ago. The oldest salmon remains were found in the northern part of the Tohoku Region, such as in Hachinohe in the Initial Jomon Period during 10,000-6,000 years ago. Thereafter, salmon remains were found in Miyako in the Early Jomon Period 6,000-5,000 years ago, in Oofunato in the Middle Jomon Period, 5,000-4,000 years ago, in Rikuzentakada in the Late omon, 4,000-3,000 years ago, and Naruse in Senda Bay in the Final Jomon, 3000-2300 years ago. These shifts of salmon remains from north to south reflect the change in salmon distribution due to decreasing temperature after the Jomon Marine Transgression, 6,000-5,000 years ago. Based on this archeological evidence, we discuss implications of these past changes on the future.

Poster FIS_P-5202

Productivity of walleye pollock *(Theragra chalcogramma)* in the eastern Okhotsk Sea in 2006-2008

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Walleye pollock is the most abundant commercial fish in the Okhotsk Sea. Often pollock is 60-80% or more of the biomass of pelagic fishes. Using data on walleye pollock production it is possible to estimate total pelagic fish production. The productivity of walleye pollock was calculated for 2006-2008 from large-scale, spring surveys in the eastern Okhotsk Sea. We used data on abundance, length and weight of different years classes of walleye pollock during the spawning period. In this period, biomass of eastern Okhotsk Sea pollock was 3.6-4.2 million t and productivity was 2.2-3.3 million t. The greatest production occurred in 2006-2007 with the production to biomass (P/B) ratio of 0.8. On the one hand, this related to a large number of young fish aged 2-3 years because these years classes of walleye pollock have a high growth rate. On the other hand, the fishery decreases abundance of slow-growing, old year classes of pollock and accordingly increases the P/B ratio. Fish aged 5-8 years constitute the majority (60-75%) of the fished stock; the proportion of older fish is not large. In 2007-2008 pollock production decreased in connection with a reduction of recruit abundance and a change of age structure. In general, pollock production depends on success of spawning, survival of young fishes and fisheries.

Poster FIS_P-5203

Lagrangian simulation of diamond squid (*Thysanoteuthis rhombus*) in the southwestern Japan Sea from 2003 to 2005

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To elucidate the effect of hydrographic conditions on the migration and distribution of diamond squid (*Thysanoteuthis rhombus*) in the Japan Sea, two numerical experiments were conducted using a Lagrangian particle-tracking model. First, Lagrangian simulations with different horizontal swimming speeds were carried out in the southwestern Japan Sea. By comparing the simulation results with the experimental tagging records from 2003, we found that horizontal migration of the diamond squid within a few days was dominated by their own individual swimming, but the effect of their swimming relatively decreased after about 10 days. The results suggest that long-term migration is dependent on the ambient current field. Second, another numerical experiment with biological processes, forced by different hydrographic conditions in 2003-2005, was conducted. Temporal variations of distributions and sizes calculated by the model roughly corresponded to those of catch data in 2003-2005. Differences in migration routes and distributions of particles among years were related to differences in hydrographic conditions, such as the mainstream position of the Tsushima Warm Current. Prediction of catch levels might be improved by considering hydrographic conditions in the southwestern Japan Sea.

Poster FIS_P-5222

Growth of larvae and juvenile Japanese anchovy *Engraulis japonicus* off the coast of western Kyusyu, Japan

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Although many studies on the growth of the early life stage of Japanese anchovy, *Engraulis japonicus*, have been conducted for the Pacific Ocean stock, there is little information on the early growth of the Tsushima Current stock distributed in the East China Sea and the Sea of Japan. Using otolith microstructure analysis we examined seasonal and annual variations of growth among cohorts of larvae and juveniles (15 – 60 mm standard length, SL) sampled off the coast of western Kyusyu during 2004 – 2007. Hatch dates and growth trajectories were estimated from the number and width of daily increments of sagittal otolith. Then, the effect of sea surface temperature (SST) on growth was examined. Overall, the relationship between daily age and SL was linear, though it showed some variability. A few different relationships were observed between otolith radius and SL of juveniles. This may imply that the relationship between somatic and otolith growth differs among juveniles distributed in the study area. Growth became faster from March to the August cohorts along with increasing SST, and every seasonal cohort showed faster growth in years of higher temperature. However, the relationships between SST and increment width for 10 day intervals suggested the existence of optimal temperature for growth.

Poster FIS_P-5232

Application of a spectral method of scale-structure analysis for salmon stock differentiation in the Pacific Rim

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A novel method for Pacific salmon origin determination in mixed stocks using spectral characteristics of their scale structure was implemented. Special software was developed that utilizes spectral analysis of the brightness signal along several cross sections of the scale digital image by the fast Fourier transform (FFT). The hardware-software complex enables image acquisition and automated determination of some spectral characteristics of the scale. Automated image processing considerably reduces time and labor costs, and minimizes human subjectivity during measurement. A case study of two chum salmon (*Oncorhynchus keta*) stocks from the Sea of Okhotsk (southeast coast of Sakhalin Island, Tunaycha Lake and southwest coast of Kamchatka Peninsula, Bolshaya River) was conducted to test the new method. It was determined that the populations studied significantly differ by some characteristics of the spatial amplitude spectrum taken from the photographic images of scales. New spectral characteristics are tested and determined to be reliable identifiers. Interannual variability of identifiers was examined. Capabilities of utilization of spatial phase spectrum characteristics and two-dimension fast Fourier transform for digital image analysis for the purpose of Pacific salmon stocks differentiation are considered.

Poster FIS_P-5262

Changes in the spatio-temporal structure of climatic variations in the North Pacific and North Atlantic during the last 20 years and their relation to fluctuations in fish stocks

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The 1987-2007 period was characterized by a clear tendency toward warming in both the North Pacific and North Atlantic. We considered the changes in the structure of climatic variations occurred during this period in both oceans in comparison with the previous 35 years (1957-1991). The results showed the shift of the borders of the earlier period (1957-1991) with the coherent long-term fluctuations of sea surface temperature anomalies (SSTA) in the North Pacific and North Atlantic to the east. This might be a result of an eastward displacement of the main atmospheric centers of action over the Northern Hemisphere. Moreover, in contrast to the 1957-1991 period the absolute values of correlation coefficients among the time series of area-averaged mean winter SSTA decreased but in many cases were statistically insignificant. Also, there was not a pronounced regime shift during the 1987-2007 period, though the rate of warming slowed down during 2000-2007. The changes in survival coefficients of the main commercial fish stocks during the period under consideration were also analyzed in the context of the changes in the structure of climatic variations in the North Pacific and North Atlantic.

Poster FIS_P-5270

On the utility of self-organizing maps (SOM) and k-means clustering to characterize and compare marine ecosystems

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We use k-means clustering and self-organizing maps (SOMs) as a data visualization technique to assist with ecosystem comparisons. SOM's help reduce data dimensionality to reveal patterns using an intuitive visual

display. Two examples are used to demonstrate the utility of SOMs – one focused on identifying temporal patterns and the other on characterizing spatial patterns. In the first, recruitment time series expressed as a survival index (log R/S) anomaly from four ecosystems (Georges Bank, Barents/Norwegian Seas, eastern Bering Sea and Gulf of Alaska) are used to show within and between ecosystem changes and synchronies. In the second, SOMs are used with ecosystem macrodescriptor indices from five ecosystems (East Sea, Yellow Sea, East China Sea, eastern Bering Sea and Barents Sea) to compare system similarities and differences. Results show that the eastern Bering Sea and Gulf of Alaska recruitment anomaly time series change in synchrony. Recruitment anomaly time series for the Georges Bank and Barents/Norwegian Sea ecosystems also change similarly in time, however the Pacific basin ecosystems demonstrated opposing temporal associations with Atlantic basin ecosystems. In the spatial analysis, the East China Sea and East Sea showed similar macrodescriptor characteristics. The eastern Bering Sea and Barents Sea were also similar. Geographically the Yellow Sea is close to the East Sea and East China Sea, but its structure and function were more similar to the eastern Bering Sea and Barents Sea ecosystems. Our analyses demonstrate that visual presentation of high dimensional data via SOMs is a useful way to compare ecosystems.

Poster FIS_P-5275

Identification of *Ammodytes* larvae using mtDNA COI with morphological descriptions

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We collected *Ammodytes* larvae from the West Sea of Korea (SL1-4) and the Bering Sea (H1-5), and analyzed a 638 base-pair sequences from their mitochondrial DNA COI genes. Sequences were compared with those of adult *Ammodytes personatus* from the East (E3, 11, 19, 30), West (S14, 25), South Sea of Korea (N26, 28), and Japan (J1-3). A neighbor-joining tree showed that four individuals (SL1-4) were closely clustered with adult *A. personatus*, except two individuals (E11 and E30). Five individuals (H1-5) were located distantly from adult *A. personatus*, and are thought to be *Ammodytes hexapterus*. We investigated larval development of *A. personatus* collected from the East (4.8-15.2 mm TL) and the West Sea of Korea (8.9-15.2 mm TL), and *A. hexapterus* from the Bering Sea (8.0-21.0 mm TL). *A. personatus* differed from *A. hexapterus* in percentage of head length to standard length (12-25% in the former *vs.* 8.3-12.1% in the latter), 1 row of pigments on the dorsal margin of the caudal region (present *vs.* absent), and the size when the notochord begins to flex (9.1-10.5 mm *vs.* 14.1 mm). Regarding the two local populations of *A. personatus*, the East Sea population was distinguished from the West Sea population in the percentage of head length to standard length (12-16% in the former *vs.* 16.7-25% in the latter), and one pigment on the isthmus (present *vs.* absent). These results suggest that the East Sea population of *A. personatus* is intermediate between *A. hexapterus* and the West Sea population of *A. personatus*.

Poster FIS_P-5278

Age and growth of *Scartelaos gigas* (Gobiidae) from a mud flat in Korea

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We estimated the age and growth rate of the mudskipper, *Scartelaos gigas*, using the second actinost bone of the pectoral girdle, based on an analysis of 552 individuals collected from a mud flat in southwest Korea. Specimens were collected semi-monthly from March to September 2003. Actinost and ring radii of each ring group showed a direct one-to-one relationship, with ring radius increasing in tandem with actinost radius. The relationship between total length (TL) and actinost radius (AR) for both sexes was expressed by the following equation: $TL = 40.413AR + 31.51$ ($r^2 = 0.72$, $p < 0.01$). Average marginal indices were high during the entire study period, except on two collection dates (May 28 and August 26). Ring formation was frequently observed

among individuals collected from May 12 to September 21; the greatest proportions of individuals showing ring formation were among specimens collected on May 28 (74%) and August 26 (75%). Our findings suggest that two new actinost rings may appear each year: one during the spawning season (May-August) and another during hibernation (November-February). Therefore, the growth of *S. gigas* must be limited to short periods each year from March to April and from September to October. Semi-monthly fluctuations in the marginal index showed that *S. gigas* has a unique survival strategy: it consumes nutrients for spawning and hibernation. The seasonalized von Bertalanffy growth parameters were TL_{∞} = 18.59 cm, K = 1.076 year $^{-1}$, t_0 = -0.195, C = 0.448, and WP = 0.216.

Poster FIS_P-5279

Effect of eelgrass on fish species composition and growth of young sea bass

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Fish were collected each month from two eelgrass areas (Gamak and Yeoja Estuaries) and one control area in the southern sea of Korea from February 2006 to February 2007. A dragnet (15-m long x 3-m wide) was used to capture fish. A total of 33 species were found at Gamak, and 28 species at each of Yeoja and the control area. *Leiognathus nuchalis* was the most abundant species at Gamak and Yeoja; *Engraulis japonicus* was the most abundant in the control area. Cluster analysis showed that eelgrass and control areas were well separated, and eelgrass areas contained at least two groups; a resident species group (*L. nuchalis, Syngnathus schlegeli, Lateolabrax japonicus, Pholis nebulosa* and *Takifugu niphobles*) and a temporary visiting species group. Young sea bass (*L. japonicus*) appeared from April to December at Gamak, but from April to July at Yeoja. Sea bass at Gamak and Yeoja grew most rapidly in July and June, respectively, even though the two eelgrass environments are highly similar, differing only in eelgrass density and environmental factors. From April to May, eelgrass density increased in Yeoja but decreased in Gamak. The amounts of phosphate and silicate in waters at Yeoja were higher than those at Gamak. These environmental factors might explain the observed differences in the growth of young sea bass at the two eelgrass areas.

Poster FIS_P-5281

Genetic relationship among six horsehead species, *Branchiostegus* (Pisces, Perciformes), and an osteological comparison

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We used partial mitochondrial DNA sequences of the cytochrome *b* gene to reveal the genetic relationship among six horsehead species, *Branchiostegus japonicus, Branchiostegus albus, Branchiostegus auratus, Branchiostegus argentatus, Branchiostegus wardi*, and one other *Branchiostegus* sp. The analyzed fish were collected from Korea, China, Japan, and Vietnam. We compared their genetic relationship, as predicted by mtDNA sequences, with osteological results. One *Branchiostegus* sp. collected from China was not identified because its color and external morphs were intermediate between those of *B. japonicus* and *B. albus*. An analysis of mtDNA cyt-*b* sequences indicated that the smallest estimated sequence divergence was between *B. japonicus* and *Branchiostegus* sp. (0.67-0.89%); the largest was between *B. auratus* and *B. argentatus* (21.66-21.93%). *B. auratus* was clearly differentiated from the other species, with transversions at 39 loci. *B. argentatus* was distinguished from the other species based on specific genetic markers at three loci. A neighbor-joining tree showed that *Branchiostegus* sp. was closely clustered with *B. japonicus*, and that *B. auratus* was located distant from the other species. Osteological results were not entirely consistent with mtDNA results. Additional research using nuclear DNA would further clarify the relationships among these species.

Poster FIS_P-5286

Regime shifts indicated in fishery catch statistics (1968-2007) from Korean coastal waters

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To evaluate and project influences of climate-driven oceanographic changes on marine ecosystems, we summarized species-composition changes in commercial fishery catches from Korean coaster waters (1968-2007) by multiple correspondence analysis (MCA) to be related with the regime-shift hypothesis. Our results indicated that species composition in commercial catches dramatically changed in 1976-1977, 1982-1983 and 1990. Compared with past studies on regime shifts in the Pacific, the suggested shift in 1997-1998 was not detected, but catch levels of Pacific cod (*Gadus macrocephalus*) have steadily increased since 1998, probably related with (1) cooling bottom water temperature that favors hatch success and (2) bottom-up controls by meso-zooplankton and Pacific herring (*Clupea pallasii*), which also increased in their biomass and catch after 1998. A more recent shift in 1982-1983 was evident in our MCA, but we speculate that technological changes in Korean trawl fisheries could partially explain it. Common squid (*Todarodes pacificus),* chub mackerel *(Scomber japonicus)* and Pacific anchovy *(Engraulis japonicus)* have been dominant in fishery catches in Korea since 1990, and we expect that these 3 species, together with Pacific cod, probably will benefit by the warming sea surface temperature and increased zooplankton biomass in coastal waters off the Korean peninsula.

Poster FIS_P-5306

Does the extent of ice cover affect the fate of walleye pollock?

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In the late-winter and early spring, walleye pollock produce pelagic, separable eggs, which were estimated to spawn at the mid-layer of spawning ground. If the spawning ground was covered by sea ice such as the Sea of Okhotsk, the eggs and larvae occurred in surface layer will be affected by cold and low saline water derived from seasonal sea ice. The extent of ice cover in the Sea of Okotsk has decreased through the 20th century and present. The present study examined the fate of walleye pollock stocks around Japan focused on the survival and hatching success of the egg. The normal hatching rate was low under 2^{o}C and high between 2-7^{o}C, however, no show differences of the rate in salinities (salinity 24-35), showing the low temperatures affect the hatching success. The specific gravities of egg in the early development stages were smaller than that of the water mass in the spawning ground, suggesting that eggs reach the surface within a day after spawning and exposed the cold water. These results suggested the intensity cold water affected by sea ice is one of the critical factors for hatching. The fate of walleye pollock stocks in relation to the spatial change of optimal temperature range (2-7^{o}C) by the result of global warming simulation model will be discussed at the meeting.

Poster FIS_P-5307

Year-to-year and inter-decadal fluctuations in abundance of pelagic fish populations in relation to climate-induced oceanic conditions

Yeong Gong[1], Young-Sang Suh[1], In-Seong **Han**[1], Ki-Tack Seong[1], Woo-Jin Go[1] and Suk-Geun Jung[2]

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Through the data of ocean climate variables, catches and body size, a negative correlation between the abundance of pelagic fishes in the Tsushima Warm Current (TWC) region and the Kuroshio-Oyashio Current (KOC) region was attributed to the climate modulation of laval transport and recruitment, which depends on the winter monsoon-induced drift, current systems, and spawning season and site. The changes in abundance and alternation of dominant fish populations in the two regions in the 1930s, 1970s, and late 1980s mirrored changes

in the climate indices. Oscillations in the decadal climate shifts between the two regions led to zonal differences in laval transport and recruitment, and hence difference in the abundance of pelagic fish populations. During deep Aleutian Lows, as in the 1980s, laval transport from the East China Sea to the KOC region increases in association with the strong winter Asian monsoon, cool regime and increased volume transport of the Kuroshio Current system, whereas during a weak Aleutian Low, laval transport to the TWC region increased in assosiation with a weak winter Asian monsoon, a warm regime, and increased volume transport of the Tsushima Current system. We postulate that the increased chub mackerel abundance in the TWC region and the decreased abundance in the KOC region in the 1990s are partly attributed to changes in recruitment and availability to the fishing fleets under the warm regime in the spawning and nursery ground in the East China Sea in association with the quasi-steady state of mild winter monsoon in the 1990s.

Poster FIS_P-5328

Relationship between ship tonnage and catch per haul examined to improve the stock assessment of chub mackerel, *Scomber japonicus*, in Korean sea waters

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Since 1997, Korean coastal fisheries vessels have reported catch per haul onboard to fisheries radio stations , in addition to reporting their departure/arrival, activity, and position. The compiled database is incomplete and contains uncertainty, mainly because the catch report is voluntary and fish species can be identified only after the catch is landed in ports. Despite this limitation, we have been analyzing the information for standardizing fishing effort and evaluating stock status. Overall, the tonnage and the average catch per haul of a ship showed a linear log-log relationship. We first examined the log-log relationship in detail for the reports from purse-seine fisheries, which primarily target chub mackerel (*Scomber japonicus*) in the Yellow and East China Seas. We excluded the records that reported no catch, because including them did not produce the log-log relationship. For the 2000-2007 period, the tonnage of purse-seiners ranged from 7-297 tons, and the 5% and 95% quintile of catch per haul was 20 and 80 tons. Annually-averaged catch per unit effort (CPUE), which ignores ship tonnage, also has been estimated based on catch reports from the ports, and we compared the intercept and slope of the log-log relationship with it. We could not find any significant and consistent relationship between the annually-averaged CPUE and the intercept or slope for the 2000-2007 period. The CPUE indicated that abundance of chub mackerel has decreased since 2004 whereas the intercept of log-log plot suggested that it has decreased since 2005. The slope of the log-log plot were generally coupled with the annually-averaged CPUE for the 2000-2004 period, but began to be decoupled in 2005. We will further examine whether the database provided by the fisheries radio stations could be useful in improving stock assessments after considering technological changes such as changing total allowable catches and increasing oil fuel prices.

Poster FIS_P-5331

Population structure of Pacific cod *Gadus macrocephalus* in Korean waters inferred from mtDNA and msDNA markers

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To investigate the extent of genetic differentiation among populations, genetic polymorphism in Pacific cod *Gadus macrocephalus*, collected from wild populations of five locations (Boryoung in the West Sea, Jinhae Bay in the South Sea, and Joomunjin, Jookbyun, Bangeojin in the East Sea of Korea), was examined using the mitochondrial DNA (mtDNA) control region and microsatellite DNA (msDNA) markers. Nucleotide sequence analysis of 584 bps in the variable portion of the 5 end of the mtDNA control region revealed 8 variable nucleotide sites among 63 individuals, which defined 7 and 3 haplotypes for western and southern populations, respectively. In addition, nucleotide diversity of those two wild populations was as low as 0.0004±0.0006 and 0.0008±0.0008. However, msDNA sequencing analysis showed a marked polymorphism in wild populations with the mean number of 13.8 to 22.6 alleles per locus in five msDNA markers and an observed (and expected)

heterozygosity of 0.755 (0.825), 0.794 (0.811) and 0.836 (0.861) for western, southern and eastern populations in Korean waters. Analysis of microsatellite loci indicates that Pacific cod in Boryoung, Jinhae Bay, Joomunjin and Jookbyun are genetically different populations. However, there is no significant differentiation between the Pacific cod population from Jinhae Bay and those from Bangeojin, Korea.

Poster FIS_P-5336

Characteristics of Pacific cod (*Gadus macrocephalus*) during spawning in Jinhae Bay, Korea

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The objective of this study was to determine the spawning peak of Pacific cod and to describe characteristics of Pacific cod during their spawning migration. Of the 1,327 specimens measured at the fish market, 549 were females and 778 males. Female body length (BL) ranged from 42.0 to 76.5 cm and male BL from 36.0 to 71.5 cm. Of the 47 specimens measured during pre-spawning period, females ranged from 49.5 to 70.0 cm BL and males from 46.0 to 67.0 cm BL. The gonad-somatic index (GSI) values of females ranged from 3.8 to 51.8. Of the 41 specimens measured during mid-spawning period. Females ranged from 48.7 to 64.0 cm BL and males from 40.6 to 67.0 cm BL. The GSI values of females ranged from 20.3 to 40.0. Of the 8 specimens measured during late-spawning period, females ranged from 51.0 to 58.5 cm BL and males from 38.0 to 55.0 cm BL. The GSI values of females ranged from 4.6 to 31.0. The GSI values of females during mid-spawning period showed the highest value among the pre-, mid-, late-spawning period. The results indicate that Pacific cod mainly spawned in the Jinhae Bay on 10th January.

Poster FIS_P-5351

The impact of seismic activity on development of populations and fishery

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In the 14th to 19th centuries fishermen noted the impact of earthquakes on fish – “fishes try to hide and many of them strand out of the water. Sometimes fishes get injures: their air bladder is cracked due to the fast changes in pressure”. Owing to extensive unloading of lithosphere fluids, juveniles and older fish of many commercial species die because of seismic activity. Surviving fish disperse for several weeks (up to 1.5 months) depending on the intensity of mixing and away migrate from seismically active areas. Thus, after receiving information about the observed seismic disturbances, it is not necessary for fishermen to fish in affected areas because the catches will be much less than forecasted and economically disadvantageous. For the spawning part of population the reproduction is disrupted, *i.e.* there is a decline down to the collapse of yearlings despite the potentially favorable biotic and abiotic conditions. Simultaneously, the catches of mollusks also decreased, while the catches of crustaceans increased.

Poster FIS_P-5396

Changes in patterns of maturation and growth of sardine in Korean waters in relation to fluctuations in abundance and temperature

Jin Yeong **Kim**[1], Jae Bong Lee[1], Suam Kim[2], Young Min Choi[1] and Ulf Dieckmann[3]

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Sardine is a typical pelagic fish that exhibits decadal demographic changes in response to climate and fishing. The abundance of Pacific sardine *Sardinops melanosticta* peaked during the 1980s and in Korean waters gradually collapsed since the late 1990s, being replaced with other pelagic species. One of the main challenges in the retrospective study of this collapse is to evaluate the importance of population fluctuations, changes in biological characteristics, and trends in environmental factors. In this study, we analyzed changes in patterns of maturation and growth relative to changes in abundance and temperature during all periods distinguished by distinctive fluctuation patterns from the late 1970s to the early 1990s. We found that maturation ogives shifted toward younger ages during periods in which the sardine population was abundant and declining. We also document that maturation occurred at smaller body length and under lower growth rates during periods in which the sardine population experienced high fishing pressure and high temperature. To disentangle the relative contributions of changes in growth, survival, and maturation to these patterns, we estimate probabilistic maturation reaction norms for Pacific sardine, by assessing the probability that sardine mature as a function of their age and size.

Poster FIS_P-5446

Spatio-temporal distribution of snailfish, *Liparis tankae* (Gilbert and Burke) in the West Sea of Korea

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The spatio-temporal distribution pattern of snailfish, *Liparis tanakae* was studied by seasonal trawl surveys in the West Sea of Korea from 2004 to 2006. During the summer, *L. tanakae* is mainly distributed in the cold water mass below 10°C that exists in the central Yellow Sea. Its distributional area extended to coastal areas in the autumn and winter, when coastal waters were cooler. Seasonal biomass distribution patterns showed highest densities in the autumn and the lowest in the spring. Body length compositions indicated juveniles (<10cm, TL) comprised more than 80% of total spring catches and that large mature fish (>30cm, TL) were 90% of catches in the autumn. Therefore, it is assumed that the spawning season of the species is in the winter. The distributional patterns of *L. tanakae* life stages are thus affected by water temperature and seasonal migration patterns. Based on the results fisheries management involving a closed season and/or area for the species is now being considered to conserve the stocks appropriately.

POC Contributed Paper Session

Co-convenors: Michael G. Foreman (Canada) and Ichiro Yasuda (Japan)

Papers are invited on all aspects of physical oceanography and climate in the North Pacific and its marginal seas. Papers on coastal upwelling should be directed to the Topic Session S6.

Tuesday, Oct. 28, 2008 09:00 – 18:00

09:00 **Lina Ceballos, Emanuele Di Lorenzo and Niklas Schneider**
North Pacific Gyre Oscillation synchronizes climate fluctuations in the eastern and western North Pacific (POC_P-5398)

09:20 **Sang-Wook Yeh, Young-Gyu Park, Hong-Sik Min, Cheol-Ho Kim and Jae-Hak Lee**
Changes in the Pacific Decadal Oscillation from observations (POC_P-5431)

09:40 **Masahiro Yagi and Ichiro Yasuda**
Turbulent mixing at the Bussol' Strait in the Kuril Islands using density inversions (POC_P-5363)

10:00 **Xianyao Chen, Qin Wang, Xiuhong Wang and Fangli Qiao**
Lagrangian hydrographic features of the Mixed Water Region in the North Pacific derived from Argo data (POC_P-5096)

10:20 **Elena I. Ustinova and Yury D. Sorokin**
Changes in the relationships between large-scale climatic indices and regional conditions in the Far-Eastern Seas (POC_P-5078)

10:40 ***Coffee / tea break***

11:00 **Fan Wang, Jiajia Hao and Yongli Chen**
Distributions and seasonal variations of the thermocline in the China Seas and northwestern Pacific Ocean (POC_P-5441)

11:20 **Tsuneo Ono and Akira Kusaka**
Advanced timing of spring mixed layer development in recent years in the Oyashio region (POC_P-5036)

11:40 **Liqi Chen, Rik Wanninkhof, Wei-Jun Cai, Zhongyong Gao, Yuanhui Zhang, Suqing Xu, Kavin Sullivan and Yongchen Wang**
Comparison of air-sea fluxes of CO_2 in the Southern Ocean and the Western Arctic Ocean (POC_P-5309)

12:00 **Vladimir I. Ponomarev, Boris A. Burov and Alexander Yu. Lazaryuk**
Seasonal heat transfer in the bottom sediment–sea water column of Amurskii Bay (POC_P-5166)

12:20 **Chuanyu Liu and Fan Wang**
An N-shape thermal front in the western South Yellow Sea in winter (POC_P-5217)

12:40 ***Lunch***

14:00 **Yun-Bae Kim, Kyung-Il Chang and Kuh Kim**
Eddy variability from direct current measurements in the southwestern East/Japan Sea (POC_P-5337)

14:20 **Muyin Wang, James E. Overland and Nicholas A. Bond**
Selection of climate models for regional ecosystem projections (POC_P-5200)

14:40 **Dmitry D. Kaplunenko, Olga O. Trusenkova and Vyacheslav B. Lobanov**
SSH variability in the northern Japan/East Sea from altimetry data (POC_P-5317)

15:00 **Xiao-Mei Yan, L. Zhang and Che Sun**
Analysis of the Kuroshio inflow at the East Taiwan Channel (POC_P-5292)

15:20 **Yeojin Jung, Jong Hee Lee, Chang-Ik Zhang and Jae Bong Lee**
Decadal changes in temperature and salinity in Korean waters (POC_P-5190)

15:40 ***Coffee / tea break***

16:00 **Georgy Shevchenko and Valery Chastikov**
Seasonal changes of the East Sakhalin Current from CTD data analysis (POC_P-5134)

16:20 **Tingting Zu and Jianping Gan**
Coupled estuarine-coastal circulation in the Pearl River Estuary: Response to the wind and tidal forcing (POC_P-5444)

16:40 **Hitoshi Kaneko, Ichiro Yasuda, Tohru Ikeya, Jun Nishioka, Takeshi Nakatsuka and Sachihiko Itoh**
Nutrient distribution around the Bussol' Strait (POC_P-5341)

17:00 **Kwang Young Jung, Young Jae Ro and Chung Ho Lee**
Impact of dam water release based on a numerical model of the Kangjin Bay, South Sea, Korea (POC_P-5132)

17:20 **Jing Lu, Fangli Qiao, Yonggang Wang, Changshui Xia and Feng Shan**
A numerical study of the sediment transport process from the Yellow River to the Bohai Sea and Yellow Sea (POC_P-5289)

17:40 **Andrey G. Andreev**
Interannual variations of the water transport through the Tsushima Strait and its impact on the chemical parameters and chlorophyll-*a* in the Japan/East Sea (POC_P-5449)

POC Contributed Paper Session Posters

POC_P-5018 **Vladimir B. Darnitskiy and Maxim A. Ishchenko**
Cyclic thermohaline changes in the topographical eddy system above Erimo Seamount

POC_P-5026 **Antonina M. Polyakova**
Atmospheric activity types over the Northern Pacific

POC_P-5027 **Antonina M. Polyakova**
Especially dangerous wave heights in the Northern Pacific

POC_P-5028 **Antonina M. Polyakova**
Extreme distribution of floating ice in the NW Pacific

POC_P-5029 **Antonina M. Polyakova**
Destructive tsunamis near the coast of Primorye

POC_P-5032 **Vladimir V. Plotnikov**
Change in seasonal cycles of ice formation in the Far East Seas of Russia in the second half of the 20th and beginning of the 21st centuries

POC_P-5033 **Valentina V. Moroz and K.T. Bogdanov**
The Kuril-Kamchatka and Oyashio Currents system water structure and circulation variability

POC_P-5034 **Valentina V. Moroz**
Oyashio and Kuroshio Currents water characteristic variability in the area of their interaction and formation zones

POC_P-5053 **Anastasiya A. Abrosimova, Igor A. Zhabin, Luiza N. Propp and Vyacheslav A. Dubina**
Hydrographic and hydrochemical conditions near the Amur River mouth

POC_P-5062 **Larissa S. Muktepavel and Tatyana A. Shatilina**
Mechanisms determining the formation of extremely low-ice winters in the Okhotsk Sea

POC_P-5063 **Elena.V. Dmitrieva and Vladimir. I. Ponomarev**
Sea surface temperature aggregation from different sources to study multiple scale variability in the Japan/East Sea

POC_P-5074 **Olga I. Kursova and Ahat A. Nabiullin**
Bibliometric analysis of oceanographic research: A case of Kuroshio literature, a half-century bibliographic survey

POC_P-5076 **Gennady I. Yurasov**
Climatic characteristics of water masses, fronts, and currents in the Japan/East Sea

POC_P-5077 **Ahat A. Nabiullin**
North Pacific oceanography: Past, present and the future. A half-century bibliometric survey

POC_P-5095 **Talgat R. Kilmatov**
Calculation of entropy flux through the World Ocean surface

POC_P-5103 **Tatyana A. Shatilina and G.I. Anzhina**
Features of atmospheric circulation and climate in the Far East in the beginning of the 21st century

POC_P-5122 **Alexander N. Man’ko andVera A. Petrova**
Temporal variability of heat exchange between the ocean and atmosphere in the North Pacific

POC_P-5124 **Du Van Toan**
Tidal energy of waves in the South China Sea

POC_P-5126 **Eugene V. Samko and N.V. Bulatov**
Structure and dynamics of eddies in the southern Okhotsk Sea

POC_P-5180 **Nadezda M. Dulova and Vadim V. Novotryasov**
Free oscillations of the Japan/East Sea in Posyet Bay

POC_P-5214 **Zheng Xian Yang**
Monitoring and assessing atmospheric deposition of pollutants to the Bohai Sea

POC_P-5216 **Jinwen Zhang, Wenjing Fan, Jinkun Yang, Ruguang Yin, Wenxi Xiang, Yongshou Cheng, Dongsheng Zhang, Jingxin Luo and Guanghao Wei**
Harmonic analysis of and predictive methods for some marine hydrometeorological elements

POC_P-5244 **Natalia Rudykh and Vladimir Ponomarev**
Cluster analyses of temperature and salinity in the Japan/East Sea pycnocline

POC_P-5287 **D.N. Vasilevsky and L.N. Vasilevskaya**
Features of Far-Eastern monsoons in summer from temperature observations

POC_P-5308 **Du Van Toan, Nguyen Hong Lan, Nguyen Huu Cuong, Nguyen Ngoc Tien, Do Huy Cuong, Nguyen Kim Cat and Vu Hai Dang**
Surface heat fluxes in the Tonkin Gulf

POC_P-5314 **Masatoshi Sato and Tokihiro Kono**
The 1000 km-scale variability of the dynamic height revealed by Argo CTD data at 40ºN in the North Pacific

POC_P-5334 **Oleg A. Bukin, Andrey N. Pavlov, Konstantin A. Shmirko, Pavel A. Salyuk and Sergey Yu. Stolyarchuk**
Aerosols and ozone dynamics in the atmosphere over Peter the Great Bay

POC_P-5355 **Alexander Yu. Lazaryuk and Vladimir Ponomarev**
Matching of Mark-IIIC CTD data

POC_P-5357 **Petr V. Lushvin**
Spectral characteristics seismogenic clouds

POC_P-5370 **Emi Shiraishi, Risako Sakai, Tokihiro Kono and Sachiko Oguma**
Density inversion in the Soya Current on the Hokkaido coast in the Okhotsk Sea

POC_P-5391 **Tomowo Watanabe, Makoto Okazaki and Hideki Akiyama**
Long-term changes of the wintertime coastal water temperature around Japan in the 20th century

POC_P-5436 **Nobuo Tsurushima, Masahiro Suzumura, Namiha Yamada and Koh Harada**
Dissolution rate change of calcite in seawater due to acidification by CO_2

POC_P-5498 **Xing Wang, Maochong Shi, Zhenhui Gao and Lunyu Wu**
The oceanic general circulation and transport in the Bohai Sea

POC Contributed Paper Session Oral Presentations

31 October, 9:00 (POC_P-5398)

North Pacific Gyre Oscillation synchronizes climate fluctuations in the eastern and western North Pacific

Lina Ceballos[1], Emanuele **Di Lorenzo**[1] and Niklas Schneider[2]

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Recent studies have identified the North Pacific Gyre Oscillation (NPGO) as a decadal mode of climate variability that is linked to previously unexplained fluctuations of salinity, nutrient and chlorophyll fluctuations in the Northeast Pacific. The NPGO reflects changes in strength of the central and eastern branches of the subtropical gyre and is driven by the atmosphere through the North Pacific Oscillation (NPO) – the second dominant mode of sea level pressure variability. We show that Rossby wave dynamics excited by the NPO propagate the NPGO signature from the central North Pacific into the Kuroshio-Oyashio Extension (KOE) with a lag of 3 years. This finding provides a physical mechanism that synchronizes decadal climate and ecosystem variations between the North Pacific eastern and western boundaries. We also present evidence that the NPO – the atmospheric driver of the NPGO – is linked to the western Pacific warm pool, and is a precursor to the El Niño Southern Oscillation. This suggests the NPO/NPGO as a mechanism for a quasi-decadal coupled oscillation involving the tropics, and the extra-tropics.

31 October, 9:20 (POC_P-5431)

Changes in the Pacific Decadal Oscillation from observations

Sang-Wook **Yeh**, Young-Gyu Park, Hong-Sik Min, Cheol-Ho Kim and Jae-Hak Lee

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A long-term time series of the North Pacific mean sea surface temperature (SST) is characterized by two distinct epochs, *i.e.*, the cold epoch (1870-1935) *versus* the warm epoch (1945-2007). By directly comparing the Pacific Decadal Oscillation (PDO) between the two epochs we examine characteristic changes in the PDO in relation to changes in the mean SST in the North Pacific. While the spatial structure of the PDO is little changed from the cold epoch to the warm epoch, the temporal structure of the PDO is significantly changed between the two epochs. During the last half of the 20^{th} century (*i.e.*, warm epoch), the period when one phase of the PDO persists becomes longer and low frequency variability in the PDO is dominant compared to the cold epoch. We argue that such a change in the PDO is closely associated with changes in the PDO-ENSO relationship from the warm epoch to the cold epoch.

31 October, 9:40 (POC_P-5363)

Turbulent mixing at the Bussol' Strait in the Kuril Islands using density inversions

Masahiro **Yagi** and Ichiro Yasuda

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Bussol' Strait is one of the Kuril Straits where straits where water exchange between the Okhotsk Sea and North Pacific takes place. It is suggested that a strong vertical turbulent mixing takes place here because of strong tides and that resulting diapycnal upwelling plays an important role in Oyashio southward intrusion and bidecadal variability in northwestern subarctic Pacific. However, it has not been made clear how strong the vertical turbulent mixing is and how much it changes with time. We measured vertical mixing directly by vertical microstructure profiler (VMP2000) during an Okhotsk cruise in August 2006 and 2007 and observed strong vertical diffusivity up to $10^3 cm^2/s$. We also required an indirect method to estimate the intensity of turbulent

mixing by using density inversions and improved this indirect method by comparing estimations made with this method to directly measured dissipation rates. The new method proposed in this study enables us to estimate the dissipation rate to within a factor of 3. We applied this method to a 1-day repeated observation at the western gap of the Bussol' Strait. A strong turbulent mixing whose vertical diffusivity exceeded $10^3 cm^2/s$ was observed corresponding to the time and depth of an intense vertical shear of the diurnal tide and a mean flow where Richardson number was less than 1/4.

31 October, 10:00 (POC_P-5096)

Lagrangian hydrographic features of the Mixed Water Region in the North Pacific derived from Argo data

Xianyao **Chen**, Qin Wang, Xiuhong Wang and Fangli Qiao

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Lagrangian hydrographic features of the Mixed Water Region (MWR), where the mixing between cold, fresh Oyashio water and warm, salty Kuroshio water occurs, is studied using Argo floats deployed in the North Pacific. The MWR is characterized by strong variability in the depth at which minimum salinity can be observed by Argo floats. With the help of the Lagrangian feature of the Argo floats, the Northwest Pacific can be separated into three regions: the Oyashio water region, the MWR, and the Kuroshio water region. It is found that the floats deployed in either side of the MWR can hardly travel across the MWR to another side. If an Argo float enters the MWR, the observed minimum salinity and correspondent depth varies significantly from one profile to another, but after the float enters either side of the MWR, the strong variations vanish. This illustrates the property of the mixing between the Oyashio water and the Kuroshio water in the MWR.

31 October, 10:20 (POC_P-5078)

Changes in the relationships between large-scale climatic indices and regional conditions in the Far-Eastern Seas

Elena I. **Ustinova** and Yury D. Sorokin

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Since large-scale patterns are used to represent the essential elements of climate, we analyzed the stability of relationships between regional characteristics (mainly sea ice coverage, air and water temperature) and large-scale climatic indices (North Pacific Index (NPI), West Pacific (WP) Index, Pacific Decadal Oscillation (PDO), Victoria pattern and Arctic Oscillation (AO), Southern Oscillation (SOI) indices, *etc*.) according to a hierarchy of the real scales of climatic variability, with an emphasis on transitions in the quality of the connections. The different combinations of the characteristics for various transformations of primary data with "running" time intervals from 11 to 30 years, a part of time series before and after regime shifts and complete time series were examined. Pronounced reorganizations of the relationships with accompanied inverse (for example, between ice cover in the Okhotsk Sea and PDO/AO, SST in the Japan/East Sea and AO), most often correspond to the 1976/77 and 1988/89 regime shifts. For the period 1976–1987, the correlation between mean winter ice cover and Victoria pattern was insignificant. The longest periods of relatively stable linkages were found for winter SST in the subtropical region of the Japan/East Sea and the SOI and WP. The steadiest relationships are between WP and regional thermal characteristics. Besides, the quasi-steady state of the climatic system (from one regime shift to other) can be broken locally in the Far-Eastern Seas because of moving climatic atmospheric and oceanic fronts, trajectories of cyclones, change of blocking processes and other boundary phenomena. The results can be useful for the improvement of empirical-statistical climate downscaling techniques for this region.

31 October, 11:00 (POC_P-5441)

Distributions and seasonal variations of the thermocline in the China Seas and northwestern Pacific Ocean

Fan **Wang**[1], Jiajia Hao[1,2] and Yongli Chen[1]

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Distributions and seasonal variations of the thermocline in the China Seas and Northwestern Pacific Ocean (NWP) were studied with an improved method for identifying the thermocline from historical data from 1930 through 2002. The thermocline has obvious seasonal variations in the study area north of 20°N influenced by the strong annual cycles of SST and wind. The occurrence probability of the thermocline is < 10% along the western coasts of the Bohai Sea, Yellow Sea (YS) and northern East China Sea (ECS) from December to March caused by the surface cooling and wind mixing, and in some areas of NWP from January to March when the subduction occurs. The inversion thermocline appears near the southeastern Chinese coast with the longest period and the highest occurrence probability resulting from the Yangtze River diluted water, coastal current and the Taiwan Warm Current (TWC) in autumn, winter and spring. In the areas west and south of the Korean Peninsula and the northern coast of the Shandong Peninsula, the emergence and disappearance of the inversion thermocline are all accorded with the onset and decay of the YS Warm Current. A multi-thermocline exists south of 20°N and in the Japan/East Sea all year round, while analyses reveal obvious seasonal variations in the branches of the Kuroshio in the YS, ECS and the South China Sea that are influenced by variations of the SST and the horizontal advection of the surface warm water carried by the wind-driven currents.

31 October, 11:20 (POC_P-5036)

Advanced timing of spring mixed layer development in recent years in the Oyashio region

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Inter-annual variations in the timing of the development of the seasonal mixed layer in spring in the Oyashio region were evaluated by analyzing historical hydrographic data obtained from 1975 to 2005. A total of 1743 hydrographic data points in the Oyashio domain west of 150°E and north of 38°N from April 1 to May 20 for the above range of years were collected from various data sources. Differences in sigma-T between sea surface and reference depth x ($\Delta\sigma[x]$; x =30m, 50m and 75m) were calculated for each data point, and the mixed layer depth (MLD) was considered to be located between x1 and x2 if $\Delta\sigma\ [x1] < 0.125 < \Delta\sigma\ [x2]$. A histogram of MLD was then calculated for each of the 5 x 6 parcels of the whole data set using 10-day and 5-year divisions from April1 to May 20 and from 1975 to 2005, respectively. Analyses showed a significant shoalward shift in the MLD after 1990 in the mid-April (*ca.* April 11-20) and late-April (April 21-30) time series. The typical date corresponding to a 50%-occurence of MLD = 50m (T50) and 30m (T30) in each 5-year component was calculated based on the histogram data, and results showed a 9- and 6-day advance of T50 and T30, respectively, in the after-1990 compartments compared to the before-1990 ones. These signals indicate an early occurrence of spring blooms in the Oyashio region in the 1990s, which may be the cause of various changes in recent springs in the Oyashio ecosystem.

31 October, 11:40 (POC_P-5309)

Comparison of air-sea fluxes of CO_2 in the Southern Ocean and the Western Arctic Ocean

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Polar oceans play an important role in the global carbon cycle. However, we lack understanding of the air-sea CO_2 fluxes and the factors controlling the fluxes in these large water bodies, in part due to the scarcity of data. Therefore, it is of paramount importance to increase observations in the polar oceans. Here we outline work planned to compare air-sea fluxes of CO_2 in the Southern Ocean and the Western Arctic Ocean along with initial observations in these areas (CFCSOA, EoI #1017). Adjacent marginal sea areas will also be studied. Research will focus on the distributions of pCO_2, air-sea carbon fluxes and their controlling factors. This work will be conducted on an icebreaker from the polar research institute of China (PRIC), the R/V *Xuelong*, during the international polar year (IPY) in 2007 to 2010. There are three overarching objectives: (1) to install a high-resolution underway pCO_2 system on the ship; (2) to achieve a quantitative understanding of the variability of sources and sinks of CO_2 in the polar and sub-polar regions from underway measurements of atmospheric and surface water pCO_2, and related chemical, physical, meteorological parameters, and (3) to provide observational information for evaluating the role of the polar regions in global change. The underway pCO_2 measurement system with a dissolved oxygen probe and fluorometer to measure Chlorophyll *a*, has been installed on the R/V *Xuelong* and will be operated in the 24th CHINARE voyage from 12 November and 15 March, 2008 and in the 3rd CHINATE-Arctic cruise from 11 July to 25 September 2008. Some results that compare air-sea fluxes of CO_2 in the Southern Ocean and the Western Arctic Ocean will be presented and their main driving forces will be discussed.

31 October, 12:00 (POC_P-5166)

Seasonal heat transfer in the bottom sediment–sea water column of Amurskii Bay

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A thin near-bottom boundary layer with increased temperature and salinity is revealed in winter oceanographic observations of ice cover in the Amurrskii Bay shallows with depth 7-20m (Ponomarev *et al.*, 2005). It is supposed that most of the brine water formed in January due to intensive ice formation and brine rejection occupies a thin near-bottom boundary layer. The temperature of this layer increases during mid- and late winter due to a seasonal heat flux from the top of sediments. From direct measurements of temperature profiles in the upper 2–2.3 m layer of sediments, the heat flux, with a maximum of about 3 W/m^2, at the top of bottom sediments in the cold period of a year is the inverse in comparison with the warm period of a year. Heat is accumulated in the upper layer of sediments in the warm period of a year, and is lost in the cold season. The annual cycle of the thermal diffusivity coefficient averaged in the upper layer of sediments is estimated by using a simple numerical model of heat conductivity in the sediments and measurements of temperature profiles in both sediments and sea water columns in different seasons. The numerical experiments show that the coefficient of thermal diffusivity in the upper layer of the bottom sediments during winter (January-March) is 5 times higher than that in October and is due to the heat transfer in the upper layer of sediments predetermined by different physical processes in winter, summer, and fall.

31 October, 12:20 (POC_P-5217)

An N-shape thermal front in the western South Yellow Sea in winter

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An N-shape sea surface thermal front in the western South Yellow Sea from late October through early March is reported in the present paper based on the Advanced Very High Resolution Radiation (AVHRR) sea surface temperature (SST) data. The front is composed of west and east wings along the northeast-southwestward isobaths with an isobath-crossing middle segment in between. After the front's generation, the orientation of the middle segment rotates from West-East (W-E) in early November through early December to Northwest-Southeast (NW-SE) in late December through late February, which always crosses the isobaths. Going with the direction of change, this front expands and moves southwestward. Both the surface waters of the colder coastal current and bottom intensified Yellow Sea Warm Current (YSWC) affect the SST distribution through strong advection and vertical mixing, inducing a departure of the front line from the bathymetry. The colder coastal current penetrates into the warmer water modified by the northwestward branch of the YSWC. The N-shape front forms along the borders between the warmer and colder waters. This mechanism is proved primarily by simulation results from the Princeton Ocean Model (POM) with a tide module. Intraseasonal and interannual variations of the front show a close relationship to the wind which is favorable to both the coastal current and the YSWC.

31 October, 14:00 (POC_P-5337)

Eddy variability from direct current measurements in the southwestern East/Japan Sea

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A tall current mooring equipped with ADCP and RCM current meters was deployed at site EC1 in the southwestern East/Japan Sea during November 2002 and April 2004. The mooring site EC1 was affected by a westward migrating anticyclonic warm eddy feature during the second half of the observation period. SST images and subsurface CTD data suggest the eddy generation was associated with the westward extension of the Offshore Branch. An increase in the subsurface temperature was observed during this period down to at least 360 m. The temperature increased to about 6 °C at 160 m. Upper currents responded to the passage of the eddy, and an intensification of northwestward (> 51 cm/s) and southwestward (> 78 cm/s) upper currents occurred when EC1 was placed near the western and eastern periphery of the eddy feature. Eddy kinetic energy (EKE) in the upper 200 m during the second half is about three to forty times higher than the EKE during the first half, and the ratio of EKE to mean kinetic energy during the second half is also higher than that during the first half. When EC1 was close to the center of the eddy, a thermostat developed and upper currents became weak.

31 October, 14:20 (POC_P-5200)

Selection of climate models for regional ecosystem projections

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To understand and forecast responses of North Pacific marine ecosystems to shifts in climate, a main goal of FUTURE, it is essential to have quality projections of climate on a range of time scales, including decadal outlooks for potential changes forced by anthropogenic impacts relative to natural variability. Results from 23 comprehensive climate models, which form the basis of the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report (AR4), are the major objective tool for climate projections. Our task is to develop

guidelines for the use of these climate models for regional ecosystem studies. There is considerable variability in each models' ability to simulate climate patterns on regional scales, arising from model structure, physical parameterizations, location, and variable of interest. Our major conclusions are that it is important to eliminate outlier models in future projections by using observational constraints and that it is important to rely on a consensus of several models (of order five rather than one), which greatly reduces the RMS errors from individual models. We recommend a two-step selection procedure for the North Pacific. First, models are required to reproduce the large scale climate pattern, the Pacific Decadal Oscillation (PDO). The second criterion depends on the specific region and ecosystem variable of interest. We provide examples from the Bering Sea for a suite of variables. CFAME and Working Group 20 have made progress on coupling climate model results to regional ecosystems.

31 October, 14:40 (POC_P-5317)

SSH variability in the northern Japan/East Sea from altimetry data

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The one of the most important and regular databases for the study of Japan/East Sea variability in recent times is the long time series of sea surface height (SSH) obtained from satellite altimetry. We have examined spatial and temporal variations of SSH in the Japan/East Sea using Complex Empirical Orthogonal Functions (CEOF) analysis. The northern part of the Japan/East Sea has its own variability which is not clear when the entire sea is considered. Hence we considered variability of entire sea and its northern part separately, and compared results. The 1/3° gridded weekly SSH from combined TOPEX/POSEIDON, Jason and ERS-1/2 satellite observations from October 1993 to July 2006 are decomposed to CEOF. Characteristic time-scales are determined from wavelet analysis. The first mode (CEOF1) for the entire sea can be considered as a seasonal signal, CEOF2 reveals variability of the Tsushima, East-Korean and Liman Currents, and CEOF3 manifests interannual variability in the Yamato basin. As for the northern Japan/East Sea, CEOF1 is similar to that for the entire Japan/East Sea (*e.g.*, seasonal signal) and CEOF2 demonstrates the seesaw between the northwestern and northernmost parts of the sea. CEOF3 reveals the seesaw between the Liman Current and the branches of the Tsushima Current in the northern Japan/East Sea.

31 October, 15:00 (POC_P-5292)

Analysis of the Kuroshio inflow at the East Taiwan Channel

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The East Taiwan Channel (ETC) is the gate to the East China Sea (ECS) where an inflow of warm and saline Kuroshio water brings nutrient supply to the broad continental shelf region. To study what physical process affects the temporal variation of this inflow, we analyze current meter measurements from the WOCE PCM-1 array, as well as concurrent surface drifter and altimeter data from 1994-1996. The Kuroshio axis is determined from the data and its relation to the propagating eddies east of Taiwan is analyzed. The results show that the Kuroshio axis over the Su-Ao Ridge moves offshore by about 15 km during summer, in accordance with the observation that the nearby Ilan Bay is flushed with shelf water in summer and Kuroshio water in winter. Cyclonic and anticyclonic eddies east of Taiwan appear to have a different influence on the ETC inflow and may even affect the intrusion path of surface drifter on the ECS shelf. Furthermore, the phase relation of each current meter mooring is calculated to examine the baroclinic stability of the ETC inflow.

31 October, 15:20 (POC_P-5190)

Decadal changes in temperature and salinity in Korean waters

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The Korean peninsula is surrounded by the Yellow Sea, East China Sea, and East/Japan Sea. We analyzed changes in temperature and salinity using serial station data of NFRDI (National Fisheries Research and Development Institute) from 1962 to 2007. We divided the Korean waters into eight areas, two of which are in the East/Japan Sea, three in the Yellow Sea, and three in the East China Sea, namely E1, E2, W1, W2, W3, S1, S2, and S3, respectively. We calculated the RSI (regime shift index) at the eight areas, and analyzed the patterns of the changes among the areas. All the eight areas showed decadal patterns of changes in 1976-77, 1988-89 and 1998-99, which are widely known as climatic regime shifts. The changes in the index for 1988-89 and 1998-99 were stronger than those for 1976-77. The changing pattern for 1976-77 was only shown in the East/Japan Sea at E1 and E2 stations, and the RSI was weak in 1976-77 at S3 which is connected with E2. Although changes in RSI were also commonly detected in 2006-07 in all of the Korean waters, the magnitude was not statistically significant.

31 October, 16:00 (POC_P-5134)

Seasonal changes of the East Sakhalin Current from CTD data analysis

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An examination of oceanological conditions along the northeastern Sakhalin shelf is interesting from the scientific point of view because of the great influence of Amour River runoff, and has significant applied importance because of oil and natural gas industry development. A number of CTD surveys were carried out in this area. However, seasonal changes in temperature and salinity fields have been studied insufficiently and this is the reason for our lack of understanding of seasonal changes in the East Sakhalin Current (ESC). To investigate these problems, we analyzed CTD data which were collected on the 6 standard (repeated) oceanological sections that cross the Sakhalin shelf and slope. Multiyear mean temperature and salinity distributions were constructed for different months from June to November. In summer time we found significant salinity differences between the northern and southern part of northeastern Sakhalin shelf, which reaches several psu. Low salinity water caused by Amour River runoff (24-28 psu) was found from Elizabeth Cape to Chaivo Bay, but its influence south of 52ºN was small. Well-expressed cold intermediate water (with the core near the shelf edge) was revealed. Significant changes were found to occur in the fall season. Low salinity water was located near the Sakhalin coast from Elizabeth Cape to Terpenia Cape, which corresponds to autumn ESC amplification. This amplification is a result of low salinity water transport to the southwestern part of the Okhotsk Sea and cold intermediate layer destruction.

31 October, 16:20 (POC_P-5444)

Coupled estuarine-coastal circulation in the Pearl River Estuary: Response to the wind and tidal forcing

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A three-dimensional, primitive equation numerical model is utilized to study the responses of the river plume and estuarine circulation in the Pearl River Estuary (PRE) to wind and tidal forcing as well as adjacent coastal circulation. This process-oriented study shows that without any other physical forcing, the buoyant-driven circulation moves westward after exiting the estuary and forms an anticyclonic fresh bulge. With the forcing of

tides, the anticyclonic bulge disappears and the seaward movement of the buoyant plume is retarded. The thickness of the plume is increased by the tidal forcing as a result of the enhancement of the vertical mixing inside the estuary and around the mouth of the estuary on the shelf. On the other hand, with wind forcing, the plume moves faster along the seaward branch of the estuarine circulation in the upper estuary and spreads over the shelf by the coastal circulation. The wind-induced circulation increases the intrusion of the oceanic saltier water into the estuary, especially in the upwelling case. Consequently enhanced stratification along the axis of the estuary reduces the vertical mixing and the thickness of the plume. This study reveals the interactive roles of the buoyant plume, and tidal and wind forcing on the circulation in the estuary and adjacent shelf waters.

31 October, 16:40 (POC_P-5341)

Nutrient distribution around the Bussol' Strait

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Intensive observations of nutrient (nitrate, phosphate, silicate) concentrations, temperature, salinity, currents and vertical diffusivity were performed in the summer of 2007 around the Bussol' Strait in the Kuril Islands. Silicate concentrations in Bussol' Strait in the density layer around $27.2\sigma_\theta$ were found to be greater than those in the Okhotsk Sea and the North Pacific at the same density. This feature cannot be explained by isopycnal mixing. Intense vertical mixing around $27.2\sigma_\theta$ with large vertical diffusivity over $1000 cm^2 s^{-1}$ observed in the Bussol' Strait could account for the nutrient distributions.

31 October, 17:00 (POC_P-5132)

Impact of dam water release based on a numerical model of the Kangjin Bay, South Sea, Korea

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Kangjin Bay (KB), surrounded by islands of Namhaedo and Changseondo, is exposed to the inflow of dam water release from the Namgang Dam. Previous research (literature references) was devoted to the tidal and sub-tidal current characteristics using field investigations as well as numerical modeling of the KB. This study investigates the impact of artificial dam water release on the circulation characteristics, as well as the overall ecosystem, in the KB by using a 3-D numerical model. Model results were calibrated to the observed tide, tidal current, temperature and salinity distribution and the model performance was verified in detail. Results showed that surface salinity dropped by 15 (psu) after 1st peak discharge and 10 (psu) after 2nd peak discharge. Flushing times in the KB were estimated to be 4.2 and 5.7 days at the 1st and 2nd peak discharges, respectively. Release of the dam water significantly changed the circulation structure by forming a 2-layer system separated by a sharp pycnocline in which the bottom layer experienced hypoxic conditions which, in turn, would devastate the local aquaculture fishery in KB.

31 October, 17:20 (POC_P-5289)

A numerical study of the sediment transport process from the Yellow River to the Bohai Sea and Yellow Sea

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Based on Ecomsed, a three-dimensional baroclinic and wave-tide-circulation coupled numerical model was established with 1/18 degree resolution covering the area of 24°~41°N and 117°~130.6°E, which considered wave-induced mixing and wave-enhanced bottom friction. To reproduce the seasonal variation of circulation in the Bohai, Yellow and East China seas, a sediment transport Module simulated the transport, diffusion, deposition and resuspending processes of the Yellow River-derived sediment. Some results are expressed below.

The sediment concentration is vertically homogeneous in winter, while a high concentration appears at the upper level in spring and summer. The Yellow River-derived suspended sediment is transported first eastward along the northern coast of Shandong Peninsula, and then southward into the South Yellow Sea. This diffusion direction remains the same all the year round. For the seasonal timescale, the maximum sediment concentration in the South Yellow Sea is simulated in winter. In the South Yellow Sea, the Yellow River-derived sediment is transported the farthest in spring. The maximum concentration in the Bohai Sea appears in summer. The maximum concentration in the North Yellow Sea occurs in autumn. The Yellow River-derived fine sediment deposits in three main areas: north of the Laizhou Gulf, west of the North Yellow Sea, and north of the South Yellow Sea.

31 October, 17:40 (POC_P-5449)

Interannual variations of the water transport through the Tsushima Strait and its impact on the chemical parameters and chlorophyll-*a* in the Japan/East Sea

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Interannual variations of sea level at coastal stations in the Japan/East Sea and water transport through the Tsushima/Korea Strait were analyzed. It is shown that interannual changes in the transport rates through the Tsushima/Korea Strait are determined by the Kuroshio (East China Sea) and Oyashio (western subarctic Pacific) transports and the zonal wind stress over Japan/East Sea in winter. Variations of the East China Sea subsurface water transport through the Tsushima/Korea Strait are responsible for the observed dissolved oxygen interannual changes in the intermediate and deep waters of the Japan/East Sea. The human impact on the Yangtze River waters leads to the increased dissolved inorganic nitrogen/dissolved inorganic phosphate (DIN/DIP) ratio in the upper (0-300 m) layer of the Japan/East Sea. There is a relationship between the water transport rate through the Tsushima/Korea Strait and the chlorophyll-*a* concentration in the surface waters of the Japan/East Sea in fall.

POC Contributed Paper Session Posters

Poster POC_P-5018

Cyclic thermohaline changes in the topographical eddy system above Erimo Seamount

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The mezoscale dynamic structure of the Subarctic front east of Japan is known for well expressed vortical activity, and remittent jet and chaotic formations of various scales (Kitano, 1975; Lobanov, *et al.*, 1991; Vasiljev, Makashin, 1993; Ohshima et al., 2005). We shall consider only one "square" of this cellular structure. To the east of Hokkaido, at coordinates 40–43°N. and 145–148°E, 4 seamounts are located: Erimo, Takujo and 2 unnamed. In this area commonly occurring vortical eddy systems have been tracked and observed by many oceanographers by means of satellite and oceanographic measurements. Due to the blocking by the underwater mountains, eddies can remain stationary and can also have longer periods of existence. Thus the centre of the eddies change in structure, depending on prevailing advection of subarctic waters (winter) or subtropical waters (spring and summer). The centres can be cold or warm, keeping traces of previous thermal processes (Darnitsky, Bulatov, 2005). During last part of the XX century, a migration of sardine-iwashi in the specified square was observed in addition to the interannual quasi-cyclic processes grazing plankton. Similar behaviour of saury and squids were observed in the area of this "square" (Samko, etc., 2006). As the vertical structure of the water column in the Subarctic frontal zone has many degrees of freedom because of stratification, we carried out research of interannual dynamics of the thermohaline parameters from zero up to 600 m depth. In this layer the great bulk of data in Levitus database (2005) is concentrated. The period of observations are taken from 1960 - 2000 in winter (February - March), spring (April - March), summer (June - July) and autumn (August - September and November - December) seasons. The purpose of this work is to establish the periods of strengthening or lessening of water interaction of various structures in a vertical field above Erimo Seamount by using calculations of the maximal temperatures and salinities at various depths.

The analysis of 40 years' worth of data for the winter period shows that the top 300 m layer had a quasi-cyclic variability averaging 3.3 - 4 years with a maximum on the 200 m horizon. The greatest range in temperature fluctuations was 8 - 10° C. In intermediate waters (400 – 600 m) periodicity of fluctuations increased up to 4.4 years (for 400 m) and 13.3 years at depths of 600 m. The maximal amplitudes thus did not exceed 8º on 400 m and 5º on 600 m. During the spring period in the top 300 m layer corresponding cycles have changed from 3.1 year (300 m) up to 3.6 years in a surface layer. The maximal temperature peaks of 10 - 14° C were observed in surface waters and 6º at a depth of 300 m. Average cyclicity increased with depth up to 4 years (400 m) and 5.7 years at 600 m depth. The greatest amplitudes of temperature had also greater periodicity - up to 7 - 8 years in the top layers and up to 13 - 15 years on deep layers. Coordination of seasonal cycles was observed only at separate time intervals.

Poster POC_P-5026

Atmospheric activity types over the Northern Pacific

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A classification of atmospheric circulation is carried out on the basis of a 50-year period of observations and, compared with other classifications, the character of cyclone trajectories and the location of anticyclones is considered. Six types are distinguished. All six types of atmospheric processes are characterized by a distinctly expressed seasonal motion: they are the most intensive in winter, somewhat weaker in autumn, even weaker in spring, and have minimum intensity in summer. Without considering the seasons, the intensity of the different types of baric situations differs significantly. Especially intensive are the North-Western, Okhotsk-

Aleutian, Latitudinal-Aleutian, and Cyclones over the Ocean types of circulation: the North-Western type occurs most often in summer and rarely in winter, and the Cyclones over the Ocean are most often in autumn and winter, and rarely in summer. There is a large interannual variability in the total duration of these two types of activity. The North-Western type of the atmospheric circulation was active for 213 days in 1982, and for only 10 days in 1950 while the Cyclones over the Ocean type was observed for 201 days in 1958, and not at all in 1971-1972. The total duration of all activity types for one year, three years, and five years is characterized by cyclic recurrences of 3-5, 6-7, 11-12-year periods.

Poster POC_P-5027

Especially dangerous wave heights in the Northern Pacific

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Big waves are often the cause of vessel and cargo loss in the Northern Pacific. The especially dangerous wave heights (8 m and more) always pose a threat to the success of the fishery trade in the Northern Pacific. For successful fishing it is necessary to know the distribution and time of the appearance of especially dangerous wave in the Northern Pacific. Dangerous wave heights are very seldom (less 1%) observed during the warm months in the North Pacific but are observed during the cold season, especially from November to February, with a maximum occurence (10-12%) in January and February. Two zones in the maximum frequency of especially dangerous wave height occur in the West and East of the Northern Pacific. These two zones are influenced by two convergence regions of cyclone trajectories in the Northern Pacific. Having an understanding of the characteristic distributions and frequency of the especially dangerous wave heights will allows us to provide security of fishery ships in the Northern Pacific.

Poster POC_P-5028

Extreme distribution of floating ice in the NW Pacific

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From January to April floating ice tongues move from the Sea of Okhotsk to the NW Pacific through the Kuril Straits. At the same time, along the eastern coast of Kamchatka Peninsula, a solid sheet of floating ice moves south. In January and February, during extremely cold years, individual floating ice tongues move from the Bering Sea along Kamchatka Peninsula to the Fourth Kuril Strait which has a width of 30-50 miles. In March, the width of the ice block along the eastern coast of Kamchatka Peninsula may increase up to 100 miles and propagate towards Onekotan Island. In April during cold years, floating ice of Bering Sea origin reaches the largest propagation along Kamchatka Peninsula, stretching to the south and southeast from the coast for 200 miles. In the area of the Northern Kuril Straits, except for the First Kuril Strait, there were no sightings of floating ice by aircraft. Along the Malaya Kuril Ridge the ice lessens, as compared to March. The floating ice blocks can still come out through any strait of the Kuril Ridge to the ocean (from Kruzenshtern Strait and farther to the south), but they no longer possess such length, and the ice tongue width does not exceed 30 miles. In April, along Hokkaido Island floating ice was not fixed for the whole period of observations.

Poster POC_P-5029

Destructive tsunamis near the coast of Primorye

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Destructive tsunami waves regularly occur in the Primorye region. The maximum number of tsunami runups occurred during the event of May 26, 1983. During this event, the maximum horizontal inundation was up to 800 m and the maximum runup heights were 6,5-7,0 m. The tsunami travel time from the earthquake epicentre to the Primorye coast in 1983 was estimated to be 30–60 min while, for the 1993 it was estimated to range from 50 min to 1 h 40 min.

Poster POC_P-5032

Change in seasonal cycles of ice formation in the Far East Seas of Russia in the second half of the 20th and beginning of the 21st centuries

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Data analyses of various types of ice conditions in the Far-Eastern Seas (Japan/East Sea, Okhotsk Sea and Bering Sea) are performed using the archives of ice information for the period 1960 until the present time. The condition and evolution of ice cover in the Far-Eastern seas of Russia are considered. It is shown that ice conditions of the Far East sea basins are closely interrelated. An analysis of 10-day multi-year trend components of ice extent shows a change in seasonal cycles of ice formation in Russian seas, and is especially noticable for the Japan/East Sea. We conclude that there is a probable reorganization of interrelations in climatic system of the northwestern part of Pacific Ocean.

Poster POC_P-5033

The Kuril-Kamchatka and Oyashio Currents system water structure and circulation variability

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We examine the long-term variability of thermohaline structure and dynamic water characteristics of the Kuril-Kamchatka and Oyashio current zones using the resources of the POI FEB RAS data bank, including archived materials of national research cruises, the data of modern observations carried out by the Pacific Oceanological Institute FEB RAS in second half of XX century, and the global array of the averaged long-term hydrological data of the semi-centennial period covering the whole area of the NW Pacific. The water structure formation in the currents zone, as related to Friez, Bussol and Kamchatka Straits water exchange variability and atmospheric circulation, was revealed. The role of these Straits in forming the water characteristics of each of the currents was analyzed. It was shown that the Kamchatka Strait is the supplier of cold transformed Bering Sea waters. The Bussol Strait is the main supplier of the transformed Okhotsk Sea waters in Oyashio Current zone. The sub-strait zone of the Friz Strait is replenished by both the warmest and the saltiest Soya Current waters, and the coldest and least-salty Okhotsk Sea waters. As a result of the water inflow variability to the ocean through the straits, there is a variable picture of the water circulation in the sub-strait areas, and correspondingly, in the thermohaline and dynamic characteristics of the particular zones of the currents. Such variability has both a seasonal and interannual character. New information about variable hydrological water characteristics was obtained. Oceanological zoning of the Kuril-Kamchatka and Oyashio Currents area was made and differences in water charateristics for the two zones are discussed.

Poster POC_P-5034

Oyashio and Kuroshio Currents water characteristic variability in the area of their interaction and formation zones

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Using the resources of the POI FEB RAS data bank, including archived materials from national research cruises, data from modern observations carried out by the Pacific Oceanological Institute FEB RAS in the Kuril Island area, Japan research cruises observations in the Kurosio Current zone, as well as the global array of averaged long-term hydrological data of the semi-centennial period covering the the NW Pacific, the thermohaline structure and dynamic water long-term variability of the Oyashio and Kuroshio Currents were investigated. The formation of the water structure in the Oyashio Current zone, as related to Kuril Straits water exchange variability, was revealed. Differences in various water characteristics in the Oyashio Current zone were shown. The Oyashio and Kuroshio water temperature anomalies in the formation zones, as related to the atmospheric circulation, was analyzed. New information about variable hydrological water characteristics was obtained showing the interaction of seasonal and interannual variblility of the Oyasio and Kurishio formed water. The obtained results can be used for developing the forecasts of hydrological conditions in West Pacific.

Poster POC_P-5053

Hydrographic and hydrochemical conditions near the Amur River mouth

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The Amur River is one of the largest rivers in the East Asia. The Amur River flows into the Amurskiy Liman which connects the Japan/East and Sea of Okhotsk. The Amur River is a major source of fresh water, sediments, nutrients and pollutants for the Sea of Okhotsk. The purpose of this study is to characterize the hydrographic and hydrochemical structure near the Amur River mouth. The data of *in situ* observations were obtained during two research cruises in the Sea of Okhotsk (July of 2003 and June of 2005). Inside of the Liman there is a distinct front which separates the lower salinity and stratified waters near the Amur River mouth from more saline, mixed waters which flow from the Japan/East. From the Sea of Okhotsk the wedge of the salinity and cold waters intrude into the Liman. The freshwater movement in the upper layer against the stronger tidal current produces a strong current shear in the interface causing the entrainment of salinity water to the upper layer. The distribution of nutrients is strongly linked to the front and water mass structure. Low nutrient concentrations are observed within the vertically mixed waters originating from the Japan/East. It is seen that the vertical distribution of silicate differs from that of phosphate and nitrate. The high values of silicate are related to the Amur River discharge. Highest nitrate and phosphate concentrations are found in the salt wedge of the Sea of Okhotsk water.

Poster POC_P-5062

Mechanisms determining the formation of extremely low-ice winters in the Okhotsk Sea

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Years of extremely low-ice conditions in Okhotsk Sea (1991, 1996, 1997, 2006) were determined by remote sensing. Ice cover in February and March was more than 20% less than the annual mean average in these years. The reason for studying such infrequent anomalous processes, accounting for 8% from 1957-2006, is presented for scientific and practical interest.

Large-scale processes above the second naturally synoptical region of the Northern Hemisphere (30°-70°N., 80°-160°E) were studied. It is shown that in 1991, 1996, 1997 and 2006, a cold centre in the troposphere over the Okhotsk Sea had large positive anomalies of 500 hPa geopotential (centres of the heat). Such a situation formed as a result of frequent intrusions of a Pacific tropospheric ridge on most areas of the sea. The anomalous circulation in the troposphere of the second naturally synoptical region prompted a change in the trajectory of surface cyclones forming a cyclogenesis over the Okhotsk Sea. The trailing part of the cyclones, displaced over the Okhotsk Sea, caused the transportation of warm air and increased warm ocean water advection through the Kuril straits. Air temperature in the central part of the Okhotsk Sea was observed to be above 8°C for the indicated years.

Poster POC_P-5063

Sea surface temperature aggregation from different sources to study multiple scale variability in the Japan/East Sea

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Interconnected relational databases of oceanographic and meteorological information, including sea surface temperature (SST) from different sources, are developed. Aggregation technology is applied to SSTs in the Japan/East Sea (JES) to transform and combine time series with different time-space resolutions. Japan Meteorological Agency (JMA) daily SSTs (1996-2006) with 0.25° horizontal resolutions and HADLEY monthly SSTs (1870-2006) with 1°x1° grids are used. The correlation analysis is applied to estimate the statistical relationship between SSTA and the climatic index (Arctic Oscillation (AO), Siberian High pressure (SH)). A cluster analysis is used to classify SSTA and its spectrum in different regions of JES. Linear trends of seasonal mean SSTA and their spatial distributions are estimated for data sets and historical periods.

Poster POC_P-5074

Bibliometric analysis of oceanographic research: A case of Kuroshio literature, a half-century bibliographic survey

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In the last century Kuroshio current studies produced a huge stream of the scientific publications. In this report we document the growth of the Kuroshio bibliography in the last 50 years using the ISI-Thomson Web of Science (WoS) database. We analyzed more than 1300 records retrieved from WoS using the keyword 'Kuroshio'. The majority of records (60%) are oceanographic publications, with meteorology/atmospheric sciences, marine biology, and fisheries accounting for 10% each. The growth of the total number of publications obeys the exponential law, with a doubling period of 5.3 years (18.7% per year). It means that half of the Kuroshio papers have been published in the last 5-6 years and currently more than a hundred publications are issued annually. The main player in Kuroshio scientific field is certainly Japan followed by the U.S.A. (34%), Taiwan (13%) and China (11%). Japanese studies account for almost 50% of the records, but only a quarter of them is made in collaboration with scientists from other countries. On the other hand, according to the analysis, 60% of the works from South Korea, 50% of the works from China and 40% of the works from Taiwan are made in collaboration. The trends in dynamics and impact of scientific output, as well as temporal changes in scientific cooperation, are discussed.

Poster POC_P-5076

Climatic characteristics of water masses, fronts, and currents in the Japan/East Sea

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A dataset of average 0.5°-gridded temperature and salinity values was obtained for the Japan/East Sea from the long-term deep-water hydrological measurements for the years 1925-1997 and processed by special techniques. This dataset was used for the study of water masses, fronts and currents.

The following water masses were detected. Surface subarctic and subtropical waters occur above the seasonal pycnocline. The subsurface water masses are the intermediate subarctic water (above 300 m), the intermediate high salinity water, the intermediate low salinity water (above the pycnocline base), the deep water mass below 2000 m, and the bottom water down to the bottom. The range of hydrological characteristics decreases with the depth, with a minimum at the sea floor.

Lateral boundaries of the water masses are represented by the fronts detected from the original observations for the typical months of every season. Locations of the fronts are detected from the highest gradients of temperature and salinity. Branching of the Subarctic (Subpolar) Front is detected in the northwestern Japan/East Sea in autumn–winter. At the same time, infrared satellite images reveal more complex frontal structures.

Geostrophic currents are estimated from the long-term density field calculated from the temperature and salinity dataset at various depths throughout the year.

Poster POC_P-5077

North Pacific oceanography: Past, present and the future. A half-century bibliometric survey

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A bibliometric analysis of scientific literature on research in the North Pacific Region is performed. The ISI-Thomson Web of Science (WoS) database was used as the main source of bibliographic records published in 1945-2007. We analyzed more than 8400 records retrieved from WoS using the keywords 'North Pacific'. A quarter of them are the oceanographic publications; meteorology/atmospheric sciences, ecology/environmental sciences, and marine biology account for 20%, 10% and 9%, respectively. The main player in the North Pacific scientific field is the U.S.A. (45% of all publications) followed by Japan (18%), Canada (5%) and China (5%) out of 80 counties doing scientific research in North Pacific. Publication trends of two Asian Tigers (Taiwan and South Korea) display the highest rates (42% and 32% per year, respectively) of growth of total number of papers. If these trends continue for the next fifteen years, then only five main players will be in the region, with 15-18% share of all publications. They are: the U.S.A., Japan, China, Taiwan and South Korea. The analysis shows that the U.S.A. and Japan account for only a quarter of North Pacific studies made in collaboration with other countries, whereas Canada, China, Taiwan, South Korea and Russian account for half. The trends in dynamics of scientific output, as well as temporal changes in scientific cooperation, are discussed from a viewpoint of the FUTURE program.

Poster POC_P-5095

Calculation of entropy flux through the World Ocean surface

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The entropy flux through the ocean-atmosphere surface characterizes a deviation level of the real climatic stationary condition from a possible equilibrium condition. This flux allows estimating the production of available potential energy and the dissipation of the ocean mechanical energy. (This case does not contain the source from the tidal energy). These estimations are based on the conservation of energy.

The energy and entropy fluxes for an approach to the climatic stationary ocean condition are considered. The calculations are executed for zonal strips 5 degree width to the direction north–south. The entropy flux is separated into two parts. One part (a thermal flux) is produced from non-homogeneous heating/cooling on the ocean surface. The second part (a mass flux) is a result of non-homogeneous precipitation/evaporation. The sea water is represented as a two-component mixing structure - pure water plus salt. A simple formula to account for the chemical potential of the sea water is obtained.

It is shown that the energy flux owing to non-homogeneous precipitation/evaporation makes 5 % of the energy acting owing to non-homogeneous heating/cooling on a surface of ocean. Scenarios of available potential energy change and redistribution of the kinetic energy owing to climatic trend are discussed.

Poster POC_P-5103

Features of atmospheric circulation and climate in the Far East in the beginning of the 21st century

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Variability of parameters (latitude and longitude of the centers, pressure in the centers, mean pressure at sea surface and mean height of 500 hPa) is investigated for the main atmospheric systems such as the Hawaiian High, Asian Low, Far Eastern Low, and the middle troposphere trough over eastern Asia. The influence of the variability of these parameters on the climate (precipitation, air temperature) of the Far East of Russia is estimated.

The data used to determine the centers for the Asian Low, Far Eastern Low and Hawaiian High were taken from NCER/NCAR archives of average monthly fields. Reanalysis of the pressure at the sea surface and mean height of the 500 hPa surface were provided over a regular grid of 2.5 by 2.5 degrees during 1948-2005. To estimate the location of the system centers, territorial boundaries were given, namely, for the Asian Low 13-35°N, 60-100°E; for the Far Eastern Low 40-55°N, 115-135°E; for the Hawaiian High were 30-45°N, 185-235°E.

Atmospheric pressure for the Asian Low and Far Eastern Low has increased since the 1970s and continues to increase into the beginning of 21st Century. Moreover, the center of the Far Eastern Low is moving eastward. As a result, the summer monsoon is weakening and dry and warm continental air is expanding over the coast of eastern Asia, with precipitation decreasing in the Primorye region and the Amur valley.

The Hawaiian High is strengthening and its movement toward Kamchatka is becoming stronger. This results in a northward shift of the tropospheric frontal zone and more intense cyclonic activity in the Okhotsk Sea in autumn with warm air masses intruding into the Okhotsk and Japan/East Seas and air temperature increasing. On the other hand, warm currents of the Kuroshio system are strengthening. The regime of the middle troposphere has been changing since 1990s with an increase of 500 hPa at the surface the Okhotsk Sea.

Poster POC_P-5122

Temporal variability of heat exchange between the ocean and atmosphere in the North Pacific

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The laws of temporal variability of in the heat exchange between the ocean and atmosphere are investigated in four regions of the North Pacific. The calculations of the statistical characteristics of the monthly net sea surface heat fluxes and their anomalies (relative to the mean magnitudes from 1948 to 2002) reveal the different characteristics of the heat exchange between ocean and atmosphere in the periods of 1948-1975 and 1976-2002. Our studies revealed the existence some cyclic components in the time variability of sea surface heat fluxes, the annual heat balance amplitude and intensity of total heat loss and total heat gain. The periods of these components are estimated by spectral analysis. The quasi-biennial and quasi-triennial periods are general for time variability characteristics of the heat exchange between ocean and atmosphere. The contributions of cyclic components in the time variability vary from month to month during a year. Thus, the time variability of the heat exchange characteristics is determined by the superposition of a few cyclic components and it is assumed that the climate shift of the middle 1970s of the XX century is a manifestation of long time (lasting for about 50 years) variability.

Poster POC_P-5124

Tidal energy of waves in the South China Sea

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This paper presents the calculation results of kinetic, potential and total energy for semi-diurnal and diurnal tidal waves. Detailed calculation results are presented for the East Vietnam Sea, the Bac Bo Gulf and the Gulf of Thailand. In these areas, tidal oscillations are characterized by the domination of mechanical energy of diurnal waves over semi-diurnal waves. This anomalous phenomenon distinguishes the East Vietnam Sea from the other oceans of the world. The tidal energy in the Gulf of Thailand is higher than in the Bac Bo Gulf. For the whole sea area, the zones with a high density of energy were defined. From the results, it is also noted that for the East Vietnam Sea, the kinetic energy of semi-diurnal waves is higher than the potential energy, while for the diurnal waves, the potential energy is higher than the kinetic energy.

Poster POC_P-5126

Structure and dynamics of eddies in the southern Okhotsk Sea

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Long-term observations in the Far-Eastern Seas of Russia have shown that eddies have a significant influence on the migration and distribution of commercial fish species. That is why the monitoring of eddy movement and development is necessary to promote successful fisheries.

Numerous eddies, cold intrusions and expanding dipoles have been observed in the southern Okhotsk Sea by means of satellite infrared images. They are mostly anticyclonically oriented and have a spatial size of 60-80 miles. The structure and movement of these eddies are considered for the area south of 52^{o}N from the results of IR images and altimetry data analysis and are compared with shipborne data obtained in 2007.

A number of eddies were observed all the year round or for several months, but others existed for no more than 1 month. A chain of stable eddies that included 6-9 eddies formed 80-120 miles from Kuril Islands. They had helical structure with a cold center and were connected with Oyashio or coastal upwelling zones by cold streamers. These eddies were able to be revealed in the fields of geostrophic currents using both shipborne and altimetry data. The vertical distribution of temperature and salinity within the anticyclonic eddies was distinguished by deeper bedding and lower salinity in the cold subsurface layer, whereas within the cyclonic eddies this layer was entrained upwards. On the other hand, the short-living eddies were poorly revealed using shipborne data. They were formed mainly between oppositely-directed currents due to a shift in velocity. Large-scale circulation of the Okhotsk Sea waters is the main reason for the eddy movements. Most of them had cyclonically-curved tracks.

Cold-water intrusions were formed at Kuril Islands in the zones of northwestward currents between coupled eddies with opposite rotation. They had cold cores well visible on oceanographic sections. In the same way, warm expanding intrusions were formed in the zone of the northeastward current in the northern part of the investigated area.

Poster POC_P-5180

Free oscillations of the Japan/East Sea in Posyet Bay

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Measurements of Japan/East Sea level at the coast of Posyet Bay have been executed by means of an original design level indicator in autumn 2001, 2003. On the basis of these measurements we study the characteristic of the level variation in the Posyet Bay in different frequency bands. Communication of fluctuations with change of atmospheric pressure is tracked. The spectral-correlation analysis of atmospheric pressure fluctuations above the water area of a gulf is executed. The analysis has shown that the variations of sea level are connected with change of pressure by the inverse-barometer law. The period's seiches of the gulf and bays adjoining to them are calculated. The spectrum of variations in level has expressive peaks at the periods: 46-52 minutes, 27-33 minutes, and 75-85 minutes. Numerical modelling of the gulf seiches nearby bays by means of the V.S. Khramushin program is executed. As a result of modeling, the frequencies of the gulf seiches have been certain. Comparison of the natural and calculated frequencies of fluctuations has shown a satisfactory result.

Poster POC_P-5214

Monitoring and assessing atmospheric deposition of pollutants to the Bohai Sea

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Atmospheric deposition of some inorganic and organic contaminants, such as nutrients, trace metals and polycyclic aromatic hydrocarbons, represents an important, frequent source of contaminants to coastal ecosystems. Thus, it is essential to assess the magnitude of atmospheric deposition of these contaminants and evaluate the contribution of atmospheric deposition to total loadings in a coastal area. China's Bohai Sea rim region is one that has witnessed rapid development, and the Bohai Sea is listed as one of the most polluted areas in China. Therefore, in May 2007 a preliminary study of atmospheric deposition to the Bohai Sea was started at a new monitoring station located on the west coast of the Liaodong Peninsula. The results show that atmospheric deposition is an important route by which atmospheric pollutants, especially biogenic elements, such as nitrogen, are delivered to the Bohai Sea. Current problems and future work plans, which include establishing a regional sampling network and developing monitoring and assessment framework, are summarized in this paper as well.

Poster POC_P-5216

Harmonic analysis of and predictive methods for some marine hydrometeorological elements

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This paper makes an analysis of the periodic variation law of some marine hydrometeorological elements such as air temperature, air pressure, relative humidity, sea surface temperature and salinity, lists the basic equations of analysis as well as the calculation of the initial phase and speed of the periodic changes of the elements, gives the amplitude and lag of the periodic changes of these elements observed by several ocean stations, and analyzes the residual standard error and correlation coefficients as well as the predicted results for the constants analyzed. The results show that the prediction made of the sea temperature and salinity changes by using these constants is accurate. The basic variation trend of a day's air temperature and pressure may be predicted by utilizing the periodic variations of air temperature and pressure. The variation of relative humidity is mainly affected by the variations of meteorological conditions, with less periodic changes.

Poster POC_P-5244

Cluster analyses of temperature and salinity in the Japan/East Sea pycnocline

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When huge amounts of oceanographic data are stored in different databases, it becomes difficult to process. After the data is sorted, a cluster analysis of T-S characteristics are carried out using an oceanographic database for 1920-2006 which includes about 185,000 salinity and temperature profiles for the Japan/East Sea. Results show a non-uniformity in interannual variability of water mass indices at the northern and southern ends of the Japan/East Sea. Eight types of water masses are distributed naturally in time and space. As rule, the southern part of the sea is distinguished by the presence of more than two water masses which are distinctly picked out using T-S structures of stable monsoon periods. Cluster analysis seems to be the initial stage of standard T-S analysis.

Poster POC_P-5287

Features of Far-Eastern monsoons in summer from temperature observations

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Here, we consider how specific climatic conditions can influence activities such as housing construction during the monsoon season. The summer Far-Eastern monsoon undergoes two stages which are defined by temperature contrasts on a mesoscale and macroscale level. We have tried to determine the beginning of the second stage of the summer monsoon according to an interdaily differential temperature of air. The average daily air temperatures from April until August from 1917 to 2004 years in Vladivostok are analyzed. A weak negative trend is characteristic for temperatures in July. The temperature rises insignificantly in April, May, June and August. An opposite trend of integral temperature curve anomalies is apparent in spring and summer. The similarity in the dynamics of interdaily accumulated thermal variations in the Vladivostok area has allowed us to choose six characteristic groups. These groups span a range from 8–14 years. The beginning of the second stage is observed during later times (from July 15–20) in some groups. In other groups the beginning falls at earlier times (June 30–July 2). The average date of the approach of the second stage of the monsoon falls on July 8–10. The duration with an earlier approach of the second stage averages from 6 to 9 years, and with a later approach -

from 10 to 12 years. There is the tendency for the beginning of the second stage to be shortened, *i.e.*, recently the second stage of the monsoon begins earlier.

Poster POC_P-5308

Surface heat fluxes in the Tonkin Gulf

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Climatological monthly mean variations of the surface heat flux for the Tonkin Gulf (Bacbo) have been calculated by bulk method using observational data from 1956 to 2008. The long-term annual mean net heat flux, averaged over the Tonkin Gulf, is 55 W/m^2 (positive sign means the sea gains heat from the air), and the seasonal variation ranges from a maximum of 146 W/m^2 in April to a minimum of -32 W/m^2 in December. The seasonal geographic distribution of the net heat flux is determined mostly by turbulent latent heat flux. In winter a negative sign means the air gains heat from the sea.

Poster POC_P-5314

The 1000 km-scale variability of the dynamic height revealed by Argo CTD data at 40ºN in the North Pacific

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We analyzed spatial and temporal variability of dynamic height referred to 1000 db and estimated using Argo CTD data every two months from September 2005 to October 2007, with a resolution about 900 km. The local variation in the dynamic height was strong in the Oyashio Extension, off the California coast, and along the Aleutian Islands. In each dynamic-height map, high and low anomalies are seen in rows along the latitudes with wavelengths of about 1000 km in the Oyashio Extension and off the California coast. To clarify the structure of these waves, we separated the variation into wavenumber components greater and less than $0.2\times10^{-3}km^{-1}$ along the parallel of 40ºN. The higher wavenumber components were dominated by the signals of $0.73\text{-}1.25\times10^{-3}km^{-1}$, whose amplitudes were large west of 170ºW and east of 140ºW, and small between 170ºW and 140ºW. These high-amplitude signals propagated westward with a phase speed of -1.9 cms^{-1}, which is almost similar to that of Rossby waves from the linear theory. Similar wavenumber signals and their westward propagation were also clearly seen west of 170ºW in SSH maps of the satellite altimetry (Chelton and Schlax, 1996). East of 140ºW the signals were obscure. This suggests that the SSH cannot always vary coherently with the upper layer thickness in the subarctic.

Poster POC_P-5334

Aerosols and ozone dynamics in the atmosphere over Peter the Great Bay

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Atmospheric aerosols and ozone play an important role in climatic changes. There are interactions between them. They also influence biological systems of in the sea. We present results from two studies. The first is seasonal aerosol dynamics inside the planetary boundary layer (PBL) and in the whole troposphere, and aerosol impact on PBL height. The second deals with the features of seasonal ozone dynamics. The main results from

the studies are presented. (1) During dust storm events aerosols stratify into three layers: 0-3 km, 6-8 km and 10-12 km. (2) PBL results obtained from Light Detection and Ranging (LIDAR) data for dust storm events differ from those calculated from meteodata. This is due to aerosol injection into the heights above the PBL. (3) Results of ozone monitoring shows that in winter-spring we have two peaks in ozone vertical distribution. We explain this phenonenon by the jet stream impact (in winter). In spring this can be due to dust storms. To find out the cause of a two-peaked ozone layer appearance, the aerosol-to-molecular ratio was calculated and is presented. The correlations between upper troposphere–lower stratosphere aerosol and ozone amounts are also presented.

Poster POC_P-5355

Matching of Mark-IIIC CTD data

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The temperature (T) and conductivity (C) measured by an oceanographic profiler (CTD) in a seawater column are mismatched at any time t, as the response times of T and C sensors (R_t and R_c) are different. Therefore, the spike structure of the calculated salinity is comparable with the thickness of the high temperature gradient layer. The analyses of raw Mark-IIIC CTD data show that the response function of a platinum thermometer (or thermistor) is non-exponential. The combined response time (R*) of Mark-IIIC temperature sensors contains two components: $R^*=R+\lambda$. The first component R (V) is a parameter for the exponential response function which depends on the probe velocity V. The second one λ=const is in respect to the parameter of the shift procedure, $t^*=t+\lambda$. To match the raw CTD data, the combined "shift and exponential sharpening" (SES) method is applied. The temperature response errors are reduced and the calculated salinity profiles are successfully despiked due to the SES-method. Furthermore, the probing intervals of unstable data mismatching and contaminated CTD data are determined by using the same method. These data artifacts are caused by such effects as a ship's rolling.

Poster POC_P-5357

Spectral characteristics seismogenic clouds

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Lithospheric contamination, amplified during earthquakes, promotes mass die-offs and limits the reproduction of many food fishes. Therefore, it is most urgent to find the areas where the unloading of lithospheric fluids is taking place. From research, we are able to detect displays of seismic activity of the Earth in atmospheric phenomena, in particular, through the development of seismogenic clouds which can trace active breaks in the Earth's crust where lithospheric contamination is actively developing. By analyzing the spectral characteristics of the seismogenic clouds, we have traced breaks in the Earth's crust over which mass fish kills are found. We also observe that there is a zone in the meteorological clouds above the seismic activity that has little atmospheric vapor.resulting in a break in the cloud structure. With the lessening of seismic electromagnetic activity the cloud can dissipate in connection with transition of a zone of deficiency of humidity. Raised concentrations of atmospheric CO_2 above the active areas of unloading lithospheric fluids also are observed.

Poster POC_P-5370

Density inversion in the Soya Current on the Hokkaido coast in the Okhotsk Sea

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Conductivity-temperature-depth (CTD) observations were taken along the eastern Hokkaido coast in the Okhotsk Sea in October 2006, and April, May, and July 2007. We observed high salinity water (>33.6psu) carried by the Soya Current along the coast from Abashiri Bay at 144.15°E to the Shiretoko Peninsula at 145.22°E. This water, which is cold (3-5°C) in April and May, and warm (7-18°C) in July and October, is called the Forerunner of the Soya Warm Water (FSWW) and the Soya Warm Water (SWW), respectively. The FSWW, which was also seen below the SWW in October, appeared to sink downstream along the Soya Current in April, May and October. We observed density inversions having scales from 1m to 70m in all the months. These strong density inversions were observed frequently in May, especially along the coast of the Shiretoko Peninsula, downstream of the current. The Thorpe scale (L_T; Thorpe, 1977) was estimated using density data every 1db to compare with the water mass structure. In May, L_T > 10m was seen for the densities 26.4-26.7σ_θ at 144.15°E, 26.6-26.9σ_θ at 144.66°E, and 26.7-27.0σ_θ at 145.22°E, at which locations the water was 4-5°C, 33.5-33.7psu, 0-4°C, 33.2-33.8psu and -1-3°C, 33.2-33.9psu, respectively. It is suggested that strong vertical mixing occurred in the FSWW and around it. Based on Stansfield *et al.* (1982), vertical diffusivities in these water columns are estimated to be 10^2-10^3 cm^2s^{-1}.

Poster POC_P-5391

Long-term changes of the wintertime coastal water temperature around Japan in the 20th century

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Monitoring sea conditions from the view point of fisheries oceanography was started in the early 20th century in Japan and many historical data sets were prepared. By using the data sets of sea surface temperature observed at coastal stations and the subsurface water temperature periodically observed at a repeat observation line around Japan, the long-term changes of the wintertime coastal water temperature were investigated. Abrupt changes from cold to warm phase were observed in the Pacific coast of Japan during 1948/49 and 1987/88, and a change from warm to cold phase was observed during 1960/61. The shift at 1987/88 is remarkable and is obviously recognized in the time series of the wintertime air temperature in Japan and in the strength of the East Asian wintertime monsoon. From the detailed analysis about relationships between atmospheric factors and coastal water temperature variation in winter, it is thought that the changes of the East Asian winter time monsoon were the principal factor for long-term changes of coastal temperature, except for warming trends.

Poster POC_P-5436

Dissolution rate change of calcite in seawater due to acidification by CO_2

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Increasing the partial pressure of carbon dioxide (pCO_2) and the corresponding decrease of pH in seawater should change the dissolution rate of calcium carbonate. To understand how the dissolution rate of calcium carbonate changes, we conducted laboratory experiments under high pressure and high pCO_2 conditions. We used aged shell of foraminifera *G. sacculifer* collected from deep sea sediments as the natural calcite samples.

About 20 mg of samples were set into plastic cells. The cells were connected to an aluminum-laminated plastic bag containing up to 5 L of seawater that was equilibrated with various concentrations of CO_2 gas. The pCO_2 of the flowing seawater ranged from 400 to 70000 ppm. The entire system was installed into a high pressure chamber and pressurized at 100-300 kg cm^{-2}. As a result, rapid dissolution was observed above 5000 ppm of pCO_2. Dissolution rates normalized by the apparent surface area fit well to the rate found in previous empirical kinetic studies. Using the function of dissolution rate of calcite, we constructed 3-D map of dissolution rate of calcite in the western North Pacific and examined the influence of acidification by increase of CO_2 on the dissolution rate of calcite.

Poster POC_P-5498

The oceanic general circulation and transport in the Bohai Sea

Xing **Wang**[1,2], Maochong Shi[3], Zhenhui Gao[1,2] and Lunyu Wu[3,4]

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Based on an unstructured grid, three dimensional hydrodynamic model FVCOM, we calculated tide- and wind-driven circulation in the Bohai Sea and analyzed the residual current pattern in summer. From the simulation results we can see there is a clockwise gyre in the center of Bohai Sea and a strong northeast residual current near the Yellow River estuary, which is consistent with observation. The distribution characteristic of the nutrients near the Yellow River estuary is depicted by field data. The influence of the circulation on mass transport was also discussed.

W1 MEQ Workshop and laboratory demonstration Review of selected harmful algae in the PICES region: IV. *Karenia* and *Prorocentrum*

Co-Convenors: Vera L. Trainer (U.S.A.) and Ming-Yuan Zhu (China)

This workshop is the fourth of an annual series in which harmful algal bloom (HAB) species that impact all or most countries in the North Pacific are discussed in detail. In 2008, we will focus on two fish-killing species *Karenia* and *Prorocentrum*. *Karenia mikimotoi* is known to kill both wild and cultured fish in China, Korea and Japan. Although this species is absent, to date, in the eastern Pacific, other species from the genus *Karenia* are known to kill fish in the southeastern U.S. *Prorocentrum* is a "red tide" species that forms dense, colored blooms in China, Korea and Japan, resulting in economic loss to fisheries due to reduced consumer confidence. *Prorocentrum* blooms are relatively rare in the eastern Pacific, but have been documented occasionally in areas of the U.S. and Canada. The integration of information from each country will advance our understanding of these organisms. Topics will include modes of toxicity, distribution, impact (differences between toxic and nontoxic strains), as well as physiology and ecology in each of the member countries. In particular, we would like to identify additional studies needed specifically to understand the difference in occurrence and toxicity of these organisms in the eastern and western Pacific. The workshop will produce a list of recommendations to help guide collaborative HAB research priorities in PICES member countries over the next five years. The workshop will be preceded by a half-day laboratory demonstration on *Karenia* and *Prorocentrum* identification and detection methods.

Saturday, October 25, 2008 09:00 – 18:00

Laboratory demonstrations on detection techniques for algal toxins

09:00 ***Introduction by convenors***

09:05 **Jacob Larsen**
Microscopic Observations and detailed analysis of *Karenia* and *Prorocentrun* taxonomy (W1-5477)

10:30 ***Cofee/tea break***

10:50 **Jacob Larsen**
Microscopic observations and detailed analysis of *Karenia* and *Prorocentrun* taxonomy (W1-5477) *(continued)*

W1 (MEQ) workshop

14:00 **Jacob Larsen (Invited)**
Karenia and *Prorocentrum:* Review

14:30 **Yutao Qin, Jinhui Wang, Yanqing Wu, MingYuan Zhu and Lingyun Xiang**
Blooms of *Karenia mikimotoi* and *Prorocentrum* sp. in the East China Sea (W1-5273)

14:50 **Charles G. Trick**
A historical overview of *Karenia* and *Prorocentrum* occurrences in North American coastal waters (W1-5463)

15:10 **Tatiana V. Morozova, Tatiana Yu. Orlova, Marina S. Selina and Inna V. Stonik**
Species of the genera *Karenia* and *Prorocentrum* from the east coast of Russia (W1-5019)

15:30 **Douding Lu**
The species complex *Prorocetrum donghaiense* (*"dentatum"*) in East Asian waters (W1-5484)

15:50 **Mineo Yamaguchi, Shigeru Itakura and Ichiro Imai**
Ecophysiological characteristics of the harmful dinoflagellate *Karenia mikimotoi* in Japanese coastal waters (W1-5464)

16:10 ***Coffee / tea break***

16:30 **Yang-Soon Kang, Youngtae Park, Kyung Suk Seo and Yoon Lee**
Karenia spp. and *Prorocentrum* spp. blooms in Korean coastal waters (W1-5496)

16:50 **Ruixiang Li, Mingyuan Zhu and Jianqiang Yang**
The formation of *Karenia mikimotoi* blooms in the Bohai Sea, China (W1-5483)

17:10 **Songhui Lu**
An ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005 (W1-5482)

17:30 ***Summary and wrap up***

W1 Workshop Posters

W1-4991 **Yasuhiro Yamasaki, Masayuki Tameishi, Sou Nagasoe, Yohei Shimasaki, Yuji Oshima, Kenichi Yamaguchi, Tatsuya Oda and Tsuneo Honjo**
Allelopathic effects of the dinophyte *Prorocentrum minimum* on the growth of the bacillariophyte *Skeletonema costatum*

W1-5495 **Jong-Gyu Park, Weol Ae Lim, Yang-Soon Kang, Kyung Suk Seo and Yoon Lee**
Pseudo-nitzschia in Korean coastal waters

W1-5497 **Tae-Gyu Park, Yang-Soon Kang, Youngtae Park, Heon Meen Bae and Yoon Lee**
Fish killing dinoflagellate *Cochlodinium polykrikoides* (Dinophyceae) blooms in Korea in 2007

October 26, Sunday, HAB Section Oral Presentations

09:25 **Mingyuan Zhu, Ruixiang Li and Zongling Wang** (*also a poster in S3-5451*)
Study on growth of macro green algae *Enteromorpha prolifera*

14:20 **David G. Foley** (*also a poster in S3-5384*))
Data integration to help identify and monitor harmful algal blooms along the West Coast of North America

15:20 **Takafumi Yoshida and Hidemasa Yamamoto**
HAB-related Activities of NOWPAP CEARAC in the NOWPAP Region (HAB-5194)

W1 Laboratory Demonstration Oral Presentations

25 October, 9:05 (W1-5477)

Microscopic observations and detailed analysis of *Karenia* and *Prorocentrun* taxonomy

Jacob **Larsen**

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The workshop will deal with both planktonic and benthic species of *Prorocentrum*. During the workshop a large number of species will be demonstrated by light microscopy of cultures or natural samples. Different observation techniques will also be demonstrated.

Taxonomic principles and problems in the genus will be discussed. Species of *Karenia* are causing increasing problems around the world being responsible for severe fish kills. This presentation will give a historic overview of *Karenia* and related species (*Karlodinium* and *Takayama*) and fish mortality associated with mass occurrences of these species. Taxonomic comparisons of the different species will be presented.

W1 Workshop Oral Presentations

25 October, 14:30 (W1-5273)

Blooms of *Karenia mikimotoi* and *Prorocentrum* sp. in the East China Sea

Yutao **Qin**[1,2], Jinhui Wang[1,2,3], Yanqing Wu[3], MingYuan Zhu[4] and Lingyun Xiang[1,2]

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Records from the coast of China show that blooms of *Karenia mikimotoi* and *Prorocentrum* sp. occur most frequently in the East China Sea. Their first occurrences were documented in the early 2000s and in the mid 1990s, respectively. About 125 blooms of *Prorocentrum* sp. have been recorded in the East China Sea. These blooms appeared to peak in 2006 when 46 events were observed. However, no direct harmful effects were documented during this year. In contrast, about 30 *Karenia* bloom have been recorded in East China Sea since 1980s. Most of these blooms have detrimental effects. Blooms of *Karenia* sp. appear to be increasing in frequency and spreading along China's coastline from south to north. During 26 May and 16 July 2005, a bloom of *Karenia mikimotoi* caused a direct loss of about RMB 20 million through the death of cultured fish including red drum, genuine porgy, large yellow croaker as well as abalone. A bloom of *Karenia mikimotoi* in 2003 caused a direct economic loss of RMB 42 million to the aquaculture industry through the deaths of fish fry, golden pompano and abalone. Records of blooms since 2001 showed a loss of more than RMB 5 million. In this paper, the variability in bloom records will be compared to the shift of nutrient structure and climate change.

25 October, 14:50 (W1-5463)

A historical overview of *Karenia* and *Prorocentrum* occurrences in North American coastal waters

Charles G. **Trick**

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The dinoflagellates, *Karenia* and *Prorocentrum*, are two Red Tide species that have a long history of regional occurrences in North American waters. While the primary regions of occurrences are the mid-salinity waters of the Chesapeake Bay and Narragansett Bay for *Prorocentrum minimum* and the colder mid-Atlantic - Bay of Fundy waters for epiphytic/epibenthic *Prorocentrum lima* (Ehr.) Dodge. *Karenia brevis* (formerly known as *Gymnodinium breve* and *Ptychodiscus brevis*) is the organism responsible for Florida red tide. While both *Karenia* and *Prorocentrum* have been reported in the Gulf of Mexico, neither genus has a strong presence in the Pacific coastal region of the US or Canada. In this overview, I will summarize the occurrence and ecological limits of these two genera and assess the likelihood of establishment the waters associated with the North Pacific waters.

25 October, 15:10 (W1-5019)

Species of the genera *Karenia* and *Prorocentrum* from the east coast of Russia

Tatiana V. Morozova, Tatiana Yu. **Orlova**, Marina S. Selina and Inna V. Stonik

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Species of the genera *Karenia* and *Prorocentrum* from the Peter of the Great Bay (Sea of Japan) and coastal water of Sakhalin Island in 1991-2007 were studied. Ten species of the genus *Prorocentrum* were recorded from the east coast of Russia: *P. balticum*, *P. compressus*, *P. dentatum*, *P. gracile*, *P. lima*, *P. micans*, *P. minimum*, *P. rostratum*, *P. triestinum* and *P. vaginula*. The bloom-forming species was *P. minimum*. Its number exceeded 1 million cells per liter in Amursky Bay (the Peter the Great Bay) in July 1991 and 1992. *P. minimum* density in coastal waters of Sakhalin Island reached 7 x 10^3 cells per liter. Number of potentially toxic *P. lima* was low. Two *Karenia* species were found: *K. mikimotoi* and *K. brevis*. An extensive bloom of *K. mikimotoi* (1 million cells per liter) was recorded from September-October, 1990, in Amursky Bay. *K. brevis* density did not exceed 3 x 10^3 cells per liter in the Peter the Great Bay and 100 cells per liter in coastal waters of Sakhalin Island. No harmful effects or damage due to either of these species have yet been reported. However, regular monitoring is needed to detect the appearance and density of potentially harmful *Prorocentrum* and *Karenia* species along the eastern coast of Russia.

25 October, 15:30 (W1-5484)

The species complex *Prorocetrum donghaiense* (“*dentatum*”) in East Asian waters

Douding **Lu**

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Extensive blooms of dinoflagellates, caused primarily by *Prorocentrum donghaiense* Lu in the spring, have been a recurrent phenomenon for the last decade in the East China Sea (ECS). A similar species complex recorded as *Prorocentrum dentatum* Stein and *Prorocentrum shikokuensis* Hada also appeared in Korean and Japanese coastal waters. Molecular data suggested that *P.* “*dentatum* (CCMP1517)” isolated from Indian Ocean and *P. donghaiense* from ECS are genetically identical. Therefore, the geographic distribution of *P. donghaiense* may be much wider than expected. *Prorocentrum donghaiense* in the ECS and *P. dentatum* in Korean and Japanese waters also appear to be the same species according to supporting illustrations (Horiguchi, 1990, Yoo and Lee 1986, Lu *et al.* 2005). However, more morphological and genetic studies in the East Asian waters will be required to determine whether this is the case.

25 October, 15:50 (W1-5464)

Ecophysiological characteristics of the harmful dinoflagellate *Karenia mikimotoi* in Japanese coastal waters

Mineo Yamaguchi[1], Shigeru **Itakura**[2] and Ichiro Imai[3]

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To elucidate the mechanism of red tide outbreaks by *Karenia mikimotoi*, we examined the ecophysiological characteristics of this species. *K. mikimotoi* grew at a low irradiance of 10µmol photons $m^{-2}s^{-1}$ and growth was saturated at 110µmol photons $m^{-2}s^{-1}$. This growth response in low light allows this species to dominate in low light environments such as in subsurface layers and in bad weather conditions typical in the rainy season. Growth of *K. mikimotoi* occurred at a range of temperatures from 10 to 30 ºC and salinities from 15 to 30 psu. The highest growth rate was observed at 25ºC and 25 psu. These findings indicate that *K. mikimotoi* is a eurythermal and euryhaline organism. *K. mikimotoi* was able to grow using both organic and inorganic N compounds as sole N sources. Nitrate, nitrite, and ammonium were found to be acceptable nitrogen sources for growth of this organism. Urea and uric acid were not so well utilized and none of the amino acids, except for glutamine and tryptophan, were assimilated. *Karenia mikimotoi* was capable of using a wide variety of inorganic and organic phosphorus compounds of different molecular structure. Under N- or P-limited steady state conditions, the dilution rate (= growth rate), as a function of the cell quota, followed the Droop equation. Kinetic parameters Dm and Q obtained for N- and P-limited cultures were 0.54 day^{-1} and 3.13 pmol•$cell^{-1}$, and 0.67 day^{-1} and 0.25 pmol•$cell^{-1}$, respectively. The nutrient availability and kinetic parameters indicate that *K. mikimotoi* requires very low concentration of nutrients for growth.

25 October, 16:30 (W1-5496)

Karenia spp. and *Prorocentrum* spp. blooms in Korean coastal waters

Yang-Soon Kang[1], Youngtae Park[1], Kyung Suk Seo[2] and Yoon **Lee**[1]

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Harmful algal blooms (HABs) have represented a significant and expanding threat to fisheries resources and human health beginning in early 1981 in Korea. In August 1981, Korea incurred substantial economic loss due to shellfish mortalities caused by a *Karenia mikimotoi* red tide in Chinhae Bay. This resulted in losses of farmed oysters, mussels and shells amounting to $2.6 million. *K. mikimotoi* blooms occurred in 1982, 1990, 1992, and 1999 in Korea. However, since 2000, its blooms have not been found and *Karenia brevis* appeared at low abundances with *Cochlodinium polykrikoides* blooms.

Procentrum spp. red tides have been observed in most years from May to September, however these organisms also were found along the southern coasts of Korea even in January 2001. The highest number of *Prorocentrum* spp. red tide outbreaks in Korea occurred in 2000. During this year, 25 events were observed, however since 2005 fewer than 7 events have been noted annually. The known species of *Prorocentrum* are *P. dentatum, P. triestinum, P. micans and P. minimum*; these species have not resulted in economic loss to Korean fisheries.

25 October, 16:50 (W1-5483)

The formation of *Karenia mikimotoi* blooms in the Bohai Sea, China

Ruixiang **Li**[1], Mingyuan Zhu[1] and Jianqiang Yang[2]

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2 Monitoring Center, North Sea Branch, State Oceanic Administration, Qingdao, PR China

Karenia mikimotoi is a eurytopic species. It forms harmful algal blooms in many coastal countries in the world and causes great concern in these countries. In China, blooms of *K. mikimotoi* occur in the Pearl River Estuary in the South China Sea, the Yangtze River Estuary in the East China Sea as well as in the coastal waters off Tianjin City. However, to date, there is no record of *K. mikimotoi* blooms in the Yellow Sea. This paper describes the *K. mikimotoi* bloom that occurred in coastal waters in June 2004 for 15 days over an area of 300 km^2. The bloom was observed at the end of spring and beginning of summer, when the weather was sunny, the wind was weak, and the temperature was increasing. These environmental conditions were favorable for the bloom. During the *K. mikimotoi* bloom, the concentration of phosphate was low, and nitrate and ammonium decreased sharply with the growth of *K. mikimotoi*. As the bloom subsided, ammonium increased, a possible explanation for why the *K. mikimotoi* bloom was followed by blooms of two other species, *Mesodinium rublum* and *Chattonela mirina*.

25 October, 17:10 (W1-5482)

An ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005

Songhui **Lu**

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A huge bloom of *Karenia mikimotoi*, co-occurring with *Prorocentrum donghaiense* was recorded on the coast of Zhejiang Province, in the East China Sea in 2005. This bloom covered an area of 15,000 km^2 and lasted about one month. A cruise during the event revealed that the population succession during the bloom followed the order: *Karenia mikimotoi*, *Prorocentrum donghaiense* and finally *Noctiluca scintillans*. The population dynamics of *Karenia mikimotoi* will be presented. The relationship between the bloom and environmental factors, such as salinity, temperature, fronts, nutrients, as well as polyamines will be shown. Possible outbreak mechanisms will be discussed.

W1 Workshop Poster Presentations

Poster W1-4991

Allelopathic effects of the dinophyte *Prorocentrum minimum* on the growth of the bacillariophyte *Skeletonema costatum*

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We investigated growth interactions between *Prorocentrum minimum* and *Skeletonema costatum* using bi-algal cultures under axenic conditions. The combinations of initial cell densities for the two species were: *P. minimum*: *S. costatum* = 10^2 cells ml^{-1}: 10^2 cells ml^{-1}, 10^2 cells ml^{-1}: 10^4 cells ml^{-1}, 10^4 cells ml^{-1}: 10^2 cells ml^{-1} and 10^4 cells ml^{-1}: 10^4 cells ml^{-1}, respectively. When low cell densities of *P. minimum* and high cell densities of *S. costatum* were inoculated into the same medium, growth of *P. minimum* was suppressed. Other

inoculum combinations resulted in reduced *S. costatum* maximum cell densities. A mathematical model was used to simulate growth and interactions of *P. minimum* and *S. costatum* in bi-algal cultures. The model indicated that *P. minimum* always outcompeted *S. costatum* over time. Enriched filtrate from low-density *P. minimum* cultures significantly stimulated *S. costatum* growth, but enriched filtrate from high-density *P. minimum* cultures notably inhibited the growth of *S. costatum*. Growth of *P. minimum* was not affected by enriched filtrate from cultures of *P. minimum* at any density. Filtrates of *P. minimum* cultures were fractionated by ultrafiltration (molecular weight cutoff > 3,000 Da), and retentate that included polysaccharide(s) (galactose: 36.1 mol%, fucose: 20.9 mol%, xylose: 15.2 mol%, rhamnose: 14.3 mol%, glucose: 7.7 mol%, and mannose: 5.8 mol%) significantly inhibited the growth of *S. costatum*. Thus, allelochemical(s) of *P. minimum* may play a key role in the growth dynamics of blooms of these species.

Poster W1-5495

Pseudo-nitzschia in Korean coastal waters

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As several species of the pennate diatom genus *Pseudo-nitzschia* produce the neurotoxin domoic acid known to be responsible for amnesic shellfish poisoning that is toxic to birds, mammals and human, it is important to know the spatiotemporal changes of relative cell abundances of potentially toxic *Pseudo-nitzschia* spp. In Korean coastal waters, however, even representative species of toxic *Pseudo-nitzschia* were clearly identified, which motivated us to carry out routine and/or irregular field surveys for several years along the southwestern coasts of the Korean Peninsula, including Jinhae Bay, Tongyeong Bay, Gwangyang Bay and coastal area of Gunsan. At least fifteen species of *Pseudo-nitzschia* were present: *Pseudo-nitzschia americana, P.* cf. *americana, P. brasiliana, P. caciantha, P. calliantha**, P. cuspidata, P. delicatissima**, P. fraudulenta**, *P.* cf. *micropora, P. multiseries**, *P. multistriata**, *P.* cf. *pseudodelicatissima, P. pungens**, *P. subfraudulenta, P. subpacifica, P.* sp. Six of them (indicated by asterisks) have been reported to be toxic previously either in Korea or elsewhere in the world. *Pseudo-nitzschia* cf. *micropora* is newly recorded species for the region and was observed in Gwangyang and Tongyeong Bay mainly in summer. The Gwangyang and Tongyeong strains of this species show little difference in the external valve shapes. The valve of Gwangyang strains taper at their distal ends with thinner rosta than that of Tongyeong strains. Most *Pseudo-nitzschia* species observed in Korean costal waters were found in Jinhae Bay. Although the *Pseudo-nitzschia* species varied spatially and temporally, the most frequently observed species was *P. pungens,* showing the highest geographical distribution and cell abundance.

Poster W1-5497

Fish killing dinoflagellate *Cochlodinium polykrikoides* (Dinophyceae) blooms in Korea in 2007

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The mixotrophic dinoflagellate *Cochlodinium polykrikoides* is a causative agent of the recurring harmful algal blooms (HABs) observed in southern coasts of South Korea. Massive *C. polykrikoides*-related fish kills have been recorded with losses of US $60 million in 1995 and US $5-20 million per year in 2000-2007. In 2007, *C. polykrikoides* blooms first occurred in early August on the coast of Yeosu, South Korea and peaked in mid August. Since then the blooms rapidly decreased and the diatom (*Chaetoceros* sp.) became dominant. However, coincident with strong winds from south in late August, *C. polykrikoides* blooms reoccurred and maximum cell density reached at over 10,000 cells mL^{-1}. The high cell densities lasted until early September and caused massive fish kills (loss of 11 million U.S. dollars) in 2007. During the mid to late August, there was no typhoon near the Korean Peninsula and favorable conditions for algal growth such as extinction of cool pool and moderate rainfall were sustained.

HAB Section Meeting Oral Presentations

October 26, 9:25 (S3/HAB-5451)

Study on growth of macro green algae *Enteromorpha prolifera*

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In the end of May, 2008, a large macro algae mass, which floating at sea surface was find in middle of western Yellow Sea. Driven by both surface current and wind, the macro algae moves towards the coastal water of Qingdao and forms the large scale of green tide in the middle of June. . This algae is a eurytherm, euryhaline and eurytopic species. The growth of this algae was studied at lab and mesocosm esperiments. The results showed that the average growth rate was 5-10% per day under lab comdition and 12% in mesocosm experiment at sea. The maximum growth rate could reach 40% per day.

October 26, 14:20 (S3/HAB-5384)

Data integration to help identify and monitor harmful algal blooms along the west coast of North America

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The environmental data providers who support resource managers along the west coast of North America place a high priority on the development of remote sensing methods to identify and track harmful algal blooms (HABs). HABs in this region are caused by a variety of plankton (*e.g.*, *Alexandrium* spp. and *Pseudonitzchia australis*) and toxins (*e.g.*, saxitoxin and demoic acid), with distinct regional differences in physical, chemical, and ecological forcing mechanisms. While satellite-based measurements of water-leaving radiances, and products derived thereof, cannot be effectively used to distinguish between these phytoplankton, they can be helpful in the identification and tracking of such, particularly when integrated into a suite of measurements that include in situ samples, and ocean currents from coastal radar and regional circulation models. However, it is unusual to find all of the relevant information in one easily accessed place. A distributed data system dedicated to serve regional data pertaining to HABS has been established to assist the efforts of State and Municipal agencies charged with monitoring these blooms. The site allows for the simple merging of toxicology standards with elements of environmental forcing, including such forecasts that might be available to predict likely trajectories and biogeochemical processes. In addition to near real time data, the web site also provides access via a single portal to time series and anomalies, which allows the non-expert data user to place contemporary measurements within the context of regional dynamics.

October 26, 15:20 (HAB-5194)

HAB-related Activities of NOWPAP CEARAC in the NOWPAP Region

Takafumi **Yoshida** and Hidemasa Yamamoto

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The NOWPAP Working Group 3 (WG3) implemented harmful algal bloom (HAB)-related activities to promote coastal environmental assessment in the NOWPAP region. WG3 published the Integrated Report on HABs and developed HAB Reference Data Base in this region to share information among the NOWPAP member states (China, Japan, Korea and Russia). WG3 also published “Booklet of Countermeasures against HABs” to enhance mitigation of HABs in the member states.
In 2008-2009, WG3 plans to implement HAB Case Studies that aims to develop effective and labor-saving ways to share HAB information, and to develop a HAB Integrated Website to share information in order to enhance activities against HABs in this region.

Selected target areas for HAB Case Studies in each member state are the Yellow Sea and adjacent area in China, the northwest sea area of Kyushu region in Japan, the southern coast of Korea and the inner part of the Amursky Bay in Russia. Information on HAB occurrences and oceanic conditions in each area will be summarized in each Case Study. Data will be summarized in HAB Case Studies Database, which will be developed in 2009. A HAB Integrated Website will be constructed and will contain information such as on HAB occurrence and monitoring, mitigation, event and reference database, remote-sensing techniques for HAB, and “hot” topics in this region.

CEARAC aims to share this information not only among the NOWPAP member states but also with the other Regional Seas and international organizations. To achieve this goal, NOWPAP CEARAC makes efforts to push forward our relationship with PICES.

W2 BIO Workshop Oceanic ecodynamics comparison in the subarctic Pacific

Co-Convenors: Charles B. Miller (U.S.A.) and Atsushi Yamaguchi (Japan)

OECOS (Oceanic Ecodynamics COmparison in the Subarctic Pacific) is a PICES project, originally aiming to advance our understanding of the dynamics of lower trophic levels in the pelagic systems of the subarctic Pacific through a comparison of the east-west regions at a new level of detail. The first OECOS workshop was held in May 2005, at Oregon State University (U.S.A.), and participants from Japan (western Pacific region) and the U.S. and Canada (eastern Pacific region) discussed gaps in our knowledge about ecosystem dynamics of both eastern and western sectors of the subarctic Pacific, and new coordinated approaches for future research activities (PICES Scientific Report No. 32, 2006). In March-April 2007, the western group (OECOS WEST) conducted two cruises to the Oyashio region before and during massive spring phytoplankton blooms. In both cruises, high-frequency samplings were made of various biological components (bacteria, phytoplankton, micro-, meso- and macrozooplankton, and micronekton) and nutrients (including iron). To aid analysis of the origin and history of water masses at the study sites, frequent CTD casts and satellite monitoring of SST and water color were made. Drifting sediment traps were tracked to collect setting particles from the upper layers. At this workshop, recent achievements of OECOS WEST will be presented and discussed along with new OECOS WEST and EAST research prospects.

Sunday, October 26, 2008 09:00 – 18:00

09:00 ***Introduction by convenors***

09:10 **Atsushi Yamaguchi and Charles B. Miller**
OECOS Workshop, PICES XVII, Dalian, China: Physical, chemical and biological dynamics of the Oyashio spring bloom (W2-5454)

09:30 **Tokihiro Kono and Masatoshi Sato (Invited)**
Effect of water mass structure on the spring bloom in the Oyashio region revealed by sequential observations (W2-5361)

10:00 **Kenshi Kuma, Koji Sugie, Satoshi Fujita and Yuta Nakayama**
Temporal variability and bioavailability of iron and nutrient during spring phytoplankton bloom in the Oyashio region (W2-4988)

10:30 ***Coffee / tea break***

11:00 **Tomonori Isada, Ai Hattori, Koji Suzuki, Mitsuhide Sato and Ken Furuya**
Community structure, productivity and photosynthetic physiology of phytoplankton in the Oyashio region of the NW subarctic Pacific during spring 2007 (W2-5142)

11:30 **Takashi Ota, Toru Kobari, Mutsuo Ishinomiya, Yasushi Gomi and Yasumasa Oikawa**
Grazing activity of microzooplankton during a diatom bloom in the Oyasio region (W2-5356)

12:00 **Atsushi Yamaguchi, Yuka Onishi, Aya Omata, Mariko Kaneda, Momoka Kawai and Tsutomu Ikeda**
Vertical distribution and population structure of large grazing copepods during spring phytoplankton bloom in the Oyashio region (W2-5120)

12:30 ***Lunch***

14:00 **Toru Kobari, Yumi Inoue, Yosuke Nakamura, Hidemi Okamura, Takashi Ota, Yuichiro Nishibe and Mutsuo Ichinomiya**
Feeding impacts of ontogenetically migrating copepods on the spring phytoplankton bloom in the Oyashio region (W2-5066)

14:30 **Hye Seon Kim, Atsushi Yamaguchi and Tsutomu Ikeda**
Abundance, metabolic rate and body composition of the euphausiid *Euphausia pacifica* and *Thysanoessa inspinata* during spring phytoplankton bloom in the Oyashio region (W2-5048)

15:00 **Tadanori Fujino, Yusuke Ito, Hiroki Yasuma and Kazushi Miyashita**
Abundance and distribution of micronektonic, mesopelagic fish at the 2007 OECOS observation site (Northwest Pacific) (W2-5318)

15:30 **Michael Dagg, S. Strom and H. Liu**
Phytoplankton community structure in the HNLC subarctic Pacific Ocean is determined by *Neocalanus flemingeri* and *N. plumchrus* (W2-4996)

16:00 ***Coffee / tea break***

16:20 **Suzanne L. Strom, K.A. Fredrickson, F. Perez, M.B. Olson and E.L. Macri**
Lower trophic level responses to gradients in iron availability in the eastern subarctic Pacific (W2-5428)

16:50 **Charles B. Miller**
OECOS Workshop: Open issues in production ecology of the oceanic Gulf of Alaska (W2-5455)

17:10 ***Workshop Discussion***
- Findings of OECOS-WEST
- Comparison between east and west
- Remaining unsolved problems

W2 Oral Presentations

26 October, 9:10 (W2-5454)

OECOS Workshop, PICES XVII, Dalian, China: Physical, chemical and biological dynamics of the Oyashio spring bloom

Atsushi **Yamaguchi**[1] and Charles B. Miller[2]

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OECOS is a PICES project, initially intended for an **O**ceanic **E**cosystem **CO**mparison in the **S**ubarctic Pacific. Physical and lower trophic level conditions were to be compared between the Oyashio region supporting an intense spring phytoplankton bloom and the Gulf of Alaska in which blooms are suppressed by continuous iron limitation. Long shipboard time series were planned for each region, but funding was only obtained for the Oyashio study. The 2008 workshop primarily presents results from two cruises before and during the spring bloom in March-April 2007, both led by Dr. Tsutomu Ikeda. A key interest was detailed characterization of growth dynamics of the ontogenetically migrating copepods: *Neocalanus* spp. and *Eucalanus bungii.* Intense phytoplankton blooms in the Oyashio should support much faster development rates than measured previously in the Gulf of Alaska. Variables measured at high frequency were water column physics, nutrients including iron, bacteria, phytoplankton abundance and community structure, micro-, meso-, and macrozooplankton (including stage structure and growth rates) and micronekton. Satellite monitoring of the area was continuous and drifting sediment traps collected settling particles. Fourteen talks by participants in these OECOS West cruises will cover the interactions among the observed variables, with emphases ranging from surface layer mixing rates, to grazer-phytoplankton interactions, to copepod and euphausiid growth. Several talks will review gaps in our understanding of ecosystem function in the oceanic Gulf of Alaska (the OECOS East region).

26 October, 9:30 (W2-5361) Invited

Effect of water mass structure on the spring bloom in the Oyashio region revealed by sequential observations

Tokihiro **Kono**[1] and Masatoshi Sato[2]

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As part of OECOS-WEST field program to reveal processes associated with the spring phytoplankton bloom, sequential CTD observations were made southeast off Hokkaido during 8-15 March and 5 April-1 May 2007. Time series of temperature and salinity profiles obtained at a fixed station (Sta.A5) were examined to clarify the water exchange in the surface mixed layer. Warm and saline water existed during 8-15 March, being replaced by cold and low salinity water on 5 April. The water mass analysis using multiple water properties suggested that all the waters in March were a mixture between the cold and low salinity water on 5 April (OYW) and the modified Kuroshio Water (MKW) located to the south of Sta.A5. After the OYW was seen, surface salinity was less than the OYW during 7-12 and 23-25 April, suggesting the influence of the Coastal Oyashio Water (COW) originating from the Okhotsk Sea. Mixing ratios of OYW, MKW and COW were calculated using temperature and salinity observed at Sta.A5 in April. We compared these ratios with Chlorophyll concentration, which showed the spring bloom twice in April. The content ratio of COW is correlated to Chlorophyll concentration with the highest correlation coefficient 0.69 (n= 133) of the three. That is, the spring bloom occurred in the COW, which was carried from the Hokkaido coast offshore to the southeast.

26 October, 10:00 (W2-4988)

Temporal variability and bioavailability of iron and nutrient during spring phytoplankton bloom in the Oyashio region

Kenshi **Kuma**[1,2], Koji Sugie[1], Satoshi Fujita[1] and Yuta Nakayama[1]

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Iron [dissolved Fe (D-Fe) and total dissolvable Fe (T-Fe)] and nutrient concentrations in the surface water of the Oyashio region (northwestern North Pacific) were measured before and during the spring phytoplankton bloom (March to May). Before the bloom (middle of March), we observed vertically uniform concentrations of iron (0.3–0.5 nM for D-Fe and 3–5 nM for T-Fe), nutrients (10–15 µM for NO_3+NO_2, 1.0–1.4 µM for PO_4 and 19–29 µM for SiO_2) and chlorophyll *a* (Chl-*a*, 0.3–0.4 µg/l) throughout the upper 100–150 m of the water column due to vertical mixing during winter. Water temperature and salinity during the pre-bloom period were also vertically uniform, >5°C and >33.5(S), respectively, and were higher than those usual in Oyashio Water. Cold Oyashio Water [<2°C, <33.2(S)] intruded a few times during the bloom period with high iron (0.4–0.6 nM for D-Fe and 10–25 nM for T-Fe), nutrient and Chl-*a* (10–23 µg/l) concentrations. In addition, phytoplankton collected during the bloom and placed in shipboard bottles increased in cell number, Chl-*a* and biogenic silica concentrations with incubation time due to high bioavailable iron and high nutrient concentrations in Oyashio Water. These results suggest that the most important mechanisms transporting iron to the surface layers in the Oyashio region are surface intrusions of iron- and nutrient-rich water and vertical mixing during winter and spring.

26 October, 11:00 (W2-5142)

Community structure, productivity and photosynthetic physiology of phytoplankton in the Oyashio region of the NW subarctic Pacific during spring 2007

Tomonori **Isada**[1], Ai Hattori[1], Koji Suzuki[1], Mitsuhide Sato[2] and Ken Furuya[2]

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Despite large diatom blooms occurring in the Oyashio region every spring, our knowledge of factors controlling primary productivity in the region during that season remains incomplete. Therefore, we examined the community structure, productivity and photosynthetic physiology of phytoplankton at a station (42°N, 145°15’E) in the Oyashio region during spring 2007. Chlorophyll *a* (Chl-*a*) concentrations in surface waters were consistently high (2-36 mg m^{-3}) and micro-sized phytoplankton accounted for > 83% of the Chl-*a* levels during our cruise. Diatoms contributed to the surface Chl-*a* concentrations by > 74%, and the dominant, micro-sized diatoms changed from *Thalassiosira* species to *Chaetoceros* species with time. Pico- and nano-sized phytoplankton became significant in phytoplankton biomass in the latter half of the cruise. Interestingly, these tiny cells sometimes showed discontinuous distributions in the water column, indicating the intrusion of different water masses into Oyashio waters. Depth-integrated daily primary production within the euphotic layer ranged between 535 and 3584 mg C m^{-2} d^{-1}. Although sufficient macronutrients remained in surface waters throughout the study, values of photosynthetic parameters such as F_v/F_m varied temporarily. A non-iron-containing flavoprotein, flavodoxin, which is a diagnostic marker for iron deficiency *in situ*, was detected in the micro-sized diatoms throughout the cruise. The result indicates that the micro-sized diatoms were stressed by low iron availability.

26 October, 11:30 (W2-5356)

Grazing activity of microzooplankton during a diatom bloom in the Oyasio region

Takashi **Ota**[1], Toru Kobari[2], Mutsuo Ishinomiya[3], Yasushi Gomi[4] and Yasumasa Oikawa[1]

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Phytoplankton growth and microzooplankton grazing rates were measured by the dilution technique in the Oyashio region over the spring bloom period in 2007. Eighteen sets of experiments were carried out in total. Phytoplankton growth rates estimated from changes in total chlorophyll *a* ranged from 0.04 to 0.52 d^{-1}. Relatively high growth rates (0.3-0.52 d^{-1}) were recorded during 6 to 8 April when the chlorophyll standing stocks in the sea surface were extremely high (22-43 μg chl-*a* l^{-1}), while no clear correlations were found between chlorophyll and growth rates throughout the sampling period. Microzooplankton grazing rates never exceeded the phytoplankton growth rates and were relatively low (undetectable to 0.20 d^{-1}) compared to previously reports from the subarctic ocean and coastal areas. Calculated daily losses of phytoplankton by microzooplankton grazing were mostly around 5-15% of the initial chlorophyll standing stock, or 10-30% of the potential primary production, indicating that microzooplankton grazing may not play an important role for controlling the spring bloom in this region. On the other hand, a large number of heterotrophic dinoflagellates ingesting chain diatoms and also their fecal pellets were observed in preserved samples obtained during mid-bloom. These organisms primarily dominated the microzooplankton communities (49-77% of total microzooplankton in carbon terms). This may indicate that microzooplankton herbivory on diatoms was highly active and substantial energy was transferred from diatoms to the microzooplankton community.

26 October, 12:00 (W2-5120)

Vertical distribution and population structure of large grazing copepods during spring phytoplankton bloom in the Oyashio region

Atsushi **Yamaguchi**, Yuka Onishi, Aya Omata, Mariko Kaneda, Momoka Kawai and Tsutomu Ikeda

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As an attempt to analyze development of six large grazing copepods (*Neocalanus cristatus, N. flemingeri, N. plumchrus, Eucalanus bungii, Metridia pacifica, M. okhotensis*), daily NORPAC net (0.33 mm mesh) samplings through the upper 500 m were made daily at a station in the Oyashio region before (8-15 March) and after the onset of the phytoplankton bloom (5 April-1 May) in 2007. Occasional day-night stratified vertical samplings with multiple VMPS nets from 9 strata between 0-1000 m were also made to evaluate their depth distribution patterns and diel vertical migration behavior (DVM). Except for *N. plumchrus*, which occurred only from April onward, the development sequences from C2 to C4 for *N. cristatus* and from C1 to C4 for *N. flemingeri* were traceable. All *Neocalanus* spp. occurred largely above 200 m, showing no DVM. *E. bungii* (C3-C6) was distributed around 400 m both day and night in March, but part of the population migrated upward in early April. Nauplii and C1-C2 *E. bungii* increased rapidly from mid-April. *M. pacifica* (C1-C6) was abundant in March, and exhibited DVM during March to mid-April, but not in late April (except C6 females). *M. okhotensis* (C5 and C6) resided at ca. 400 m both day and night in March, showed DVM in mid-April, and no DVM in late April (except C6 females). No clear development sequence was seen in *Metridia* spp. These results, combined with those of daily egg production monitoring on *E. bungii*, *M. pacifica* and *M. okhotensis*, will be discussed in the light of the species-specific responses to phytoplankton blooms.

26 October, 14:00 (W2-5066)

Feeding impacts of ontogenetically migrating copepods on the spring phytoplankton bloom in the Oyashio region

Toru **Kobari**[1], Yumi Inoue[1], Yosuke Nakamura[1], Hidemi Okamura[1], Takashi Ota[2], Yuichiro Nishibe[3] and Mutsuo Ichinomiya[4]

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It has been recently suggested that mesozooplankton prevent the accumulation of large phytoplankton by direct feeding and stimulate the accumulation of small phytoplankton through trophic-cascade effects in the subarctic Pacific Ocean. However, there is little information on their feeding impacts during natural phytoplankton blooms. We report feeding habits and activity of the ontogenetically migrating copepods in the Oyashio region from gut fluorescence and *in situ* feeding experiments. We evaluate their grazing impacts on the spring phytoplankton bloom. A massive phytoplankton bloom occurred during April, and then chlorophyll *a* concentrations decreased after mid-April. Biomass of the copepod community reached a maximum in mid-April with the dominant species, *Neocalanus cristatus* and *Eucalanus bungii*. Gut pigments of the predominant copepods were much higher during the bloom than in March (pre-bloom), and the temporal variations corresponded to those of mean chlorophyll-*a* concentrations in the 0-150 m layer. Major food items for the copepods were centric diatoms, dinoflagellates and naked ciliates. Tintinnids and autotrophic nanoplankton were additional sources. Negative and positive clearance rates were evident for bacteria and picophytoplankton, respectively. Feeding rate of the copepod community was estimated to be 0.1 to 1.2 gC m^{-2} day^{-1} and accounted for ~70% of primary production. These results suggest that the copepod community has impacts sufficient to terminate the phytoplankton bloom by direct feeding on diatoms and dinoflagellates, accompanied by trophic-cascade effects on bacteria and smaller phytoplankton by consumption of their major predators.

26 October, 14:30 (W2-5048)

Abundance, metabolic rate and body composition of the euphausiid *Euphausia pacifica* and *Thysanoessa inspinata* during spring phytoplankton bloom in the Oyashio region

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Abundance, metabolic rate (oxygen consumption and ammonia excretion) and body composition (water contents, C and N composition) of euphausiids (*Euphausia pacifica* and *Thysanoessa inspinata*: juveniles and adults) were investigated in the Oyashio region during the March-April 2007 phytoplankton bloom. Both *E. pacifica* and *T. inspinata* were abundant and contributed 90% to the total abundance of euphausiids, and the abundance of both was related to chl-*a* and temperature. From the comparison between March and April, no significant differences were seen in oxygen consumption or ammonia excretion rates of either euphausiid. Water contents (75-80% of WW) and C:N ratios (3.5-4.0) were also stable throughout the study period, suggesting little accumulation of lipids. These results suggest that abundance was rapidly affected by the phytoplankton bloom, while the responses of metabolic rate and body composition might be delayed.

26 October, 15:00 (W2-5318)

Abundance and distribution of micronektonic, mesopelagic fish at the 2007 OECOS observation site (Northwest Pacific)

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An acoustic survey was conducted to estimate the abundance and vertical distribution of micronektonic mesopelagic fish at the 2007 OECOS observation site (Northwest Pacific) from 5 Apr. to 1 May. Acoustic data were collected using a 38kHz FQ80 quantitative echosounder (Furuno Electric Co.). Biological samples were collected using a 16m^2 Framed Midwater Trawl (FMT/ mesh size 8mm). Acoustic data showed sound scattering layers (SSL) distributed deeper than 200m both day and night in most observations. No obvious diurnal vertical migration was observed. FMT sampling of these SSL showed *Diaphus theta* and *Stenobrachius leucopsarus* dominant in both number and weight. *Lipolagus ochotensis, Leuroglossus schmidti* and *Gonostoma gracile* were also dominant in number in some tows, however, their fraction of sample weight were low. Assuming the acoustic reflection was mostly contributed from *D. theta* and *S. leucopsarus*, their abundances in the daytime between 100-400m were estimated by acoustic methods as 5.4 g/m^2 and 1.5 g/m^2, respectively. These density estimates were relatively low compared to other acoustic density estimates in the North pacific, which mainly reveals the regional difference of distribution between the slope waters and the open ocean.

26 October, 15:30 (W2-4996)

Phytoplankton community structure in the HNLC subarctic Pacific Ocean is determined by *Neocalanus flemingeri* and *N. plumchrus*

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The open Gulf of Alaska is a High Nitrate Low Chlorophyll (HNLC) system with phytoplankton characterized by low concentration, small cell size, and iron-limited growth. Most energy and material flow is through the microbial web, and microzooplankton grazing exerts the main control on total phytoplankton production. Copepods are considered to graze mostly on microzooplankton occupying the top of this web. Previous work supports this, showing that much of the nutrition of the dominant copepods in this system, *Neocalanus flemingeri and N. plumchrus,* is derived from microzooplankton and that these copepods consume only a small fraction of the total phytoplankton production. However, our recent data from the Gulf of Alaska indicate *Neocalanus* spp. have significantly higher clearance rates on large particles than previously thought, and we suggest a re-evaluation of lower food-web dynamics is required. We show that, by selectively removing large phytoplankton and microzooplankton, *Neocalanus* spp. establish and maintain the observed structure of the phytoplankton community in the HNLC Gulf of Alaska by (a) directly preventing the accumulation of large phytoplankton cells, which are growing slowly due to iron limitation, and (b) indirectly stimulating the accumulation of the smaller phytoplankton by consumption of their major predators, the microzooplankton. Key components of this revision are: low growth rates of large cells due to iron limitation; low concentrations of large cells resulting in high clearance rates by copepods; copepod ingestion of microzooplankton that otherwise would consume small phytoplankton; and high concentrations of *Neocalanus* spp. in the surface layer.

26 October, 16:20 (W2-5428)

Lower trophic level responses to gradients in iron availability in the eastern subarctic Pacific

Suzanne L. **Strom**, K.A. Fredrickson, F. Perez, M.B. Olson and E.L. Macri

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During the U.S. GLOBEC project in 2001 and 2003, we examined properties of the phyto- and microzooplankton communities in the northern coastal subarctic Pacific. The cross-shelf distribution of phyto- and microzooplankton biomass, community structure, and rate processes all reflected a cross-shelf gradient in dissolved iron availability. Nearshore communities exhibited spring and episodic summer blooms of chain diatoms, complete drawdown of nitrate and, on occasion, silicate, and variable grazing pressure by large microzooplankton, especially heterotrophic dinoflagellates. Moving offshore, the community became progressively dominated by small phytoflagellates and cyanobacteria, with intense microzooplankton grazing. Nutrient drawdown ratios indicated iron limitation of diatom production. Outer shelf and slope assemblages were reminiscent of intensely iron-limited, open subarctic communities, with low biomass levels, mainly small phyto- and microzooplankton cells, limited macronutrient utilization, and reduced phytoplankton growth rates. The boundaries between these communities are fluid in space and time, likely influenced by cross-shelf transport of water masses by various mechanisms. Climate-induced variability in these boundaries may be an important determinant of year-to-year production differences in this highly productive region, and may influence the size of different habitats for marine animals at higher trophic levels.

26 October, 16:50 (W2-5455)

OECOS Workshop: Open issues in production ecology of the oceanic Gulf of Alaska

Charles B. **Miller**

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The SERIES field-scale iron-fertilization experiment has confirmed the hypothesis of Martin and Fitzwater that the HNLC character of the oceanic Gulf of Alaska is attributable to iron limitation. Iron addition enables diatoms to draw down major nutrients. Many issues of ecosystem function at iron concentrations limiting growth of large phytoplankton remain open. Nano- and picophytoplankton are not severely iron limited, exhibiting rapid growth, and evidently they do not increase to bloom levels or deplete nitrate and phosphate because of population control by protozoan grazing. However, below the usual low maxima of their stocks (0.6-0.8 mg m^{-3} chlorophyll) there are cycles of abundance (0.1 to 0.45 mg m^{-3} chlorophyll) of ~10 day to month-long periods. These must correspond to similar variations in production rate and are fundamental to the overall trophic output of the ecosystem as fish, squid, marine mammals and sinking organic matter. A single but important data set shows that phytoplankton oscillations are opposite in phase to cycles in ammonium concentration, suggesting that grazing with rapid recycling is a key process in the cycling. Hypothetical explanations of cycles include (1) intermittent but modest inputs of iron, most likely from the atmosphere; (2) intrinsic predator-prey oscillations betwen small autotrophs and microheterotrophs; (3) modulation of microheterotroph grazing by their macrozooplankton predators, mostly copepods presumably. Effective research into these production cycles will involve time-series observation of a patch of oceanic waters in the manner of SERIES, but without iron addition. A station occupation of sixty days in mid-spring would be ideal.

W3 MONITOR/ESSAS Workshop
Status of marine ecosystems in the sub-Arctic and Arctic seas - Preliminary results of IPY field monitoring in 2007 and 2008

Co-Convenors: Ken Drinkwater (Norway), George Hunt, Jr. (U.S.A.), Sei-Ichi Saitoh (Japan), and Jin Ping Zhao (China)

The sub-Arctic and Arctic seas have distinct marine ecosystems that are affected by seasonal sea ice. During the summer, the water column is stratified by melt water from retreating sea ice, and phytoplankton are found near the sea surface, where the incoming sunlight is sufficient for photosynthesis. These summer conditions result in the highest primary production in the world's oceans and support high levels of fishery resources. Algae that live on the bottom of sea ice also play an important role in maintaining fishery resources by falling and decomposing on the sea floor in summer. Recently, global climate change has become a cause for concern. The greenhouse effect, produced by increasing anthropogenic CO_2 emissions, has induced increases in atmospheric and seawater temperatures. The effect of such increases on the cryosphere of the Arctic is already visible, and understanding its direct and indirect effects on the physical and chemical environments and the responses of marine ecosystems is critical. However, the knowledge of most aspects and responses of marine ecosystems to global climate change is still inadequate. PICES nations have conducted several field programs in these regions during the International Polar Year (IPY) 2007-2008. This workshop will discuss the features and mechanisms of the responses of marine ecosystems to global climate change in the Arctic and sub-Arctic seas, based on results from the IPY cruises in 2007 and 2008.

Friday, October 24, 2008 09:00 – 18:00

09:00 ***Introduction by convenors***

09:10 **Robert R. Dickson (Invited)**
The integrated Arctic Ocean Observing System (iAOOS) (W3-5252)

09:40 **Ling Du, Jia Wang and Juncheng Zuo**
Sea level variation and its contributing factors in the Arctic Ocean and sub-Arctic region (W3-5251)

10:00 **Yong Cao and Jinping Zhao**
A study of the subsurface warm water and its formation mechanism in the Canada Basin (W3-5250)

10:20 **Jie Su, Dong Xu, Shujiang Li and Jinping Zhao**
Interannual variations of sea ice in the Pacific side of the Arctic and its relation with the Pacific Inflow (W3-5245)

10:40 ***Coffee / tea break***

11:00 **Kohei Mizobata, Koji Shimada, Sei-ichi Saitoh, Toru Hirawake and Masahiro Hori (Invited)**
Japanese IPY activities in the western Arctic Ocean and the Bering Sea (W3-5050)

11:30 **Jinping Zhao and Jiuxin Shi**
Study of the extension of Pacific warm water under sea ice of the Chukchi Sea (W3-5316)

11:50 **Liqi Chen and Zhongyong Gao**
Differences of water masses in Bering Strait throughflow and mixing on their way to the Arctic Ocean (W3-5225)

12:05 **Shujiang Li, Jinping Zhao and Jie Su**
The warming evolution of the Intermediate Water in the Arctic (W3-5303)

12:20 **Jiuxin Shi, Jinping Zhao and Shujiang Li**
The double haloclines in the Canada Basin under the warming climate (W3-5321)

12:35 ***Lunch***

14:00	**Lee W. Cooper and Jacqueline M. Grebmeier (Invited)** Results from BEST, BSIERP and other IPY-relevant research in the northern Bering Sea (W3-5212)
14:30	**Nikolay S. Vanin** The summer hydrography of the west Chukchi Sea shelf during opposite patterns of atmospheric circulation in 2007 and 2003 (W3-5012)
14:50	**Sei-Ichi Saitoh, I Nyoman Radiarta, Toru Hirawake, Yasunori Sakurai, Mamoru Yabe, Yoshihiko Kamei and Shogo Takagi** Change in the biodiversity of the demersal fish community in the northern Bering and Chukchi Seas (W3-5229)
15:10	**Kenneth F. Drinkwater** A frontal attack – Norwegian IPY studies of the Arctic Front in the Norwegian and Barents Seas (W3-5113)
15:30	***Coffee / tea break***
16:00	**Rolf Gradinger, Bodil Bluhm and Katrin Iken (Invited)** The role of sea ice in the sub-Arctic Bering Sea ecosystem (W3-5427)
16:30	**Jun Nishioka, Takeshi Nakatsuka, Kenshi Kuma, Yutaka W. Watanabe, Tsuneo Ono and Kay I. Ohshima** The importance of sea-ice formation in the Sea of Okhotsk for supplying iron to the western subarctic Pacific (W3-5105)
16:50	**Hongli Fu, Jinping Zhao and Jie Su** Study of polynya processes in the Bearing Sea using a high resolution dynamic-thermodynamic sea ice model (W3-5288)
17:10	**Geneviève Desportes, Daniel Pike, Mario Acquarone, Igor Golyak, Jean François Gosselin, Thorvaldur Gunnlaugsson, Sverrir D. Halldórsson, Mads Peter Heide-Jørgensen, Jack Lawson, Christina Lockyer, Bjarni Mikkelsen, Droplaug Ólafsdóttir and Malene Simon** From the Barents Sea to the St. Lawrence: A Trans North Atlantic Sightings Survey (T-NASS) (W3-5267)
17:30	**George L. Hunt, Jr.** Hotspots in cold seas (W3-5367)
17:50	***Discussion and summary***

W3 Posters

W3-5015	**Wen Yu, Liqi Chen, Jianping Cheng, Jianhua He, Zhongyong Gao and Heng Sun** Western Arctic Ocean POC flux derived by the small volume 234Th method
W3-5075	**Eduard A. Spivak, Nina I. Savelieva and Anatoliy N. Salyuk** Winter oceanographic conditions in the coastal waters of the Laptev Sea (Buor-Khaya Bay) – Results of IPY field monitoring in 2007
W3-5102	**Maxim V. Ivanov and A.S. Astakhov** Mercury distribution in the sediments of the Chukchi Sea
W3-5114	**Kenneth F. Drinkwater** The Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) Consortium
W3-5208	**Shinya Nagashima, Hideaki Kudo and Masahide Kaeriyama** Spatial comparison of the feeding ecology of Pacific salmon in the North Pacific Ocean during summer of 2007 IPY (Preliminary results)
W3-5228	**Sei-Ichi Saitoh and Toru Hirawake** Preliminarily results from the Oshoro-Maru IPY cruises in summer 2007 and 2008

W3 Oral Presentations

24 October, 9:10 (W3-5252) Invited

The integrated Arctic Ocean Observing System (iAOOS)

Robert R. **Dickson**

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The integrated Arctic Ocean Observing System (iAOOS) is one of around 110 'Coordination Proposals' approved for the International Polar Year, designed to optimise the cohesion and coverage of Arctic Ocean Science during the IPY. As such, iAOOS is not a funded programme but a pan-Arctic framework to achieve optimal coordination of funded projects during the IPY. Its main concern is with Arctic change and the role of the Northern Seas in Climate. Its underlying aim is that by piecing together various national observing efforts across Arctic and subarctic seas, it might be possible to view the ocean-atmosphere-cryosphere system of high northern latitudes operating *as a complete system* for the first time. Understanding that system and testing its predictability seems the most direct way of extending our ability to mitigate or adapt to its changes, including global change. The pan-Arctic approach of iAOOS appears to have been effective. We describe cases where the emerging science could only have been achieved by a particularly close international coordination, those where long-awaited results are now being achieved by a novel observing effort, or those which provide the Community with advanced warning of climatically-interesting events passing through our northern seas to which PIs might contribute while they are still evolving. The 2008 iAOOS Report will add new emphases on major new contributions by the Pacific Arctic Group, on new efforts to model the physical system of northern seas and in applying new observations and modelling to understanding the changing ecosystem in high northern latitudes.

24 October, 9:40 (W3-5251)

Sea level variation and its contributing factors in the Arctic Ocean and sub-Arctic region

Ling **Du**[1,4], Jia Wang[2,4] and Juncheng Zuo[3]

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Based on tide gauge records in the Arctic Ocean and sub-Arctic region (AOSR), the relative sea level variations in the past 40-yr are analyzed with the stochastic dynamic method. The average secular trend of the sea level record is about 1 mm/yr, which is smaller than that cited by the forth IPCC climate assessment report (2007). The secular trend in the coastal region differs from that in the deep water. After the mid-1970s, a weak acceleration of sea level rise is found along the coasts of the Siberian and Aleutian Islands. Analysis of synchronous TOPEX/Poseidon altimetry data indicates that the amplitude of the seasonal variation is less than that of the inter-annual variation, whose periods vary from 4.7 to 6 years. This relationship is different from that in the mid-latitudes. Numerical simulation experiments are used to further examine the sea level variation and steric effects (including thermal expansion and halosteric variation) in the 20th century. The climate indices are the pre-cursors of the sea level variations on multi-temporal scales. The model results show that while steric effects contribute significantly to the seasonal variation, the influence of atmospheric forcing are dominant in the AOSR.

24 October, 10:00 (W3-5250)

A study of the subsurface warm water and its formation mechanism in the Canada Basin

Yong **Cao** and Jinping Zhao

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The vertical properties and the space-time variations of the upper water mass in the Canada Basin are investigated using CTD data collected from 1993 to 2006. The layer at about 20-40 m, between the mixed layer and the Pacific-origin summer water, is called sub-surface warm water (SSWW). The temperature of the SSWW was higher than the freezing point and lower than the shallow temperature-maximum waters (STMs) which originated from the Pacific summer water. Four vertical structures of the SSWW are recognized: (1) in sea-ice covered area (tmax<-0.5°C); (2) in ice-free sea area (0°C <tmax<2°C); (3) the SSWW below a warmer mixed layer and (4) the SSWW without STMs. These four types of SSWW are found in all of the 14 years, but they differ significantly in different areas and in different years. The SSWW only occurred in a small area in the Beaufort Sea in the heavy ice years of 1995, 1996 and 1998. In most years the SSWW were found in the Chukchi slope, the Barrow valley and the Beaufort Sea. The reason is that the solar radiation heats the water more if the ice melts earlier in summer or near the marginal ice zone (MIT). In Canada Abyssal Plain there was no SSWW except in 2004, 2005 and 2006. The reduction of the Arctic sea ice could increase and enhance the SSWW phenomenon.

24 October, 10:20 (W3-5245)

Interannual variations of sea ice in the Pacific side of the Arctic and its relation with the Pacific Inflow

Jie **Su**, Dong Xu, Shujiang Li and Jinping Zhao

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Over the past 30 years significant changes happened in the Arctic Ocean including the rapid increasing of surface air temperature, shrinking of sea ice cover, and thinning of sea ice thickness. According to satellite remote sensing observations, the extent and area of Arctic sea ice reached their minimum in the summer of 2007. The region with the most retreating sea ice is the Pacific side of the Arctic. In this study we focus on interannual sea ice variations in the Chukchi Sea, Bering Sea, East Siberian Sea and Beaufort Sea. By analyzing the HadISST data from 1979 to 2007, we found that the most significant interannual variation appear in October, February, October and September, respectively. In summer, the Pacific side contributes more than Atlantic side to the sea ice retreat. There is an abrupt change in the Pacific side of the Arctic around 1996-1998. Sea ice area in September decreased more during 1998-2007 than during 1979-1997. In terms of the area with the average decreasing rate of sea ice concentration exceeds 3% per year, during 1998-2007 it is more than two times that during 1979-1997. The East Siberian Sea plays the most important role in this decadal change. We try to link this abrupt decrease with the atmospheric circulation and Pacific inflow and discuss its mechanism.

24 October, 11:00 (W3-5050) Invited

Japanese IPY activities in the western Arctic Ocean and the Bering Sea

Kohei **Mizobata**[1], Koji Shimada[1], Sei-ichi Saitoh[2], Toru Hirawake[2] and Masahiro Hori[3]

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The Japanese IPY hydrographic surveys were conducted in the western Arctic Ocean and Bering Sea. Observational results describe warming trend and changes in spatial distributions of salinity and nutrients. We will discuss the impacts of sea ice reduction on the marine ecosystem in both seas.

24 October, 11:30 (W3-5316)

Study of the extension of Pacific warm water under sea ice of the Chukchi Sea

Jinping **Zhao** and Jiuxin Shi

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During the Arctic cruise of China in 2003, a CTD transverse section in the Chukchi Sea along 169.5°W was conducted from 67°N to 74°N. The section passes the east side of the Harold Shoal, which is believed to be a pathway of a northward flow. The data show a clear decline of temperature from 4.5°C in open water to the freezing point in the ice-covered area over a distance of 200 nm. The temperature of the warm water coming from the Pacific Ocean decreased linearly with distance, showing a throughflow under the ice sheet and the cooling by the ice cover. The water layer thickness infiltrated under sea ice is about 28 m, below which the water mass is mainly undisturbed winter water with lower temperatures. At the midway of the section, 70°41'N, a surface mooring with two Aanderraa Current meters was deployed at 20 m and 40 m. The residual current under sea ice is a quite weak northern flow. It indicates that this section is not the major pathway of Pacific water. An attempt to obtain an analytical solution is made to validate the dynamic mechanism of the penetrating flow through the marginal ice zone. The result shows that the linear decrease of water temperature is hard to explain. A decrease of water temperature is usually caused by advection and/or diffusion, by which an exponential decrease is expected. Our result indicates that the linear trend of water temperature is caused by horizontally tidal mixing.

24 October, 11:50 (W3-5225)

Differences of water masses in Bering Strait throughflow and mixing on their way to the Arctic Ocean

Liqi **Chen**[1,2,3] and Zhongyong Gao[1,2]

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The characteristics of the water masses of Bering Strait throughflow were distinguished from each other by using underway pCO_2 (partial pressure of CO_2) observations, together with the measurements of CO_2 system parameters and hydrographic parameters in the Bering Strait during the 1st and 2nd Chinese National Arctic Research Expedition. Significant differences between water masses were revealed by analyzing those chemical signals. Based on these differences, various water masses could be easily distinguished each other, and their mixing on the way to the Arctic Ocean could be also tracked well. Water masses in the Bering Strait were highly stratified from July to August. The Anadyr Current and the Alaska Coastal Current almost overlaid the local water masses when transport into the Arctic Ocean. Meanwhile, other water masses in the middle of the Bering Strait were mixed vertically and enriched in nutrients. The winter residual water was distinguished by the abnormality of pCO_2, nutrients, temperature, salinity etc. All the evidence above would support that there is significant nutrient input into the Arctic Ocean from the northern Bering Sea during summer time.

24 October, 12:05 (W3-5303)

The warming evolution of the Intermediate Water in the Arctic

Shujiang **Li**, Jinping Zhao and Jie Su

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In the early 1990s, the Atlantic water entering the Arctic Ocean through the Fram Strait exhibited an anomalously warming phenomenon. Subsquently, a similar anomaly was observed in the Arctic Intermediate Water (AIW) on the pathway of the Arctic Circumpolar Boundary Current (ACBC). Here we focus on the AIW warming which started in the early 1990s in the Arctic Ocean, especially in the Canada Basin using the collected hydrographical data in the Arctic Ocean from 1990-2007 and the reanalysis data. The result shows that the warming trend of AWI in the North Pole reversed after it reached its maximum (1.75°C) in 1995, but it is still in a warm phase. In the Canada Basin, which is located in the downstream section of the ACBC, most of the AIW is still warming. In 2006, the maximum temperature of the AIW at all stations was higher than 0.5°C. We also found that the AIW warming events in the west of the Chukchi Plateau have tended to decrease since 2000. The spatial distribution of temperature and salinity in the core layer in the south Canada Basin shows that after flowing through Mendeleev Ridge, the intermediate warm water enters the Canada Basin via the north of the Chukchi Plateau but before intruding into the Canada Abyssal Plain, the warm intermediate water splits into two branches. One branch turns southward along the east shelf slope of the North Wind Ridge, while the other breaks away from the shelf slope, and then turns northeastward into the northern Canada Abyssal Plain.

24 October, 12:20 (W3-5321)

The double haloclines in the Canada Basin under the warming climate

Jiuxin **Shi**, Jinping Zhao and Shujiang Li

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The upper ocean thermohaline structures in the Canada Basin are analyzed with the historical data and recent in situ data collected by the Chinese National Arctic Research Expeditions (CHINARE). A double halocline structure, different from the Cold Halocline Layer (CHL) in the Eurasian Basin, is found in the southern Canada Basin. The Pacific-origin water is the dominant factor of the permanent double haloclines. Three Pacific-origin water masses exist in the upper layer in the Canada Basin, the Alaska Coastal Water (ACW), the summer Bering Sea Water (sBSW) and the winter Bering Sea Water (wBSW), which are indicated by two temperature maximums and a temperature minimum, increasing in depth, respectively. For the double halocline, the upper halocline lies between the summer modification and the winter modification of the Pacific-origin water while the lower halocline results from the overlying of the Pacific-origin water upon the Atlantic-origin water. The extreme warm ACW with a maximum temperature over 1ºC was found in the southwestern Canada Basin at a depth of about 50 m. Furthermore, another shallower temperature maximum with salinity less than 30 was observed at 20 m depth (above the ACW) in the region east to the Northwind Ridge in some recent observations. This subsurface warm water might be formed by local solar heating. The decreased ice cover and a shallower, seasonal stronger halocline due to the warming climate are the preconditions for the formation of the new subsurface warm water.

24 October, 14:00 (W3-5212) Invited

Results from BEST, BSIERP and other IPY-relevant research in the northern Bering Sea

Lee W. **Cooper** and Jacqueline M. Grebmeier

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The Bering Sea Ecosystem Study (BEST) and Bering Sea Integrated Ecosystem Research Program (BSIERP) are large-scale analytical efforts directed at understanding the Bering Sea ecosystem in the context of environmental change. Our presentation will outline the approaches being actively used in this on-going effort during the International Polar Year that are being contributed by a large contingent of active researchers. We will also outline recent results from other projects that have been mounted in the portion of the Bering Sea north of St. Matthew Island. In the northern Bering Sea, and extending through the Bering Strait into the Chukchi Sea, short food-chains over the shallow shelf lead to the deposition of large volumes of organic materials that sustain some of the richest infaunal and epifaunal biological communities in the Arctic or its marginal seas. These communities in turn support specialized diving apex predators including walruses, bearded seals, gray whales, and sea ducks that feed on the sea floor. Changes in fish distributions, higher water temperatures, declining sea ice extent and duration, shifts in benthic community biomass and species distributions all provide evidence for a changing food web and on-going ecosystem re-organization. We will present data demonstrating the tight linkages among sea ice retreat, chlorophyll biomass, water mass structure and particulate sedimentation on the sea floor. Interlocking processes and events suggest that significant shifts in benthic ecosystem productivity and impacts on the associated benthic based food web can be expected with continued seasonal sea ice retreat in the northern Bering Sea.

24 October, 14:30 (W3-5012)

The summer hydrography of the west Chukchi Sea shelf during opposite patterns of atmospheric circulation in 2007 and 2003

Nikolay S. **Vanin**

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Results of two oceanographic surveys conducted by TINRO-Center in the southwest part of the Chukchi Sea in the summers of 2007 and 2003 with different regimes of atmospheric circulation are presented. The stationary high centered over the Beaufort Sea during summer 2007 resulted in intensive incoming solar radiation to the sea surface and an outbreak of warm continental air masses into the east arctic basin, which caused enhanced ice thawing and a quick ice edge retreat. The ice-free area in the eastern Arctic was record-breaking in its small size. Air temperature along the Chukchi coast in July and August was close to or exceeded the historical maximum of 2005. Sea surface temperatures east of Wrangel Island attained 12°C (6-8°C above normal). Due to offshore winds along the Chukchi coast an upwelling of bottom waters occurred and the Siberian Coastal Current (SCC) was not observed. In contrast during 2003 over the east arctic seas a cyclonic regime of atmospheric circulation prevailed, and westerly winds promoted the SCC extension almost to the Bering Strait. Due to outbreak of cold arctic air from the north-west the sea surface temperature was 2-3° below normal. Salinity at the sea surface along the coast was only 23-25 psu against 31-32 psu in 2007. A coastal thermal front was observed in both situations, in the former case it was caused by upwelling and in the latter by an extension of freshened cold SCC waters.

24 October, 14:50 (W3-5229)

Change in the biodiversity of the demersal fish community in the northern Bering and Chukchi Seas

Sei-Ichi **Saitoh**[1], I Nyoman Radiarta[2], Toru Hirawake[1], Yasunori Sakurai[1], Mamoru Yabe[1], Yoshihiko Kamei[3] and Shogo Takagi[3]

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In the northern Bering Sea and Chukchi Sea, arctic cod, *Boreogadus saida* (Lepechin), is one of the key species strongly responding to climate change. During the summers of 1991 and 1992, Hokkaido University conducted oceanographic and experimental fishing surveys using the T/S Oshoro-Maru in the northern Bering Sea and Chukchi Sea to study the oceanographic environment and demersal fish community. We have conducted the Oshoro-Maru International Polar Year (IPY) research cruises with similar surveys in same regions in July and August 2007 and June and July 2008. We compare abundance and distribution of arctic cod and the other bottom fishes between in summer 1991/1992 and in summer 2007/2008 and examine the effect of recent global warming on these arctic and sub-arctic marine ecosystems. Walleye pollock and arctic cod were dominant in the northern Bering Sea and in the Chukchi Sea, respectively.

24 October, 15:10 (W3-5113)

A frontal attack – Norwegian IPY studies of the Arctic Front in the Norwegian and Barents Seas

Kenneth F. **Drinkwater**

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The aims of NESSAR (Norwegian Component of the Ecosystem Studies of Subarctic and Arctic Regions) are to examine the physical dynamics, as well as the structure and function of the marine ecosystems, in and around the Arctic Fronts separating Atlantic and Arctic waters in the Norwegian and Barents seas. Field studies during 2007 and 2008 were carried out on the Jan Mayen Front between the Norwegian and Iceland Seas and the Polar Front in the Barents Sea. Measurements included hydrography and currents, turbulence levels, nutrients, light spectral measurements, DOC, phytoplankton structure and production, zooplankton structure and distributions, benthic collections and fish distributions and diets. The primary goals of each of the components will be outlined and some preliminary results from the field studies will be described. Data from an autonomous glider at the Jan Mayen Front shows interleaving between the Arctic and Atlantic water masses at the Jan Mayen Front with mixing due to both current shear and double diffusive processes. Low fluorescence was observed at both fronts suggesting the possibility of low primary production in the front. Small zooplankton appears to be more prominent at the front and large zooplankton away from the fronts. The fish distributions (herring in the Norwegian Sea and capelin in the Barents Sea) relative to front will also be discussed. Finally some preliminary comparisons between the two regions will be presented.

24 October, 16:00 (W3-5427) Invited

The role of sea ice in the sub-Arctic Bering Sea ecosystem

Rolf **Gradinger**, Bodil Bluhm and Katrin Iken

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Our presentation focuses on recent insights into the multitude of effects and contributions of sea ice to the ecosystem in the sub-Arctic Bering Sea. We studied sea ice biological properties and their relevance for pelagic and benthic food webs in spring 2008 as a contribution to the joint Bering Sea Ecosystem Study (BEST) and Bering Sea Integrated Ecosystem Research Program (BSIERP). We will present data focusing on the following aspects: (1) What are the basic physical characteristics of Bering Sea ice, (2) how much ice algal biomass is produced during spring and (3) which taxonomic groups are the major consumers of the sea ice-derived organic material. The last aspect will focus on consumers living within the sea ice, grazers occurring at the bottom of the sea ice, and also grazing after release of organic material during ice melt by benthic and/or pelagic invertebrates. We will compare these results with information available from other Arctic seas on a pan-Arctic scale. Based on our results and other data, we will discuss the relevance of changes in the Bering Sea ice regime for the Bering Sea ecosystem during periods of ice formation, cover, and ice melt within the framework of BEST and BESIERP.

24 October, 16:30 (W3-5105)

The importance of sea-ice formation in the Sea of Okhotsk for supplying iron to the western subarctic Pacific

Jun **Nishioka**[1], Takeshi Nakatsuka[1], Kenshi Kuma[2], Yutaka W. Watanabe[3], Tsuneo Ono[4] and Kay I. Ohshima[1]

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Iron is an essential nutrient and plays an important role in the control of phytoplankton growth. Atmospheric dust has been thought to be the most important source of iron supporting annual biological production in the Western Subarctic Pacific (WSP). Our study clearly indicates that there is another important source of iron for WSP. We conducted observations in the Sea of Okhotsk and found that iron was re-suspend from the sediments of the north-western continental shelf area. This source of iron is transported by ventilation processes, which are driven by sea-ice formation in the Sea of Okhotsk, and which distributes the iron to wide area of the intermediate layer in the WSP. Furthermore, we observed a clear seasonality in dissolved iron concentrations in the surface waters of the Oyashio region. The surface waters are significantly influenced by high iron concentrations in the intermediate waters through diffusion and winter mixing. Therefore, in addition to the traditional view of dust input, iron transported into the mesopelagic zone by ventilation of intermediate waters should be considered as an important source of iron for phytoplankton blooms in the Oyashio region. Additionally, resent studies have reported that the ventilation of the intermediate waters has been reduced through a reduction of se-ice formation, probably due to global warming. Therefore, our findings contribute to a better understanding and prediction of the influence of environmental change on biogeochemical cycles and ecosystem in the WSP.

24 October, 16:50 (W3-5288)

Study of polynya processes in the Bearing Sea using a high resolution dynamic-thermodynamic sea ice model

Hongli **Fu**, Jinping Zhao and Jie Su

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The circumpolar polynyas are of vital importance for ice production and feedback processes in the atmosphere-ice-ocean system. Thus, they play a crucial role in the Arctic climate as well as the global ocean circulation. A high-resolution dynamic-thermodynamic sea ice model with a horizontal resolution of 5 km has been implemented to investigate polynya processes in the Bering Sea. The model has the same dynamical and thermodynamic process as the Los Alamos National Laboratory CICE model. The data set of Large and Yeager (2004) was used to drive the model. The model performed well in predicting the current polynya conditions in the Bering Sea compared with satellite data and theoretical calculations. The sea-ice concentration in the region of the polynyas is very small, even less than 0.1%. Through appropriately selecting a threshold value of the ice thickness, we calculate the area of every polynya along with their time evolution. The factors of polynya formation are analyzed through sensitivity experiments. Based on these analyses, polynya formation mechanisms are discussed. Our model results suggest that it is possible that polynyas can be represented in future synoptic and climate prediction systems.

24 October, 17:10 (W3-5267)

From the Barents Sea to the St. Lawrence: A Trans North Atlantic Sightings Survey (T-NASS)

Geneviève **Desportes**[1], Daniel Pike[2], Mario Acquarone[2], Igor Golyak[3], Jean François Gosselin[4], Thorvaldur Gunnlaugsson[5], Sverrir D. Halldórsson[5], Mads Peter Heide-Jørgensen[6], Jack Lawson[7], Christina Lockyer[2], Bjarni Mikkelsen[8], Droplaug Ólafsdóttir[5], Malene Simon[6], Gísli A. Víkingsson[5], Lars Witting[6], Vladimir Zabavnikov[3] and Niels Øien[9]

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T-NASS, planned under the auspices of NAMMCO and a component of IPY project ESSAR, estimates the abundance of cetacean populations in the Northern North Atlantic from survey data collected during summer 2007. It adds to the series of NASS surveys - 1987, 89, 95 and 2001 - thus forming a 20-year time series providing an opportunity to detect temporal changes in abundance. Line transect methods, with when possible double platform methodology, were used to collect visual data. Passive acoustic data were collected from 5 vessels, with focus on sperm whales. TNASS was coordinated in time, spatial contiguity and methodology with the European CODA and the American SNESSA surveys. The 12 main platforms covered 62.121 nm in effort in an area of c. 1,6 mill. nm², extending from the Eastern Barents Sea to the East coast of Canada and from 78º N to 52ºN in the east and 42 ºN to 61º N in the west. Observers placed on opportunistic surveys (MarEco, ICES Redfish and Norwegian pelagic) conducted a supplementary effort of 5,253 nm in the Irminger and Norwegian Sea and over the Mid Atlantic Ridge. Cetacean encounters numbered c. 4000 from 22 identified species, with fin whales as the most frequently encountered species. Abundance estimates are being calculated and results for some species show significant variation with previous surveys in some areas, *e.g.* minke, humpback and fin whales. The participation of Greenland and Canada, and observers on fishery surveys, made a trans North Atlantic survey possible for the first time.

24 October, 17:30 (W3-5367)

Hotspots in cold seas

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To prioritize conservation efforts in terrestrial habitats, regions with extraordinary species richness have been designated as hotspots. Similarly, in low latitude marine systems, areas with high species richness or endemism have been singled out as hotspots. More recently, Sydeman *et al.*, in a special issue of Deep-Sea Research Part II that resulted from a PICES Symposium on hotspots, included in the hotspot concept regions with high biomasses of top predators, that is, areas where trophic transfer to upper trophic levels was enhanced. At least two mechanisms promote these rich foraging opportunities. There may be regions of exceptionally high primary production that are sufficiently stable to promote the formation of a food web that reaches to the highest trophic levels. Alternatively, there may be interactions between physical processes and prey behavior that result in predictable aggregations of prey, much of which may have resulted from distant production. Within the sub-arctic seas, both mechanisms result in large aggregations of seabirds and possibly marine mammals. In these areas of aggregation, species diversity is not particularly high; in fact often one or two species dominate the foraging and one or perhaps two species of prey support the aggregation. It is not clear how these hotspots will respond to climate change, though those associated with ice edges are likely to retreat northward. Since hotspots may account for considerable trophic transfer, the population consequences of changing hotspot distribution, abundance and prey densities is a research topic worthy of study.

W3 Posters

Poster W3-5015

Western Arctic Ocean POC flux derived by the small volume ^{234}Th method

Wen **Yu**[1,2], Liqi Chen[1], Jianping Cheng[2], Jianhua He[1], Zhongyong Gao[1] and Heng Sun[1]

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To estimate the vertical flux of Particulate Organic Carbon (POC) in the Bering Strait, Chukchi Sea and Canada Basin, the deficit of ^{234}Th-^{238}U in the water column was measured during the 3rd Chinese Arctic Scientific Expedition (Jul.-Sept., 2008), in the International Polar Year 2007-2008. The recently developed small volume MnO_2 co-precipitation method has substantially increased the spatial and temporal sampling resolution of ^{234}Th in the Arctic. In this study, ^{234}Th-^{238}U deficit was widely found in the upper ocean in the research region, indicating a strong biological pump effect in the sub-Arctic and Arctic seas during summer. The POC flux and the organic carbon sedimentation rate are compared and the relationship of POC flux and environmental parameters are discussed.

Poster W3-5075

Winter oceanographic conditions in the coastal waters of the Laptev Sea (Buor Khaya Bay) – Results of IPY field monitoring in 2007

Eduard A. **Spivak**, Nina I. Savelieva and Anatoliy N. Salyuk

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In April, 2007 complex oceanographic observations under the fast ice in the Buor Khaya Bay (estuarine zone of the Lena River) have been carried out within the framework of the first expedition of the IPY 2007-2008. CTD profiles (temperature, salinity, density) and hydrochemistry sampling (silica, phosphate, nitrite and nitrate) at 53 oceanographic stations were collected during 15 days. At 3 stations daily CTD soundings and current measurements (subsurface and bottom layer) have been made. The Bay is characterized by a two-layer structure, with each layer having different hydrochemical characteristics. Freshened upper layer waters identify the arctic surface waters. Minimal values of salinity ($S < 2.5$) and maximal values of temperatures (T~0ºC) were observed in the layer immediately under the ice in the western part in the vicinity of the Lena River delta. Minimal temperature ($T < -0.8$ºC) and maximal salinity ($S > 27.5$) were recorded in the bottom layer in the east part of the Bay. At station 28 daily temperature and salinity fluctuated in the range of 0.04°-0.08°C and 0.17-1.04, respectively, being the highest at 5 m depth, weaker at 10 m and the weakest near the bottom. Daily records of current measurements have shown a change in direction from south-east to north–north-west. Maximum variability of current speed (0-0.04 m/s) is obtained in the bottom layer and related to tidal motion. Spatial distribution of temperature, salinity, and hydrochemical parameters are considered.

Poster W3-5102

Mercury distribution in the sediments of the Chukchi Sea

Maxim V. **Ivanov** and A.S. Astakhov

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Our investigation used grabs and core sediment samples from the RV "Professor Khromov" cruises in 2004 and 2006. In addition, sediment samples from the cruise by RV "Professor Khromov" in 2002 were studied. The description and initial analyzing of core sediments were carried out by standard techniques. Mercury analyses used a mercury Zeeman atomic absorption spectrometer with high frequency modulation of light polarization RA-915+ (manufactured by Lumex Ltd, Russia) and the RP-91C pyrolysis attachment without sample

pretreatment. The distribution of mercury in core sediments is characterized by small variability and mainly low concentrations due to homogeneous sediment composition and absence of anthropogenic pollution. The distribution of mercury in surface sediments of Chukchi Sea is controlled by two areas of increase concentrations. They are Gerald's Canyon and adjacent shelf and the southwest part of the sea adjoining to Hope Cape. The comparison of mercury concentrations with maps of the distribution of sediment types, grain-size composition, distribution of organic matter, biogenic opal, and hydrocarbon gases show no correlation with any of these parameters. Some correlation of the mercury content with clay grain-size fraction and opal contents is observed in area of Gerald's Canyon and to the south but not near Hope Cape. The area of Gerald`s Canyon is characterized by the greatest depths (up to 103 m), which means little probability of the presence of permafrost. The prevailing sediment type here is sandy mud with a high admixture of biogenic opal and the low content of organic matter. The Canyon is located on the presumably tectonically active riftogenic structure of Chukchi Graben. It is possible that the presence here may result from a natural mercury emission from the earth's crust. The maximal Hg concentrations are in the northern point of the investigated part (station 85B) of the canyon, on the border with the oil-bearing North Chukchi Depression.

Poster W3-5114

The Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) Consortium

Kenneth F. **Drinkwater**

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The Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) IPY Consortium is addressing how climate variability and change affects the marine ecosystems of the polar (Subarctic and Arctic) seas and their sustainability. It is lead by the Ecosystem Studies of Sub-Arctic Seas (ESSAS) GLOBEC regional program. It consists of 9 funded national and 1 international project ranging from small-scale studies of Arctic fronts to large-scale whale surveys in the North Atlantic. They are lead by scientists in 9 different countries including Canada, China, Denmark, France, Iceland, Japan, Norway, Poland and the United States. The projects span the northern Pacific, northern Atlantic and Arctic Oceans and cover studies of the physics and chemistry of the waters, sea ice conditions, and various components of the food web from plankton to seabirds and marine mammals. A brief description of the objectives and activities being carried out by the various projects and some of their initial results will be presented.

Poster W3-5208

Spatial comparison of the feeding ecology of Pacific salmon in the North Pacific Ocean during summer of 2007 IPY (Preliminary results)

Shinya Nagashima, Hideaki Kudo and Masahide **Kaeriyama**

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Pacific salmon (*Oncorhynchus* spp.) are extremely adaptable to changes in the ocean environment and their forage base, and prey on a wide diversity of organisms. In summer of 2007 IPY, we investigated spatial differences in the feeding ecology of Pacific salmon collected by non-selective drift gillnets, long line, and anglings aboard the T/V Oshoro-maru (Hokkaido University) in the Western Subarctic Gyre (WSG), the Oyashio Area (OA) and the Bering Sea (southern area: SBS, northern area: NBS). The stomach content index (SCI) of chum salmon (*O. keta*) was highest at the NBS, followed by the WSG, the SBS, and the OA in the North Pacific Ocean. They mainly fed on gelatinous zooplankton and polychaete at the OA and the WSG, pteropods at the SBS, and amphipods at the NBS. Spatial differences of their food will reflect inter- and intra-specific interaction and structure of marine ecosystems.

Poster W3-5228

Preliminarily results from the Oshoro-Maru IPY cruises in summer 2007 and 2008

Sei-Ichi **Saitoh** and Toru Hirawake

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The Bering Sea and Chukchi Sea have distinct marine ecosystems that are affected by seasonal sea ice. During the summer, the water column is stratified by melt water from retreating sea ice and phytoplankton is found near the sea surface, where the incoming sunlight is sufficient for photosynthesis. These summer conditions result in the highest primary production in the world's oceans and support high levels of fishery resources. We have conducted the Oshoro-Maru International Polar Year (IPY) research cruises in both regions in July and August 2007 and June and July 2008. The objective of this study is to examine affect of recent global warming to these arctic and sub-arctic marine ecosystem.

W4 CCCC/POC/FIS Workshop Climate scenarios for ecosystem modeling (II)

Co-Convenors: Michael G. Foreman (Canada), Anne B. Hollowed (U.S.A.), Suam Kim (Korea) and Gordon McFarlane (Canada)

Members of the Climate Forcing and Marine Ecosystem Task Team (CFAME), the Working Group on Evaluations of Climate Change Projections (WG 20), and the FIS Committee will present the results of their research on developing and applying the output of regional and global climate scenarios to ecosystem and fish stock forecasts. These groups have been developing conceptual and empirical models of the mechanisms that link climate variation to the dynamics of marine ecosystems and their commercially important species. Their work has focused on comparisons among a diversity of North Pacific ecosystems with differing dominant physical processes. WG 20 is developing higher resolution regional coupled atmosphere-ocean models forced by IPCC global or regional models to provide forecasts of regional parameters (such as SST, sea ice cover, and river discharge) that are relevant to ecosystem processes. This workshop will provide an opportunity to discuss the results, present them to the PICES community, and describe their potential for the FUTURE Program.

Friday, October 24, 2008 09:00 – 18:00

09:00 ***Introduction by convenors***

09:10 **Thomas A. Okey, Anne B. Hollowed, Michael J. Schirripa and Richard J. Beamish (Invited)**
The 2035 modelling challenge for forecasting climate impacts on marine biota and fisheries: A collaboration emerging from an international workshop (W4-5422)

09:40 **James E. Overland, Muyin Wang and Nicholas A. Bond**
Utility of climate models for regional ecosystem projections (W4-5453)

10:00 **Young Shil Kang and Sukgeun Jung**
Regional differences in responses of meso-zooplankton to long-term oceanographic changes in Korean sea waters (W4-5196)

10:20 **Yasuhiro Yamanaka *et al.***
(WG 20 update): Recent results connecting climate change to fish resources using the high resolution model, COCO-NEMURO

10:35 ***Coffee / tea break***

10:55 **Emanuele Di Lorenzo *et al.***
(WG 20 update): North Pacific Decadal Variability in the FUTURE

11:10 **James Christian *et al.***
(WG 20 update): Canadian Earth System Model scenarios for the North Pacific

11:25 **Qigeng Zhao, Qingquan Li, Jianglong Li and Fanghua Wu**
A simulation of acidification in the Pacific Ocean (W4-5432)

11:45 **Enrique Curchitser *et al.***
(WG 20 update): Downscaling climate scenarios with a fully coupled global-to-regional model

12:00 **Michael G. Foreman, William J. Merryfield, Badal Pal and Eric Salathé**
An update of regional climate modelling along the British Columbia Shelf (W4-5152)

12:20 **Vadim Navrotsky**
(WG20 update): On the role of ocean and land living matter in Global Climate Change

12:35 ***Lunch***

14:00 **Anne B. Hollowed, Teresa A'mar, Richard J. Beamish, Nicholas A. Bond, James E. Overland, Michael Schirripa and Tom Wilderbuer**
Fish population response to future climate drivers: A next step forward (W4-5365)

14:20 **Gordon H. Kruse, Jie Zheng and James E. Overland**
A scenario approach to forecast potential impacts of climate change on red king crabs in the Eastern Bering Sea (W4-5475)

14:40 **Sukyung Kang, Jae Bong Lee, Anne B. Hollowed, Nicholas A. Bond and Suam Kim**
Techniques for forecasting climate-induced variation in the distribution and abundance of mackerels in the northwestern Pacific (W4-5468)

15:00 **Michio J. Kishi, Yasunori Sakurai and Masahide Kaeriyama**
What affects on the growth and stock of chum salmon, walleye pollack, and common squid in the Northern Pacific (W4-5467)

15:20 ***Coffee / tea break***

15:40 **Richard J. Beamish**
A tail of two sockeyes (W4-5041)

16:00 **Richard J. Beamish**
Evidence that the carrying capacity of local marine ecosystems can regulate the productivity of chinook salmon (W4-5042)

16:20 **Discussions** (led by Young-Shil Kang and James Overland):

- Finishing off CFAME (timeline, assignments)
- Final report, publications, etc.…
- Needs from WG20

Saturday, October 25, 2008 09:00 – 10:30

09:00 – 10:30 **Discussions** (led by A. Hollowed)

W4 Posters

W4-5061 **Yulia Rybiakova**
Pollen records from deep-sea core LV 32-33: changes of climate and vegetation of the Northwest Japan Sea and of his shores during Holocene.

W4-5472 **Leonid Klyashtorin and Alexey Lyubushin**
Cyclic climate changes and salmon production in the North Pacific

W4 Oral Presentations

24 October, 9:10 (W4-5422) Invited

The 2035 modelling challenge for forecasting climate impacts on marine biota and fisheries: A collaboration emerging from an international workshop

Thomas A. **Okey**[1,2], Anne B. Hollowed[3], Michael J. Schirripa[4] and Richard J. Beamish[5]

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We are coordinating the development of an international collaboration for the advancement of capabilities to forecast the impacts of climate change on marine biota and fisheries. This collaboration is emerging from a workshop held at the 2008 International Symposium on Climate Change and the World Oceans, in Gijon, Spain, titled: *Linking global climate model output to (a) trends in commercial species productivity and (b) changes in broader biological communities in the world's oceans.* Given the lack of current programmatic support for such an international collaboration, an idea advanced at the workshop was to challenge the scientific community to simulate marine climate change impacts (*e.g.* for the years 2035 and 2100) by the end of the decade (late 2009) using existing modelling frameworks and structures, for any system being examined. We plan for the results of these un-standardized simulations to be assembled in a special journal issue. These documented simulations would showcase available approaches and contribute to a more standardized design for regular forecasting and assessment of the impacts of climate change on the ecological, economic, and social values of marine ecosystems. To help frame the early stages of this initiative, we identify the types of information that will be needed for the various forecasting approaches, the current availability of such information, and some related research needs.

24 October, 9:40 (W4-5453)

Utility of climate models for regional ecosystem projections

James E. **Overland**, Muyin Wang and Nicholas A. Bond

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Climate models, such as the 23 from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), are the major objective tool for climate projections, both for global warming and to assess the range of natural variability. Although there is considerable variability in each models' ability to hindcast climate patterns on regional scales, arising from model structure, physical parameterizations, location, and variable of interest, there is considerable utility in the use of these models for regional ecosystem studies if two conditions are met. We conclude that it is important to eliminate models with large hindcast errors (about half) by using observational constraints and for those models which remain that it is important to rely on a consensus of several models (of order five), which greatly reduces the remaining RMS errors from individual models. We recommend a two-step selection procedure for the North Pacific. First, models are required to reproduce the large scale climate pattern, the Pacific Decadal Oscillation (PDO). The second criterion depends on the specific region and ecosystem variable of interest. CFAME and Working Group 20 have made progress on coupling climate model results to regional ecosystems.

24 October, 10:00 (W4-5196)

Regional differences in responses of meso-zooplankton to long-term oceanographic changes in Korean sea waters

Young Shil **Kang** and Sukgeun Jung

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To understand responses of marine ecosystems to climate change in the Northwestern Pacific, we related variability in hydrological conditions to long-term changes in community structure of meso-zooplankton in the 3 distinct sea regions adjacent to the Korean peninsula (East/Japan, Yellow and South Seas), focusing on the 1990s. Overall, February Sea Surface Temperature (SST) has increased since the early 1990s in all of the three seas. April and June SST have increased since the late 1990s in the East/Japan and Yellow Seas. Sea surface salinity has decreased after the late 1990s in the all seas. The biomass of meso-zooplankton turned to an increasing phase after the early 1990s, and sharply increased after the late 1990s, indicating a regime shift triggered by the increased SST. Unusually higher biomass also was occasionally observed in April, June or October after the late 1990s in the South and Yellow Seas. The abundance of the major 4 zooplankton groups (copepods, amphipods, chaetognaths and euphausiids) have generally increased since the late 1990s, especially in 2002-2003. However, the pattern of changes in abundance varied depending on group and region. In the East-Japan Sea, a deep basin weakly influenced by the Tsushima Warm Current and the Liman Cold Current, all of the 4 groups increased in their abundances after the late 1990s. In the Yellow Sea, a semi-closed sea mainly controlled by riverine discharge, copepods and amphipods showed an increasing trend in their abundance, but chaetognaths showed a decreasing trend. In the South Sea, the intermediate sea between the East and Yellow Seas, copepods and euphausiids showed an increasing trend in their abundance but amphipods showed a decreasing trend. We will further investigate the regional differences in responses of meso-zooplankton to climate change in relation to geomorphological and oceanographic features.

24 October, 11:25 (W4-5432)

A simulation of acidification in the Pacific Ocean

Qigeng **Zhao**, Qingquan Li, Jianglong Li and Fanghua Wu

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Using BCC_OGCM_L40 with a carbon cycle, a simulation of ocean acidification by anthropogenic CO_2 has been performed. The model framework is based on MOM4. Its horizontal resolution is 1/3°~1° x 1° (1/3° in 10S~10N)). There are 40 levels in vertical. The vertical resolution is 10m in top 20 levels. The historical simulation is from 1765 to 2005. The future simulation is for 2005 to 2100 with the A2, B1 and S450 scenarios.

The historical simulation results show that the distribution patterns of the anthropogenic CO_2 flux to the ocean are similar to observations over the Pacific in 2005. The strongest flux (2~3 mol/m^2/yr) over Pacific was found in the Antarctic Circumpolar Current (150E~160W, 50S~65S). The next strongest fluxes (1~2 mol/m^2/yr) are to north of the Aleutian Islands and to the east of Japan. The south and north tropics off the equator also are higher flux (0.75~1 mol/m^2/yr) regions. The low flux (<0.25 mol/m^2/yr) bands are in subtropics.

The increase in ocean CO_2 has consequences for the chemical equilibrium of the ocean. The surface waters become more acidic. The simulated pH values decreased by about 0.1 over the Pacific Ocean from 1765 to 2005 (N Pacific: 8.147 to 8.048; S Pacific: 8.156 to 8.06). The pH has rapidly decreased by about 0.04 over the last 30 years. This causes a reduction of the capacity of the ocean to take up additional CO_2. The simulated DIC concentration changes in the 165W and 60S sections since 1765 suggest that the DIC increase was happening primarily above the 1000m depth.

Simulations with the A2, A1B, B1 and S450 scenarios for 2005~2100 show that pH in the Pacific will rapidly decrease when pco2 increases continually in the atmosphere. The pH will reduce by 0.06, 0.10 and 0.14, respectively, from that in 2005 if pco2 is increased to 430(S450), 482(B1) and 522(A2) ppm in 2050. The pH for 2100 will reduce by 0.07, 0.14 and 0.29 when pco2 is increased to 450(S450), 540(B1) and 536(A2) ppm. This ocean acidification will badly impact marine organisms.

24 October, 12:00 (W4-5152)

An update of regional climate modelling along the British Columbia Shelf

Michael G. **Foreman**[1], William J. Merryfield[2], Badal Pal[2] and Eric Salathé[3]

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Winds and precipitation from the Salathé *et al.* (2008) high-resolution climate model for the US Pacific Northwest have demonstrated that statistical downscaling of global climate model variables is inadequate in regions with significant topographic variations. Instead, regional climate models (dynamical downscaling) must be developed to more accurately represent important meso-scale processes. In this presentation, we will update progress in the development of a regional climate model for the British Columbia continental shelf. Initially this will be a ROMS ocean circulation model that takes its ocean boundary conditions from a global climate model and its atmospheric forcing from one or two regional, atmosphere-only, climate models. However, future plans for incorporating biology and two-way atmosphere-ocean coupling, as well as obtaining ocean boundary forcing from Curchitser's Northeast Pacific regional climate model, will also be discussed.

24 October, 14:00 (W4-5365)

Fish population response to future climate drivers: A next step forward

Anne B. **Hollowed**[1], Teresa A'mar[2], Richard J. Beamish[3], Nicholas A. Bond[4], James E. Overland[5], Michael Schirripa[6] and Tom Wilderbuer[1]

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The development of the analytical tools to implement forecasts of commercially exploited fish populations represents a critical first step towards integrated ecosystem assessment. We present an analytical approach to projecting climate change effects on groundfish and salmon in Alaskan waters. We use climate model simulations carried out for the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) and our knowledge of processes underlying recruitment of managed fisheries to project the impacts of climate change on selected fish species. Climatologists screen models based on their ability to replicate the observed climate variability of the North Pacific in the hindcasts for the 20th century. The subset of better models provides a basis for projections through the first half of the 21st century. The ranges of realizations from an ensemble of forecasts provide measures of natural variability and uncertainties in the variables of interest. We will utilize these scenarios to predict the impact of climate change on ocean variables that influence recruitment success of our fish species. Time series of key oceanographic factors will be produced through analysis of the direct model output, and where necessary, through empirical downscaling. We demonstrate how time series of fish production can be estimated by incorporating the projected time trend in ocean variables to a stock recruit relationship to track population fluctuations under different harvest control rules and climate change scenarios. We report on an international effort to apply this approach to species throughout the Pacific Rim through the coordination of PICES and ICES.

24 October, 14:20 (W4-5475)

A scenario approach to forecast potential impacts of climate change on red king crabs in the Eastern Bering Sea

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We developed scenario-based forecasts of potential impacts of climate change on three stocks (Bristol Bay, Pribilof Islands, and Norton Sound) of red king crabs *(Paralithodes camtschaticus)* in the eastern Bering Sea (Alaska). Seven mechanisms responsible for crab population dynamics were identified: larval prey type, larval prey timing, larval advection, juvenile predation and competition, benthic energy flow, ocean acidification, and commercial fisheries. Based on reasoned expert professional judgment, scenarios of the impacts of climate change on the biomass and commercial harvests for the years 2030 and 2050 were developed, driven by forecasts of anthropogenic and environmental conditions. Forecasts were developed largely from projections of key atmospheric and oceanographic variables from the Fourth Assessment Review by the Intergovernmental Panel on Climate Change. For each crab stock, three estimates of red king crab biomass – central, low, and high – were derived for each scenario year. Although results vary by area, global warming is generally expected to result in declines in all three stocks of red king crabs in the Bering Sea. Mechanisms operating to favor crab productivity include benefits of stock rebuilding plans and potential improved timing of red king crab larvae and their prey. These positive effects are likely to be overwhelmed by deleterious mechanisms including larval advection to unsuitable nursery habitats (Bristol Bay only), increased predation and food competition by expanding groundfish populations, and reduced energy flow to the benthic invertebrate prey species. Effects of ocean acidification on the growth and survival of king crab larvae are not likely by 2050.

24 October, 14:40 (W4-5468)

Techniques for forecasting climate-induced variation in the distribution and abundance of mackerels in the northwestern Pacific

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Scientists have compared time trends in interannual variability in oceanographic, climatic, and fishery data to time trends in the production or distribution of marine fish to evaluate the potential impact of climate variability on fisheries resources. In this investigation we examine time series of mackerel production in relation to ocean conditions in the marginal seas of the northwestern Pacific Ocean. SST in the Yellow Sea, the East China Sea (ECS) and the East/Japan Sea were compared to the national landings of mackerels in China, Japan and Korea. Data sets included time series of landings from Korean and Japanese fisheries from 1950 to the Present. Analysis of time trends in SST revealed a decadal signal in SST that was negatively correlated to the PDO before and after 1981. Analysis of the spatial pattern of SST revealed an inverse phase relationship in SST anomalies between in the eastern (130^o E) and western (123^o E) ECS. We hypothesize that mackerel production is positively influenced by warm ocean conditions in the ECS through its influence on the volume of suitable spawning habitat. We forecast the impact of climate change on mackerel production by imbedding time trends in the volume of spawning habitat into a stock projection model. We downscale time forecasts of atmospheric/ocean conditions from the Intergovernmental Panel on Climate Change models to extract time trends for local ocean conditions in the ECS. These time trends are incorporated into stock projection models by adding terms governing density dependent competition for spawning habitat.

24 October, 15:00 (W4-5467)

What affects on the growth and stock of chum salmon, walleye pollack, and common squid in the Northern Pacific

Michio J. **Kishi**[1,3], Yasunori Sakurai[2] and Masahide Kaeriyama[2]

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How will commercial fish stocks in the Northern Pacific respond to inter-annual fluctuations due to climate change? We will evaluate environmental affects on the growth of northern fish species by using a coupled bio-energetic model and NEMURO. NEMURO and NEMURO.FISH were developed by PICES MODEL Task Team. The bio-energetic model of common squid and chum salmon around Japan showed that differences in observed growth may correspond to trends in environmental conditions associated with climate change. We will discuss the future possibility of forecasting future ecological states using NEMURO. We will show the future status of fish stock based on the outputs from global atmosphere – ocean - terrestrial coupled model of A3 scenario and also show the results by bio-energetic model. Preliminary forecasts indicate that the Hokkaido stock of chum salmon will disappear by 2100 although chum salmon in Bering Sea survive. The Honshu stock of walleye pollock is expected to collapse in 2050 and Hokkaido stock will decrease dramatically in 2100. The spawning season of Japanese common squid will shift one-two months earlier than the present season.

24 October, 15:40 (W4-5041)

A tail of two sockeyes

Richard J. **Beamish**

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The Fraser River is a major producer of sockeye salmon in British Columbia and one of the major producers of sockeye salmon in the subarctic Pacific. In recent years there has been an unexpected variation in the abundance of returning adults that appears to be related to the impacts of changing climate. There is a dramatic declining trend in abundance of one of the largest populations and an even more dramatic increase in abundance of one of the smaller populations. The reasons for the differing responses remain elusive but the life history strategies of the two populations indicate that the explanation relates to feeding conditions in the ocean.

24 October, 16:00 (W4-5042)

Evidence that the carrying capacity of local marine ecosystems can regulate the productivity of chinook salmon

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DNA and coded-wire tag data indicate that an important population of chinook salmon rear in a local marine area in the Strait of Georgia for about four months. The poor marine survival of this population appears to be a function of the restricted use of the Strait of Georgia and the resulting reduced growth and is associated with the declining carrying capacity in the local area.

W4 Posters

Poster W4-5061

Pollen records from deep-sea core LV 32-33: Changes of climate and vegetation of the Northwest Japan Sea and of his shores during Holocene

Yulia **Rybiakova**

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Data of pollen-spore analysis have wide field of application, including paleogeography, paleobotany and paleoclimatology. The attributes of the paleoenvironment may reveal information about the paleoclimate. Pollen assemblages from sediments of seas can be used to reconstruct the history of changes in vegetation and climate. Pollen assemblages reflect the zonal vegetation types of seacoasts. These vegetation types are due to climatic conditions during the growing season. The pollen-spore analysis from the sediments of the Northwest Japan Sea is done in order to make reconstruction of vegetation. Pollen-spore analysis reveals the percentage of fossil pollen of different trees (broad-leaved and coniferous) and shrubs. This analysis reveals that the vegetation and climate during Holocene (13,104 years BP) was characterized mainly bushes, which are indicators of rather cool climatic conditions in this region. In contrast, the vegetation during period 10,433 years BP was dominated by oak. Thus conditions were favorable for other deciduous trees therefore they are warmer as compared with present. Now vegetation of observable region differs of dominance of wood species of conifers.

Poster W4-5472

Cyclic climate changes and salmon production in the North Pacific

Leonid **Klyashtorin**[1] and Alexey Lyubushin[2]

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The main climatic indices of the North Pacific including the Bering Sea are PDO and ALPI. The PDO index reflects the mean annual ocean surface temperature in the North Pacific and shows 60-65 year fluctuations. Unlike the Global temperature dynamics the secular PDO upward trend is absent. The same dynamics (without ascending long-term trend) are observed in surface temperature in the North Atlantic and in whole Arctic region. These observations suggest that the ascending long-term temperature trend associated with "global warming" has not been observed in the recent century in the North Pacific, North Atlantic and Arctic Ocean.

Due to reliable multiyear commercial fishery statistics, long-term changes in catches of Pacific salmon may provide good indicators of ecosystem and climatic changes in the North Pacific. The total catch of Pacific salmon for the recent century follows the cyclic PDO and ALPI dynamics: maximum in 1920-1940s, depression in 1950-1970s and new ascent from 1970s to maximum of 1990s – early 2000s. The curve of total Pacific salmon catch passed the deflection point in the late 1990s-early 2000s according to PDO dynamics. A simple stochastic model of approximate 60-65 year cyclic climate changes is suggested that makes it possible to predict trends of basic climatic indices and populations of Pacific salmon for several decades ahead. According to modeling it is possible to project a probable downward trend in the total Pacific salmon population for the upcoming 5-10 years.

W5 CCCC/ESSSAS Workshop Marine ecosystem model inter-comparisons

Co-Convenors: Masahiko Fujii (Japan), Shin-ichi Ito (Japan) and Bernard A. Megrey (U.S.A.)

Comparative analysis is a valuable scientific activity because the size and complexity of marine ecosystems precludes conducting controlled *in situ* experiments. It is also a powerful technique for understanding the important similarities and differences between and among ecosystems. Modelling is a central approach to comparative analyses of ecosystem structure, function and responses. It is important to understand whether inter-relationships among physical, chemical and biological variables vary geographically, and the extent to which any particular conclusions depend on the model used to derive them. The model inter-comparison project will use different models to develop forecasts of different ecosystems and will use different models to compare forecasts of the same location/species. The intention of the project is to develop ensemble model forecasts to compare predicted and observed responses of marine ecosystem types to global changes–similar to the widely-accepted approach used by the IPCC to evaluate alternative climate models. The project will implement the same model evaluation process with marine ecosystem models rather than climate prediction models. A major goal of the workshop is to begin planning the work of the project. Workshop activities will include: (1) nomination and discussion of potential models (and their data needs) to compare (the EurOceans Model Shopping Tool, http://www.eur-oceans.eu/WP3.1/shopping_tool/about.php, provides a large array of documented models from which to choose); (2) nominate location(s) for comparisons; (3) identify comparison protocols to compare model performance, given data needs against location data availability and compatibility; (4) identify the most appropriate indicator species on which to base comparisons, such as krill, as the "metric" for correct model behavior; and (5) plan "pseudo-controlled" experiments. Workshop participants should have at least one of the following characteristics: (1) be familiar with ecosystem models from beyond the PICES region; (2) be knowledgeable about running models; (3) be experts on the life histories of selected organisms and data associated with them; and (4) have a broad perspective on marine ecosystems.

Saturday, October 25, 2008 09:00 – 18:00

09:00 ***Introduction by convenors***

09:10 **Fei Chai, Masahiko Fujii and Marjorie Friedrichs (Keynote)**
A regional ecosystem modeling intercomparison project (W5-5369)

09:55 **J. Icarus Allen (Invited)**
Some thoughts on assessing the skill of marine ecosystem models (W5-5085)

10:15 **William T. Peterson, Tracy Shaw, Jennifer Menkel and Leah Feinberg (Invited)**
An overview of the ecology and population dynamics of euphausiids around the Pacific Rim (W5-5459)

10:30 ***Coffee / tea break***

11:00 **Harold (Hal) P. Batchelder (Invited)**
Copepods as indicator species for comparing pelagic marine ecosystem models (W5-5366)

11:20 **Toru Kobari, Tsutomu Ikeda, Michael Dagg and Atsushi Yamaguchi (Invited)**
Neocalanus copepods are useful for inter-comparison of marine ecosystem models in the PICES region (W5-5175)

11:40 Discussion and Strategy

12:30 ***Lunch***

13:30 Break Out Groups: Models, Indicator Species, Protocol, Locations

15:00 ***Coffee / tea break***

15:30 Breakout Group Reports

16:00 Discussion, Summary, Terms of Reference, and Recommendations

W5 Oral Presentations

25 October, 9:10 (W5-5369) Keynote

A regional ecosystem modeling intercomparison project

Fei **Chai**[1], Masahiko Fujii[2] and Marjorie Friedrichs[3]

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Application of biogeochemical models to the study of marine ecosystems and global carbon cycle is pervasive; but evaluation of these models' performance is problematic, especially at the global scale. Regions with extensive observations provide opportunities for developing and testing ecosystem models. As part of a regional ecosystem modeling "testbed" project, we conducted intercomparisons to critically examine which ecosystem structures and formulations are best able to simulate observed data across regions. Twelve lower trophic level models of varying complexity are objectively assessed in two distinct regions (equatorial Pacific and Arabian Sea). We run different ecosystem models using identical physical forcing fields, and implementing variational adjoint method to assimilate the same biogeochemical data. Model experiments were performed in which data were assimilated from each site individually and from both sites simultaneously. A cross-validation experiment was also conducted whereby data were assimilated from one site, and the resulting optimal parameters were used to generate a simulation for the second site. When a single pelagic regime is considered, the simplest models fit the data as well as those with multiple phytoplankton functional groups. However, those with multiple phytoplankton functional groups produced lower misfits when the models are required to simulate both regimes using identical parameter values. The cross-validation experiments revealed that the models with greater phytoplankton complexity were generally more portable. Even when different models produced similar least squares model-data misfits, they often did so via very different element-flow pathways, highlighting the need for more comprehensive data sets that uniquely constrain these pathways.

25 October, 9:55 (W5-5085) Invited

Some thoughts on assessing the skill of marine ecosystem models

J. Icarus **Allen**

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Marine systems models are becoming increasingly complex and sophisticated, and are increasingly used to support high stakes decisions. For such applications it is imperative that the model capabilities are understood, however far too little attention is been paid to model errors and the extent to which model outputs actually relate to ecosystem processes. This requires quantitative rather than qualitative approaches. The level of model skill assessment and choice of metrics is context specific; we cannot rely on a single metric to define model skill. The routine application of model skill assessment is required if we are to understand the limitations of our models and improve model forecast skill. By way of introduction and illustration, a number of approaches from simple univariate statistics through to Taylor diagrams, binary discrimination and multivariate analysis will be presented using examples from 3D coupled hydrodynamic ecosystem models applied to both the North Sea and the Global Ocean.

25 October, 10:15 (W5-5459) Invited

An overview of the ecology and population dynamics of euphausiids around the Pacific Rim

William T. **Peterson**[1], Tracy Shaw[2], Jennifer Menkel[2] and Leah Feinberg[2]

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This talk will address several goals of the workshop, including (but not limited to) a discussion of why krill would be an appropriate indicator species on which to base model comparisons. This goal will be accomplished by presenting to the Workshop participants the results of the first meeting of PICES WG 23, a new working group that will undertake a comparison of the life history and population dynamics of *Euphausia pacifica* and *Thysanoesss* spp. around the Pacific Rim. We are experts on the life histories of krill and we have a broad perspective on marine ecosystems. We will provide to the modelers in attendance a table which lists values for various physiological rates including ingestion rates as a function of food concentration, egg production rates, and growth rates (from cohort analysis of bongo tow samples and from direct measurement of molting rates in the laboratory), and age structure and mortality rates derived from our biweekly-monthly sampling program. One important message is that at the individual level, euphausiid rates are extremely variable, thus the ability to model these animals successfully may depend on the ability to deal with them in individual based models, rather as an "average individual" in more traditional NPZ models.

25 October, 11:00 (W5-5366) Invited

Copepods as indicator species for comparing pelagic marine ecosystem models

Harold (Hal) P. **Batchelder**

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Numerous types of pelagic ecosystem models exist. By "types", I refer to the state variables that are in the models and the linkages among these variables. The details of how compartments are linked, for example the specific grazing function linking prey and predator, are referred to as the "formulation". Model types can differ in complexity, ranging from very simple NPZ models with one limiting nutrient, one phytoplankton-type, and one grazer (zooplankton) to very complex models, having multiple forms of each of these and detritus (D), *e.g.*, $N_2P_3Z_2D_2$, where the subscript indicates the number of types represented. Representing detailed processes like remineralization, competition, predation, and, in some environments nitrogen-fixation and/or iron limitation, leads to more complex models. The PICES supported North Pacific Ecosystem Model for Understanding Regional Oceanography (NEMURO) has intermediate complexity ($N_3P_2Z_3D$) and includes also dissolved-organics and particulate-Si. A goal in developing NEMURO was to provide a framework for local-site ecosystem modeling, but also one that provides opportunities for larger-scale, regional comparisons of marine ecosystems. Since the original development of NEMURO, the basic model type has been modified (tweaked) to either better represent local ecosystems or add other biogeochemical processes, but this enhancement has come at the cost of generality. Copepods, an important grazer and a key trophic level for transfer of primary production to fish, have deservedly had an important role in marine ecosystem models, and are suitable for assessing how ecosystem models intercompare. I will describe several ecological complexities of copepods that might be important in modeling them.

25 October, 11:20 (W5-5175) Invited

Neocalanus copepods are useful for inter-comparison of marine ecosystem models in the PICES region

Toru **Kobari**[1], Tsutomu Ikeda[2], Michael Dagg[3] and Atsushi Yamaguchi[2]

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Neocalanus copepods occur abundantly over the PICES region and dominate the zooplankton biomass. They carry out ontogenetic vertical migrations where they develop at the surface from early spring to summer and descend to mesopelagic depths during autumn to winter for dormancy and reproduction. The life-cycle patterns are suited to the large seasonal fluctuations of food availability which are well known in both the eastern and western Pacific. Here we review the recent results of *Neocalanus* copepods to evaluate suitability as indicators for inter-comparison of marine ecosystem models. Feeding experiments show that these copepods change the size composition of the phytoplankton community by direct feeding and trophic-cascading effects. They can feed on phytoplankton, protozoans and sinking particles depending on the season and locality. Active feeding contribute a large amount of lipids and fecal pellets to the carbon flux. These results suggest that they are keystone species for trophodynamic linkage and biogeochemical cycle in food webs. Moreover, retrospective analyses indicate that decadal fluctuations with a negative anomaly in 1980s are likely associated with global climate change. We suggest that *Neocalanus* copepods are useful for model comparison for the following reasons:

1. Basic information for running models (*e.g.* life history, feeding ecology, physiology) is available.
2. These copepods have significant impacts on trophic linkage and biogeochemical cycle in food webs
3. They are relatively sensitive to climate changes.

In the presentation, we will mention the advantages of modeling copepds towards understanding ecosystem dynamics in the PICES region.

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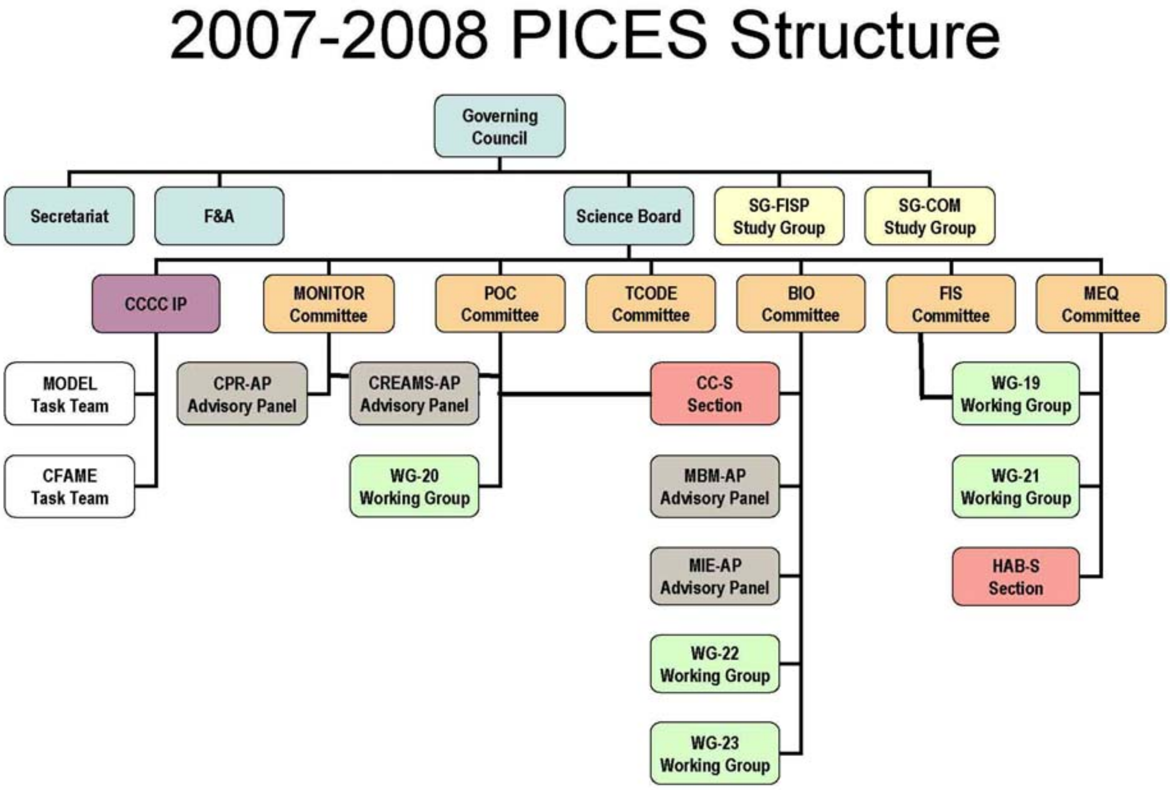
2007-2008 PICES Structure
Governing Council
Secretariat
F&A
Science Board
SG-FISP Study Group
SG-COM Study Group
CCCC IP
MONITOR Committee
POC Committee
TCODE Committee
BIO Committee
FIS Committee
MEQ Committee
MODEL Task Team
CFAME Task Team
CPR-AP Advisory Panel
CREAMS-AP Advisory Panel
WG-20 Working Group
CC-S Section
MBM-AP Advisory Panel
MIE-AP Advisory Panel
WG-22 Working Group
WG-23 Working Group
WG-19 Working Group
WG-21 Working Group
HAB-S Section

PICES STRUCTURE ACRONYMS

GC	Governing Council

Executive Committees

SB	Science Board
F&A	Financial and Administration Committee

Permanent Scientific and Technical Committees

BIO	Biological Oceanography Committee
FIS	Fishery Science Committee
MEQ	Marine Environmental Committee
POC	Physical Oceanography and Climate Committee
MONITOR	Technical Committee on Monitoring
TCODE	Technical Committee on Data Exchange

Temporary Expert Groups

HAB-S	Section on *Harmful Algal Blooms*
CC-S	Section on *Carbon and Climate*
WG-19	Working Group on *Ecosystem-based Management Science and its Application to the North Pacific*
WG-20	Working Group on *Evaluations of Climate Change Projections*
WG-21	Working Group on *Non-indigenous Aquatic Species*
WG-22	Working Group on *Iron Supply and its Impact on Biogeochemistry and Ecosystems in the North Pacific Ocean*
WG-23	Working Group on *Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim*
SG-FISP	Study Group on *Future Integrative Scientific Program(s)*
CPR-AP	Advisory Panel on *Continuous Plankton Recorder Survey in the North Pacific*
CREAMS-AP	Advisory Panel on *CREAMS/PICES Program in East Asian Marginal Seas*
MBM-AP	Advisory Panel on *Marine Birds and Mammals*
MIE-AP	Advisory Panel on *Micronekton Sampling Inter-calibration Experiment*

Scientific Program

CCCC-IP	PICES-GLOBEC Climate Change and Carrying Capacity (CCCC) Program Implementation Panel
CFAME	Climate Forcing and Marine Ecosystem Response Task Team
MODEL	Conceptual/Theoretical and Modeling Studies Task Team