

PICES-2011

**Mechanisms of Marine Ecosystem
Reorganization in the North Pacific Ocean**

North Pacific Marine Science Organization



PICES

October 14-23, 2011
Khabarovsk, Russia

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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 meeting is hosted by the Russian Federal Agency for Fisheries in cooperation with the government of the Khabarovsk Region and in coordination with the PICES Secretariat. Local arrangements are made by the Pacific Research Fisheries Centre (TINRO-Centre) and the Khabarovsk branch of TINRO-Centre.

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. All authors should designate at least 5 minutes for questions. Authors can download their presentations straight to the computers where the session/workshops will be held.

Important: Please rename your files - time-name.ppt (e.g. 0900-Smith.ppt, 1530-Kim.ppt).

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 18 (a.m.) until the end of the “Wine and Cheese” Poster Session on the evening of October 20, when poster presenters are expected to be available to answer questions. Posters must be removed in the morning of October 21.

Internet access

Internet access via wireless LAN will be available at the Official Conference Hall. A few desktop computers will also be available for participants.

Social activities

October 17, Monday (19:00-22:00)

Welcome Reception

The Welcome Reception for all participants (and registered guests) will be held in the Intourist Hotel (restaurant, 1st floor).

October 18, Tuesday (19:00-22:00)

Sports Event

This year’s Sports Event will be shooting! We have chartered the indoor rifle range in the Army Sport Club for the night. Competition between 2 teams and individuals will be arranged. Some snacks and drinks will be provided. Participation is strictly limited to 80 people, please sign up at the Registration Desk.

October 20, Thursday (18:00-20:30)

Wine & Cheese Poster Session Reception

The Poster Session Reception will be held in the Official Conference Hall, where all the posters are on display. Participants can roam around the poster displays and chat with poster presenters while nibbling on snacks and sipping beer.

Meeting Timetable

Friday, October 14						
09:00 12:30		BIO Workshop (W1), Day1	MEQ Workshop (W3)	POC/MONITOR/ TCODE Workshop (W4) <i>followed by</i> CREAMS-AP Meeting	<i>MEQ WG 21 Meeting</i>	
14:00 18:00	<i>FIS/POC WG25 Meeting (WGFCCIFS)</i>					
Saturday, October 15						
09:00 12:30	MEQ Workshop (W2)	<i>CC-S Meeting</i>	<i>MEQ/FIS WG 24 Meeting</i>	<i>POC WG 27 Meeting</i>	BIO Workshop (W1), Day2	<i>MEQ WG 21 Meeting</i>
14:00 18:00					<i>BIO WG 26 Meeting</i>	<i>MEQ/BIO WG 28 Meeting</i>
18:00 19:30	<i>CPR-AP Meeting</i>					
Sunday, October 16						
09:00 12:30	<i>HAB-S Meeting</i>	<i>BIO WG 23 Meeting</i>	<i>MBM-AP Meeting</i>	<i>AICE-AP Meeting</i>	<i>COVE-AP Meeting</i>	<i>SOFE-AP Meeting</i>
12:30 14:00	SB Lunch Meeting *					
14:00 18:00	<i>HAB-S Meeting</i>	Joint AICE-AP/COVE-AP/SOFE-AP Meeting				
18:00 19:30	<i>BIO Meeting</i>	<i>FIS Meeting</i>	<i>MEQ Meeting</i>	<i>POC Meeting</i>	<i>TCODE Meeting</i>	<i>MONITOR Meeting</i>
Monday, October 17						
09:00 10:00	OPENING SESSION					
10:40 18:00	Science Board Symposium (S1)					
18:30 22:00	Welcome Reception					
Tuesday, October 18						
09:00 12:30	MEQ Topic Session (S5)		BIO/POC Topic Session (S2)		FIS Paper Session, Day1	
14:00 18:00	MEQ/FIS Topic Session (S6)				POC Paper Session, Day1	
Wednesday, October 19						
09:00 12:30	FIS Paper Session, Day2		POC Paper Session, Day2		MONITOR/POC/FUTURE Topic Session (S9), Day1	F&A Meeting *
14:00 18:00	<i>BIO Meeting</i>	<i>FIS Meeting</i>	<i>MEQ Meeting</i>	<i>POC Meeting</i>	<i>TCODE Meeting</i>	<i>MONITOR Meeting</i>
Thursday, October 20						
09:00 12:30	FIS/POC Topic Session (S4)		MEQ/FUTURE Topic Session (S7)		MONITOR/POC/FUTURE Topic Session (S9), Day2	
14:00 18:00					BIO Paper Session, Day1	
18:00 20:30	POSTER SESSION					

Friday, October 21			
09:00 12:30	FIS Topic Session (S3)	POC/FIS Topic Session (S8)	BIO Paper Session, Day2
12:30 13:30	Closing Session		
13:30 18:30	Science Board Meeting *		
Saturday, October 22			
09:00 18:00	Science Board Meeting *	Governing Council Meeting *	
Sunday, October 23			
09:00 17:00	Governing Council Meeting *		

* Closed Session

** Award-winning scientists (Best Oral/Poster presentations) will be announced during the Closing Session

Sessions/Workshops

- S1 Mechanisms of Marine Ecosystem Reorganization in the North Pacific Ocean
- S2 Mechanisms of physical-biological coupling forcing biological “hotspots”
- S3 Population dynamics, trophic interactions and management of cephalopods in the North Pacific ecosystems
- S4 Recent changes of North Pacific climate and marine ecosystems: Implications for dynamics of the dominant species
- S5 Harmful algal blooms in a changing world
- S6 Identification and characterization of environmental interactions of marine aquaculture in the North Pacific
- S7 Land-sea interactions and anthropogenic impacts on biological productivity of North Pacific Ocean coastal ecosystems
- S8 Linking migratory fish behavior to end-to-end models
- S9 How well do our models really work and what data do we need to check and improve them?
- BIO-P BIO Paper Session
- FIS-P FIS Paper Session
- POC-P POC Paper Session
- GP General Poster Session
- W1 MEMIP-IV: Quantitative comparison of ecosystem models applied to North Pacific shelf ecosystems-
-humble pie or glee?
- W2 Remote sensing techniques for HAB detection and monitoring
- W3 Pollutants in a changing ocean: Refining indicator approaches in support of coastal management
- W4 Recent advances in monitoring and understanding of Asian marginal seas: 5 years of CREAMS/
PICES EAST-I Program

Meetings

AICE-AP	Advisory Panel on Anthropogenic Influences on Coastal Ecosystems (<i>belongs to FUTURE Science Program</i>)
BIO	Biological Oceanography Committee
COVE-AP	Advisory Panel on Climate, Oceanographic Variability and Ecosystems (<i>belongs to FUTURE Science Program</i>)
CPR-AP	Advisory Panel on the Continuous Plankton Recorder Survey in the North Pacific (<i>belongs to MONITOR Committee</i>)
CREAMS-AP	Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas (<i>belongs to MONITOR and POC Committees</i>)
CC-S	Section on Carbon and Climate (<i>belongs to BIO and POC Committees</i>)
FIS	Fishery Science Committee
HAB-S	Harmful Algal Blooms Section (<i>belongs to MEQ Committee</i>)
MBM-AP	Advisory Panel on Marine Birds and Mammals (<i>belongs to BIO Committee</i>)
MEQ	Marine Environmental Quality Committee
MONITOR	Technical Committee on Monitoring
POC	Physical Oceanography and Climate Committee
SOFE-AP	Advisory Panel on Status, Outlooks, Forecasts, and Engagement (<i>belongs to FUTURE Science Program</i>)
TCODE	Technical Committee on Data Exchange
WG-21	Working Group on Non-indigenous Aquatic Species (<i>belongs to MEQ Committee</i>)
WG-23	Working Group on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim (<i>belongs to BIO Committee</i>)
WG-24	Working Group on Environmental Interactions of Marine Aquaculture (<i>belongs to FIS and MEQ Committees</i>)
WG-FCCIFS	Joint PICES/ICES Working Group on Forecasting Climate Change Impacts on Fish and Shellfish (<i>belongs to FIS and POC PICES Committees and OCC ICES Committee</i>)
WG-26	Working Group on Jellyfish Blooms around the North Pacific Rim: Causes and Consequences (<i>belongs to BIO Committee</i>)
WG-27	Working Group on North Pacific Climate Variability and Change (<i>belongs to POC Committee</i>)
WG-28	Working Group on Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors (<i>belongs to BIO and MEQ Committees</i>)

Keynote Lecture

Recent changes in the North Pacific marine ecosystems related to climate change: Global or regional forcing?

Vjacheslav P. Shuntov and Olga S. **Temnykh**

Pacific Research Fisheries Centre (TINRO-Centre), 4 Shevchenko Alley, Vladivostok, 690090, Russia. E-mail: temnykh@tinro.ru

The idea that anthropogenic greenhouse gases are among the major drivers of climate change became widespread at the end of the 20th century. Some researchers suggest that global warming caused by the greenhouse effect will continue at least until the end of the 21st century. We do not argue that increasing human activity will have an increasing effect on regional and global climate. However, there is a real need to outline the magnitude of natural climate oscillations, with periods from hundreds to thousands of years, that were occurring long before humans started to have any noticeable impacts on the biosphere. All physical processes on Earth evolve under the guidance of cosmogenic and global geophysical factors influencing the atmosphere and hydrosphere. This may be the reason for the approximately synchronous cycles in physical (climate) and biological processes. The simultaneous overlaying of cycles having a time span from years and decades to centuries produce numerous combinations in the observed patterns of climatic, and especially, biological events. Existing trends in the dynamics of populations, biotic communities, and ecosystems depend on temporal and spatial factors. When global factors produce major effects, changes in biota occur in phase over wide areas and on a long time scale. When regional (province) factors are in play, local and short-term trends are more evident. Therefore, even large, occasionally local anomalies should not be interpreted as responses to global causes, either natural, or anthropogenic. Global changes may occur differently in different regions. Patterns in population and community dynamics may differ significantly even during analogous cycles due to multivariate impacts on biota. Biotic processes are influenced not only by fundamental environmental factors, but by population and community factors as well. Therefore, widely used climatic indices are not always reliable for unraveling mechanisms and cause-and-effect relationships. Such a conclusion is supported by newly revised datasets on variations in productivity of pelagic and bottom fish, squids, zooplankton and jellyfish acquired by TINRO-Centre in the northwestern Pacific Ocean during the last 3 decades. Observed sharp changes in fluctuating fish stocks are still poorly predictable on the basis of existing stock assessment approaches. It is therefore, important to support stock assessment models with real observational data obtained in ecosystem surveys when abundance and biomass of each species are evaluated. Macroecosystems of the North Pacific function normally, keeping biological (in particular, fish) productivity at a high level today, though it is somewhat lower than in the 1980s. Traditional methods of assessing further changes in populations and ecosystems do not have the power for producing long-term forecasts. To improve our understanding of marine ecosystem function, we need in-depth studies on how climate and oceanographic factors impact energy transfer (especially during the earliest ontogenetic stages of marine organisms) in the biosphere.

**Schedules
and
Abstracts**

S1 Science Board Symposium

Mechanisms of Marine Ecosystem Reorganization in the North Pacific Ocean

Co-Convenors: Sinjae Yoo (SB), Atsushi Tsuda (BIO), Mikhail Stepanenko (FIS), Steven Rumrill (MEQ), Hiroya Sugisaki (MONITOR), Kyung-Il Chang (POC), Toru Suzuki (TCODE), Thomas Therriault (AICE), Hiroaki Saito (COVE), Robin Brown (SOFE) and Fangli Qiao (China)

Invited Speakers:

Sukgeun Jung (Jeju National University, Korea)

Maurice Levasseur (Université Laval, Canada)

William Sydeman (Farallon Institute for Advanced Ecosystem Research, U.S.A.)

Mitsuo Uematsu (University of Tokyo, Japan)

Igor Volvenko (TINRO-Center, Russia)

Marine ecosystem variation often is attributed to natural or anthropogenic stressors, especially climatic or hydrological forcing. These studies typically show correlations among ecosystem characteristics and indices of global warming or climatic oscillations. Also, changes in biological communities often are described in terms of their correlative relationships to these large-scale indices. While these studies have produced interesting results, the underlying mechanisms responsible for ecosystem change have not been totally identified, especially when it comes to understanding how populations, communities, and ecosystems are reorganized, sometimes dramatically, over short time periods. Complexity, arising from varying influences of biotic and abiotic factors on multiple spatial and temporal scales, challenges our understanding of these processes. Because of our insufficient understanding of ecological mechanisms for oceanic regions, it is not unusual to find that what has happened in the past cannot adequately predict what will happen in the future. Thus, the focus of this Science Board Symposium will be on describing mechanisms of ecosystem change and reorganization. The influence of factors operating at various temporal and spatial scales will be considered. This symposium will lead to a better understanding of factors that control species composition and ecosystem structure in the North Pacific Ocean, and improve our ability to predict system responses to future stressors, including climate change

Monday, October 17 (10:40-18:00)

- 10:40 **Vjacheslav P. Shuntov and Olga S. Temnykh (Keynote)**
Recent changes in the North Pacific marine ecosystems related to climate change: Global or regional forcing?
- 11:20 **Mitsuo Uematsu, Shigenobu Takeda, Hiroshi Furutani and Itsushi Uno**
Potential importance of volcanic emissions on marine biogeochemical cycles and clouds over the North Pacific (S1-7776), Invited
- 11:45 **Maurice Levasseur**
Response of the plankton ecosystem of the Alaska Gyre to dust and ash depositions under current and future pH conditions (S1-7694), Invited
- 12:10 **Ryan R. Rykaczewski, John Dunne and William T. Peterson**
Projected changes in the relationship between water-column stratification and nutrient supply in the northeast Pacific (S1-7836)
- 12:30 **Lunch**
- 14:00 **Igor V. Volvenko**
Biological structure of the ocean and general patterns in the spatial-temporary distribution of the integrative characteristics of pelagic macrofauna of the north-west Pacific (S1-7855), Invited

- 14:25 **William J. Sydeman, Isaac D. Schroeder, Jarrod A. Santora, Sarah Ann Thompson, Jeffrey G. Dorman, John C. Field, Steven J. Bograd, Baldo Marinovic, Julie A. Thayer and Bryan A. Black**
Mechanisms of change in the California Current: An ecosystem case history (S1-7876), Invited
- 14:50 **Chan Joo Jang, Sinjae Yoo, Taewook Park, Jisoo Park and Minho Kwon**
Mixed layer depth variability and its associated changes in chlorophyll concentration in the North Pacific Ocean (S1-7766)
- 15:10 **William T. Peterson**
Variations in source waters which feed the California Current may be the mechanism which links the PDO and climate change with ecosystem response (S1-7837)
- 15:30 **Min Bo Luo, Xin Qian Shen and Yun Long Wang**
Comparison between the biodiversity index, Exergy, and the AMBI index for the benthos during large-scale engineering within the Yangshan Deep-water Harbor (Yangtze Estuary, China) (S1-7826)
- 15:50 ***Coffee/Tea Break***
- 16:10 **Sukgeun Jung and Ilsu Choi**
Climate-driven ecosystem shifts in Korean waters during the past 40 years (S1-7791), Invited
- 16:35 **Sanae Chiba, Kosei Sasaoka, Hiroya Sugisaki, Tsuneo Ono, Tomoko M. Yoshiki and Sonia Batten**
Phytoplankton phenology and community changes in the western subarctic North Pacific 2000-2009 based on satellite and CPR observation (S1-7707)
- 16:55 **Yury Zuenko**
Winter monsoon influence on reproduction of winter-spawning fish (Japanese sardine and Saffron cod) in the Japan/East Sea (S1-7586)
- 17:15 **Nick Tolimieri, Jameal Samhuri and Phillip Levin**
Ecological consequences of a precipitous decline in mean trophic level in the Northern California Current (S1-7885)
- 17:35 **David M. Checkley, Jr.**
A framework for ocean observing (S1-7909)
- 17:50 Summary
- 18:00 Session ends

S1 Posters

- S1-7740 **Pavel A. Saveliev**
The deep-water ichthyofauna of the Sea of Japan and global climate variability
- S1-7765 **Chan Joo Jang, Jisoo Park, Taewook Park and Sinjae Yoo**
Projected changes in the North Pacific Ocean mixed layer depth and their impacts on primary production
- S1-7784 **Jongyeon Park, Jongseong Kug, Jisoo Park, Sangwook Yeh and Chan Joo Jang**
Variability of chlorophyll associated with ENSO and its possible biological feedback in the Equatorial Pacific
- S1-7810 **Jiyeon Kim, Kwangbae Kim, Chaewoo Ma and Heungsik Park**
Changes in the population and distribution of the amphipoda *Haustorioides koreanus* (Family Dogielinotidae) caused by the Hebei Spirit oil spill in the Hakampo and Ggotji beach on the west coast of Korea
- S1-7815 **Kwangbae Kim, Jiyeon Kim and Chaewoo Ma**
Spatio-temporal changes in distribution and density of polychaete communities in Hebei Spirit oil spill impacted intertidal zones of the west coast of Korea
- S1-7844 **Xinming Pu and Ruixiang Li**
Changes in phytoplankton within the Yellow Sea during the past 50 years

S1 Session Oral Presentations

October 17, 11:20 (S1-7776), Invited

Potential importance of volcanic emissions on marine biogeochemical cycles and clouds over the North Pacific

Mitsuo Uematsu¹, Shigenobu Takeda², Hiroshi Furutani¹ and Itsushi Uno³

¹ Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Chiba, 277-8564, Japan. E-mail: uematsu@aori.u-tokyo.ac.jp

² Graduate School of Fisheries Science and Environmental Studies, Nagasaki University, Bunkyo-machi, Nagasaki-shi, 852-8521, Japan

³ Research Institute for Applied Mechanics, Kyushu University, Kasuga, Fukuoka, 816-8580, Japan

Large volcanic eruptions have been observed and their impacts have been reported on land and they have affected peoples' lives during the past several decades. Included are such eruptions as Mt. St. Helens (USA) in 1980, Pinatubo (The Philippines) in 1991, and Mt. Eyjafjallajökull (Iceland) in 2010. Volcanoes emit a number of gases (H₂O, CO₂, H₂S, SO₂, HCl, HF, H₂, N₂, Ar, CH₄, CO, NH₃) and ash particles that contain Si, Al, Fe, Ca, and P, both through sporadic explosions and continuous eruptions. It is well known that those gases and particles affect the composition of the atmosphere and, through this, global climate. However, there is very little knowledge of their impact on the marine environment, although many volcanic activities have been reported in oceanic regions. In this talk three case studies addressing different marine-related processes are introduced, and the importance of sporadic volcanic emission on biogeochemical cycles and climate, especially over the North Pacific, are discussed: (Case 1) Supply of nitrogen compounds emitted from the Miyake-jima Volcano, Tokyo, Japan; (Case 2) Supply of Iron from volcanic ash of Mt. Okmok, Aleutian Islands, USA; and (Case 3) Effect on marine clouds caused by Kilauea Volcano on Hawaii Island, USA.

October 17, 11:45 (S1-7694), Invited

Response of the plankton ecosystem of the Alaska Gyre to dust and ash depositions under current and future pH conditions

Maurice Levasseur

Biologie (Québec-Océan), Université Laval, Pavillon Alexandre-Vachon, Québec, QC, G1K 7P4, Canada

E-mail: Maurice.levasseur@bio.ulaval.ca

During the early 1990's, John Martin first experimentally demonstrated that iron (Fe) could limit the growth of autotrophic plankton in High Nutrient - Low Chlorophyll (HNLC) oceanic regions of the Alaska Gyre. Since then, the Fe-limited status of the Alaska Gyre phytoplankton community has been further investigated through several *in situ* observations and a large scale Fe fertilisation experiment (SERIES). These studies highlighted the diverse ways Fe can be sporadically delivered through the Gyre: lateral transport and vertical mixing, advection of coastal-born eddies, and aeolian deposition of dust and volcanic ash. Most of these studies have relied on indirect evidence or the use of chemical forms of iron (FeSO₄) as a proxy for aeolian depositions. It is only recently that experimental studies using natural dust and ashes have started to emerge. Given our poor understanding of the bioavailability of iron in the ocean, it is expected that dust or ash fertilisation will generate responses different than those triggered by the addition of chemical forms of iron. During this talk, I will summarize the results of a series of onboard incubation experiments designed to test the impact of various sources and concentrations of Asian dust and volcanic ash on the North Pacific plankton ecosystems. An exploration of how predicted changes in pH could alter the response of the ecosystem will also be presented.

October 17, 12:10 (S1-7836)

Projected changes in the relationship between water-column stratification and nutrient supply in the northeast Pacific

Ryan R. Rykaczewski^{1,2}, John Dunne¹ and William T. Peterson²

¹ NOAA Geophysical Fluid Dynamics Laboratory, 201 Forrestal Rd., Princeton, NJ, 08540, USA. E-mail: rrykacze@ucar.edu

² Cooperative Institute for Marine Resources Studies, Hatfield Marine Science Center, 2030 SE Marine Science Dr., Newport, OR, 97365, USA

Historical observations of climate and ecosystem variability in the subtropical oceans have recognized a negative relationship between surface temperature and ecosystem production. Generally, cooler surface waters are associated with higher production, while warmer conditions are associated with lower production. Climate-driven shifts from cool to warm conditions often have detrimental effects on ecosystem production in the northeast Pacific. Based on this historical relationship, it is reasonable to expect that productivity will decline with global warming and increased water-column stratification. We investigate ecosystem responses to projected warming for the California Current using an earth system model. Contrary to expectations, we find that biological productivity in the California Current is projected to increase in the coming century despite increased stratification. This increase is the result of changes in the isopycnal structure and deep-water circulation which enrich the nutrient content of waters entering the region. In addition to increasing primary productivity, these changes in circulation have important implications for the oxygen concentration and ocean acidification in the California Current. We also consider how these changes in circulation are applicable to nutrient supply in other ocean basins. Our results emphasize that regional ecosystem responses to warming vary at different spatial and temporal scales, and responses to long-term warming may be unexpected and counterintuitive. Historical correlations relating ecosystem changes to physical climate variability may not persist under future conditions of climate change.

October 17, 14:00 (S1-7855), Invited

Biological structure of the ocean and general patterns in the spatial-temporary distribution of the integrative characteristics of pelagic macrofauna of the north-west Pacific

Igor V. Volvenko

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia

E-mail: volvenko@tinro.ru

The integrative properties of large multispecies assemblages are investigated for the northwest Pacific. These integrative properties include total number and overall biomass, average animal size (mean individual weight), species diversity (Shannon's index), species richness and evenness (Pielou's index). These generalized parameters describe the macrofauna as a whole. For the first time, it is possible to correlate all listed integrative characteristics with each other and for a specific target research object in space and time. This allows description of the essence of the occurring phenomena to proceed from control by an extremely small set of general principles that characterize organization of life in the pelagic water layer.

October 17, 14:25 (S1-7876), Invited

Mechanisms of change in the California Current: An ecosystem case history

William J. **Sydeman**¹, Isaac D. Schroeder^{2,3}, Jarrod A. Santora¹, Sarah Ann Thompson¹, Jeffrey G. Dorman¹, John C. Field², Steven J. Bograd³, Baldo Marinovic⁴, Julie A. Thayer¹ and Bryan A. Black⁵

¹ Farallon Institute for Advanced Ecosystem Research, P.O. Box 750756, Petaluma, CA, 94975, USA. E-mail: wsydeman@comcast.net

² Southwest Fisheries Science Center, 110 Shaffer Rd., Santa Cruz, CA, 95060, USA

³ NOAA-Environmental Research Division, 1352 Lighthouse Ave., Pacific Grove, CA, 93950, USA

⁴ Long Marine Laboratory, 110 Shaffer Rd., UC Santa Cruz, Santa Cruz, CA, 95060, USA

⁵ Hatfield Marine Science Center, 2030 Southeast Marine Science Dr., Newport, OR, 97365, USA

Global climate change is expected to substantially impact eastern boundary current/upwelling ecosystems of the world. Ecosystem-specific mechanisms for impacts include ocean warming and increasing stratification, poleward shifts of the westerly winds and shifts in current positioning and flow rates, and increasing or decreasing regional upwelling as a result of enhanced thermal gradients between land and sea. Beyond the responses of individual biological species and populations to physical variations (*e.g.*, changes in phenology or range shifts), insight may be gained by investigating mechanistic variations in ecological interactions, such as changes in the spatial and temporal availability of prey and predator-prey functional relationships (*e.g.*, levels of trophic synchrony) or changes in competitors or predators that introduce different “top-down” controls on local food webs. The central-northern California Current Ecosystem (CCE) is a well-studied system for which vertical and horizontal transport mechanisms drive primary productivity on multiple scales. Evidence of slow secular changes in currents, upwelling, and stratification have been observed, as predicted under climate change. Range shifts and changes in phenology and demographic attributes of krill, forage fish, and predators (seabirds, salmon, marine mammals), as well as apparent non-linear responses in these functional groups, have also been observed. These changes are leading to an increasing frequency in trophic mismatches as well as greater variation in apparent top-down mechanisms. Previous co-variation in the ecological responses to temporal environmental variation is breaking down, and variability is increasing. These changes decrease the predictability of the ecosystem and have significant fisheries and ecosystem (area-based) management implications.

October 17, 14:50 (S1-7766)

Mixed layer depth variability and its associated changes in chlorophyll concentration in the North Pacific Ocean

Chan Joo **Jang**, Sinjae Yoo, Taewook Park, Jisoo Park and Minho Kwon

Korea Ocean Research and Development Institute, 1270 Sa-dong, Ansan, Gyeonggi-do, 426-170, R Korea. E-mail: cjjang@kordi.re.kr

This study investigates variability of mixed layer depth (MLD) and its relation with chlorophyll (CHL) in the North Pacific Ocean (NP) on seasonal to year-to-year timescales. The Pacific MLD field was calculated from SODA (Simple Ocean Data Assimilation; version 2.1.6) covering 51 years from January 1958 to December 2008. The CHL data, which cover the period of 1998-2008, were taken from SeaWiFS (Sea-viewing Wide Field-of-view Sensor). The North Pacific MLD changes appear to be associated with ENSO and global warming. The NP MLD at mid-latitudes increases during La Niña years, while it decreases during El Niño years, with about a two month lag. The annual cycle in CHL in the NP shows a 3-4 year fluctuation, possibly through ENSO modulation of the NP MLD, but it cannot be confirmed because of the short data period. On the other hand, MLD in the Kuroshio Extension regions shoals continuously for the time period (1958-2008) in this study, suggesting global warming effects. In some regions, CHL was relatively low in 1998-2004, and high in 2005-2008 periods (reverse in other areas), indicating possible contribution of the Pacific Decadal Oscillation to NP CHL changes.

October 17, 15:10 (S1-7837)

Variations in source waters which feed the California Current may be the mechanism which links the PDO and climate change with ecosystem response

William T. **Peterson**

Northwest Fisheries Science Center (NWFS), NOAA-Fisheries, 2030 SE Marine Science Dr., Newport, OR, 97365, USA
E-mail: Bill.Peterson@noaa.gov

Analysis of hydrographic and zooplankton data collected fortnightly in the coastal upwelling zone off Oregon for the past 16 years show that variations in SST, salinity, copepod biodiversity and community structure are significantly correlated with the Pacific Decadal Oscillation. When the PDO is negative, winter winds are northerly and westerly (1999-2002 and 2008-2009), cold salty waters from the Gulf of Alaska feed the northern California Current (NCC) and transport large, lipid-rich copepods to the shelf waters of the NCC; when the PDO is in positive phase, winter winds are more southerly (as in 2003-2007) and a greater proportion of warm sub-tropical waters from offshore move shoreward and feed the NCC, and transport small, oceanic lipid-poor copepods to the coast. Thus the basin-scale variations in winds that drive the PDO result in changes in transport that in turn control local food chain structure. Changes in food chain structure are correlated with (and predict) salmon returns to the Columbia River and likely influence recruitment of sablefish (black cod). Thus the mechanism that links the PDO with fish is the transport of sub-arctic vs. sub-tropical waters to the California Current; transport in turn determines food chain structure (lipid-rich vs lipid-poor zooplankton) and survival and growth of salmon. To determine how the NCC might react to various climate change scenarios, we will need better coupled global climate-ROMS models and better observations of winds and hydrography so as to track the variations in source waters which feed the NCC.

October 17, 15:30 (S1-7826)

Comparison between the biodiversity index, Exergy, and the AMBI index for the benthos during large-scale engineering within the Yangshan Deep-water Harbor (Yangtze Estuary, China)

Min Bo **Luo**, Xin Qian Shen and Yun Long Wang

Key and Open Laboratory of Marine and Estuarine Fisheries Resources and Ecology, East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, 300 Jungong Rd., Shanghai, 200090, PR China. E-mail: minbl@163.com

The Hangzhou Bay ecosystem of the Yangtze Estuary exhibits sensitivity and complexity as ecological habitat for various fishes, shrimps, crabs and parrs, and the bay is famous for the Zhoushan Fishing Grounds. In recent years, a series of large-scale ocean engineering activities were initiated at Hangzhou Bay, and the benthos communities have direct or indirect relationships with the physical and chemical processes of the ecosystem. We conducted a comprehensive oceanographic survey (2001-05) at 20 sampling sites in waters around the Yangshan Islands (30°32' - 30°50'N, 121°53' - 122°17'E) during the months of February, May and August, and focused on infauna and epifauna communities. From 2001-03 the Exergy index increased for infauna sampled from the Yangshan deep-water harbor, and the index declined over the period of 2003-06 (ANOVA, $P < 0.05$). The difference was significant (ANOVA, $P < 0.01$) for the comparison between 2001 and 2003-06. These results indicate that the infauna Exergy declined during the large-scale estuary engineering activities, while the epifauna Exergy rose in the first engineering year and declined from the high point. AMBI (AZTI Marine Biological Index) values are influenced by the species distribution for the ecological groups. AMBI indices for infauna increased (Feb. and Aug.) over 2003 to 2005, indicating that the infauna were exposed to heavy disturbance or pollution. The analysis indicates that suspended solids were a primary factor for changes in the successional ecology of the infauna, especially in Feb. 2003 to 2005.

October 17, 16:10 (S1-7791), Invited

Climate-driven ecosystem shifts in Korean waters during the past 40 years

Sukgeun **Jung**¹ and Ilsu Choi²

¹ School of Marine Biomedical Sciences, Jeju National University, 1 Ara 1-dong, 102 Jejudaehakno, Jeju, 690-756, R Korea
E-mail: sukgeun.jung@gmail.com

² Department of Applied mathematics, Chonnam National University, Yeosu, 550-749, R Korea

To understand the mechanisms by which climate changes influence marine ecosystems, we analyzed the following spatially-explicit long-term times series data from 1968 to 2009: (1) meteorological and hydrographical conditions in the southern Korean peninsula and its adjacent waters; (2) volume transport of the Tsushima Warm Current (TWC); (3) zooplankton abundance/biomass; and (4) fisheries yields. By applying categorical multivariate analyses and regime detection methods, we define four regimes and their characteristic commercial fish species: (1) saury (1968-1974); (2) pollock (1975-1982); (3) sardine (1983-1990); and (4) common squid (1991-2009). Because these four species have been caught mostly in the TWC region, we analyzed seasonal and annual variations in volume transports of the TWC, but could not detect any significant shift. For depth-specific oceanic conditions, shifts were detected in water temperature and salinity at the mixed-layer (0-50 m), but not at deeper depths (50-100 m). The 1991 shift in fisheries species composition seemed to have been driven by the well-established 1988-1989 regime shift, which was confirmed again here in air surface temperature, mixed-layer water temperatures and zooplankton biomass. The other two shifts in fish species composition (1975 and 1983) seemed to be remotely related with strong El Niño events, although we could not detect the corresponding oceanographic shifts in Korean waters. Overall, the 1989 shift was most evident in Korean waters. We will further investigate the links between physical oceanography and fish community by applying hierarchical Bayesian spatio-temporal models for the two distinct systems, the Yellow Sea and the TWC region.

October 17, 16:35 (S1-7707)

Phytoplankton phenology and community changes in the western subarctic North Pacific 2000-2009 based on satellite and CPR observation

Sanae **Chiba**¹, Kosei Sasaoka¹, Hiroya Sugisaki², Tsuneo Ono³, Tomoko M. Yoshiki² and Sonia Batten⁴

¹ Research Institute for Global Change, JAMSTEC, 3173-25 Showamachi, Kanazawa, Yokohama, Kanagawa, 236-0001, Japan
E-mail: chibas@jamstec.go.jp

² National Research Institute of Fisheries Science, FRA, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

³ Hokkaido National Fisheries Research Institute, FRA, 16 Katsurakoi, Kushiro-shi, Hokkaido, 085-0802, Japan

⁴ Sir Alister Hardy Foundation for Ocean Science, 4737 Vista View Cres., Nanaimo, BC, V9V 1N8, Canada

We investigated phytoplankton phenology and community changes in the western subarctic North Pacific for 2000-2009 with particular focus on the regional comparison of its response to Pacific Decadal Oscillation (PDO) in the East section, off Kamchatka (43-55°N, 155-170°E), and the West section, off Northeast Japan (40-50°N, 142-155°E). Timing of peak phytoplankton abundance and duration of the bloom was estimated by the cumulative-sum technique for 10 day-composite satellite Chl *a* data. Community structure of phytoplankton was examined based on the CPR samples. In the West, timing of the bloom peak was delayed in the years of positive PDO coupled with cool spring SST anomalies, and these conditions were likely to result in observed higher diatom abundance in May - June. In the East, SST was more strongly correlated to ALPI than PDO. Bloom duration was long in the years of positive ALPI with warm spring and cool summer conditions, while influence of seasonal SST on the timing of the bloom peak was less clear. Also in the years of warm spring, dinoflagellates dominated the phytoplankton community and annual phytoplankton abundance decreased. Results from this study suggest that climatic forcing related to the North Pacific Decadal Oscillation influenced the regional SST pattern. Phytoplankton phenology and community were also influenced in both regional sections but in different temporal patterns, as interannual variation of the spring SST anomaly was out of phase between the two regions. The possible link between phenology of phytoplankton and zooplankton will be discussed in the presentation.

October 17, 16:55 (S1-7586)

Winter monsoon influence on reproduction of winter-spawning fish (Japanese sardine and Saffron cod) in the Japan/East Sea

Yury Zuenko

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: zuenko_yury@hotmail.com

The winter monsoon exhibited a weakening trend in the last decades, despite decadal and year-to-year fluctuations and abnormal strengthening in 2009-2011. Decadal fluctuations are formed by air redistribution between polar and moderate latitudes (Arctic Oscillation), but the negative trend is caused by enhanced thermal isolation of the atmosphere ("greenhouse effect"). Hence, winters become warmer in the Japan/East Sea, SST increases, depth of convection decreases, and ventilation of deep layers weakens. Concurrently, the abundance of zooplankton and stocks of many commercial warm-water species of fish and squids increases due to improved conditions for reproduction. In contrast, stocks of winter-spawning species such as Saffron cod (*Eleginus gracilis*) and Japanese sardine (*Sardinops melanostictus*) exhibited drastic declines after winter warming in the 1990s, although conditions for their reproduction appeared to improve. Spawning grounds for these species occur in the north and south of the Japan Sea, respectively, and they spawn almost simultaneously in January-March. Recent data on their spawning dynamics show that the timing of spawning shifted to earlier dates, with the most prominent shift in the late 1980s. A statistical relationship exists between the timing of spawning and thermal conditions in the preceding months; warmer winter results in earlier spawning, and vice versa. Optimal conditions for spawning are identified relative to spring bloom conditions, and earlier spawning is unfavorable for survival of fish larvae. Dependence of fish year-class strength on the interval between spawning and the spring bloom is identified as a potential basis for prognostic modeling of their stocks.

October 17, 17:15 (S1-7885)

Ecological consequences of a precipitous decline in mean trophic level in the Northern California Current

Nick Tolimieri, Jameal Samhuri and Phillip Levin

Northwest Fisheries Science Center, NOAA Fisheries, 2725 Montlake Blvd. East, Seattle, WA, 98112, USA
E-mail: jameal.samhuri@noaa.gov

Mean Trophic Level (MTL) is a ubiquitous, and recently contentious, indicator of marine ecosystem status. Surprisingly, the ramifications of reductions in the biomass of upper trophic level species (especially those that are exploited) for broader ecosystem structure and function have been little explored. Using a fisheries-independent data set, we document a rapid decline in the MTL for the groundfish community along the Pacific U.S. Coast from 2003 - 2009. We show that while biomass decreased in lower, intermediate, and upper trophic level groups, loss of upper trophic level biomass (top predators) was most rapid. As a consequence, the structure of the groundfish community shifted over time, with top predators making up proportionally less of the total groundfish biomass. An ecosystem model suggests that this type of perturbation could result in short-term positive responses by many lower trophic level species (*e.g.*, forage species), while in the longer term initial patterns of prey release may be tempered in part by lagged responses of upper trophic level, non-groundfish predators (mammals and seabirds). Interestingly, aggregate ecosystem functions, such as respiration and production, are expected to change little following the initial reorganization of biomass from groundfish to other components of the food web. We suggest that efforts to manage and conserve marine ecosystems will benefit from a fuller consideration of the information content contained within, and implied by, fisheries-independent trophic level indicators.

October 17, 17:35 (S1-7909)

A framework for ocean observing

David M. Checkley, Jr.

Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA, 92093-0218, USA
E-mail: dcheckley@ucsd.edu

Ocean scientists are increasingly being called upon to provide data and impartial scientific information to support all levels of management, requiring more and better-coordinated efforts towards observing and understanding oceans and coastal seas throughout the globe. To date, largely independent observing systems have evolved to meet the needs of particular disciplines and end users, most focusing on ocean physics while the problems we face are interdisciplinary. At OceanObs'09 (Venice, 2009), attended by representatives of ocean observation programs worldwide, a Task Team (TT) was commissioned to develop a Framework for Ocean Observing. The TT agreed that Framework should be organized around essential ocean variables (EOVs) adopted according to their readiness levels, allowing timely implementation of components that are already mature, while encouraging innovation. The Framework takes advantage of existing structures, promotes a collaborative system with voluntary participation, and seeks to support self-funding and self-managing elements. The TT recommends establishment of a governance model consisting of a Framework Steering Group, three Ocean Observing System Panels focused on physics, biogeochemistry, and biology, and Ocean Observing System Implementation Teams. The TT recommends that the ocean observing community, including PICES, quickly adopt, adapt to, and support the Framework. A framework based on broad community collaboration will foster innovation and scientific discovery; improve communications and data sharing across the community; result in faster and better-coordinated information to support both science and societal needs; contribute to capacity building and enhancement of ocean observations in developing countries; and finally increase confidence and support among sponsoring and funding entities.

S1 Session Posters

S1-7740

The deep-water ichthyofauna of the Sea of Japan and global climate variability

Pavel A. **Saveliev**

A.V. Zhirmunsky Institute of Marine Biology, FEB RAS, 17 Palchevskii St., Vladivostok, 690041, Russia. E-mail: tomthumb@mail.ru

The diversity and biomass of deep-water fishes in the Sea of Japan (SJ) is currently much lower than occurs at corresponding depths within adjacent seas. This observation is in agreement with data on the composition and biomass of deep-water benthos and zooplankton of the SJ (Levenstein, Pasternak, 1976; Sazhin, Vinogradova, 1979). Absence of ancient deep-water animals is a characteristic feature of the deep-water fauna of the SJ (Andriashev, 1979). Only few representatives of secondary deep-water ichthyofauna are known within the 1,000 to 2,000m depth range: Zoarcidae (3), Liparidae (2), Psychrolutidae (1) (Okiyama, 2004; Saveliev, 2010; Dolganov, Saveliev, 2010). Fishes have not yet been recorded at depths beyond 2,000m (SoJaBio-expedition, 465-3,666m). Paucity of the SJ deep-sea ichthyofauna is connected with repeated replacements from the basin during past geological epochs (Dolganov, Saveliev, 2010). Pleistocene glacial events were accompanied by considerable sea level regression and the lack of water exchange with adjacent basins (Ingle, 1992). Superficial layer freshening limited mixing of vertical water masses and resulted in suffocation phenomena at great depths. Deep-water species that were unable to abandon their biotope were doomed for extinction or resettlement in the upper bathyal zone. Former natural habitats could be resettled only by eurybathic forms which currently constitute most of the SJ deep-water bottom fauna (Dolganov, Saveliev, 2010). Significant long-term global climate change towards both cold snaps or warming can negatively influence the deep-water fauna. Qualitative and quantitative composition of the deep-water fauna can be used as an indicator of local and global climate changes.

S1-7765

Projected changes in the North Pacific Ocean mixed layer depth and their impacts on primary production

Chan Joo **Jang**, Jisoo Park, Taewook Park and Sinjae Yoo

Korea Ocean Research and Development Institute, 1270 Sa-dong, Ansan, Gyeonggi-do, 426-176, R Korea. E-mail: cjjang@kordi.re.kr

This study investigates changes in the mixed layer depth (MLD) in the North Pacific Ocean in response to global warming and their impacts on primary production by comparing outputs from 11 models of the coupled model intercomparison projects phase 3. The MLD in the 21st century decreases in most regions of the North Pacific, whereas the spatial pattern of the MLD is nearly unchanged. The overall shoaling results in part from intensified upper-ocean stratification caused by both surface warming and freshening. A significant MLD decrease (> 30 m) is found in the Kuroshio Extension (KE), which is predominantly driven by reduced surface cooling, caused by weakening of wind. Associated with the mixed layer shoaling in the KE, the primary production component resulting from seasonal vertical mixing will be reduced by 10.7-40.3% (ranges of medians from 11 models) via decreased nitrate fluxes from below. Spring blooms in most models are projected to initiate earlier in the KE by 0-13 days (ranges of medians from 11 models). Despite the overall trends, the magnitude of changes in primary production and timing of spring blooms are quite different depending on models and latitudes.

S1-7784

Variability of chlorophyll associated with ENSO and its possible biological feedback in the Equatorial Pacific

Jongyeon Park¹, Jongseong Kug¹, Jisoo Park¹, Sangwook Yeh² and Chan Joo **Jang**¹

¹ Korea Ocean Research and Development Institute, 1270 Sa-dong, Ansan, Gyeonggi-do, 426-176, R Korea. E-mail: cjang@kordi.re.kr

² Department Environmental Marine Science, Hanyang University, 1271 Sa 3-dong, Sangrok-gu, Ansan, 426-791, R Korea

The relationship between oceanic phytoplankton and climate variability has been given increasing attention with the accumulation of satellite-derived chlorophyll data over the past decade. Here, we examine the dominant variability of phytoplankton and its associated tropical climate systems, in particular, the El Niño-Southern Oscillation (ENSO). The analysis, using 148 months of chlorophyll data, reveals that the first two leading modes of tropical chlorophyll anomalies are linked to the mature phase and the decaying phase of the ENSO cycle. It is also found that when El Niño events occur the reduced surface solar radiation (enhanced convective activity), as well as the insufficient nutrient supply (suppressed equatorial upwelling), can also play a significant role in reducing chlorophyll concentration. The effect of reduced surface solar radiation on the chlorophyll is larger in the central Pacific than in the eastern and western Pacific, and this regional difference of the impact induces a distinctly asymmetric response of ocean chlorophyll to El Niño and La Niña in the central Pacific. A linear statistical analysis shows that the dominant variability of chlorophyll associated with ENSO contributes radiant feedback to the equatorial Pacific by altering the surface shortwave albedo. The decreased chlorophyll concentration during El Niño tends to induce radiant cooling at the ocean surface.

S1-7810

Changes in the population and distribution of the amphipoda *Haustorioides koreanus* (Family Dogielinotidae) caused by the Hebei Spirit oil spill in the Hakampo and Ggotji beach on the west coast of Korea

Jiyeon **Kim**¹, Kwangbae Kim¹, Chaewoo Ma¹ and Heungsik Park²

¹ Department of Marine Biotechnology, Soonchunhyang University, 646 Eupnae-ri, Asan, Chungcheongnam-do, 336-745, R Korea
E-mail: kji8122@naver.com

² Marine Living Resources Research Division, Korea Ocean Research and Development Institute, 787 Haeon-ro, Sangrok-gu, Ansan, Kyunggi-do, 426-744, R Korea

The life history and distribution of amphipoda (*Haustorioides koreanus*) were investigated within the intertidal zone on Hakampo and Ggotji beaches (west coast of Korea) in response to the Hebei Spirit oil (December 2007). Hakampo beach is located near the Hebei Spirit oil spill site and Ggotji beach is located far from the accident site. *H. koreanus* were collected shortly after the oil spill (July, October 2009) and again from January 2010 to March 2011. Seasonal density of *H. koreanus* differed substantially between the sites with 92 inds./m² at Hakampo and 665 inds./m² at Ggotji. Monthly density also differed (76 inds./m² at Hakampo and 96 inds./m² at Ggotji). The monthly sex ratio was 0.77 (F:M) at Hakampo during February 2011 and 0.75 at Ggotji during March 2010. Mean body length was larger at Ggotji (6.46 mm) compared to Hakampo (5.76 mm) during Feb 2010 to Mar 2011. Brooded females appeared at Ggotji during April, May, September 2010, while brooding occurred from July to September 2010 at Hakampo. The brooding period was delayed for female populations at Hakampo compared to Ggotji. Early mortality may be higher at Hakampo than Ggotji because juveniles were not collected after the appearance of brooded females at Hakampo during September 2010. We observed a high correlation between the number of brooding eggs and body length at both Hakampo and Ggotji. The annual recruitment pattern of *H. koreanus* exhibited two major peaks. Females grew faster than males at Hakampo, while males grew faster than females at Ggotji.

S1-7815

Spatio-temporal changes in distribution and density of polychaete communities in Hebei Spirit oil spill impacted intertidal zones of the west coast of KoreaKwangbae **Kim**, Jiyeon Kim and Chaewoo MaDepartment of Marine Biotechnology, Soonchunhyang University, 646 Eupnae-ri, Asan, Chungcheongnam-do, 336-745, R Korea
E-mail: kkb9043@naver.com

The *Hebei Spirit* oil spill (Taean county, west coast of Korea; Dec. 2007) caused significant changes in the intertidal polychaete communities. We compared the pre- and post-oil spill status for polychaete communities at six stations (Hakampo, Yeonpo, Mongsanpo, Magumpo, Ggotji, and Baramarae beaches) over the period of 2007-2010. After the oil spill, the total number of species increased in 2008-09 but decreased in 2010. The mean density of polychaetes decreased in 2008 but gradually increased in 2009-10. In 2007, the dominant species were *Euzonus* sp. (24 inds./m²), *Haploscoloplos elongates* (18 inds./m²), and *Armandia lanceolata* (12 inds./m²). In 2008, *H. elongates* (7 inds./m²), *Laonice cirrata* (7 inds./m²) and *Nerinides yamaguchii* (7 inds./m²) were dominant, and in 2009 species of Spionidae (52 inds./m²), *A. lanceolata* (32 inds./m²) and *Spio filicornis* (26 inds./m²) were dominant. Three years after the oil spill (2010), species such as *N. yamaguchii* (116 inds./m²) and *A. lanceolata* (35 inds./m²) were dominant. One dominant species (*A. lanceolata*) appeared continuously during the study period, although their density was low in 2008 and higher in 2009-10. Overall species diversity was higher in 2008 (one year after the oil spill) than in 2007, but species diversity was decreased further from 2009. Azit's Marine Biotic Index values (estimated to represent the 'health' of benthic community) were low (1.662) in 2007 (pre-oil spill survey), and indicate uncontaminated polychaete communities. These post-oil spill surveys indicate a 1.47-1.56 fold increase in the index values, suggesting that drastic changes occurred in the local polychaete communities.

S1-7844

Changes in phytoplankton within the Yellow Sea during the past 50 yearsXinming **Pu** and Ruixiang Li

First Institute of Oceanography, State Oceanic Administration, Qingdao, 266061, PR China. E-mail: xmpu@fio.org.cn

Understanding long-term changes in phytoplankton is a vital step to identification of connections between climate change and marine ecosystem dynamics in the Yellow Sea. We collected historical data for phytoplankton communities in 1959, 1984-1985, 1998-2000, 2006-2007, and 2008. In all these datasets, phytoplankton samples were obtained by vertically towing a phytoplankton net with 0.1 m² mouth size and 76 µm mesh size, and phytoplankton were identified and enumerated with a microscope. The average phytoplankton abundance in the Yellow Sea covered 4 orders of magnitude, from 2.24 × 10⁴ cells/m³ to 6.34 × 10⁷ cells/m³. Since phytoplankton abundance changed dramatically in both space and time, we cannot identify any stable trends over the past 50 years. Difficulties with identification of changing phytoplankton patterns may lie in the great differences in different areas, so we divided the Yellow Sea into 7 sub-sections. In the Central South Section of the Yellow Sea, a phytoplankton bloom usually occurred in spring. Phytoplankton abundance generally exhibited an increasing trend from 1959 to 2006-07, and the dominant species changed from *Hemiaulus sinensis* in 1959, *Bacteriastrum hyalinum* in 1984, to *Skeletonema costatum* in 2005 and 2006 (all chain-forming centric diatoms). In the Changjiang Estuary North Section, the phytoplankton bloom usually occurred during summer. Dominant species changed from *Skeletonema costatum* and *Nitzschia pungens* in 1959 to *Chaetoceros* spp. Climate-related events such as formation of the spring thermocline, Asia Dust events, and the intrusion of the Changjiang Diluted Water exert controls on the succession of phytoplankton in the Yellow Sea.

S2 BIO/POC Topic Session

Mechanisms of physical-biological coupling forcing biological “hotspots”

Co-Sponsored by ICES

Co-Convenors: Jürgen Alheit (ICES/Germany), Elliott Hazen (PICES/U.S.A.), Oleg Katugin (PICES/Russia), Robert Suryan (PICES/U.S.A.), Yutaka Watanuki (PICES/Japan) and Ichiro Yasuda (PICES/Japan)

Invited Speakers:

Jürgen Alheit (Leibniz Institute for Baltic Sea Research, Germany)

Igor Belkin (University of Rhode Island, U.S.A.)

Sei-Ichi Saitoh (Hokkaido University, Japan)

Robert M. Suryan (Oregon State University, U.S.A.)

This session will examine the physical and oceanographic factors that correspond to ecological or economic “hotspots” in the North Pacific and North Atlantic and their marginal seas. For the Pacific, this session will focus on the Kuroshio/Oyashio extensions and ecotone, the intersection of the Sea of Okhotsk and the western North Pacific (Kuril Islands region), and the Western Bering Sea. For the Atlantic, this session will focus on the North Sea, the intersection of the Gulf Stream and Labrador Current, in addition to tidally driven systems such as the Gulf of Maine and Gulf of St. Lawrence. “Hotspots” can broadly be defined as areas encompassing high species diversity, high abundance of individuals, especially of important indicator species, or areas of high economic value. Interdisciplinary contributions on physical-biological coupling and resulting seasonal or year-round “hotspots” in primary to tertiary productivity are invited. This includes data on physics, phyto- and zooplankton, forage fish, and upper trophic level predators (e.g., fish, seabirds, mammals, humans). We are particularly interested in simultaneous multi-species multi-use hotspots (i.e., sites of ecological importance that overlap highly with sites of economic value) and potential changes in hotspots under future climate change scenarios. Modeling and empirical studies are encouraged. We will solicit a special publication in the primary literature pending subscription to the session.

Tuesday, October 18 (9:00-18:00)

- 9:00 **Introduction by Convenors**
- 9:05 **Sei-Ichi Saitoh, Robinson M. Mugo, Mukti Zainuddin and Fumihiro Takahashi**
Potential fishing zones as “hotspots” of skipjack tuna (*Katsuwonus pelamis*) and albacore (*Thunnus alalunga*) in the western North Pacific (S2-7875), Invited
- 9:30 **Shin-ichi Ito, Yugo Shimizu, Shigeho Kakehi, Taku Wagawa, Masatoshi Satoh, Daisuke Ambe, Takeshi Okunishi and Kazuyuki Uehara**
A quasi-steady warm water jet and an ecological hotspots in the western North Pacific (S2-7642)
- 9:50 **David G. Foley**
Constructing oceanographic data sets and delivery systems to meet the needs of biologists (S2-7829)
- 10:10 **Robert Suryan, Kathy Kuletz, Martin Renner, Patrick Ressler, Shannon Fitzgerald, Kiyooki Ozaki, Fumio Sato, Tomohiro Deguchi and Elizabeth Labunski**
Mechanisms affecting seabird-prey associations over submarine canyons in the northwestern Bering Sea (S2-7847), Invited
- 10:35 **Coffee/Tea Break**
- 11:00 **Igor M. Belkin**
Satellite oceanography of fronts as biological hotspots (S2-7839), Invited

- 11:25 **Hiroaki Saito, Kazutaka Takahashi, Miwa Nakamachi, Mutsuo Ichinomiya, Shigeho Kakehi, Tadafumi Ichikawa, Kiyotaka Hidaka, Koji Hamasaki, Yuta Nishibe and Ken Furuya**
Horizontal variability in nitrogen dynamics in the Kuroshio Extension Region (S2-7800)
- 11:45 **Robinson M. Mugo, Sei-Ichi Saitoh, Fumihiro Takahashi, Akira Nihira and Tadaaki Kuroyama**
When, where and why skipjack tuna, red flying squid and pacific saury potential fishing zones are likely to overlap in the western North Pacific: A proof of concept (S2-7874)
- 12:05 **Takashi Yamamoto, Akinori Takahashi, Nariko Oka, Takahiro Iida, Nobuhiro Katsumata, Katsufumi Sato and Philip N. Trathan**
Foraging areas of streaked shearwaters in relation to seasonal changes in the marine environment of the Northwestern Pacific (S2-7678)
- 12:25 **Lunch**
- 14:00 **Jürgen Alheit**
Climate variability impact on North Sea ecosystem (S2-7845), Invited
- 14:25 **Elliott L. Hazen, Scott A. Shaffer, Michelle A. Kappes, Ryan R. Rykaczewski, David G. Foley, Steven J. Bograd and Daniel P. Costa**
Oceanographic habitat segregation among postbreeding Hawaiian albatrosses and potential changes from 2001-2100 (S2-7679)
- 14:45 **Mary-Anne Lea, Jeremy T. Sterling, Nicholas A. Bond, Sharon Melin, Rolf Ream and Tom Gelatt**
Habitat use of Alaskan northern fur seal pups in the western North Pacific Ocean (S2-7849)
- 15:05 **Kaoru Hattori, Takeomi Isono and Orio Yamamura**
Wintering aggregations of Steller sea lions in Ishikari-Bay, Sea of Japan (S2-7598)
- 15:25 **Coffee/Tea Break**
- 16:00 **Haruka Nishikawa, Ichiro Yasuda, Sachihiko Itoh, Yoshikazu Sasai and Hideharu Sasaki**
Impacts of climatic regime shift on Japanese sardine stock collapse (S2-7792)
- 16:20 **Konstantin Rogachev**
Satellite and direct observations of circulations features associated with bowhead feeding hotspots in the Sea of Okhotsk (S2-7576)
- 16:40 **George L. Shillinger, Alan M. Swithenbank, Helen Bailey, Steven J. Bograd, Michael R. Castelton, Bryan P. Wallace, James R. Spotila, Frank V. Paladino, Rodney Piedra and Barbara A. Block**
Vertical and horizontal habitat preferences of post-nesting leatherback turtles in the South Pacific Ocean (S2-7864)
- 17:00 Discussion
- 18:00 Session ends

S2 Posters

- S2-7634 **Tomoko Harada, Kentaro Kazama, Tomohiro Deguchi, Hajime Suzuki and Yutaka Watanuki**
Foraging behavior of subtropical black-footed albatross *Phoebastria nigripes* and the marine environment around Bonin Islands
- S2-7828 **Igor M. Belkin and S. Kalei Shotwell**
Propagation of SST anomalies along the North Pacific Polar Front and their impact on the Gulf of Alaska, Aleutians, and Bering Sea ecosystems

S2 Session Oral Presentations

October 18, 9:05 (S2-7875), Invited

Potential fishing zones as “hotspots” of skipjack tuna (*Katsuwonus pelamis*) and albacore (*Thunnus alalunga*) in the western North Pacific

Sei-Ichi **Saitoh**^{1,2}, Robinson M. Mugo^{1,3}, Mukti Zainuddin⁴ and Fumihiro Takahashi²

¹ Laboratory of Marine Bioresource and Environment Sensing, Faculty of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan. Email: ssaitoh@salmon.fish.hokudai.ac.jp

² Green and Life Innovation Inc., 16-3-1102 Toyokawa-cho, Hakodate, Hokkaido, 040-0065, Japan

³ Kenya Marine and Fisheries Research Institute, P.O. Box 81651, Mombasa, Kenya

⁴ Faculty of Marine Science and Fishery, Hasanuddin University, Makassar, 90245, Indonesia

Sustainability of fishery resources is an issue of global concern, and therefore detection and monitoring of marine “hotspots” of fished species is important. Detection of potential fishing zones based on the marine “hotspots” concept has benefited significantly from satellite remote sensing (RS) and marine-GIS, recently advancing to fairly effective operational levels. To support fishing activities and management of fishing fleets, we developed a system for detecting marine “hotspots”, known as TOREDAS (Traceable and Operational Resource and Environment Data Acquisition System). The system provides a variety of information packages including fishing ground forecasts and marine environmental parameters to fishermen through satellite communication. It also gathers geo-referenced data on fishing fleets (GPS information) using a VMS (Vessel Monitoring System), which is a very important tool for fisheries management. Using VMS data, we have examined the behavior of fishing vessels and compared that with prevailing oceanographic conditions. Here we use specific case studies for skipjack tuna (*Katsuwonus pelamis*) and albacore (*Thunnus alalunga*) to demonstrate the importance of marine “hotspots” in fishing ground formation in the western North Pacific, and further discuss potential uses of the underlying technology for fisheries management under future climate change scenarios.

October 18, 9:30 (S2-7642)

A quasi-steady warm water jet and an ecological hotspots in the western North Pacific

Shin-ichi **Ito**¹, Yugo Shimizu¹, Shigeho Kakehi¹, Taku Wagawa¹, Masatoshi Satoh¹, Daisuke Ambe², Takeshi Okunishi² and Kazuyuki Uehara³

¹ Tohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shioyama, Miyagi, 985-0001, Japan
E-mail: goito@affrc.go.jp

² National Research Institute of Fisheries Science, FRA, Kanazawa-Ku, Yokohama, Kanagawa, 236-8648, Japan

³ Tokai University, 3-20-1 Orito, Shimizu-ku, Shizuoka, Shizuoka, 424-8610, Japan

Recently quasi-steady warm water jets, which separated from the Kuroshio Extension, were found. The western quasi-steady jet flows from the northern boundary of the deep wintertime mixed layer in the region 40-42N and 152-160E, which is the formation region of the Transition Region Mode Water (TRMW). For the formation of TRMW, a supply of saltier water by the quasi-steady jet is considered to play an important role. However, observations in this region have been limited and the structure of the quasi-steady jet itself is still unclear. We conducted hydrographic surveys from the upstream to the downstream of the quasi-steady jet. Additionally, an underwater winch was mounted on the mooring (at a depth of 220m to avoid hazards from purse seining), and a CTD sensor buoy moves up and down from the winch to observe the TRMW formation. In the TRMW region, the mixed layer depth exceeded 220 m and the salinity and temperature were increased when the mixed layer depth was deepened. The hydrographic surveys showed the TRMW contains salty and warm water which is supplied by the quasi-steady jet. The wintertime deep convection enhances nutrient supply to the surface layer and resulted in high primary production that possibly create ecological hotspots in the western North Pacific.

October 18, 9:50 (S2-7829)

Constructing oceanographic data sets and delivery systems to meet the needs of biologists

David G. **Foley**

Environmental Research Division, Southwest Fisheries Science Center, NOAA-Fisheries, 1352 Lighthouse Ave., Pacific Grove, CA, 93950, USA
Email: dave.foley@noaa.gov

Biologging involves the use of electronic tags placed on animals to track their movements and record environmental information along their track. Analysis of these data, especially when used in conjunction with environmental information can provide baselines for biological hotspots and the possible impact of climate change. But as the accuracy of calculated positions and precision of on-board measurements improve, biologists are rapidly outpacing the ability of oceanographers to provide complementary environmental information on temporal and spatial scales commensurate with those sampled by the electronic tags. At the same time, there is clearly a need to go beyond the basic oceanographic products typically available from satellite-based observations (*e.g.*, surface temperature, surface phytoplankton pigments, sea surface height) through the generation of derived products (*e.g.*, frontal structures and primary productivity) that provide a description of the marine environment more relevant to understanding the behavior of the animals. Several examples of how the use of these derived products has improved the baseline habitat models are provided. Finally, it is essential to establish data delivery mechanisms that allow for free and simple access. Those not especially familiar with oceanography often encounter a bewildering array of data sets, formats and internet-based systems. In cooperation with the Tagging of Pelagic Predators (TOPP) program, we have developed systems that gather many kinds of representative data in one interface and allow importation of that data directly into the researcher's preferred working environment, or to a variety of common data formats.

October 18, 10:10 (S2-7847), Invited

Mechanisms affecting seabird-prey associations over submarine canyons in the northwestern Bering Sea

Robert **Suryan**¹, Kathy Kuletz², Martin Renner³, Patrick Ressler⁴, Shannon Fitzgerald⁴, Kiyooki Ozaki⁵, Fumio Sato⁵, Tomohiro Deguchi⁵ and Elizabeth Labunski²

¹ Oregon State University, Hatfield Marine Science Center, 2030 S.E. Marine Science Dr., Newport, OR, 97365, USA
E-mail: rob.suryan@oregonstate.edu

² U.S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, AK, 99503, USA

³ School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA, 98195, USA

⁴ Alaska Fisheries Science Center, NOAA Fisheries, Seattle, WA, 98115, USA

⁵ Yamashina Institute for Ornithology, 115 Konoyama, Abiko, 270-1145, Japan

The Bering Sea is a highly productive system that supports major U.S. and Russian fisheries, a wide diversity of marine life, and is critical habitat for threatened and endangered species. While the vast majority of fishing effort and research occur on the expansive continental shelf, the submarine canyons along the shelf edge remain understudied, yet greatly influence productivity of adjacent shelf regions. Moreover, these submarine canyons, among the largest in the world, provide nursery habitat and refuge for many commercial and forage fish species, as well as predators, such as seabirds.

One upper-trophic level consumer that forages extensively over Bering Sea canyons is the endangered short-tailed albatross (*Phoebastria albatrus*). This species is primarily found over continental shelf and canyon break-slope habitats, yet, in the Bering Sea, they also regularly use shelf waters adjacent to canyons. Likewise, many other seabirds concentrate over the heads of submarine canyons and adjacent waters. Their use of Bering Sea canyons, however, is non-uniform in space and time. Indeed, fisheries dependent, fisheries independent, and remotely sensed data support non-uniform productivity and prey species occurrence among Bering Sea canyons. Navarin canyon on the U.S. - Russia border, in particular, hosts large aggregations of predators and prey that appear to be locally enhanced by the divergence of the Bering Slope current and onshelf transport via eddy activity. These highly mobile consumers appear to track upper water column productivity over canyons, thereby reflecting variation in water column productivity, trophic transfer, and advection onto adjacent shelf regions.

October 18, 11:00 (S2-7839), Invited

Satellite oceanography of fronts as biological hotspots

Igor M. **Belkin**

Graduate School of Oceanography, University of Rhode Island, 215 South Ferry Rd., Narragansett, RI, 02882, USA
E-mail: igormbelkin@gmail.com

Biological hotspots can be defined as areas of high species diversity, abundance of individuals, productivity, and economic value. Oceanic fronts perfectly fit this definition. Fronts are ubiquitous and the most salient features of the ocean world. They span a broad spectrum of spatial and temporal scales, from meters to thousands of km, and from days to millennia. Owing to their wide-ranging scales and very dynamic nature, oceanic fronts are best studied from space where satellite sensors provide frequent snapshots of vast swaths of the ocean surface, enabling daily mapping of frontal patterns and their continuous high-resolution monitoring over seasons, years, and decades. State-of-the-art algorithms have been developed for automated detection of oceanic fronts in sea surface temperature (SST), chlorophyll (Chl), and sea surface height (SSH). Regional climatologies of SST, Chl, and SSH fronts are becoming available to biological and fisheries oceanographers to study spatial and temporal correlations between oceanic fronts and biota. The global satellite survey of oceanic fronts conducted at the University of Rhode Island led to the discovery of numerous fronts that have never been explored from *in situ* data. Even well-known fronts revealed new features owing to the synopticity, high-resolution, large-scale coverage, and continuous, repeat nature of satellite remote sensing. Joint efforts of physical, biological and fisheries oceanographers are necessary to fully understand the role played by oceanic fronts in marine ecosystems and protect these fragile hotspots for future generations.

October 18, 11:25 (S2-7800)

Horizontal variability in nitrogen dynamics in the Kuroshio Extension Region

Hiroaki **Saito**¹, Kazutaka Takahashi², Miwa Nakamachi¹, Mutsuo Ichinomiya³, Shigeo Kakehi¹, Tadafumi Ichikawa⁴, Kiyotaka Hidaka⁴, Koji Hamasaki⁵, Yuta Nishibe³ and Ken Furuya³

¹ Ecosystem Dynamics Group, Tohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan. E-mail: hsaito@affrc.go.jp

² Graduate School of Agricultural and Life Science, The University of Tokyo, Yayoi, Bunkyo-ku, 113-8657, Japan

³ Department of Environmental Resources, Prefectural University of Kumamoto, Tsukide, Kumamoto, 862-8502, Japan

⁴ National Research Institute of Fisheries Science, FRA, 2-12-4 Fukuura, Kanazawa, Yokohama, 236-8648, Japan

⁵ Atmosphere and Ocean Research Institute, the University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, 277-8564, Japan

The Kuroshio Extension (KEX) region is the key area of fish species alternation among Japanese sardine, Japanese anchovy and chub mackerel. Previous studies pointed out that SST and winter-time mixed layer depth in the north of the Kuroshio Extension are correlated with the recruitment success of Japanese sardine. It has been suggested that the increase in SST and shoaling in the winter mixed layer depth decrease nutrient supply into the surface mixed layer and then decrease the productivity of zooplankton prey and/or change the timing of spring bloom relative to larval and juvenile fish arrival to the KEX. However, we have limited information of nutrient and plankton dynamics in the KEX. During the SUPRFISH (Studies on prediction and application of fish species alternation) programme, we investigated horizontal and temporal variability in nitrogen inventory by means of measuring nutrients, DON and plankton biomass in the KEX. Nitrate supply at the northern edge of KEX axis was higher than the south of KEX where nutrient depletion prevented phytoplankton growth in May. In the transition zone, chlorophyll concentration was low in spite of high nitrate concentration suggesting that iron limitation prevented phytoplankton growth. The trophic transfer efficiency in the northern KEX region where the hot spot of larval and juvenile fish transportation seems to be higher than other regions in the KEX. We will discuss physical, chemical and biological factors controlling the horizontal variability of nitrogen dynamics in the KEX and its influence on pelagic fish recruitment.

October 18, 11:45 (S2-7874)

When, where and why skipjack tuna, red flying squid and pacific saury potential fishing zones are likely to overlap in the western North Pacific: A proof of concept

Robinson M. Mugo^{1,2}, Sei-Ichi Saitoh^{1,3}, Fumihiro Takahashi^{1,3}, Akira Nihira⁴ and Tadaaki Kuroyama⁵

¹ Laboratory of Marine Environment and Resource Sensing, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan. E-mail: robin_mugo@salmon.fish.hokudai.ac.jp

² Kenya Marine and Fisheries Research Institute, P.O. Box 81651, Mombasa, Kenya

³ Green and Life Innovation Inc., 16-3-1102 Toyokawa-cho, Hakodate, Hokkaido, 040-0065, Japan

⁴ Japan Fisheries Information Service Center, 4-5 Toyomi-cho, Chuo-ku, Tokyo, 104-0055, Japan

⁵ Ibaraki Prefecture Fisheries Research Station, Hitachinaka, Ibaraki, Japan

Skipjack tuna, the neon flying squid (warm water species) and pacific saury (cold water species) fishing grounds show some spatial synchrony in autumn in the western North Pacific (WNP). To assess possible spatial habitat overlaps between skipjack tuna, pacific saury and/or neon flying squid along the Oyashio and/or sub-arctic front in the WNP, skipjack tuna fishery presence-only data and monthly (August–November) satellite remotely sensed SST, chlorophyll *a* and sea surface height anomaly images were used to calculate habitat suitability indices (HSIs) using maximum entropy models (MaxEnt) between 30–50°N and 140–160°E. A second set of HSIs for the same area was calculated using presence-only data derived from DMSP/OLS nightlight images, (which indicate fishing areas for neon flying squid and pacific saury) and the same set of environmental parameters. Model performances were evaluated using the area under the curve (AUC) statistic and jack-knife tests. Maps of both sets of HSIs were compared and areas of overlap identified using a joint probability and longitudinal transects. Results indicate that an area of spatial overlap exists among the species habitats, gradually increasing from August to November. The causes of these overlaps include the presence of strong thermal gradients between cold Oyashio waters and warm Kuroshio waters, and also the presence of the sub-arctic front. We conclude that a spatial overlap of habitats observed could be as a result of skipjack tuna and neon flying squid foraging on nekton on the warmer edges of thermal gradients while pacific saury aggregate on cold edges of such gradients.

October 18, 12:05 (S2-7678)

Foraging areas of streaked shearwaters in relation to seasonal changes in the marine environment of the Northwestern Pacific

Takashi Yamamoto¹, Akinori Takahashi^{1,2}, Nariko Oka³, Takahiro Iida^{1,2}, Nobuhiro Katsumata⁴, Katsufumi Sato⁴ and Philip N. Trathan⁵

¹ Department of Polar Science, The Graduate University for Advanced Studies, 10-3 Midori-cho, Tachikawa, Tokyo, 190-8518, Japan
E-mail: taka.y@nipr.ac.jp

² National Institute of Polar Research, 10-3 Midori-cho, Tachikawa, Tokyo, 190-8518, Japan

³ Yamashina Institute for Ornithology, 115 Konoyama, Abiko, Chiba, 270-1145, Japan

⁴ Atmosphere and Ocean Research Institute, University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba, 277-8564, Japan

⁵ British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Rd., Cambridge, CB3 0ET, UK

As the spatial distribution of marine organisms is often affected by seasonal changes, pelagic seabirds may change their foraging areas in response to seasonal changes in the marine environment. We examined the foraging area of streaked shearwaters *Calonectris leucomelas*, breeding at Sangan and Mikura Islands, Japan, from spring to summer during pre-laying and incubation periods. Those colonies are located at the north and south of the Northwestern Pacific's Kuroshio-Oyashio transition area where high seasonal temperature changes are observed, and where, consequently, birds may show comparable responses to such changes. Our results showed that streaked shearwaters from both colonies shifted their foraging areas northwards as the season progressed. The seasonal shift of foraging areas appeared to coincide with the movement pattern of pelagic fishes that migrate northward in association with the increase in water temperature. However, the pattern of seasonal movement differed between the colonies; shearwaters from Sangan Island moved their foraging area along the coastal area of the Kuroshio-Oyashio transition, while those from Mikura Island moved along the Kuroshio Extension. Our results also indicated sex-related differences in this general pattern: females showed clear seasonal changes in foraging area, while males did not. During the pre-laying period males returned to the colony frequently to defend their nests or mates, and spent less time at sea. Our results suggest that streaked shearwaters changed their foraging areas in response to seasonal changes in the marine environment, although colony location and sex-related differences in reproductive roles may constrain the birds' responses to seasonal change.

October 18, 14:00 (S2-7845), Invited

Climate variability impact on North Sea ecosystem

Jürgen **Alheit**

Biological Oceanography, Leibniz Institute for Baltic Sea Research, IOW, Seestr. 15, Warnemuende, 18119, Germany
E-mail: juergen.alheit@io-warnemuende.de

The North Sea is a heavily fished marine ecosystem which is considerably influenced by climate variability on the decadal and on the multi-decadal scale. The North Atlantic Oscillation (NAO) is an oscillation of atmospheric mass on the decadal scale. It refers to the difference in the pressure anomalies between the Icelandic Low and the Azorian High which influences the climate in central and northern Europe, particularly in winter time. Its intensification in the late 1980s has led to pronounced changes in the North Sea fauna, especially to changes in distribution, abundance and phenology of the zooplankton community which are described as an ecosystem regime shift. The influence of the NAO on European ecosystems is not a permanent phenomenon, as observed during the recent shift of its centers of action to the northeast. In contrast, the Atlantic Multidecadal Oscillation (AMO) is a multi-decadal oscillation based on lasting warm and cold periods of the North Atlantic. It causes long-term changes in the North Sea as observed by multi-decadal fluctuations in the fish community. Superimposed on this are the consequences of the recent contraction of the subpolar Atlantic gyre in 1995 which affected plankton and fish communities in the North Sea. The combined effects of the different atmospheric drivers on the North Sea ecosystem will be discussed.

October 18, 14:25 (S2-7679)

Oceanographic habitat segregation among postbreeding Hawaiian albatrosses and potential changes from 2001-2100

Elliott L. **Hazen**^{1,2}, Scott A. Shaffer³, Michelle A. Kappes³, Ryan R. Rykaczewski⁴, David G. Foley^{1,2}, Steven J. Bograd² and Daniel P. Costa³

¹ Joint Institute for Marine and Atmospheric Research, University of Hawaii, Honolulu, HI, 96822, USA
E-mail: elliot.hazen@noaa.gov

² Environmental Research Division, SWFSC/NMFS/NOAA, 1352 Lighthouse Ave., Pacific Grove, CA, 93950-2097, USA

³ Ecology and Evolutionary Biology, University of California, 1156 High St., Santa Cruz, CA, 95060-5730, USA

⁴ Geophysical Fluid Dynamics Laboratory, NOAA, 201 Forrestal Rd., Princeton, NJ, 08540, USA

Laysan (*Phoebastria immutabilis*) and black-footed (*P. nigripes*) albatrosses breed sympatrically at Tern Island (23.87°N, 166.28°W) in the Northwest Hawaiian Islands. Biologging studies have shown that the two albatross species travel to different oceanographic regimes and with little habitat overlap. Post-breeding distributions are not well defined, but we hypothesize that these oceanic habitats have significant differences in water mass properties. Post-breeding adults are no longer tied to the breeding colony and niche separation should reduce competition between the two species. We equipped 30 albatrosses with archival geolocation loggers in 2005 (15 of each species), and 30 more in 2006 (15 of each species). For successful breeders in both species, time at sea ranged from 130-179 days and birds traveled up to 4,500 km from Tern Island. Species segregation was apparent (within core habitats) in both years where Laysans' traveled to cool oceanic waters (12-14°C) of the Subarctic Gyre and black-foots' traveled to warmer coastal waters (12-20°C) along the coast of central California, north to British Columbia. We used habitat models (Generalized Additive Mixed and MAXENT models) in combination with climate prediction models to examine how albatross oceanic habitat may change from 2001-2100 and how this may affect distance from the colony. Differences in environmental characteristics (*i.e.* SST, SSH, Primary Productivity) and static features (bathymetry, distance to colony) associated with each habitat may reflect species-specific foraging preferences where individuals maximize body reserves before breeding again. This segregation could have evolved as a mechanism to partition resources and reduce competition, and climate change is predicted to increase available habitat, resulting in greater niche partitioning, and less competition across both species.

October 18, 14:45 (S2-7849)

Habitat use of Alaskan northern fur seal pups in the western North Pacific Ocean

Mary-Anne **Lea**^{1,2}, Jeremy T. Sterling¹, Nicholas A. Bond³, Sharon Melin¹, Rolf Ream¹ and Tom Gelatt¹

¹ National Marine Mammal Laboratory, NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA
E-mail: ma_lea@utas.edu.au

² Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 129, Hobart, TAS, 7000, Australia

³ JISAO Deputy Director, Room 2074, Bldg. 3, NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 98115, USA

Northern fur seals, *Callorhinus ursinus*, extend in range across the North Pacific Ocean from California to the Kuril Islands, yet until recently very little was understood of their dispersal and survival during their first winter migrations. Post-weaning pups from four North American populations (n=166) were tracked in 2005/6 and 2006/7 to determine the extent of naive dispersal and influence of environmental features on pup behaviour. Pups conducted far-ranging migrations across the North Pacific Ocean, triggered by the onset of autumnal storms. At-sea conditions differed markedly between the two years as did pup movements. The majority of Alaskan Northern fur seal pups conducting long migrations to the Western North Pacific tended to be males and comprised approximately 30% of the animals tracked from the three Alaskan populations. Those pups migrating to the western North Pacific may eventually emigrate to Kuril and western Bering Sea northern fur seal populations. This study compares the behaviour (proportion of time in area restricted search, dive behaviour) and environmental conditions (wind conditions, sea surface height and temperature) encountered by those animals dispersing to the western North Pacific with that of conspecifics migrating to the Central and eastern North Pacific.

October 18, 15:05 (S2-7598)

Wintering aggregations of Steller sea lions in Ishikari-Bay, Sea of Japan

Kaoru **Hattori**, Takeomi Isono and Orio Yamamura

Fisheries Resources Division, Hokkaido National Fisheries Research Institute, FRA, 116 Katsurakoi, Kushiro-shi, Hokkaido, 085-0802, Japan
E-mail: khattori@fra.affrc.go.jp

Steller sea lion (SSL, *Eumetopias jubatus*) is a large piscivorous marine mammal, whose distribution and feeding are affected by prey availability and oceanographic conditions. The population of SSLs in the Okhotsk Sea and the Kuril Islands has been recovering from severe decline since the early 1990s. Some portion of the population winters around Hokkaido Island to avoid sea ice in the Sea of Okhotsk and to meet their energetic demands for growth and reproduction in the following seasons. There is some evidence of persistence in wintering ground based on the mark-resighting studies at Ofuyu Point, which is one of the major haul-out sites, located at the northern mouth of Ishikari-Bay in the Sea of Japan. The high concentration of SSLs in the eastern area of Ishikari-Bay was also witnessed by a series of aerial surveys conducted during January to March (2008, 2011). Since this area is known to be an important spawning ground of Pacific herring (*Clupea pallasii*), SSLs were probably attracted to this high-energy prey. Herring is also an important target of commercial fishery, so the competition between SSLs and fishery for herring is a serious problem in this area.

October 18, 16:00 (S2-7792)

Impacts of climatic regime shift on Japanese sardine stock collapse

Haruka **Nishikawa**¹, Ichiro Yasuda², Sachihiko Itoh², Yoshikazu Sasai¹ and Hideharu Sasaki¹

¹ Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanazawa-ku, Yokohama-shi, Kanagawa, 236-0001, Japan. E-mail: harukan@aori.u-tokyo.ac.jp

² Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba, 277-8564, Japan

Japanese sardine (*Sardinops melanostictus*) is known to show a drastic and multi-decadal stock fluctuation. The most notable stock collapse began to occur from 1988 and its economic impact was very serious. Recently, our group suggested that successive shallow winter mixed layer state and high winter SST state near the Kuroshio axis south of Japan from 1988 to 1994 were a possible cause of the stock collapse. This is because such mixed layer and SST states could create bad feeding conditions and unfavorable habitat temperature to sardine larvae. To clarify why this winter mixed layer and SST regime shift occurred, analyses are conducted using OFES (OGCM for the Earth Simulator) model data. As a result, the shallow mixed layer and high SST near the Kuroshio axis south of Japan during 1988-1994 are revealed to be mainly caused by the acceleration of the Kuroshio current velocity and the reduction of the surface cooling. The strong current velocity reduces time during which the mixed layer is exposed to wintertime cooling. For that reason, winter mixed layer did not deepen and SST was not cooled. Weaker surface cooling due to meteorological variability also causes the shallow mixed layer and high SST. Since the signal of the current acceleration is seen in the Central Pacific a few years prior to the occurrence in the Kuroshio area, this study implies the predictability of sardine stock collapse.

October 18, 16:20 (S2-7576)

Satellite and direct observations of circulations features associated with bowhead feeding hotspots in the Sea of Okhotsk

Konstantin **Rogachev**

Ocean Physics, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: rogachev@poi.dvo.ru

The bowhead whale is the largest zooplankton predator in the northern Sea of Okhotsk and requires high concentrations of large zooplankton to feed efficiently. Oceanographic characteristics, which produce a favourable feeding environment for the bowhead whale, are examined. Bowhead whale as the top predator is linked via zooplankton to this entire marine food chain. Among the zooplankton in the Okhotsk Sea shelf, the shelled pteropod *Limacina helicina* and arctic grazer *Calanus glacialis* play a key role in the pelagic food web. The present work combines satellite observations with physical measurements (CTD, currents and tides) and zooplankton sampling. Satellite data and *in situ* observations revealed regular eddies in the bays and cyclonic circulation in the northwestern shelf waters of the Okhotsk Sea. This cyclonic circulation determines the distribution of a key species of the ecosystem, and retains the pelagic mollusk *Limacina helicina* within this gyre. Headland eddies with the diameter of 4-40 km regularly form within the Shantar archipelago. These eddies play an important role in the dispersion of ice and plankton. Sea ice is used as a tracer for the study of headland eddies and their role in the circulation in the bay. The results of *in situ* observations indicate that tidal currents are the main mechanism of ephemeral but regular convergence, associated with the headland eddies. Converging currents is considered as the mechanism of formation of plankton patches. The results of direct observations indicate that tidal currents are the main mechanism for the formation of dense aggregations of pteropod.

October 18, 16:40 (S2-7864)

Vertical and horizontal habitat preferences of post-nesting leatherback turtles in the South Pacific Ocean

George L. **Shillinger**^{1,2}, Alan M. Swithenbank¹, Helen Bailey^{3,4}, Steven J. Bograd³, Michael R. Castelton¹, Bryan P. Wallace^{5,6}, James R. Spotila⁷, Frank V. Paladino⁸, Rotney Piedra⁹ and Barbara A. Block¹

¹ Hopkins Marine Station, Stanford University, 120 Oceanview Blvd., Pacific Grove, CA, 93950, USA. E-mail: georges@stanford.edu

² Present address: Center for Ocean Solutions, 99 Pacific St., Suite 155A, Monterey, CA, 93940, USA

³ Environmental Research Division, SWFSC/NMFS/NOAA, 1352 Lighthouse Ave., Pacific Grove, CA, 93950, USA

⁴ Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, Solomons, MD, 20688, USA

⁵ Global Marine Division, Conservation International, 2011 Crystal Dr., Suite 500, Arlington, VA, 22202, USA

⁶ Division of Marine Science and Conservation, Duke University Marine Laboratory, 135 Duke Marine Lab Rd., Beaufort, NC, 28516, USA

⁷ Department of Biology, Drexel University, Philadelphia, PA, 19104, USA

⁸ Department of Biology, Indiana-Purdue University, Fort Wayne, IN, 46805, USA

⁹ Parque Nacional Marino Las Baulas, Ministerio de Ambiente y Energía y Telecomunicaciones, Apartado 10104-1000, San José, Costa Rica

In this study, we analyzed the vertical and horizontal habitat preferences of 46 satellite-tagged female leatherback turtles (Playa Grande, Costa Rica; 2004-2007) in the South Pacific Ocean. Turtles exhibited short, shallow dives during their migration southward (mean depth = 45 m, mean duration = 23.6 min), followed by deeper, longer dives (mean depth = 56.7 m, mean duration 26.4 min) in the South Pacific Gyre that probably indicated searching for prey. We integrated the horizontal movements with remotely-sensed oceanographic data to determine the turtles' response to the environment, and applied this information to recommendations for conservation in the pelagic environment. A generalized additive mixed model applied to the daily turtle travel rates confirmed that slower travel rates occurred at cooler sea surface temperatures, higher chlorophyll *a* concentration and stronger vertical Ekman upwelling, all of which are considered favorable foraging conditions. The southern terminus (35-37°S) of the leatherback tracks was also in an area of increased mesoscale activity that might act as a physical mechanism to aggregate their prey, gelatinous zooplankton. However this could also act as a thermal limit to their distribution. This characterization of leatherback habitat use could aid the development of management efforts within the South Pacific Ocean to reduce mortality of leatherback turtles from fisheries interactions.

S2 Session Posters

S2-7634

Foraging behavior of subtropical black-footed albatross *Phoebastria nigripes* and the marine environment around Bonin Islands

Tomoko Harada¹, Kentaro Kazama¹, Tomohiro Deguchi², Hajime Suzuki³ and Yutaka Watanuki¹

¹ Graduate School of Fisheries Sciences, Hokkaido University, Hakodate, 041-8611, Japan. E-mail: ywata@fish.hokudai.ac.jp

² Yamashina Institute for Ornithology, Chiba, 270-1145, Japan

³ Institute of Boninology, Ogasawara, Tokyo, 100-2101, Japan

Foraging behavior of marine top predators gives useful information for identifying important areas for conservation and management of marine ecosystem. At sea movement of nine black-footed albatrosses rearing chicks (9 birds, 13 trips) in the Bonin Islands, a region of high endemic biodiversity, was studied using GPS data-loggers. The albatross fed on fish, fish egg and squids in the water surface both in day and night within a range of 96 - 427 km from the colonies. Area-Restricted-Search (ARS) behavior was observed at the scale of 11 - 71 km (n = 7 full trips of 6 birds) and ARS positions (n = 48) tended to occur in areas with high primary production and in the deep shelf slope. During trips where average distance from colonies to ARS positions was shorter, ARS scale was smaller. A cluster of ARS positions overlapped with an intensive swordfish fishing area west of the Bonin Islands and could be an important feeding ground for surface feeding black-footed albatross.

S2-7828

Propagation of SST anomalies along the North Pacific Polar Front and their impact on the Gulf of Alaska, Aleutians, and Bering Sea ecosystems

Igor M. Belkin¹ and S. Kalei Shotwell²

¹ Graduate School of Oceanography, University of Rhode Island, 215 South Ferry Rd., Narragansett, RI, 02882, USA

E-mail: igormbelkin@gmail.com

² Auke Bay Labs, Alaska Fisheries Science Center, NMFS, NOAA, Juneau, AK, 99801, USA

Eastward propagation of SST anomalies along the North Pacific Polar Front (NPPF) was studied from Hadley climatology. The NPPF is the boundary of the Subarctic Zone that features a well-defined subsurface temperature minimum (T-min), a remnant of wintertime convective cooling. The eastward Polar Front Current associated with the NPPF acts as a conduit of oceanic anomalies originating off the Siberian and Japanese coasts. Therefore, through the along-front advection, the Gulf of Alaska (GOA), Aleutians, and eastern Bering Sea ecosystems are affected by large-scale atmospheric and oceanic perturbations that occur in the NW Pacific. These perturbations propagate along the NPPF into the GOA where the NPPF retroflects and extends westward along the shelf break to the Aleutians and into the Bering Sea. Thus, the Polar Front Current connects ecosystems of the West Subarctic Gyre, East Subarctic Gyre, Aleutians, and eastern Bering Sea. Along its entire extent from Hokkaido into the GOA, the NPPF shifts north-south interannually, exhibiting especially regular multi-year oscillations over the Emperor Seamounts. Farther east, the NPPF Retroflexion in the GOA shifts east-west on the multi-year time scale. These shifts must profoundly affect the GOA ecosystem, including the Alaskan Shelf, although this effect is not quantified yet. The NPPF experienced rapid warming since 1978 at the depth of the subsurface T-min (~100 m) associated with winter convection. The observed warming of the winter T-min layer is a manifestation of rapid amelioration of winter climate of the northern North Pacific.

S3 FIS Topic Session

Population dynamics, trophic interactions and management of cephalopods in the North Pacific ecosystems

Co-Convenors: *John Field (U.S.A.), Yasunori Sakurai (Japan) and Mikhail Zuev (Russia)*

Invited Speakers:

Mary Hunsicker (Oregon State University, U.S.A.)

Chingiz Nigmatullin (AtlantNIRO, Russia)

Mitsuo Sakai (National Research Institute of Far Seas Fisheries, Japan)

In most coastal and oceanic ecosystems, cephalopods are or can be an influential driver of food web dynamics due to their rapid growth, high population turnover rates. They also represent a major, and apparently growing, fraction of total catches, both in the Northern Pacific and throughout the world's oceans. In contrast to the generally slower population response rates of most finfish, cephalopod populations tend to exhibit boom-bust cycles, challenging traditional management strategies. As events along the West Coast of the United States and Canada have shown, they may also represent highly visible indicators of ecosystem change, and both the causes and the consequences of the jumbo squid range expansion on the California Current ecosystem are questions of growing interest as a result. This session will focus on the ecology and management of cephalopods in North Pacific ecosystems, specifically on the known or suspected drivers of population dynamics, and applied or potential management strategies that are (or may be) robust to such dynamics. Papers on the role of cephalopods within marine ecosystems, particularly with respect to trophic interactions and the strategic management of marine ecosystems (e.g., the role of cephalopods as forage versus fisheries targets, or as competitors for species targeted by commercial fisheries), are highly encouraged.

Friday, October 21 (9:00-12:30)

- 9:00 ***Introduction by Convenors***
- 9:05 **Chingiz M. Nigmatullin**
Structural and functional aspects of nektonic squid food and parasite relations in the World Ocean ecosystems (S3-7663), Invited
- 9:30 **Mitsuo Sakai, Yoshiobu Hiraoka, Taro Ichii, Hitoshi Imaizumi, Shintaro Imamura, Denzo Inagake, Toshie Wakabayashi, Yoshiki Kato, Katsuhiko Miki, Hideki Nikaido, Yosuke Ochi, Yuji Omura, Hiroaki Saito, Go Takayama, Takakashi Yanagimoto, Takanori Kobayashi, Nobuhide Hamaji and Ken-Ichi Ishida**
Utilization structure of jumbo flying squid stock in fluctuating environments: Possible impact on other squid harvests in the North Pacific (S3-7688), Invited
- 9:55 **Mary E. Hunsicker, Timothy E. Essington, Reg Watson and Ussif R. Sumaila**
The value of cephalopods to global marine fisheries (S3-7746), Invited
- 10:20 ***Coffee/Tea Break***
- 10:50 **Hideaki Kidokoro, Norio Yamashita, Sangwoo Kim, Youngmin Choi and Yasunori Sakurai**
Ecological traits and population dynamics of Japanese common squid *Todarodes pacificus* that concerned with the fishing grounds and fishing seasons of Japanese and Korean fisheries (S3-7638)
- 11:10 **Polina Dulenina and Alexander Dulenin**
Some data on biology and fishing of Pacific squid (*Todarodes Pacificus*) in northwestern part of the Tartar Strait and their relations with hydrological processes (S3-7870)

- 11:30 **Hyejin Song, Michio J. Kishi and Yasunori Sakurai**
Prediction of trade-off between growth and maturation depending on the environmental conditions in common squid *Todarodes pacificus* (S3-7640)
- 11:50 **Mikhail A. Zuev, Nikolai S. Vanin, Oleg N. Katugin and Gennady A. Shevtsov**
Long-term fluctuations in gonatid squid (Gonatidae) abundance in the Okhotsk Sea (S3-7644)
- 12:10 **Hikomichi Igarashi, Toshiyuki Awaji, Masafumi Kamachi, Yoichi Ishikawa, Norihisa Usui, Yosuke Fujii, Takahiro Toyoda, Shuhei Masuda, Toshimasa Doi, Shiro Nishikawa, Yoshihisa Hiyoshi, Mitsuo Sakai, Yoshiki Kato, Sei-Ichi Saitoh and Shin-ichi Sato**
A statistical approach to identify optimal habitat suitability of neon flying squid in northwestern North Pacific by using satellite datasets and 3-D ocean data assimilation product (S3-7774)
- 12:30 Session ends

S3 Posters

- S3-7591 **Gennady A. Shevtsov and Evgenyi V. Slobodskoy**
Cephalopods inhabiting Japan/East Sea off Korean Peninsula
- S3-7606 **Osamu Tamaru, Kazushi Miyashita, Yasuzumi Fujimori, Toshihiro Watanabe and Teisuke Miura**
Fishery Income fluctuation by selecting fishing ground in the Japanese coastal squid jigging fishery
- S3-7613 **Mikhail A. Zuev, Gennady A. Shevtsov and Oleg N. Katugin**
Seasonal shifts in species composition and distribution of cephalopods in the epipelagic northwest Pacific Ocean
- S3-7625 **Gennady A. Shevtsov and Konstantin A. Karyakin**
Pelagic cephalopods of the Subarctic transition zone in spring 2010
- S3-7636 **Toshie Wakabayashi, Takashi Yanagimoto, Shiro Wada, Yoshiki Kato and Mitsuo Sakai**
A review of population structure of the neon flying squid, *Ommastrephes bartramii* and new findings based on mtDNA sequence data
- S3-7639 **Konstantin A. Karyakin, Gennady A. Shevtsov and Oleg N. Katugin**
Cephalopods from the Emperor Seamounts
- S3-7713 **Julia S. Stewart, William F. Gilly and John C. Field**
Movement patterns and foraging ecology of the Humboldt squid in the California Current
- S3-7873 **Vasiliy D. Didenko, Nikolai S. Vanin and Oleg N. Katugin**
Is there a relation between the abundance of *Berryteuthis magister* (Teuthida: Gonatidae) off the Kuril Islands and variability in atmospheric circulation patterns?

S3 Session Oral Presentations

October 21, 9:05 (S3-7663), Invited

Structural and functional aspects of nektonic squid food and parasite relations in the World Ocean ecosystems

Chingiz M. Nigmatullin

Atlantic Research Institute of Fisheries and Oceanography (AtlantNIRO), 5 Donskoy St., Kaliningrad, 236022, Russia
E-mail: chingiznigmatullin@rambler.ru

The concept of holistic multistage ecological niche in squid population life cycle was developed to generalize data on the trophic-parasite relations of 24 species of abundant nektonic squids of the World Ocean, which together represent approximately 90% of total squid biomass and an annual consumption rate more one billion tons of prey. This approach allows one to take in account the intricate positions in the ecosystem of different ecologically specific population life cycle stages, and simultaneously to obtain the adequate idea on place and role of population as whole in ecosystem. With increase in body size during life cycle, nektonic squid with size-dependent predation stage by stage penetrate the trophic pyramid, consecutively transferring from consumers of II-III to IV-VI orders and changing the spectrum of their prey, predators and parasites. They are one of the keystone-interactors that organize the community structure at the consumer levels II-VI orders. These squids are members of fast energy flow in trophic webs, and act as the peculiar “ecosystem enzymes” that significantly accelerates of biogeochemical processes. Owing to regular migrations, they are important element in the “integrity framework” of migrants that integrate local ecosystems into ecosystems of the higher level. The trophic and parasitic relations of squid are interfacing. In ontogenetic and evolutionary terms, parasitic relations formed parallel trophic relationships, and their helminthes are at larval stages with life cycles that are completed via trophic webs. The various life stages of squid are typically “transport” hosts with various top-predators as the definitive hosts.

October 21, 9:30 (S3-7688), Invited

Utilization structure of jumbo flying squid stock in fluctuating environments: Possible impact on other squid harvests in the North Pacific

Mitsuo Sakai¹, Yoshiobu Hiraoka², Taro Ichii³, Hitoshi Imaizumi⁴, Shintaro Imamura⁵, Denzo Inagake⁵, Toshie Wakabayashi¹, Yoshiki Kato¹, Katsuhiko Miki⁵, Hideki Nikaido⁴, Yosuke Ochi⁶, Yuji Omura⁵, Hiroaki Saito⁵, Go Takayama⁷, Takakashi Yanagimoto⁵, Takanori Kobayashi⁸, Nobuhide Hamaji⁸ and Ken-Ichi Ishida⁹

¹ National Research Institute of Far Seas Fisheries, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, 236-8648, Japan. E-mail: sakaimit@affrc.go.jp

² Ehime Institute of Industrial Technology, Ehime, Japan

³ Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, Japan

⁴ Seikai National Fisheries Research Institute, Fisheries Research Agency, Japan

⁵ National Research Institute of Fisheries Science, Fisheries Research Agency, Japan

⁶ Marine Fisheries Research and Development Center, Fisheries Research Agency, Japan

⁷ National Research Institute of Fisheries Engineering, Fisheries Research Agency, Japan

⁸ Fisheries Research Agency, Japan

⁹ Atmosphere And Ocean Research Institute, University of Tokyo, Japan

Synchronous fluctuations in pelagic species, such as sardines and anchovies, in the north and south Pacific Basin have been associated with shifts in atmospheric/oceanic teleconnections and El Niño Southern Oscillation (ENSO) events. Populations of ommastrephid squid species in the Pacific Basin have also fluctuated on a decadal time scale. For example, the fishery of the jumbo flying squid (*Dosidicus gigas*), well-known for being the largest edible squid, has fluctuated markedly in terms stocks, body size, and range which extends from southern Chile to northern California and Alaska. These fluctuations have impacted on the global supply-and-demand relationship in all sectors of the jumbo flying squid fishery, *i.e.*, the capture, processing, sales, distribution, marketing, and other downstream activities. We therefore conducted an interdisciplinary study to more accurately assess the utilization of this squid resource. Specifically, we examined aspects related to fishery biology, oceanography, capture fishery, biochemistry, food technology, genetics, and the market economy. In this session, we describe

the utilization structure of this squid resource and examine the possible impact on the utilization structure of other commercially important squid species (*e.g. Todarodes pacificus* and *Ommastrephes bartramii*). We will also examine the possible connection between squid catches and environmental conditions in the Pacific Basin.

October 21, 9:55 (S3-7746), Invited

The value of cephalopods to global marine fisheries

Mary E. **Hunsicker**, Timothy E. Essington, Reg Watson and Ussif R. Sumaila

College of Oceanic and Atmospheric Sciences (COAS), Oregon State University, 104 Ocean Administration Bldg., Corvallis, OR, 97331, USA. E-mail: mhunsicker@coas.oregonstate.edu

A key element of the ecosystem-based approach to fisheries management is the potential for conflicts to arise from the simultaneous harvesting of predator and prey populations. When species provide sustenance for myriad predators and are of economic importance there can be ecological and economic trade-offs associated with harvesting them. Cephalopods are a major forage item in marine ecosystems and are of growing importance as a commercial resource. Thus, it is prudent to evaluate the potential trade-offs associated with cephalopod fisheries prior to further exploitation to anticipate any negative impacts on marine predators, including species of commercial and conservation value. We provide the first measure of the ecosystem services that cephalopods contribute to fisheries in 28 marine ecosystems, both as a commodity and an ecological support service. We also examine how current demands on cephalopods compare to mid- 20th century conditions to determine if there is a historical precedent of cephalopods withstanding heavy fishing pressure while simultaneously acting as an ecosystem support service. Our findings indicate that cephalopod contributions to fisheries vary widely. Commodity and supportive services provided by cephalopods contributed as much as 55% of fishery landings (tonnes) and 70% of landed values (\$USD). Further, the commodity and supportive services increased in most of the coastal ecosystems between the mid-20th century and contemporary periods, indicating the rising demand for cephalopods. Ecosystems in which cephalopods are highly exploited as a targeted resource and as an ecological support service should be further evaluated to prevent the unsustainable development of marine fisheries within them.

October 21, 10:50 (S3-7638)

Ecological traits and population dynamics of Japanese common squid *Todarodes pacificus* that concerned with the fishing grounds and fishing seasons of Japanese and Korean fisheries

Hideaki **Kidokoro**¹, Norio Yamashita², Sangwoo Kim³, Youngmin Choi³ and Yasunori Sakurai⁴

¹ Japan Sea National Fisheries Research Institute, FRA, 1-5939-22 Suido-cho, Niigata, 951-8121, Japan
E-mail: kidokoro@fra.affrc.go.jp

² Hokkaido National Fisheries Research Institute, FRA, 116 Katsurakoi, Kushiro, 085-0802, Japan

³ East Sea Fisheries Research Institute, National Fisheries Research and Development Institute, Gangneung, 210-861, R Korea

⁴ Graduate School of Fisheries Sciences, Hokkaido University, Minatocho, Hakodate, Hokkaido, 041-8611, Japan

The Japanese common squid, *Todarodes pacificus*, is usually divided into two stocks based on differences in spawning season and distribution area, *e.g.* the autumn spawning stock which is distributed in the Japan Sea and the winter spawning stock which is distributed in the Pacific region. The stock size of Japanese common squid was low, particularly for the winter spawning group, during the 1980s at which time SST anomalies were negative in the North West Pacific. Most of catch was from the offshore area of the Sea of Japan during this period. The catch by Korean fisheries was also low level during the 1980s, because common squid did not migrate toward Korean Peninsula. The stock size of Japanese common squid increased in the 1990s when SST anomalies turned to positive, and the catch by Japanese fisheries increased in the Pacific side. Catches by Korean fisheries also increased in the Sea of Japan during this period, with the change in migration pattern of autumn spawning stock. These changes in the main fishing grounds of Japanese common squid with changing environmental conditions and/or stock size emphasize the importance of cooperation in the stock management of Japanese common squid between Japanese and Korean fisheries.

October 21, 11:10 (S3-7870)

Some data on biology and fishing of Pacific squid (*Todarodes Pacificus*) in northwestern part of the Tartar Strait and their relations with hydrological processes

Polina Dulenina and Alexander **Dulenin**

Khabarovsk Branch of TINRO-Center, 13-A Amursky Blvd., Khabarovsk, 680028, Russia. E-mail: dulenin@mail.ru

There are Pacific squid feeding migrations to coastal waters of the north-western part of the Tartar Strait (in Khabarovsk territory) in summer-autumn period. In the 1990s mass squid migrations recommenced after a long period during which migrations were not observed. These migrations contributed to commercial fishing development in the area. The reason for this shift is likely related to ocean warming trends. Average annual water temperature index has been increased for the last years for 1.3°C. However, this squid is not a well studied species in this region. Specialists of Khabarovsk branch TINRO have been monitoring this species since 1993. Our data shows that at least 3 season squid groupings migrate to the study area, representing winter, autumn and summer groups. The winter spawning group appears to be the most prevalent (Shuntov, 1964; Zuev, Nesis, 1971). Statistical analysis of catch rates from 2003-2010 shows that maximal squid catches (up to 4717kg/vessel per 24 hours) were marked in different times from September to November. The likely explanation is that in warm years squid migrate to the north-western part of the Japanese Sea earlier (July-August) than in cold years (Mokrin, 2006). Thus, hydrometeorological data can help to forecast the beginning of squid fishery and periods of maximal squid catches.

October 21, 11:30 (S3-7640)

Prediction of trade-off between growth and maturation depending on the environmental conditions in common squid *Todarodes pacificus*

Hyeyin **Song**¹, Michio J. Kishi² and Yasunori Sakurai¹

¹ Division of Marine Bioresources and Environmental Science, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minto-cho, Hakodate, Hokkaido, 041-8611, Japan. E-mail: song.squid@fish.hokudai.ac.jp

² Division of Biosphere science, Graduate School of Environmental Science, Hokkaido University, N10 W5, Sapporo, Hokkaido, 060-0810, Japan

In order to discuss the environmental conditions on the trade-off between growth and maturation of common squid, *Todarodes pacificus*, around Japan and Korea, a bioenergetics model was applied. The model includes feeding and spawning migration, which means the water temperature and prey density varies depending on squid's location. The parameters in the bioenergetics model were estimated by captive experiments during 2006-2010. Outputs from three dimensional physical-biological coupled model (3D-NEMURO, Aita *et al.*, 2006) were used as inputs to bioenergetics model. Water temperature and output of ecosystem compartments (ZL in NEMURO is used as prey) along the migration route were averaged from the surface to 50m depth, which is the habitat of common squid. We compared the environment before and after the regime shift in 1989. The life history of the common squid was divided into five stages based on its mantle length (starting at 50 mm ML), and two migration routes were supposed depending on spawning seasons, autumn and winter. The results show that the difference of wet weights and maturation between two routes is caused mainly by the difference of water temperature along migration route, rather than by prey density. Increase of wet weight and reproductive organs depends on the duration of time that the squid stays at the area within the optimum temperature range. However, maturation is determined by temperature shifts. Thus, changes in growth and maturation with cold- and warm regime shifts, or global warming, must be discussed by this coupled model. Interestingly, the model shows the growth in a cold year (*e.g.*, 1986) is worse than that growth during a warm year (1996), which is consistent with observations.

October 21, 11:50 (S3-7644)

Long-term fluctuations in gonatid squid (Gonatidae) abundance in the Okhotsk Sea

Mikhail A. **Zuev**, Nikolai S. Vanin, Oleg N. Katugin and Gennady A. Shevtsov

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia
E-mail: maiklzusqd@mail.ru

Long-term fluctuations in abundance of pelagic squid of the family Gonatidae were analyzed, based on data from midwater trawl surveys conducted by TINRO-Centre research vessels in the Okhotsk Sea. Data were collected in 25 expeditions during 1990-2008. Tows were made in the epipelagic (0-200 m) and upper-mesopelagic (200-500 m) layers. In the northern Okhotsk Sea (north of 54°N), eight gonatid species were encountered, three of which were highly abundant; *Gonatus madokai*, *Berryteuthis magister* and *Boreoteuthis borealis*. Biomass distribution density varied from 7.7-65.2 kg per km² in spring to 65.9-3,182.6 kg per km² in autumn. Nine gonatid species occurred in the southern Okhotsk Sea (south of 54°N), and *B. borealis* dominates the region in terms of both biomass and numbers. Biomass distribution density varied from 12.4-557.0 kg per km² in spring-summer to 43.0-900.1 kg per km² in autumn. In the area off of west Kamchatka (51-54°N, 154-156°E), for which a major hydrographic feature is the West Kamchatka Current, the same three species are highly abundant; *B. magister*, *B. borealis* and *G. madokai*. Biomass distribution density varied from 51.7-116.6 kg per km² in spring to 317.5-5,459.4 kg per km² in autumn. Annual and seasonal changes in gonatid squid abundance were related to long-term fluctuations in seasonal variability of pressure gradient and associated changes in intensity of Pacific Ocean water inflow into the Okhotsk Sea through the northern Kuril passes.

October 21, 12:10 (S3-7774)

A statistical approach to identify optimal habitat suitability of neon flying squid in northwestern North Pacific by using satellite datasets and 3-D ocean data assimilation product

Hiromichi **Igarashi**¹, Toshiyuki Awaji^{1,2}, Masafumi Kamachi^{1,3}, Yoichi Ishikawa^{1,2}, Norihisa Usui³, Yosuke Fujii³, Takahiro Toyoda³, Shuhei Masuda¹, Toshimasa Doi¹, Shiro Nishikawa¹, Yoshihisa Hiyoshi¹, Mitsuo Sakai⁴, Yoshiki Kato⁴, Sei-Ichi Saitoh⁵ and Shin-ichi Sato⁶

¹ Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanazawa-ku, Yokohama, Kanagawa, Japan
E-mail: higarashi@jamstec.go.jp

² Department of Geophysics, Kyoto University, Oiwake-cho, Kita-shirakawa, Sakyou-ku, Kyoto, Kyoto, Japan

³ Oceanographic Research Department, Meteorological Research Institute, Japan Meteorological Agency, 1-1 Nagamine, Tsukuba, Ibaraki, Japan

⁴ National Research Institute of Far Seas Fisheries, Fisheries Research Agency, 2-12-4 Fuku-ura, Kanazawa-ku, Yokohama, Kanagawa, Japan

⁵ Laboratory of Marine Environment and Resource Sensing, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, Japan

⁶ Fisheries Research Institute, Aomori Prefectural Industrial Technology Research Center, 10 Tsukidomari, Mouro, Hirainai-machi, Tsugaru-gun, Aomori, Japan

The neon flying squid (*Ommastrephes bartramii*) plays an important role in the pelagic ecosystem and is one of the major targets in Japanese squid fisheries in the North Pacific. In particular, the winter-spring cohort became the main target of a jigging fishery after a moratorium was imposed on the use of large-scale driftnets. In this study, the suitable habitat area for the winter-spring cohort east of northern Japan (in detail, offshore of the Sanriku coast in northwestern North Pacific) was investigated using satellite-based observational SST and SSH datasets and MOVE (Meteorological Research Institute multivariate ocean variational estimation) product, which can provide realistic fields of 3-dimensional ocean circulation and environmental structures including meso-scale eddies (Usui *et al.*, 2006). The Japanese commercial fisheries data of neon flying squid from November to March during 2000-2007 and the ocean environmental datasets described above have been applied to the identification and characterization of possible habitat suitable areas for the winter-spring cohort of neon flying squid offshore of Sanriku by using an improved habitat suitability index (HSI) model. The results indicate the high HSI area is likely to locate the northern edge of anti-cyclonic eddies generated in the Kuroshio-Oyashio transition zone offshore of the Sanriku coast, which suggests that the mixture of warm, nutrient-poor water in Kuroshio region and cold, nutrient-rich water in Oyashio region, and the local upwelling by meso-scale eddy activities leads to high-productivity and subsequent suitable habitat for neon flying squid.

S3 Session Posters

S3-7591

Cephalopods inhabiting Japan/East Sea off Korean Peninsula

Gennady A. **Shevtsov** and Evgenyi V. Slobodskoy

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia
E-mail: shevnast@mail.primorye.ru

Cephalopods were collected in 20 Russian and Korean research cruises during 1971-2004. Cephalopods were captured during light stations using hand-nets, hand jigging and machine jigging, and in trawl nets towed at depths 0-720 m. In the research area, cephalopod fauna was represented by 18 species belonging to 4 orders (Sepiida, Sepiolida, Teuthida and Octopoda) and 8 families (Sepiidae, Sepiolidae, Loliginidae, Enoploteuthidae, Gonatidae, Ommastrephidae, Octopodidae, Argonautidae). Two species of cuttlefishes (Sepiida) were captured: *Sepia lycidas* and *Sepiella japonica*. Two species of bobtail squids (Sepiolida) were captured: *Sepiolo birostrata* and *Rossia pacifica*. Ten species of squids (Teuthida) were captured: *Sepioteuthis lessoniana*, *Loligo larvae*, *Enoploteuthis chunii*, *Abralia multichamata*, *Abralia andomanica*, *Watasenia scintillans*, *Gonatopsis octopedatus*, *Gonatopsis japonicus*, *Beryteuthis magister*, and *Todarodes pacificus*. Four species of octopuses (Octopoda) were captured: *Octopus longispadiceus* (larva), *Octopus yendoii* (larva), *Octopus minor typicus* and *Argonauta hians*. Most species were captured occasionally, some species occurred in low numbers (e.g., *B. magister*, *E. chunii*, *S. birostrata* and *R. pacifica*). Two squid species were the most abundant among cephalopods: common squid (*T. pacificus*) and firefly squid (*W. scintillans*). Common squid is intensively harvested in Korean waters, where 200-300 thousand tons are taken annually during May-January. Biomass of firefly squid peaks at 20-30 thousand tons in the north of the study area. Different life cycle stages of these two species (from larvae to post-spawning individuals) were found in the research area.

S3-7606

Fishery Income fluctuation by selecting fishing ground in the Japanese coastal squid jigging fishery

Osamu **Tamaru**¹, Kazushi Miyashita², Yasuzumi Fujimori³, Toshihiro Watanabe¹ and Teisuke Miura⁴

¹ National Research Institute of Fisheries Engineering, Fisheries Research Agency, 7620-7 Hasaki, Kamisu, Ibaraki, 314-0408, Japan
E-mail: otamaru@fra.affrc.go.jp

² Laboratory of Marine Ecosystem Change Analysis, Field Science Center for Northern Biosphere, Hokkaido University, 3-1-1 Minato, Hakodate, Hokkaido, 041-8611, Japan

³ Laboratory of Marine Bioresource and Environment Sensing, Faculty of Fisheries Sciences, Hokkaido University, 3-1-1 Minato, Hakodate, Hokkaido, 041-8611, Japan

⁴ Hokkaido Industrial Technology Center, 379 Kikyō, Hakodate, Hokkaido, 041-8611, Japan

In recent years in Japan, falling fish prices and rising fuel costs have worsened conditions for many fisheries-dependent households. Typically, fishermen have operated their fisheries with their own knowledge and / or intuition, without a scientific basis. In general, many fishermen select the fishing ground in which they can maximize their total catch, even when such grounds are very far from their home harbor. As a result, fishermen have the potential to select the fishing ground in which they do not maximize their income. Especially the Japanese coastal squid jigging fishermen need development of the energy-saving squid jigging fishery, because it uses a lot of fuel in comparison with other kind of fishery. This study shows that income fluctuations are caused by many factors, by using the Management Simulation Method. We used the social factors (such as fuel price and squid price) and the fishing ground factors (such as distance from harbor to fishing ground, and squid catches) in this simulation. According to the simulation results, small changes in social and fishing ground situations can result in changes to the optimal fishing grounds. We concluded that fishermen's selection of fishing grounds based only with their own knowledge and / or intuition might not result in choices that maximize their income, and it is necessary to develop the scientific methods to choose fishing ground in which can maximize their income.

S3-7613**Seasonal shifts in species composition and distribution of cephalopods in the epipelagic northwest Pacific Ocean**Mikhail A. Zuev, Gennady A. Shevtsov and Oleg N. KatuginPacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia
E-mail: maiklzusqd@mail.ru

To study seasonal features in species composition and distribution of cephalopods, we used data collected in three epipelagic trawl surveys. Data were collected during 21 June - 3 August 2002, 20-30 September 2005, and 31 March - 8 April 2011, in the area between 44°30'-40°N and 147°-155°E, and bounded by the Russian EEZ in the West. The research area was occupied by subarctic water in the north, subtropical water in the south, and transitional zone waters between these water masses. Patterns of cephalopod distribution were associated with seasonal changes in hydrographic features. In spring, when the area was occupied mainly by cold subarctic water, only 13 cephalopod species were encountered, most of which (69%) were boreal, and occurred occasionally. Two species (*Watasenia scintillans* and *Boreoteuthis borealis*) accounted for 98% of all cephalopods. In summer, during seasonal warming, the total number of species has increased to 16, most of which (63%) were of subtropical origin. Three most abundant species (*Todarodes pacificus*, *Watasenia scintillans* and *Onychoteuthis borealijaponica*) accounted for 87% of all cephalopods. The highest species abundance was observed in autumn, when warm water of subtropical origin dominated the research area. Of 28 cephalopod species, the majority (72%) were subtropical. Four species (*Watasenia scintillans*, *Enoploteuthis chunii*, *Boreoteuthis borealis* and *Abraliopsis felis*) accounted for 96% of all cephalopods.

S3-7625**Pelagic cephalopods of the Subarctic transition zone in spring 2010**Gennady A. Shevtsov and Konstantin A. KaryakinPacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia
E-mail: karyakin@tinro.ru

Data collected during spring trawl survey in the epipelagic (0-110 m) oceanic subtropical area bounded by 36-39°N and 158-167°E were used to study offshore cephalopod community structure. Cephalopods were also taken by plankton nets and from fish stomachs. A total of 24 cephalopod species belonging to 2 orders and 12 families were observed in the catches. Of these, 19 species occurred occasionally. Three small-sized squid (*Enoploteuthis chunii*, *Abraliopsis felis* and *Watasenia scintillans*) occurred regularly and in large quantities. Juveniles of two species (*Onychoteuthis borealijaponica* and *Ommastrephes bartramii*) were highly abundant. The most numerous were neon flying squid (*O. bartramii*) juveniles, ranging in size (mantle length) from 25-82 mm. Their occurrence in catches was typically about 60% of the total catch, and the inferred distribution density varied from 49 to 23,659 (2,740, on the average) individuals per square km. The total number of neon flying squid juveniles in research area was assessed as 1,081 million individuals, and their biomass as 2.836 thousands tons.

S3-7636

A review of population structure of the neon flying squid, *Ommastrephes bartramii* and new findings based on mtDNA sequence dataToshie **Wakabayashi**¹, Takashi Yanagimoto², Shiro Wada³, Yoshiki Kato¹ and Mitsuo Sakai¹¹ National Research Institute of Far Seas Fisheries, 2-12-4 Fuku-ura, Kanazawa-ku, Yokohama, Kanagawa, 236-8648, Japan

E-mail: toshiew@fra.affrc.go.jp

² National Research Institute of Fisheries Science, 2-12-4 Fuku-ura, Kanazawa-ku, Yokohama, Kanagawa, 236-8648, Japan³ National Research Institute of Aquaculture, 6-31-1 Nagai, Yokosuka, Kanagawa, 238-0316, Japan

The neon flying squid *Ommastrephes bartramii* plays an important role in the pelagic ecosystem and as a fisheries resource in the North Pacific Ocean with an annual catch of about 140,000 t by jigging. *O. bartramii* is widely distributed in the world's oceans from subtropical to temperate zones. The worldwide population structure is considered to consist of three groups, the North Pacific, North Atlantic and southern populations. The North Pacific Ocean has an autumn cohort and a winter-spring cohort based on age estimation from statolith and mantle length compositions. Parasite data suggested the autumn cohort and the winter-spring cohort are each separated into two stocks. Genetic variability was observed in *O. bartramii* from the western and the eastern part of the North Pacific Ocean. To reveal the population structure of *O. bartramii*, we performed mitochondrial DNA sequence analysis. Comparison of partial mitochondrial 16S ribosomal RNA (16SrRNA) sequence data revealed genetic differences between samples from the North Pacific Ocean and South Atlantic Ocean. These two populations shared no haplotypes and had different nucleotides at three sites. The F_{ST} value (0.851) was significantly difference between the two populations. Furthermore, we compared NADH1-16SrRNA sequences of samples from the North Pacific Ocean, but no genetic differences among areas, although comparison between the western and the eastern area suggested significant differences between populations in these two regions.

S3-7639

Cephalopods from the Emperor SeamountsKonstantin A. Karyakin, Gennady A. **Shevtsov** and Oleg N. Katugin

Fisheries Resources of the Far Eastern Seas, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia. E-mail: katugin@tinro.ru

Cephalopods were captured and enumerated during trawl survey in the northern portion of the Emperor Seamounts (Nintoku, Jingu, Ojin, Northern Koko and Koko). Hauls were made using midwater and bottom trawls from the surface down to 1000 m. A total of 25 species of cephalopods belonging to three orders and 14 families were captured. The following cephalopod species were collected above Nintoku: *Octopoteuthis deletron*, *Gonatus pyros*, *Chroteuthis calyx*, *Galiteuthis phyllura*, *Grimpoteuthis albatrossi*, and *Japetella diaphana*. Three individuals of the onychoteuthid squid *Onykia carriboea* were found in stomachs pink salmon, captured near Nintoku in the upper 30 m. *Brachioteuthis riisei* was captured above Jingu and Ojin. Seven squid species: *Enoploteuthis chunii*, *Moroteuthis robusta*, *Onychoteuthis banksii*, *Gonatus* sp., *Ctenopteryx siculus*, *Helicocranchia pfefferi* and *Megalocranchia maxima* were captured above Northern Koko. The greatest diversity of cephalopods was observed above Koko, where 10 species occurred in trawl catches: *Lampadioteuthis megaleia*, *Abraliopsis felis*, *Pyroteuthis margaritifera*, *Pyroteuthis addolux*, *Pholidoteuthis boschmai*, *C. siculus*, *Cranchia scabra*, *M. maxima*, *Iridoteuthis iris* and *Eledonella pygmae*. Two species: *Abraliopsis pacificus* and *Pterigioteuthis gemmata*, – were found in stomach contents of rosefish and North Pacific armorhead. Mainly boreal cephalopods occurred in transitional waters above Nintoku, whereas waters above seamounts to the south of Nintoku were of subtropical structure, and hosted higher variety of subtropical species.

S3-7713

Movement patterns and foraging ecology of the Humboldt squid in the California CurrentJulia S. Stewart¹, William F. Gilly¹ and John C. **Field**²¹ Hopkins Marine Station, Stanford University, 120 Ocean View Blvd., Pacific Grove, CA, 93950, USA² Fisheries Ecology Division, Southwest Fisheries Science Center (SWFSC), NMFS, NOAA, 110 Shaffer Rd., Santa Cruz, CA, 95060, USA
E-mail: John.Field@noaa.gov

Humboldt squid have been seen in Monterey Bay nearly every year since 1997, with the summertime distribution occasionally extending as far north as Southeast Alaska. The distribution of squid throughout this ecosystem appears to follow a strongly seasonal movement pattern, most likely representing movement of a single cohort from either southern or offshore waters to the northern California current in summer and fall, returning to southern or offshore waters in the spring. Abundance is also highly variable, but seems to be associated with oceanographic factors. We have successfully tagged several Humboldt squid with pop-up satellite tags off the California coast, as well as acoustic tags in the Pacific Northwest, and have used the resulting data to better understand habitat utilization both vertically in the water column and geographically along the coast using data from the tags. These results are currently being compared with *in situ* temperature and oxygen measurements at depth and with sea surface temperatures gathered by remote sensing in order to model their habitat utilization. This, in combination with ongoing food habits and demographic studies, will provide a better picture of how these new ecosystem players are interacting with their environment, an important component of assessing ecosystem interactions.

S3-7873

Is there a relation between the abundance of *Berryteuthis magister* (Teuthida: Gonatidae) off the Kuril Islands and variability in atmospheric circulation patterns?Vasily D. Didenko, Nikolai S. Vanin and Oleg N. **Katugin**

Fisheries Resources of the Far Eastern Seas, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia. E-mail: katugin@tinro.ru

The schoolmaster gonate squid (*Berryteuthis magister*) is a highly abundant squid species, widely distributed in the North Pacific Ocean. In the ocean off the central and northern Kuril Islands, where this squid is fished commercially almost all the year round, seasonal and annual landings vary significantly. We compared decadal (1997-2010) data on catch per unit effort (CPUE) for *B. magister*, calculated as catch per day per vessel, and regional patterns of atmospheric circulation, assuming that associated changes in the Okhotsk Sea hydrography might influence squid abundance. Higher CPUE values were obtained in 1997-2000 and 2006-2010, and lower in 2001-2005. We used an index of pressure difference between the southern Kuril Islands and Kamchatka, which is related to the Aleutian Low climate features. It appeared that higher pressure gradients are associated with lower squid catches, suggesting that stronger northwesterly winds and consequent declines in the inflow of Pacific water into the Okhotsk Sea through the northern Kuril passes create a negative impact on squid catches.

S4 FIS/POC Topic Session

Recent changes of North Pacific climate and marine ecosystems: Implications for dynamics of the dominant species

Co-Sponsored by ICES

Co-Convenors: Sukyung Kang (Korea), James Overland (U.S.A.), Akihiko Yatsu (Japan) and Skip McKinnell (PICES)

Invited Speakers:

Jürgen Alheit (Leibniz Institute for Baltic Sea Research, Germany)

Emanuele Di Lorenzo (Georgia Institute of Technology, U.S.A.)

The coincidence of multidecadal-scale alternations of dominant marine fish species coupled with multidecadal-scale “Climatic Jumps” created a concept of the Regime Shift. The recently published PICES North Pacific Ecosystem Status Report noted that the frequency of these events appears to have increased, and various indicators suggest that their amplitude has increased as well. The Arctic Oscillation Index, for example, reached an extreme negative anomaly during January-March of 2010, which brought a severe winter to much of the Northern Hemisphere, while other areas were warmed equivalently by the effects of the 2009/10 El Niño. The summer of 2010 saw record-setting high temperatures in some PICES member countries, accompanied by an abrupt shift in the tropics from El Niño to La Niña in July 2010. In the northwestern Pacific, after decades at low levels, sardine abundance has begun to increase, while the anchovy abundance is declining; perhaps signaling a new Regime. This session will review recent ocean/climate variability, with emphasis on what has occurred from 2009 to 2010. It will focus on the major ecological components of North Pacific marine ecosystems, particularly commercially important fish species. Papers on mechanistic linkages between population dynamics of marine species and environmental conditions are especially encouraged.

Thursday, October 20 (9:00-17:55)

- 9:00 **Introduction by Convenors**
- 9:05 **Emanuele Di Lorenzo and Mark Ohman**
A null hypothesis linking zooplankton “regime shifts” to North Pacific climate (S4-7719),
Invited
- 9:35 **Soonil An, Jiwon Kim, Seulhee Im, Beakmin Kim and Jaeheung Park**
Recent and future sea surface temperature trends in Tropical Pacific (S4-7607)
- 9:55 **C. Tracy Shaw, Leah R. Feinberg, Cheryl A. Morgan and William T. Peterson**
Recent high variability in hydrography and lower trophic levels in the upwelling region off
Newport, OR, USA (S4-7850)
- 10:15 **Tomoko M. Yoshiki, Sanae Chiba, Hiroya Sugisaki, Kosei Sasaoka, Tsuneo Ono and
Sonia Batten**
Interannual variability of zooplankton community structure based on Continuous Plankton
Recorder in the western subarctic North Pacific during 2001-2009 (S4-7803)
- 10:35 **Coffee/Tea Break**
- 11:00 **David Mackas and Moira Galbraith**
Zooplankton time series from the Strait of Georgia (British Columbia, Canada): Changes in
biomass and community structure 1990-2010 (S4-7872)
- 11:20 **Lu Guan, John Dower, Skip McKinnell and Pierre Pepin**
Inter-annual variation in the spring ichthyoplankton assemblage in the Strait of Georgia from
2007-2010 (S4-7739)

- 11:40 **Jianguo Du, Zhenbin Lu, Shengyun Yang, Mingru Chen and Bin Chen**
Changes in the ecological characteristics and population dynamics of the main fishes in Taiwan Strait and its adjacent areas (S4-7783)
- 12:00 **Jinyeong Kim, Heeyong Kim and Sukgeun Jung**
Predicting recruitment of anchovy based on oceanographic and reproductive conditions in the southern waters of Korea (S4-7817)
- 12:20 *Lunch*
- 13:50 *Announcements by Convenors*
- 13:55 **Jürgen Alheit**
Simultaneous Atlantic and Pacific regime shifts through northern hemisphere teleconnection pattern (S4-7846), Invited
- 14:25 **Anatoliy Ya. Velikanov**
Some features of changes in species composition and stock abundance for pelagic fishes off Sakhalin Island during the first decade of the 21 century: Recurrent influence of climatic regime shift (S4-7585)
- 14:45 **Yongjun Tian and Hideaki Kidokoro**
Response patterns of the fish community in the Japan Sea to the climate regime shifts and identification of ecosystem indicators (S4-7703)
- 15:05 **Anne Hollowed, Matt Baker, Megan Stachura, Nathan J. Mantua and Ray Hilborn**
Regime shift effects on Bering Sea fish and fisheries (S4-7868)
- 15:25 *Coffee/Tea Break*
- 15:55 **Andrei S. Krovnin, Nataliya V. Klovach, Boris N. Kotenev and George P. Moury**
Multi-decadal changes in the Far East salmon stocks in relation to climate regime shifts in the Northern Hemisphere (S4-7616)
- 16:15 **Akihiko Yatsu, Kaoru Nakata, Kimio Hanawa, Tomowo Watanabe and Hiroya Sugisaki**
Recent changes in stock abundance of small pelagics in the Kuroshio/Oyashio ecosystem and associated physical conditions (S4-7842)
- 16:35 **Sangdeok Chung and Hideaki Nakata**
The change in the environment and fish community structure in an enclosed bay of western Japan over the last five decades (S4-7682)
- 16:55 **Boris N. Kotenev, Andrei S. Krovnin and Mikhail V. Bondarenko**
On the different physical-biological mechanisms of survival of Northeast Arctic cod generations during 1946-2010 (S4-7686)
- 17:15 **Jacquelynne R. King, Gordon A. McFarlane, Simon R.M. Jones, Scott R. Gilmore and Cathryn L. Abbott**
Abrupt changes in migratory behaviour of Pacific hake in Canadian waters: Stock delineation and implications for fishery management (S4-7904)
- 17:35 **J. Anthony Koslow, A. Lara-Lopez, P. Davison and N. Bowlin**
Climate, biomass, and the trophic role of midwater fishes in the southern California Current (S4-7751)
- 17:55 Session ends

S4 Posters

- S4-7589 **Kyungsu Kim, Jeonghee Shim and Suam Kim**
Effect of ocean acidification on the early life history of coastal fishes
- S4-7600 **Dmitriy Antonenko and Nadezhda L. Aseeva**
The long-term dynamics of biomass and species composition of flatfish in waters of Primorye Region (Sea of Japan)
- S4-7617 **Chih-Hao Hsieh, Wann-Nian Tzeng, Yu-Heng Tseng, Yu-San Han, Chih-Chieh Hsu, Chih-Wei Chang, Sen Jan and Emanuele Di Lorenzo**
Multi-scale climate effects on the recruitment of Japanese eel, *Anguilla japonica*, to Taiwan
- S4-7779 **Kazuaki Tadokoro, Yuji Okazaki, Tsuneo Ono and Hiroya Sugisaki**
Recent changes of *Neocalanus* copepods biomass in the Oyashio waters, western North Pacific
- S4-7816 **Jun Sui and Jun Wang**
A three-dimensional numerical ecosystem dynamic model of Xiamen Bay
- S4-7859 **Sukyung Kang, Kwangho Choi, Jisuk Ahn, Jaedong Hwang and Dongwoo Lee**
Distribution and species composition of major fish species under varying climate scenarios in Korean waters
- S4-7878 **Antonina Artemova**
Paleoceanography changes in the Sea of Okhotsk during late Pleistocene and Holocene according to diatoms

S4 Session Oral Presentations

October 20, 9:05 (S4-7719), Invited

A null hypothesis linking zooplankton “regime shifts” to North Pacific climate

Emanuele **Di Lorenzo**¹ and Mark Ohman²

¹ School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA, 30332-0340, USA. E-mail: edl@gatech.edu

² Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, 92037, USA

State transitions in marine ecosystem species of the North Pacific are correlated to large-scale oceanic modes of climate variability such as the Pacific Decadal Oscillation. However, the ecosystem timeseries are often characterized by sharp and prolonged state changes that are not as evident in the climate modes, which in contrast exhibit more “high frequency” variability. After reviewing the dominant modes of Pacific climate variability this talk discusses a null hypothesis to test ecosystem “regime shifts”. This hypothesis uses a simple process-based model to show how sharp ecosystem transitions can emerge from the smoother variability in the physical oceanic climate modes. As an example we examine a long-term timeseries of zooplankton in the California Current and show that its “regime shifts” can be understood as an integrated effect of climate forcing by the Pacific Decadal Oscillation.

October 20, 9:35 (S4-7607)

Recent and future sea surface temperature trends in Tropical Pacific

Soonil **An**, Jiwon Kim, Seulhee Im, Beakmin Kim and Jaeheung Park

Department of Atmospheric Sciences, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul, 120-749, R Korea. E-mail: sian@yonsei.ac.kr

Using coral data, sea surface temperature (SST) reanalysis data, and Climate Model Intercomparison Project III (CMIP3) data, we analyze 20th-century and future warm pool and cold tongue SST trends. For the last 100 years, a broad La Niña-like SST trend, in which the warming trend of the warm pool SST is greater than that of the cold tongue SST, has appeared in coral records, reanalysis SST data sets, and 20C scenario experiments of the CMIP3 data. However, most Coupled General Circulation Models (CGCMs) subjected to scenarios of future high greenhouse gas concentrations produce larger SST warming trends in cold tongues than in warm pools, resembling El Niño-like SST patterns. In other words, warmer tropical climate conditions correspond to stronger El Niño-like response. Heat budget analyses further verify that warmer tropical climates diminish the role of the ocean’s dynamic thermostat, which currently regulates cold tongue temperatures. Therefore, the thermodynamic thermostat, whose efficiency depends on the mean temperature, becomes the main regulator (particularly via evaporative cooling) of both warm pool and cold tongue temperatures in future warm climate conditions. Thus, the warming tendency of the cold tongue SST may lead to that of the warm pool SST.

October 20, 9:55 (S4-7850)

Recent high variability in hydrography and lower trophic levels in the upwelling region off Newport, OR, USA

C. Tracy **Shaw**¹, Leah R. Feinberg¹, Cheryl A. Morgan¹ and William T. Peterson²

¹ Cooperative Institute for Marine Resources Studies, Oregon State University, 2030 SE Marine Science Dr., Newport, OR, 97365, USA
E-mail: tracy.shaw@oregonstate.edu

² Northwest Fisheries Science Center, NOAA Fisheries, 2030 SE Marine Science Dr., Newport, OR, 97365, USA

Ocean conditions off Newport, OR, USA, have been monitored biweekly for 16 years, from 1996 to the present. This time period encompasses warm & cold phases of the PDO, El Niño and La Niña events, and episodes of strong & weak upwelling. Conditions from 2007-2010 were among the most changeable observed during this time series. Ocean conditions were cold from fall 2007 until mid-2009 after which an El Niño event emerged at the equator, reaching Oregon in fall 2009 and continuing into spring 2010. As a result, 2010 began as a “warm year”, started cooling in May, and by July water temperatures were among the coldest observed in recent years. Copepods responded quickly to these changing ocean conditions - a warm-water subtropical community appeared with the onset of the El Niño but with the demise of the El Niño, a “normal” lipid-rich sub-arctic community dominated. Euphausiids were present throughout this time period but spawning activity was minimal during the warm ocean conditions. Numbers of the pteropod *Limacina* were low during the El Niño and higher during periods of cold ocean conditions. Changes in the zooplankton community that serves as prey to higher trophic level predators are likely to have consequences throughout the food web. For example, catches of juvenile salmonids in our 14-year long time series were particularly low in September 2009: coho n=2 versus a maximum of 158 (1999), subyearling Chinook n=2 versus a maximum of 465 (2001), and yearling Chinook n=2 versus a maximum of 93 (2002).

October 20, 10:15 (S4-7803)

Interannual variability of zooplankton community structure based on Continuous Plankton Recorder in the western subarctic North Pacific during 2001-2009

Tomoko M. **Yoshiki**¹, Sanae Chiba², Hiroya Sugisaki¹, Kosei Sasaoka², Tsuneo Ono³ and Sonia Batten⁴

¹ National Research Institute of Fisheries Science, FRA, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan
E-mail: tyoshiki@affrc.go.jp

² Research Institute for Global Change, JAMSTEC, 3173-25 Showamachi, Kanazawa, Yokohama, Kanagawa, 236-0001, Japan

³ Hokkaido National Fisheries Research Institute, FRA, 16 Katsurakoi, Kushiro-shi, Hokkaido, 085-0802, Japan

⁴ Sir Alister Hardy Foundation for Ocean Science, 4737 Vista View Cres., Nanaimo, BC, V9V 1N8, Canada

Zooplankton community structure was investigated based on Continuous Plankton Recorder (CPR) observations in the western subarctic North Pacific (40-55°N, 142-170°E) during 2001-2009. The variations of copepod community structures in the WEST(142-155°E) and EAST(155-170°E) parts of the study area were analyzed by cluster analysis, and they were classified into four seasonal communities; “Spring”, “Early-summer”, “Summer” and “Autumn” in both areas. Dominant species were *Neocalanus flemingeri* (Nf), *N. cristatus* (Nc) and *Encalanus bungii* (Eb) in the Spring community, Nf, Nc, Eb and *N. plumchrus* (Np) in the Early-summer community, Np, Nc and *Calanus pacificus* (Cp) in the Summer community, and Np and Cp in the Autumn community based on abundance, while *Metridia pacifica* was abundant regardless of season. Monthly species composition was classified into the same seasonal group in both areas except for June 2004. The species composition of this month belongs to “Early-summer community” in the EAST, and “Autumn community” in the WEST. The WEST community in June 2004 was dominated by Cp CV and Np CV which were observed after July in other years. On the other hand, the EAST community in this month was dominated by Eb CVI, Nc CV and Nf CV as similar to other years. Average SST of the WEST area was higher in June 2004, that might be responsible for formation of an “Autumn” community earlier than other years. Relationships between the copepod community structure and environmental variables such as satellite Chl. *a* data will be discussed.

October 20, 11:00 (S4-7872)

Zooplankton time series from the Strait of Georgia (British Columbia, Canada): Changes in biomass and community structure 1990-2010

David **Mackas** and Moira Galbraith

Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: Dave.Mackas@dfo-mpo.gc.ca

The Strait of Georgia [SoG] is a deep marine basin lying between Vancouver Island and the mainland. Despite a long history of research, there has been no sustained monitoring of zooplankton. To enable a retrospective analysis, we assembled historic zooplankton data from various shorter-term programs. Because sampling became more consistent after 1990, we focus this analysis on the past two decades. Despite spatial proximity, the SoG zooplankton time series differ from our previously analyzed outer coast zooplankton time series: within the SoG we see little evidence of ENSO-linked oscillation between ‘northern’ and ‘southern’ communities; greater dominance by “oceanic” species; and more evidence of sustained trends and/or very low frequency fluctuations. SoG biomass of large and medium-sized copepods was much lower after 2000 than in the early 1990s although there has been some recovery in 2009 and 2010. The euphausiid time series shows a downward trend from 1990-2004, a minimum 2005-2007, followed by a partial recovery after 2008. Large copepods, euphausiids, and large amphipods all provide an energy-rich food resource for higher trophic levels (either direct or through intermediate predators). High availability of these taxa enhances the growth and survival of juvenile salmon, herring and sablefish. Low SoG zooplankton biomass and altered community composition may have contributed to recent poor survival of salmon that forage in the Strait. However, low biomass lasted at least 5 years, extending both before and after the 2007 ocean entry year for the Fraser River sockeye that had poor returns in 2009.

October 20, 11:20 (S4-7739)

Inter-annual variation in the spring ichthyoplankton assemblage in the Strait of Georgia from 2007-2010

Lu **Guan**¹, John Dower^{1,2}, Skip McKinnell³ and Pierre Pepin⁴

¹ Department of Biology, University of Victoria, P.O. BOX 3020 STN CSC, Victoria, BC, V8W 3N5, Canada. E-mail: lguan@uvic.ca

² School of Earth and Ocean Sciences, University of Victoria, P.O. Box 3065 STN CSC, Victoria, BC, V8W 3V6, Canada

³ North Pacific Marine Science Organization (PICES), Sidney, BC, Canada

⁴ Biological and Physical Oceanography Section, Fisheries and Oceans Canada, St John's NL, Canada

The Strait of Georgia (SoG hereafter) is an important nursery ground for commercially valuable fish species on the west coast of Canada; however, very little is known about either the overall species abundance or the composition of the ichthyoplankton community in this area. To investigate the status and possible changes in the SoG ichthyoplankton community, we recently conducted three spatially intensive field surveys in late-April of 2007, 2009 and 2010. Our analyses indicate similar and lower species richness and diversity in 2007 and 2009, but similar average taxonomic distinctness among these years. Total larval abundance in 2009 (~ 30 per 1000 m³) was much lower than either 2007 or 2010 (~ 200 per 1000 m³). Analysis of similarity revealed a gradual change in species composition from 2007 to 2010 with larger difference between 2009 and 2010, which suggested a relative ‘jump’ from 2009 to 2010; the major contributors to the differences included four commercially important species: *Clupea pallasii*, *Merluccius productus*, *Theragra chalcogramma* and *Sebastes* sp.. The larvae of these four spring spawners were smaller in 2010 than their size at peak abundance during the same period in 2009, possibly indicating that spawning was delayed in 2010 in response to changes in ocean temperature during the previous winter. Taken together, the significant changes in SoG ichthyoplankton community and the commercially valuable species within this system from 2007-2009 to 2010 are consistent with the suggestion of a regime shift in 2010.

October 20, 11:40 (S4-7783)

Changes in the ecological characteristics and population dynamics of the main fishes in Taiwan Strait and its adjacent areas

Jianguo **Du**¹, Zhenbin Lu³, Shengyun Yang², Mingru Chen² and Bin Chen¹

¹ Third Institute of Oceanography, State Oceanic Administration, Xiamen, 361005, PR China. E-mail: dujianguo999@gmail.com

² Department of Oceanography, Xiamen University, Xiamen, 361005, PR China

³ Fisheries Research Institute of Fujian, Xiamen, 361012, PR China

The ecological characteristics of 23 pelagic fishes, 8 semi-demersal fishes and 20 demersal fishes were studied from specimens collected in Taiwan Strait between 2005 and 2006. The population dynamics of 11 pelagic fishes such as *Sardinella aurita*, 4 semi-demersal fishes such as *Trichiurus lepturus* and 8 demersal fishes like *Pseudosciaena polyactis* were also discussed by the comparison with the previous studies. Compared with the studies in 1970s and 1980s, the maximum and mean fork length, body weight and age of the pelagic fishes, semi-demersal fishes and demersal fishes in Taiwan Strait declined gradually; the populations were younger in age and smaller in size. The asymptotic fork length L_{∞} decreased while increasing growth coefficient k , and age at the inflexion point of weight t_r was younger than before. The declining of older ones has moderated the feeding competition and the younger ones grew faster. The smaller change of the first mature fork length of some fishes has indicated a more vulnerable fishery ecosystem in this area. The changes of ecological characteristics and population dynamics of main fishes in this area may be caused by over-exploitation, water pollution, habitat loss and climate change. Therefore, in addition to the traditional fishery management approach such as the minimum length-limit, ecosystem approach to fisheries management (EAF) should be taken to improve the practical fisheries management, in order to restore the fishery population and achieve the sustainable use of the fishery stocks.

October 20, 12:00 (S4-7817)

Predicting recruitment of anchovy based on oceanographic and reproductive conditions in the southern waters of Korea

Jinyeong **Kim**¹, Heeyong Kim¹ and Sukgeun Jung²

¹ Southwest Sea Fisheries Institute, NFRDI, Yeosu, Cheollanam-do, 556-823, R Korea. E-mail: jiykim@nfrdi.go.kr

² School of Marine Biomedical Sciences, Jeju National University, Jeju, 690-756, R Korea

To forecast fishing conditions for anchovy, we related fluctuating oceanographic and anchovy reproductive conditions in spring to the subsequent recruitment in summer by applying multivariate analyses to times-series data of water temperature, salinity and copepod density during spawning season from 1992 to 2009. Most juvenile anchovies are caught by a dragnet fishery conducted for 2 or 3 months after the spring spawning season. Averaged salinity and water temperature at 10- and 50-m depth during February-June, and copepod density explained 33%, 19% and 8% of the total variation in annual anchovy recruitment in summer. These results suggest that higher water temperature and salinity in the southern area of Korea could lead to higher recruitment. The gonadosomatic index of anchovy collected in the spawning grounds was positively correlated with monthly-averaged copepod density, suggesting bottom-up controls. Because nutrients that are transported by wind mixing and river runoff can be directly available to phytoplankton in the mixed layer, we will analyze and discuss influences of climate-driven fluctuations in river-water discharge and oceanographic conditions on primary and secondary productivity, and on anchovy recruitment in southern Korean waters.

October 20, 13:55 (S4-7846), Invited

Simultaneous Atlantic and Pacific regime shifts through northern hemisphere teleconnection pattern

Jürgen **Alheit**

Biological Oceanography, Leibniz Institute for Baltic Sea Research, IOW, Seestr. 15, Warnemuende, 18119, Germany
E-mail: juergen.alheit@io-warnemuende.de

Ecosystem regime shifts have been observed in marine ecosystems throughout the northern hemisphere in the Pacific and Atlantic ocean. In the late 1980s, regime shifts occurred simultaneously in the North Sea, the Baltic Sea and the Mediterranean in the Atlantic and in the Oyashio/Kuroshio system and the Japan/East Sea, in the Pacific, apparently related to atmospheric teleconnections involving the Arctic Oscillation. Long-term time series from these regional ecosystems were recently compared by joint expert teams from PICES and ICES using multivariate statistics within the context of an overarching objective to conduct a meta-analysis of ecosystem trends and their potential drivers over the northern hemisphere. These studies yielded further insight into how ecosystems change state and it became clear that rates and magnitude of change are not the same for the different systems reflecting regional specific differences in the forcing factors. In any geographical ecosystem the expression of changes resulting from climatic forcing may take on different patterns reflecting the detailed mechanisms and local processes that are influential within the constraints of the larger scale forcing. In the late 1980s, all ecosystems under investigation changed from a cold to a warm phase affecting *inter alia* commercially important small pelagic fish species, such as sardine and anchovy. This situation will be compared to the recent change from a warm to a cold phase as observed over the last three years.

October 20, 14:25 (S4-7585)

Some features of changes in species composition and stock abundance for pelagic fishes off Sakhalin Island during the first decade of the 21 century: Recurrent influence of climatic regime shift

Anatoliy Ya. **Velikanov**

Sakhalin Research Institute of Fisheries and Oceanography (SakhNIRO), 196 Komsomolskaya St., Yuzhno-Sakhalinsk, Sakhalin, 693023, Russia. E-mail: velikanov@sakhniro.ru

Species composition of the pelagic ichthyofauna of the Tatar Strait and south-western part of the Okhotsk Sea varies significantly due to the periodic migrations of the south-latitude fishes. In general, a definite periodicity is also observed for increased frequency of the southern species along Sakhalin Island. In comparison with the 1980-1990s, during the past decade the frequency of warm-water species was essentially increased in the Tatar Strait. During the last century the subtropical fishes were also frequent in this area in the late 1940s to early 1950s and in the 1970s. In the recent ten-year period, the southern fish species were found along the Sakhalin Is. coasts in approximately twice the abundance as in the late 1940s. During the recent ten-year period, the majority of commercial fish species were characterized by low abundance in the above-mentioned areas. Now, a comparatively high abundance is observed only for Japanese anchovy, arabesque greenling, and probably Pacific saury and walleye pollock near north-eastern Sakhalin, and anadromous species (pink salmon) of eastern Sakhalin. In the recent 60 years, significant changes in stock abundance have been observed for many fish species in the Tatar Strait and southwestern part of the Okhotsk Sea. Changes in fish abundance in these sea areas occurred against the increase in Siberian High Index and PDO Index, decrease in MOI Index, increase in water temperature and decrease in ice cover.

October 20, 14:45 (S4-7703)

Response patterns of the fish community in the Japan Sea to the climate regime shifts and identification of ecosystem indicators

Yongjun **Tian** and Hideaki Kidokoro

Japan Sea National Fisheries Research Institute, Fisheries Research Agency (FRA), 1 Suidou-cho, Chuo-ku, Niigata, 951-8121, Japan
E-mail: yjtian@affrc.go.jp

Principal Component Analysis (PCA) of more than 100 long time series including climatic, oceanic, biological and fisheries data identified a regime shift, characterized by an abrupt change from a cool to warm conditions, occurred in the Tsushima Warm Current (TWC) region of the Japan Sea in the late 1980s, and the fish community in the TWC responded strongly to the climate regime shift. Response patterns are different between warm-(pelagic) and cold-water (demersal) species. Cold-water species (*e.g.*, walleye pollock, Pacific cod) decreased (increased) both in biomass and distribution during the warm (cold) regime, while warm-water (*e.g.* yellowtail) species increased in biomass and/or distribution during the warm 1990s. The two dominant modes (PC1 and PC2) in the fish community agreed closely with winter and summer water temperature in the TWC, respectively, suggesting that PC1 (PC2) was associated with cold- (warm-) water species and forced by winter (summer) water temperature. Different response pattern to the regime shift and different forcing (winter and summer water temperature) between cold- and warm-water species resulted in the complexity of the variability in the fish community and increased the difficulty toward to ecosystem-based management in the TWC. Based on their response patterns and life history characteristics, a limited number of species were selected as ecosystem indicators among the large number target species to monitor the trend in the fish community in the TWC. Recent changes in these ecosystem indicator species and their responses to climate were discussed in the context of the the regime shift.

October 20, 15:05 (S4-7868)

Regime shift effects on Bering Sea fish and fisheries

Anne **Hollowed**¹, Matt Baker², Megan Stachura², Nathan J. Mantua² and Ray Hilborn²

¹ Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way NE, Seattle, WA, 98115, USA
E-mail: anne.hollowed@noaa.gov

² School of Fisheries and Aquatic Sciences, University of Washington, P.O. Box 355020, Seattle, WA, 98195-5020, USA

In the North Pacific, retrospective studies show strong linkages between time trends in northern hemisphere ocean gyre circulation and time trends in groundfish, salmon and pelagic fish production. Statistical models suggest that the region has experienced change points in environmental forcing in 1976/77, 1988/89, 1997/98. More recent data suggests that another regime may have occurred in the mid 2005/06. This paper updates and reviews the evidence for these linkages and develops conceptual models linking fish responses to shifts in ocean conditions. We build on the rich new source of information made available from the BEST-BSIERP research program. The target species for this study will be Bering Sea fishes including walleye pollock, Pacific cod, arrowtooth flounder and capelin. We begin with a review of the exposure of fishes to different sources of stress by life stage by an examination of the spatial distribution of predator and prey. Key processes such as prey availability, metabolic requirements, predation and competition are considered. Linear and non-linear statistical relationships between environmental forcing and fish production (growth and recruitment) are evaluated using the indicators selected for key processes. This approach serves as a model for integrated ecosystem assessments that rely on key ecosystem indicators as early warnings of shifts in ecosystem properties. The potential impact of regime shifts on commercial fisheries is examined by incorporating environmental thresholds in a stock projection model.

October 20, 15:55 (S4-7616)

Multi-decadal changes in the Far East salmon stocks in relation to climate regime shifts in the Northern Hemisphere

Andrei S. **Krovnin**, Nataliya V. Klovach, Boris N. Kotenev and George P. Moury

Laboratory of Climatic Bases of Bioproductivity, Russian Federal Research Institute of Fisheries and Oceanography (VNIRO),
17 V. Krasnoselskaya St., Moscow, 107140, Russia. E-mail: akrovnin@vniro.ru

The climate transitions in the North Pacific occurred in the winters of 1976/77 and 1988/89 were quite different. The former was characterized by changes in the level of variations of main North Pacific climatic indices (PDO, NPI, *etc.*) and resulted in growth of North American salmon stocks. But it practically did not affect the Asian stocks. The increase in their abundance began only after the 1988/89 regime shift, with a peak in 2005-2009. In contrast to the 1976/77 climate transition, this regime shift was accompanied by changes in the large-scale ocean-atmosphere patterns in the Northern Hemisphere. We used the catch data for West Kamchatka pink and sockeye salmon stocks to analyze the association between their long-term variations and large-scale climatic patterns for two periods: prior to the 1988/89 climate transition (1951-1988) and after it (1989-2010). The results showed that the growth of these stocks as well as other Far East salmon stocks was related to shift in dominant mode of the air-sea coupling in the Northern Hemisphere after 1988. In particular, the resulting strengthening of the North Pacific Subtropical Gyre during the 1989-2010 period created the favorable conditions for winter survival of salmon that encouraged an increase in their abundance. In our opinion, these favorable conditions will continue in the next 5-7 years.

October 20, 16:15 (S4-7842)

Recent changes in stock abundance of small pelagics in the Kuroshio/Oyashio ecosystem and associated physical conditions

Akihiko **Yatsu**¹, Kaoru Nakata², Kimio Hanawa³, Tomowo Watanabe⁴ and Hiroya Sugisaki⁴

¹ Hokkaido National Fisheries Research Institute, Fisheries Research Agency, 2-4-1 Nakanoshima 2-jyuu, Toyohira-ku, Sapporo, 062-0922, Japan. E-mail: yatsua@fra.affrc.go.jp

² Fisheries Research Agency, Queens Tower B-15F, 2-8-3 Minatomirai, Nishi-ku, Yokohama, 220-6115, Japan

³ Graduate School of Science, Tohoku University, 6-3 Aramaki-aza-aoba, Aoba-ku, Sendai, 980-8578, Japan

⁴ National Research Institute of Fisheries Science, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, 236-8648, Japan

Decadal scale alternations of dominant small pelagics or species replacement are well known in the Kuroshio/Oyashio Ecosystem (KOE). Japanese sardine flourished in 1970s and 1980s was replaced by Japanese anchovy and common squid in 1990s. Linkages between species replacement and large-scale physical forcing such as the Aleutian Low and regional-scale oceanographic conditions in KOE have been documented under the concept of Regime Shift. Yasunaka and Hanawa (2005) pointed out that a swift shift from an El Niño state to La Niña state (or vice versa) indexed by sea surface water temperature (SST) anomalies in the Niño 3+4 area within 12 month is characteristic to years of Regime Shift detected by the global SST field. The Niño 3+4 index changed from the El Niño state to La Niña state between January and November 2009, and reversed between March and August 2010. Also, the Arctic Oscillation Index marked the historical lowest value in February 2010, bringing a severe winter around Japan and elsewhere. The 2010 year-class of Japanese sardine in KOE was extremely abundant and had not been so abundant since the late 1990s when stock was collapsed. On the other hand, the abundance of common squid declined drastically from 2009 to 2010, and the abundance of Japanese anchovy has been decreasing since 2004 in KOE. These physical and biological conditions may suggest an arrival of a new regime or regimelette. Highlights of the very recent symposium held in Japan on this topic will be presented and discussed.

October 20, 16:35 (S4-7682)

The change in the environment and fish community structure in an enclosed bay of western Japan over the last five decades

Sangdeok **Chung** and Hideaki Nakata

Graduate School of Science and Technology, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki, 852-8521, Japan
E-mail: nakata@nagasaki-u.ac.jp

The fish community structure in Omura Bay, an enclosed bay in the western Japan, was investigated using commercial landings for half a century. Its time change was divided into three phases; the first phase (1960-1979) was dominated by anchovy in the pelagic domain and a variety of demersal fish species as well, the demersal fish landings remarkably declined with sardine dominance in the pelagic domain in the second phase (1980-1985), and anchovy returned with further reducing demersal fish landings in the third phase (1986-2006). The mean trophic level of the landings in Omura Bay decreased from 3.5 to 2.8 over the last five decades. The drop in the trophic level might occur due to the decline in demersal fish, which was possibly caused by the loss of nearshore nurseries as evidenced by rapid increase in the area of reclamation during the late 1970s. Besides, further decline in the demersal fish landings in the third phase corresponded with the downward trend in bottom dissolved oxygen. The anchovy catch showed significant negative correlation with the PDO, indicating that warming trends may enhance the anchovy dominance, which leads to more simplification of fish community of the bay. In fact, the trophic level from 1986 negatively correlated with the anchovy catch ($r=-.929$, $p<0.01$), which accounted for 65.5% of total landings since 1986. This means that the fish community in Omura Bay has been simplified with anchovy dominance over the last two decades probably due to regional human impacts under a global warming trend.

October 20, 16:55 (S4-7686)

On the different physical-biological mechanisms of survival of Northeast Arctic cod generations during 1946-2010

Boris N. **Kotenev**, Andrei S. Krovnnin and Mikhail V. Bondarenko

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 Verkhnyaya, Krasnoselskaya, Moscow, 107140, Russia
E-mail: akrovnnin@vniro.ru

The retrospective analysis of the Northeast Arctic (NEA) cod stock dynamics for 1946-2010 has permitted to define 3 periods with the different levels of abundance: 1946-1970, 1971-1987, and 1988-2010. During the first period the number of strong year-classes was maximal. All high-abundant cod generations appeared under the negative phase of the NAO due to development of favorable wind conditions, irrespective of the SST anomaly sign. The second period was characterized by predominance of the weakest year-classes, especially in 1976-1981 and 1984-1987. The wind conditions, low water temperature, and advection of the negative salinity anomaly into the Barents Sea determined unfavorable conditions for survival of cod juveniles. From 1990 on, the period of medium NEA cod generations is observed. After 1996-1997, the temperature and salinity anomalies of Atlantic water in the Norwegian and Barents Seas became positive, but the wind conditions typical for formation of strong year-classes in 1946-1970, were not formed. The mechanism of appearance of medium year-classes during this period will be discussed, with account of feeding conditions (capelin, zooplankton). The causes of nonoccurrence of the high-abundant cod generations in years with the negative NAO phase (1996, 2001) will be considered.

October 20, 17:15 (S4-7904)

Abrupt changes in migratory behaviour of Pacific hake in Canadian waters: Stock delineation and implications for fishery management

Jacquelynne R. **King**, Gordon A. McFarlane, Simon R.M. Jones, Scott R. Gilmore and Cathryn L. Abbott

Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, BC, V9T 6N7, Canada
E-mail: Jackie.King@dfm-mpo.gc.ca

Within Canadian waters there are two distinct stocks of Pacific hake (*Merluccius productus*); an inshore resident stock and an offshore, migratory stock. The offshore population is a straddling stock which spawns off the coast of California in winter and migrates northward throughout the California Current and into Canadian waters to feed in summer. The summer feeding grounds have typically been off the west coast of Vancouver Island. Since the early 1990s, the northern extent of their summer feeding distribution expanded to include Queen Charlotte Sound. This change in distribution was concomitant with observed changes in the ecosystem off the west coast of Vancouver Island. However, from 2006 to 2008, Pacific hake were virtually absent from the west coast of Vancouver Island, and the vast majority of the migrating biomass were in Queen Charlotte Sound for summer feeding. As a result of this change in migratory behavior, the offshore Canadian Pacific hake fishery was propagated in Queen Charlotte Sound. Management concerns regarding the unknown exploitation of any resident stocks in this area prompted a re-examination of Pacific hake stock structure in Canadian waters. Population genetic techniques determined that the Pacific hake found in Queen Charlotte Sound in the summer were connected to the offshore migratory population and also to resident populations. In addition, two previously unidentified resident populations were discovered which also mix with the offshore stock in summer. These results suggest caution should be used in assuming that the fishery does not intercept resident inshore stocks of Pacific hake.

October 20, 17:35 (S4-7751)

Climate, biomass, and the trophic role of midwater fishes in the southern California Current

J. Anthony **Koslow**¹, A. Lara-Lopez¹, P. Davison¹ and N. Bowlin^{1,2}

¹ Scripps Institution of Oceanography, University of California, SD, 9500 Gilman Dr., La Jolla, CA, 92093-0218, USA
E-mail: jkoslow@ucsd.edu.

² Southwest Fisheries Science Center, National Marine Fisheries Service/NOAA, La Jolla, CA, 92037, USA

Considerable fisheries research in the southern California Current (CC) has focused on small, commercially-exploited pelagic fishes, such as Pacific sardine (*Sardinops sagax*) and northern anchovy (*Engraulis mordax*), which are often assumed to dominate the transfer of energy from plankton to higher trophic levels in the CC ecosystem. The apparent dominance of a few pelagic fish species at this mid-trophic level has led some to characterize upwelling ecosystems as ‘wasp-waisted.’ However, little is known about the biomass and relative importance of midwater fishes as plankton consumers and forage for higher predators in the CC. Multifrequency acoustic and pelagic trawl sampling were recently incorporated into the quarterly sampling of the southern CC by the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program. We report here initial estimates for the biomass of midwater planktivorous fishes and assess their role in the marine food web of the southern CC, relative to small pelagic planktivorous fishes. We also examine historical changes in the trophic structure of the CC ecosystem induced by fisheries and climate variability since 1951, focusing on the mid- and higher trophic levels.

S4 Session Posters

S4-7589

Effect of ocean acidification on the early life history of coastal fishes

Kyungsu **Kim**¹, Jeonghee Shim² and Suam Kim¹

¹ Department of Marine Biology, Pukyong National University, 45 Yongso-ro, Nam-Gu, Busan, 608-737, R Korea
E-mail: kskim@fishocean.pknu.ac.kr

² National Fisheries Research and Development Institute, 152-1, Haeanro, Gijang-Up, Gijang-Gun, Busan, 619-705, R Korea

Due to the high concentration of CO₂ in atmosphere, the ocean is becoming acidified. However, little is known about how fishes respond to the reduced pH. We reared newly hatched larvae of the olive flounder, *Paralichthys olivaceus*, and the black seabream, *Acanthopagrus schlegeli*, in three different concentrations of CO₂ (450, 850 and 1500 ppm atmospheric CO₂) for up to 30-days to examine the significance of acidification impacts on early life stages of fish. Weight (mg) and length (mm) of all larvae were measured after rearing 30-days. In our experiment with black seabream, larvae reared in high CO₂ conditions seemed to have low growth rate in terms of length and weight. Chemical analysis on body tissue using ICP-MS, however, indicated that higher calcium concentrations in high CO₂ concentration condition.

S4-7600

The long-term dynamics of biomass and species composition of flatfish in waters of Primorye Region (Sea of Japan)

Dmitriy Antonenko and Nadezhda L. **Aseeva**

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: antonenko@tinro.ru

Based on the results of bottom trawl surveys performed between 1981 and 2010, analysis of long-term dynamics of biomass and species composition of flatfish in the northwestern part of Sea of Japan was carried out. Surveys showed that the average annual estimate of flatfish in waters of Primorye Region now forms 58.6 thousand tons, which is more than 2 times less than what was found in the 1980-1990s. A trend to greater proportions of deep water flatfishes and lesser fractions of shallow flatfish species in catches was noted. The dominant flatfish species Primorye Region waters is the scale-eye plaice, *Acanthopsetta nadeshnyi*. The fraction of this species in the total biomass of flatfish increased from 46% in 1980-1990s to 65% at present. The analysis of long-term data demonstrates that a considerable decrease in biomass of shallow water species of flatfish has occurred against a background of an overall decrease of stocks of flatfish in waters of Primorye Region, compared to the estimates developed 20-30 years ago. The root causes of the overall decline in biomass of flatfishes are not due to anthropogenic factors. It is quite possible that the dynamics of biomass of flatfishes off the shores of Primorye Region are mainly invoked by natural factors that have a cyclic character.

S4-7617

Multi-scale climate effects on the recruitment of Japanese eel, *Anguilla japonica*, to Taiwan

Chih-Hao **Hsieh**¹, Wann-Nian Tzeng^{2,3}, Yu-Heng Tseng⁴, Yu-San Han², Chih-Chieh Hsu^{5,6}, Chih-Wei Chang⁷, Sen Jan¹ and Emanuele Di Lorenzo⁸

¹ Institute of Oceanography, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan. Email: chsieh@ntu.edu.tw

² Department of Life Science & Institute of Fisheries Science, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan

³ Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, No. 2, Pei-Ning Rd., Keelung, 20224, Taiwan

⁴ Department of Atmospheric Sciences, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan

⁵ Earth Dynamic Center, National Cheng-Kung University, No.1, University Rd., Tainan, 701, Taiwan

⁶ Department of Geography, National Changhua University of Education, No.1, Jin-De Rd., Changhua, 500, Taiwan

⁷ National Museum of Marine Biology and Aquarium, No. 2, Houwan Rd., Checheng, Pingtung, 944, Taiwan

⁸ School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Dr., Atlanta, GA, 30332-0340, USA

Long-term (1967-2008) glass eel catch data were used to investigate climatic effects on the recruitment of Japanese eel to Taiwan. Specifically, three prevailing hypotheses in explaining the recruitment were evaluated. Hypothesis 1: ENSO events affect locations of salinity fronts, which results in unfavorable spawning grounds. Hypothesis 2: latitudinal shift of North Equatorial Current (NEC) bifurcation determines the larval transport route. Hypothesis 3: ocean condition (eddy activities and productivities) along the larval migration route influences larval survival. Results of time series regression and wavelet analyses suggest that Hypothesis 1 is only partially supported, as the influence of ENSO indices is only marginally significant. Hypothesis 2 is plausibly supported, however, the catches are correlated with NEC bifurcation with a 1-year lag. Considering the time needed for larval transport (only 4-6 months), the 1-year lagged correlation does not support the direct transport hypothesis. Hypothesis 3 is supported, but indirectly. Significant correlations are found between catches and climate indices that affect ocean productivity and eddy activities, such as Quasi Biennial Oscillation (QBO), North Pacific Gyre Oscillation (NPGO), Pacific Decadal Oscillation (PDO), and Western Pacific Oscillation (WPO). Wavelet analysis reveals three dominant periodicities of eel catches: 2.7, 5.4, and 10.3 years. The interannual coherence with QBO and Niño3.4 suggests that equatorial dynamics modulates the shorter-term climate variability zonally. The low-frequency coherence with WPO, PDO, and NPGO shows the decadal modulation of meridional teleconnection (coupling and feedback between tropics and extra-tropics) via ocean-atmosphere interactions. Further, WPO and QBO are linked to solar activities.

S4-7779

Recent changes of *Neocalanus* copepods biomass in the Oyashio waters, western North Pacific

Kazuaki **Tadokoro**¹, Yuji Okazaki¹, Tsuneo Ono² and Hiroya Sugisaki³

¹ Tohoku National Fisheries Research Institute, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan. E-mail: den@affrc.go.jp

² Hokkaido National Fisheries Research Institute, 116 Katsurakoi, Kushiro, Hokkaido, 085-0802, Japan

³ National Research Institute of Fisheries Science, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

Our research group had previously reported decadal-scale variation in the meso-zooplankton community based on the long-term zooplankton sample set of "Odate Collection" from 1960 to 2000. We have continued to monitor the western North Pacific Ocean from 2001 to present. In this study, we will describe recent changes of three species of *Neocalanus* copepods. *N. cristatus* and *N. flemingeri* had high biomass during 2000s in the Oyashio waters. In the previous study, we revealed that the copepods had significant increasing trend in biomass from 1960s to 2000. The recent monitoring confirms that the increasing trend has continued from 2000 to 2010. Although *N. plumchrus* biomass did not exhibit a trend from 1960s to 2000, its biomass was higher from 2000 to 2010. *N. cristatus* and *N. plumchrus* biomass has a significant positive correlation with phosphate concentration in the surface layer. This suggests that the nutrient supply is related to the productivity of the copepods. We will also discuss the other effects of factors to the variation in *Neocalanus* copepods.

S4-7816

A three-dimensional numerical ecosystem dynamic model of Xiamen BayJun **Sui** and Jun WangNational Center of Ocean Standards and Metrology, No.219 NanKai District Jieyuan West Rd., Tianjin, 300112, China, PR
E-mail: jianghebe@tom.com

Xiamen Bay is located on the south-east coast of Fujian Province, and is one of the major ports of China. Recently, along with the development and of marine economy, the total urban and rural sewage is increasing. This degraded part of the marine water quality and led to localized ecological and environmental damage. Problems between the ecological resources and the environment are becoming increasingly apparent, mainly due to our lacking understanding of the function and the change mechanism of the marine ecosystem. Therefore, the understanding of marine ecosystems is important on how to solve the problems. We used a three-dimensional baroclinic hydrodynamic model as well as a three-dimensional ecological dynamics model, based on nitrogen and phosphorus cycling in Xiamen Bay. By this model we can simulate the distribution of nutrients and plankton volume and the trends of the different variables and discuss the impact and contribution of the biochemical process. Based on this model, considering the sea area of Xiamen Bay as the research object, the tide situation and main ecological processes were simulated considering the impact of the flow of the Xiamen Bay from the three-dimensional perspective. The results agree well with the measured magnitudes and distributions, so it can basically reflect the general characteristics of ecological processes of the Xiamen Bay and lay the foundation for related applications and studies of ecological in this area.

S4-7859

Distribution and species composition of major fish species under varying climate scenarios in Korean watersSukyung **Kang**, Kwangho Choi, Jisuk Ahn, Jaedong Hwang and Dongwoo LeeNational Fisheries Research and Development Institute (NFRDI), MIFAFF, 152-1 Haean-ro, Gijang-eup, Gijang-gun, Busan, 619-705, R Korea
E-mail: kangsk@nfrdi.go.kr

Temperature is one of the main factors, together with food availability and suitable spawning grounds, which determine the large-scale distributions of fishes and regulate the timing of migration for feeding and spawning. In this study, we examined potential impact of climate variability on the distribution and species composition of major fish species that are taken in the purse seine fishery in Korean waters. Sea surface temperature (SST) in Korean waters has increased by 1.31°C during the past 41 years. However, in 2010 SST was abnormally lower than the average of last two decades (1990-2010) which led to change of species composition. The proportion of chub mackerel decreased to 56.9% in 2010 from 69.2% in 2009 and that of common squid was increased to 6.0% in 2010 from 3.6% in 2009. Prices of the major fish species were found to fluctuate according to the changes of catch amount and the size of fish caught. We hypothesize that the distribution and changes of species composition is related to changing ocean conditions in Korean waters, and forecast the impact of climate variability on major fish stocks by a stock projection model. The results of stock projection models will provide early warnings message for the purse seine fishery management and the price stabilization of major fish species in Korean waters.

S4-7878

Paleoceanography changes in the Sea of Okhotsk during late Pleistocene and Holocene according to diatoms

Antonina **Artemova**

VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: artemova@poi.dvo.ru

The aim of this work was to study the paleoenvironment conditions of the Okhotsk Sea during the Late Pleistocene and Holocene. The basis for this work was the results of diatom analysis of the 6 cores of bottom sediments from the central Sea of Okhotsk (OS). The age of sediments in the cores was determined from an age model based on marine isotope stages (MIS). Age boundaries were determined according to Martinson by using the oxygen isotope curves, the sediment magnetic susceptibility records, AMS C14 data and tephrochronology. The taxonomic analyses, as well as the quantitative (the diatom cell abundance per sediment dry weight unit) content and ecological group definition, were applied. The obtained results of the studied cores allow us to separate 6 diatom assemblages, which reflect the OS environmental changes during last 140 kyr synchronously with MIS 6 - MIS 1 (Holocene).

S5 MEQ Topic Session

Harmful algal blooms in a changing world

Co-Convenors: *Tatiana Morozova (Russia) and Mark Wells (U.S.A.)*

Invited Speaker:

Feixue Fu (University of Southern California, U.S.A.)

The impacts of regional and global climate change and other anthropogenic forcing on the initiation, frequency and severity of harmful algal blooms (HABs) are widely anticipated but are difficult to identify. Often these “blooms” reflect subtle adjustments in the relative proportion of HAB species within a larger, more abundant phytoplankton community. In others, new blooms may reflect the possible climate-driven range extension of HAB species, but direct evidence that previous environmental conditions were unfavorable for bloom development normally is lacking. Ascribing HAB events to specific, but slowly evolving driving forces, will demand comparative observations among similar but geographically separated ecosystems. This session invites papers that focus on emerging toxic and ecosystem disruptive HAB events as well as changing plankton assemblages that are evolving towards more frequent or intense HAB incidents. Papers addressing long-term time series data, land use changes, effects of macro- or micro-nutrient stress on cell physiology, trophic interactions, and the impacts of changing riverine runoff, ocean development (e.g., aquaculture, wind turbines), and ocean acidification are particularly encouraged. The goal of the session is to help formulate a better understanding of conditions enhancing the success of HAB species.

Tuesday, October 18 (9:00-12:50)

- 8:55 **Introduction by Convenors**
- 9:00 **Feixue Fu**
Global change and the future of toxic algal blooms in the North Pacific Ocean (S5-7661),
Invited
- 9:30 **Tetsuya Nishikawa, Yutaka Hori, Satoshi Nagai, Kazutaka Miyahara, Yukinobu Nakamura, Kazuhiro Harada, Minoru Tanda, Takehiko Manabe, Kuninao Tada and Ichiro Imai**
Long term (35 years) observations in dynamics of nutrients and phytoplankton including the harmful diatom *Eucampia zodiacus* in Harima-Nada, eastern Seto Inland Sea, Japan (S5-7822)
- 9:50 **Xuelei Zhang, Y. Li, P. Sun, L.Y. Qu, C.L. Gao, L.Y. Duan and Ruixiang Li**
The impacts of temperature and salinity on growth and toxicity of an emerging harmful alga *Phaeocystis globosa* in the Northern Seas of China (S5-7896)
- 10:10 **Charles G. Trick and Brian Sutton-Quaid**
Are fish-killing flagellates a sign of things to come? (S5-7912)
- 10:30 **Coffee/Tea Break**
- 10:50 **Marina S. Selina, Tatiana V. Morozova, Nellya G. Litvinova, Dmitry I. Vyshkvartsev and Tatiana Yu. Orlova**
Seasonal dynamics and spatial distribution of *Ostreopsis* spp. in the Peter the Great Bay, the Sea of Japan (S5-7631)
- 11:10 **Akira Ishikawa, Yumi Takeichi, Setsuko Sakamoto and Mineo Yamaguchi**
Year-round occurrence of the benthic dinoflagellate *Gambierdiscus* sp. in temperate coastal waters of Japan (S5-7706)
- 11:30 **Mingyuan Zhu and Ruixiang Li**
HAB in coastal waters of China in 2010 (S5-7562)

- 11:50 **Ekaterina V. Lepkaya**
Toxic micro alga in Okhotsk Sea in Kamchatka shore (S5-7648)
- 12:10 **Stephanie K. Moore, Vera L. Trainer, Nathan J. Mantua and Eric P. Salathé, Jr.**
Future scenarios for environmental conditions favoring the accumulation of paralytic shellfish toxins in Puget Sound shellfish (S5-7895)
- 12:30 **Raphael M. Kudela, John P. Ryan and Jenny Q. Lane**
Multiple, simultaneous harmful algal bloom organisms and toxins in the California Current: An emerging threat? (S5-7886)
- 12:50 Session ends

S5 Posters

- S5-7573 **Qiulu Wang and Yanxia Zhou**
The elementary study of the bacteria biomass and environmental factor in East China Sea
- S5-7672 **Inna V. Stonik, Tatiana Yu. Orlova, Luisa N. Propp, Natalia L. Demchenko and Anna V. Skriptsova**
Bloom of *Pseudo-nitzschia* species in Amurskii Bay, the northwestern East/Japan Sea: The role of environmental factors in population dynamics
- S5-7738 **Hao Guo**
Study on the growth characteristics of cultured red-tide-algae *Alexandrium tamarense*
- S5-7899 **Qiufen Li, Bijuan Chen and Hong Jiang**
The toxicity mechanism of two toxic algae *Heterosigma akashiwo* and *Alexandrium tamarense* on the fish *Paralichthys olivaceus*

S5 Oral Presentations

October 18, 9:00 (S5-7661), Invited

Global change and the future of toxic algal blooms in the North Pacific Ocean

Feixue **Fu**

Department of Biology, University of Southern California, Los Angeles, CA, 90089, USA. E-mail: ffu@usc.edu

Harmful algal blooms (HABs) are an increasingly serious environmental and economic problem in the North Pacific basin and globally. These increases may be partly linked to cultural eutrophication, but this is only one of multiple anthropogenic biogeochemical impacts. In addition to human disturbance of natural nutrient cycles, human fossil fuel burning is modifying both seawater chemistry and climate through CO₂-induced ocean acidification and greenhouse warming. Some HAB groups, including raphidophytes, some dinoflagellates, and the toxic diatom genus *Pseudo-nitzschia*, may respond to higher CO₂ levels and temperature in seawater with increased growth rates and/or elevated toxin production. Thus it appears that there is a potential for future “CO₂ fertilization” of more frequent and more intense toxic algal blooms, and yet relatively few ocean global change studies have so far addressed HAB species. I will present recent research results showing that CO₂ increases, either alone or in combination with other environmental change variables such as altered nutrient supply, temperature or irradiance, can dramatically enhance the growth rates and toxin production of HAB groups that are already problematic in the North Pacific, including *Pseudo-nitzschia*, *Heterosigma*, and some dinoflagellates. A critical challenge for marine resource managers will be accurate prediction and effective mitigation of intensifying HAB impacts in this region resulting from poorly-understood algal physiological responses to the many interacting global change processes at work in the changing future ocean.

October 18, 9:30 (S5-7822)

Long term (35 years) observations in dynamics of nutrients and phytoplankton including the harmful diatom *Eucampia zodiacus* in Harima-Nada, eastern Seto Inland Sea, Japan

Tetsuya Nishikawa¹, Yutaka Hori¹, Satoshi Nagai², Kazutaka Miyahara³, Yukinobu Nakamura⁴, Kazuhiro Harada³, Minoru Tanda³, Takehiko Manabe³, Kuninao Tada⁵ and Ichiro **Imai**⁶

- ¹ Tajima Fisheries Technology Institute, Hyogo Prefectural Technology Center for Agriculture, Forestry and Fisheries, Kasumi, Kami, Mikata, Hyogo, 669-6541, Japan
- ² Research Center for Environmental Conservation, National Research Institute of Fisheries and Environment of Inland Sea, Maruishi, Hatsukaichi, Hiroshima, 739-0452, Japan
- ³ Fisheries Technology Institute, Hyogo Prefectural Technology Center for Agriculture, Forestry and Fisheries, 22-2 Minami-Futami, Futami, Akashi, Hyogo, 674-0093, Japan
- ⁴ Inland Waters Branch, Hyogo Prefectural Technology Center for Agriculture, Forestry and Fisheries, 1134 Touji, Asago, Hyogo, 679-3442, Japan
- ⁵ Laboratory of Biological and Chemical Oceanography, Kagawa University, Miki, Kida, Kagawa 761-0795, Japan
- ⁶ Plankton Laboratory, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-machi, Hakodate, Hokkaido, 041-8611, Japan. E-mail: imai1ro@fish.hokudai.ac.jp

Long-term monitoring (1973 - 2007) of water quality and phytoplankton was conducted at 19 sampling stations in Harima-Nada, eastern Seto Inland Sea, Japan for 35 years from 1973 to 2007. There were two significant long-term changes, an increase in winter water temperatures of 0.042°C year⁻¹, and a decline in dissolved inorganic nitrogen (DIN) from about 10 mM in the 1970s to ~5 mM in the late 1990s due to the reduction in nutrient inputs. DIN concentrations and total phytoplankton cell density were both higher during the 1970s to the early 1980s and then exhibited a significant decrease in the mid 1980s and remained relatively constant thereafter. Diatoms were the dominant phytoplankton group (>90%) over the 35-year period, and there was a distinct shift from *Skeletonema* dominance (~70%) to *Chaetoceros* in the mid 1980s, attributable to the response to the decrease in DIN concentration.

Long-term variations (1974 - 2008) of the harmful diatom *Eucampia zodiacus*, a causative organism for bleaching of aquacultured “nori” (*Porphyra yezoensis*), had also been monitored. *E. zodiacus* cells were detected every year, and seasonal cell densities tended to be higher from January to April. The proportion of *E. zodiacus* to the total phytoplankton cell density has increased in recent years. An increase in winter water temperatures and a decrease in the concentration of dissolved inorganic nitrogen may be more advantageous to the growth of *E. zodiacus*, which contributed to the domination of *E. zodiacus* abundance in recent years.

October 18, 9:50 (S5-7896)

The impacts of temperature and salinity on growth and toxicity of an emerging harmful alga *Phaeocystis globosa* in the Northern Seas of China

Xuelei **Zhang**, Y. Li, P. Sun, L.Y. Qu, C.L. Gao, L.Y. Duan and Ruixiang Li

Center for Marine Ecology Research, The First Institute of Oceanography, SOA, 6 Xian-Xia Ling Rd., LaoShan District, Qingdao, Shandong, 266061, PR China. E-mail: zhangxl@fio.org.cn

The microalgae *Phaeocystis* spp. (Chrysophyta) occur in many seawaters, often forming blooms, from the polar region to the tropical, and some species such as *P. globosa* are toxic. In the seawaters of China, *P. globosa* used to be found and cause blooms only in the subtropical region. From the year of 2004, however, *P. globosa* has formed blooms in the temperate Bohai Sea and also occurred, though not in blooms, in the Yellow Sea. This recalls us to study the growth and toxicity of *P. globosa* (Bohai strain) in changing environmental conditions, such as temperature and salinity. Our study found that both temperature (10-35°C) and salinity (10-35) had significant impacts on the growth of *P. globosa* and its haemolytic activity. Higher growth rate of *P. globosa* occurred at 20-30°C and salinity 30-35. The haemolytic activity was higher at 25-35°C and salinity 25-35. The results present some differences from those reported earlier for the subtropical strain of *P. globosa* and support our molecular study result that the Bohai strain of *P. globosa* is closer to other temperate strain and less close to the sub- and tropical strains.

October 18, 10:10 (S5-7912)

Are fish-killing flagellates a sign of things to come?

Charles G. **Trick** and Brian Sutton-Quaid

Ecosystem Health - Schulich School of Medicine and Dentistry and Department of Biology, The University of Western Ontario, London, ON, N6A 5B7, Canada. E-mail: trick@uwo.ca

There has been a considerable increase in the scientific interest in fish-killing flagellates over the past 20 years. HAB species such as *Heterosigma akashiwo*, *Cochlodinium*, *Prymnesium* have had local outbreaks but there is a concern that these flagellates are having more frequent, longer-lasting or more damaging blooms. To assess whether fish-killing flagellates are an emerging HAB concern or just a periodic re-occurring outbreak, we have documented the historical record with an emphasis on PICES communities and assessed the co-occurrence of outbreaks with anthropogenic alterations of coastal waters. We will assess if the outbreaks can be explained through a physiological cell model that considers altered nutrient inputs, metal loadings and changes in ocean pH or if an alternative ecological model is necessary to explain the bloom frequency.

October 18, 10:50 (S5-7631)

Seasonal dynamics and spatial distribution of *Ostreopsis* spp. in the Peter the Great Bay, the Sea of Japan

Marina S. Selina, Tatiana V. **Morozova**, Nellya G. Litvinova, Dmitry I. Vyshkvartsev and Tatiana Yu. Orlova

A.V. Zhirmunsky Institute of Marine Biology, FEB RAS, 17 Palchevskogo St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: tatiana_morozova@mail.ru

Studies of epiphytic dinoflagellates on macroalgae in Russian coastal waters of the Sea of Japan revealed the presence of *Ostreopsis* cf. *ovata* and *O.* cf. *siamensis*. These species are widespread in the tropical, subtropical, and temperate zones. However, they have not been previously reported in seas with negative winter temperatures. Seasonal dynamics of *Ostreopsis* spp. on macroalgae at the 1 m depth was examined in September 2008 - November 2009 and in June-November 2010 at two monitoring stations. The spatial distribution of *Ostreopsis* spp. in coastal waters of Peter the Great Bay was analyzed in September 2010. Cells of *Ostreopsis* spp. were found on macroalgae from August to October at 9-24°C and dominated at that time. Maximum density (above 300×10^3 cells g⁻¹ dry wt. of macrophytes [DW]) was recorded in the mid of September. Relative abundance of *Ostreopsis* spp. reached 100%. In other months, accompanying species were potentially toxic *Amphidinium operculatum*, *Prorocentrum lima*, as well as *Prorocentrum fukuyoi*, *Pseudothecadinium campbellii* and *Cabra* sp.

Analysis of the spatial distribution revealed the wide spread of *Ostreopsis* spp. throughout Peter the Great Bay. The greatest cell density (10^4 - 10^5 cells g^{-1} DW) was recorded in slightly shaken sites; cell density decreased to 10^2 cells g^{-1} DW in shaken sites; epiphytic dinoflagellates were absent on macroalgae in calm sites. Due to the high abundance of potentially toxic dinoflagellates during the summer-autumn period, monitoring of epiphytic assemblage is a necessity.

October 18, 11:10 (S5-7706)

Year-round occurrence of the benthic dinoflagellate *Gambierdiscus* sp. in temperate coastal waters of Japan

Akira **Ishikawa**¹, Yumi Takeichi¹, Setsuko Sakamoto² and Mineo Yamaguchi²

¹ Graduate School of Bioresources, Mie University, Kurima-machiya, Tsu, Mie, 514-8507, Japan. E-mail: ishikawa@bio.mie-u.ac.jp

² National Research Institute of Fisheries and Environment of Inland Sea, Fisheries Research Agency, Maruishi, Hatsukaichi, Hiroshima, 739-0452, Japan

The benthic dinoflagellate *Gambierdiscus* spp. is the primary causative agent of ciguatera fish poisoning (CFP) which occurs in tropical and subtropical regions. However, incidents of CFP have been occasionally reported even in temperate coastal waters of Japan. Recently we found the cells of *Gambierdiscus*, attaching to the macroalgae, in temperate embayment, Ago Bay, central part of Japan. The morphology of the cells is similar to that of *G. toxicus*. However, phylogenetic analysis utilizing 18S rDNA as well as 28S rDNA sequence indicated that this species is not classified into any other *Gambierdiscus* species reported so far, although close to *G. caribaeus*. In a seaweed bed of Ago Bay, we have monitored the cell abundance (density of the cells attached to macroalgae) of *Gambierdiscus* sp. monthly since November 2008. The abundance of *Gambierdiscus* sp. increased in warmer season (especially from August to October): maximum density, 32 cells g^{-1} (of macroalga wet weight), was recorded in the brown alga *Sargassum thunbergii* (Phaeophyceae) in October 2009. On the other hand, although the cell density was very low (sometimes under the detection limit), they also occurred even in the cold season (from January to March). These results suggest that *Gambierdiscus* sp. maintains its population throughout the year in the bay. To support the field observations, we also show the growth response of *Gambierdiscus* sp. strains, observed in the laboratory, at different temperatures.

October 18, 11:30 (S5-7562)

HAB in coastal waters of China in 2010

Mingyuan **Zhu** and Ruixiang Li

Key Lab. for Marine Ecology, First Institute of Oceanography, SOA, 6 Xian-Xia Ling Rd., Hi-Tech Park, LaoShan District, Qingdao, Shandong, 266061, PR China. E-mail: zhumingyuan@fio.org.cn

There were 69 HAB events in coastal water of China in 2010. The effected area was 10,892 km². Among them, 7 in Bohai Sea, 9 in Yellow Sea, 39 in East China Sea and 14 in South China Sea. May was the month with more HAB and followed by June and July. The large scale HABs with an area larger than 1,000 km² were occurred in Bohai Sea and East China Sea. The main causative species include *Prorocentrum donghaiense*, *Noctiluca scintillan*, *Skelotonema costatum*, *Gymnodinium catenatum*, *Mesodinium rubrum*, *Chaetoceros curvisetus*, etc.

There was a large scale green tide in Yellow Sea during June and July. In early July, the effected area reached 29,000 km² and covered area 530 km². It disappeared in middle of August.

October 18, 11:50 (S5-7648)

Toxic micro alga in Okhotsk Sea in Kamchatka shore

Ekaterina V. **Lepskaya**

Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO), Naberezhnaya, 18, Petropavlovsk-Kamchatsky, 683000, Russia
E-mail: lepskaya@list.ru

Toxic micro alga among diatoms (*Pseudonitzschia seriata*-complex), and dinophyta (*Alexandrium tamarense*-complex, *Dinophysis acuta*, *D. acuminata*) were found during annual (from 2004) monitoring of phytoplankton in Okhotsk Sea in Kamchatka shore (the region of the first summer nursery of pacific salmon young fishes). *Pseudonitzschia* number more than 1000 cells/l occurred in May at the water temperature of surface-bottom layer 3.3-4.3°C. Dinophyta occurred in June-July generally in surface water at its temperature 8.5-11.6°C. The increases of *Alexandrium* number from 2000 to 8000 cells/l closely connect with the warming of the surface water. It is possible that toxic micro alga may be one of the factor, affecting on the survival, and abundance of pacific salmon populations of the west shore of Kamchatka, especially on the years, when the water surface temperature rise 8.5°C and more.

October 18, 12:10 (S5-7895)

Future scenarios for environmental conditions favoring the accumulation of paralytic shellfish toxins in Puget Sound shellfish

Stephanie K. Moore¹, Vera L. **Trainer**¹, Nathan J. Mantua^{2,4} and Eric P. Salathé, Jr.^{3,4}

¹ West Coast Center for Oceans and Human Health, Northwest Fisheries Science Center, NOAA, 2725 Montlake Blvd. E., Seattle, WA, 98112, USA. E-mail: Vera.L.Trainer@noaa.gov

² School of Aquatic and Fishery Sciences, University of Washington, P.O. Box 355672, Seattle, WA, 98195, USA

³ Science and Technology Program, University of Washington-Bothell, 18115 Campus Way NE, Bothell, WA, 98011-8246, USA

⁴ Climate Impacts Group, University of Washington, P.O. Box 354235, Seattle, WA, 98195, USA

The marine dinoflagellate *Alexandrium catenella* produce potent neurotoxins called paralytic shellfish toxins usually when they bloom. These toxins can accumulate in shellfish and cause human illness or even death if contaminated shellfish are consumed. A specific combination of environmental conditions creates a window of opportunity for these harmful algal blooms (HAB-WOO) and can significantly increase the risk for toxic events in Puget Sound (Moore *et al.* 2009). HAB-WOOs of long duration indicate long periods of time when conditions in the marine environment are favorable for the development of toxic blooms that threaten shellfish safety.

Here we evaluate past trends and future scenarios for the HAB-WOO for the 2020s, 2040s, and 2080s using an innovative modeling approach. Specifically, we simultaneously calculate time periods when multiple environmental parameters are within a range that has been determined to be favorable for the development of toxic events. Model results show that the HAB-WOO duration increased since 1978, as did the frequency and geographic extent of toxic events.

Climate change projections for the Pacific Northwest are used to evaluate scenarios for the future HAB-WOO. Under a moderate greenhouse gas emissions scenario (*i.e.*, A1B), the annual HAB-WOO is projected to increase by an average of 13 days by the end of the 21st century. Furthermore, the annual HAB-WOO may begin up to 2 months earlier in the year and persist for up to 1 month later in the year compared to the present day typical annual HAB-WOO time period.

The extended lead time offered by these projections will allow managers to put mitigation measures in place faster and more effectively to protect human health against these toxic outbreaks. This study demonstrates for the first time how a changing climate alters the marine environment in a way that may increase the risk of human exposure to HAB toxins.

October 18, 12:30 (S5-7886)

Multiple, simultaneous harmful algal bloom organisms and toxins in the California Current: An emerging threat?

Raphael M. **Kudela**¹, John P. Ryan² and Jenny Q. Lane¹

¹ Ocean Sciences Department, University of California Santa Cruz, Santa Cruz, CA, 95064, USA. Email: kudela@ucsc.edu

² Monterey Bay Aquarium Research Institute, Moss Landing, CA, 95039, USA

Harmful Algal Blooms (HABs) are recognized as an increasing threat in both intensity and frequency throughout the world's coastal oceans, but many HAB hotspots are assumed to be dominated by one or two organisms. In central California, for example, domoic acid and paralytic shellfish toxins, produced by the diatom genus *Pseudo-nitzschia* and the dinoflagellate *Alexandrium catenella*, are routinely monitored for both human and wildlife health. In contrast, many toxins and organisms are not monitored or regulated in California, including okadaic acid, yessotoxins, and microcystins, all of which are routinely monitored in other regions. Time series from the US west coast suggest that true red tides have increased dramatically since 2005 coincident with mesoscale changes in depth and intensity of stratification and upwelling favorable winds. Land-sea coupling also seems to be exacerbating both the transfer of freshwater toxins such as microcystins into the coastal ocean and the occurrence of marine toxins such as domoic acid within the last few years. We suggest that these changes are not coincidental, but are related to decadal-scale oceanographic forcing and increasing anthropogenic impacts. Very little is known about the synergistic or antagonistic effects of exposure to multiple toxins, but this threat is likely to increase in coastal regions in response to both climate change and increased human utilization of the coastal zone. This will require a paradigm shift in HAB monitoring and management to take in account the threat of both the most dominant HAB organisms and the increased presence of lesser known organisms and toxins.

Session 5 Posters

S5-7573

The elementary study of the bacteria biomass and environmental factor in East China Sea

Qiulu **Wang** and Yanxia Zhou

National Marine Data and Information Center, 93 Liuwei Rd., Hedong District, Tianjin, 300171, PR China. E-mail: shelleyqing@hotmail.com

Two cruise investigations of hetero-bacteria biomass were done in the East China Sea during the spring of 2006. The relationship between bacteria biomass and influencing factors was analyzed. The results indicated that the biomass was respectively 0.40-4.13 (average~2.09) $\text{mg}\cdot\text{cm}^{-3}$ and 0.28-4.97 (~2.53) $\text{mg}\cdot\text{cm}^{-3}$ in the two cruises. The biomass of the two cruises both decreased from Changjiang estuary to extra sea and the maximum both occurred on the middle water layer.

Through analyzing the correlation between biomass and temperature in different water layers, it was obvious that there was the best correlation in the middle water layer. Substrate supply was enough in the middle layer due to the photosynthesis production, so the temperature was major controlling factor on biomass. Surface and bottom water belonged to interface layer where the land substance input and the substance exchanged with sediment. Thereby, the influencing factors were complicated and temperature was not the crucial factor.

The results of the second cruise were different with the first, which indicated that the dissolved inorganic nitrogen (DIN) decreased by 34%, the bacteria biomass increased by 21%, but the ratio of NH_4^+ to DIN increased by 48%. The better regeneration of NH_4 in the second cruise was explained.

S5-7672

Bloom of *Pseudo-nitzschia* species in Amurskii Bay, the northwestern East/Japan Sea: The role of environmental factors in population dynamics

Inna V. **Stonik**, Tatiana Yu. Orlova, Luisa N. Propp, Natalia L. Demchenko and Anna V. SkriptsovaHydrobiology, A.V. Zhirmunsky Institute of Marine Biology, FEB RAS, 17 Palchevskogo St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: innast@imb.dvo.ru

Bloom of potentially toxic diatoms of the genus *Pseudo-nitzschia* was registered in October-November 2005 in Amurskii Bay in the vicinity of the city of Vladivostok (northeastern East/Japan Sea) at a salinity of 31-33.5‰ and water temperature of 6-12°C. The most intensive peak of the *Pseudo-nitzschia* spp. density (the mean value of 1428.9 thousand cells l^{-1}) was recorded in the last two weeks of October after heavy rains, the outburst was determined presumably by mass development of *P. multistriata* (67% of the total density) and *P. calliantha* (9%). The methods of correlative and regressive analyses were used to find that water salinity, NH_4 concentrations in the environmental waters and water temperature had an influence on the "bloom" of *Pseudo-nitzschia* spp. A negative correlation was revealed between the density of *Pseudo-nitzschia* spp. and water salinity and NH_4 concentrations in the waters and a positive correlation was found between the population density of diatom algae and water temperature.

S5-7738

Study on the growth characteristics of cultured red-tide-algae *Alexandrium tamarense*Hao **Guo**

National Marine Environmental Monitoring Center, SOA, 42 Linghe St., Shahekou District, Dalian, Liaoning, 116023, PR China
E-mail: hguo@nmemc.gov.cn

Alexandrium tamarense is one of the main toxic red-tide-algae which can produced Paralytic Shellfish Poisoning (PSP) and often burst out to form blooms in globe oceans. The growth characteristics of this unicellular alga were observed by artificial culture in laboratory. In addition we have confirmed the adscription and have detected toxins of this alga. The result demonstrates that the optimum situation is: T=22-26°C; S=28-31‰; L=1500-2500 lux and L/D=16/8h. The growth pattern accord with the Logistic Equation and the average double arise time is 85h.

S5-7899

The toxicity mechanism of two toxic algae *Heterosigma akashiwo* and *Alexandrium tamarense* on the fish *Paralichthys olivaceus*Qiufen **Li**, Bijuan Chen and Hong Jiang

Yellow Sea Fisheries Research Institute, CAFS, 106 Nanjing Rd., Qingdao, Shandong, 266071, PR China. E-mail: liqf@ysfri.ac.cn

The toxicity and its mechanism of two toxic algae *Heterosigma akashiwo* and *Alexandrium tamarense* on the fish *Paralichthys olivaceus* was studied in this paper. The experiment result of the effect of different algal culture fragments on *Paralichthys olivaceus* indicated that the algal culture of *Heterosigma akashiwo* and *Alexandrium tamarense* had the remarkable harmful influence on the different growth phases of *Paralichthys olivaceus* ($P<0.05$), but the toxicity on the early development phases was the highest. The restrict ability of fish to the toxic algae increased with their growth. The toxicity of *Heterosigma akashiwo* to *Paralichthys olivaceus* was not only through eating algae, which causes accumulation of algal toxin in body, but also through direct touching of algae, the toxin emitted into surrounding seawater by algal cells may also cause toxic effect. The toxicity mechanism of *Alexandrium tamarense* on *Paralichthys olivaceus* was mainly co-caused by PSP and other novel toxin on the surface of the algal cell. The effect of *Heterosigma akashiwo* on the activity of Na^+/K^+ -ATPase in the gill cell of *Paralichthys olivaceus* was significant ($P<0.05$), The activity of Na^+/K^+ -ATPase was activated temporarily at the low concentration of *Heterosigma akashiwo* in short time, while it was decreased and inhibited significantly as the increase of toxic concentration and the extent of exposure time ($P<0.01$). The dose/time-response relationships were obvious. The change of the activity of Na^+/K^+ -ATPase in gill cells could be used as an index of harmful influence of *Heterosigma akashiwo* to the fish.

S6 MEQ/FIS Topic Session

Identification and characterization of environmental interactions of marine aquaculture in the North Pacific

Co-Convenors: Katsuyuki Abo (Japan), Brett Dumbauld (U.S.A.) and Galina Gavrilova (Russia)

Invited Speakers:

Shuanling Dong (Ocean University of China, PR China)

Tomoko Sakami (Tohoku National Fisheries Research Institute, Japan)

Marine aquaculture is an important economic and social activity within PICES member countries. To ensure that development of aquaculture is environmentally and economically sustainable we need to: 1) improve our understanding of interactions between marine aquaculture and the environment (including wild stocks of plants and animals, 2) develop methods to study and/or predict such interactions, and 3) devise ways to reduce negative impacts on the environment. To this end the PICES Working Group on Environmental Interactions of Marine Aquaculture has begun to characterize the nature of these interactions with a focus on the benthic environment and aquatic animal health. To align with the activities, papers for this session are solicited in the following areas: 1) identification and characterization of marine aquaculture-environmental interactions; 2) development of tools to identify and study such interactions; and 3) social science research related to aquaculture interactions with the marine environment.

Tuesday, October 18 (14:00-17:55)

- 14:00 **Introduction by Convenors**
- 14:05 **Tomoko Sakami, Ryuji Kondo and Takanori Kobayashi**
An attempt to assess the environment by using microbial communities of the bottom sediments from marine areas of fish aquaculture (S6-7567), Invited
- 14:35 **Shuanglin Dong**
Integrated aquaculture in China (S6-7755), Invited
- 15:05 **Katsuyuki Abo**
Environmental interactions of marine aquaculture in Japan (S6-7736)
- 15:30 **Coffee/Tea Break**
- 15:50 **Brett R. Dumbauld, Jennifer L. Ruesink, Alan C. Trimble and Jessica Ramsay**
Ecosystem services provided by oyster aquaculture in Willapa Bay, Washington compared with historical estimates for native oysters (S6-7665)
- 16:15 **Stewart Johnson, Michael Foreman, Kyle Garver, Brent Hargreaves, Simon R.M. Jones and Chrys Neville**
Interactions between wild and farmed salmonids in Southern British Columbia: Pathogen transfer (S6-7861)
- 16:40 **Tatiana Krupnova, Vladimir Pavlutcykov and Nina Shepel**
Environmental influences on harvesting from hanging plantations for *Laminaria* kelp (S6-7858)
- 17:05 **I Nyoman Radiarta, Sei-Ichi Saitoh, Toru Hirawake and Hajime Yasui**
GIS-based spatial models for Japanese kelp (*Laminaria japonica*) aquaculture site selection in the Southwestern Hokkaido, Japan (S6-7827)
- 17:30 **Wei Zheng, Honghua Shi, Xuelei Zhang, Mingyuan Zhu and Zongling Wang**
Ecological-economic assessment of monoculture and integrated multi-trophic aquaculture in Sanggou Bay, China (S6-7580)
- 17:55 Session ends

S6 Posters

- S6-7627 **Chunjiang Guan and Feng'ao Lin**
Absorption of carbon and nitrogen by culturing *Sargassum thunbergii* in coastal waters
- S6-7728 **Vera Valova**
The influence of salmon hatchery conditions on the physiological status of Amur sturgeon
- S6-7741 **Olga G. Shevchenko**
Monitoring of potentially toxic microalgae in Severnaya Bight (Slavyanskii Bay, the Sea of Japan) in 2008, 2009

S6 Session Oral Presentations

October 18, 14:05 (S6-7567), Invited

An attempt to assess the environment by using microbial communities of the bottom sediments from marine areas of fish aquaculture

Tomoko **Sakami**¹, Ryuji Kondo² and Takanori Kobayashi³

¹ Tohoku National Fisheries Research Institute, Fisheries Research Agency, 3-27-5 Shinhama, Shiogama, Miyagi, 985-0001, Japan

E-mail: sakami@affrc.go.jp

² Department of Marine Bioscience, Fukui Prefectural University, 1-1 Gakuen, Obama, Fukui, 917-0003, Japan

³ Fisheries Research Agency, 15F Queen's Tower B, 2-3-3 Minato Mirai, Nishi-ku, Yokohama, Kanagawa, 220-6115, Japan

In areas where fish aquaculture is carried out, uneaten food and fish feces often accumulate on the bottom sediments and cause environmental adversities such as hypoxic water mass formation. Therefore, the bottom environment needs to be constantly monitored to continue sustainable aquaculture. In order to monitor biological diversity, we assessed the microbial communities thriving in the bottom sediments. We examined environmental microbial genomes using culture-independent techniques and aimed to develop a new biological parameter for the evaluation of aquaculture environments. We collected the bottom sediments from various fish farming areas and extracted DNA from the communities living in them. The composition of the bacterial community in the sediments was profiled using a terminal restriction enzyme fragment polymorphism method for the 16S rRNA genes: the composition of the bacterial community varied according to the pollution level, which was determined by the acid-volatile sulfide content. We also found that the abundance of some 16S rRNA genes increased or decreased in heavily polluted sediments. We designed oligonucleotide probes using the sequence data collected from the sediments to prepare a DNA chip. The DNA chips prepared showed different luminescent patterns when they were applied to the sedimentary bacterial DNA, indicating that they can be used as a testing tool for determining bacterial DNA in sediments. Our results suggest that sedimentary microbe genomic information is a prospective parameter to assess the environments of areas where fish aquaculture is carried out.

October 18, 14:35 (S6-7755), Invited

Integrated aquaculture in China

Shuanglin **Dong**

The Key Laboratory of Mariculture, Ministry of Education, Ocean University of China, P.O. Box 266100, Qingdao, Shandong, PR China

E-mail: dongsl@ouc.edu.cn

China has the longest history and the richest experience of integrated aquaculture (INTAQ), and there are several dozen types of INTAQ practices currently in China, which is one of the important reasons for fast and persistent development in aquaculture. This paper deals with definition, history, ecological rationales, classification and development of INTAQ in China.

The ecological rationales for INTAQ are: waste reclamation through trophic relationships, ecological balance maintenance by complementary or commensalism of technical measures or farmed species or production systems, making full use of the resources (time, space and natural food) of aquaculture waters, ecological prevention of diseases and so on.

INTAQ can be divided into three groups: Technical measure integration in a waters, Species integration in a waters and Systems integration. The Species integration in waters group includes such types as Trophic integration or Integrated multi-trophic aquaculture, Spatial integration, Rotary stocking and harvesting, Temporal integration, Multi-function integration and Others. The Systems integration group includes two sub-groups: Integration of aquatic systems (such types as Partitioned aquaculture systems, Aquaculture and agriculture integration, Aquaponics, Aquaculture and waterfowl integration, Aquasilviculture, Fish and amphibian integration, and Others), and Integration of aquatic and land systems (such types as Integration of pond and livestock or poultry breeding, Integration of pond and planting, and Others).

October 18, 15:05 (S6-7736)

Environmental interactions of marine aquaculture in Japan

Katsuyuki **Abo**

National Research Institute of Fisheries and Environment of Inland Sea, Fisheries Research Agency, 2-17-5 Maruishi, Hatsukaichi, Hiroshima, 739-0452, Japan. E-mail: abo@fra.affrc.go.jp

Since mariculture generates large amounts of organic wastes and nutrients in and around aquaculture facilities, it may have large impacts on the benthic environment. Feeding aquaculture (fish farming) especially discharges large amount of organic waste to benthic environment. Although non-feeding aquaculture (shellfish culture, algae culture) has less impact, intensive and long-term culture activity causes eutrophication and hypoxia due to feces and associated remnants. In this talk, studies on impacts of marine aquaculture on benthic environments in Japan will be reviewed to identify and characterize the environmental interaction of marine aquaculture including finfish culture, shellfish culture and algal culture. The interaction covers short and long term effects on the near and far-field benthic environment.

October 18, 15:50 (S6-7665)

Ecosystem services provided by oyster aquaculture in Willapa Bay, Washington compared with historical estimates for native oysters

Brett R. **Dumbauld**¹, Jennifer L. Ruesink², Alan C. Trimble² and Jessica Ramsay³

¹ Agricultural Research Service, U.S. Department of Agriculture, Newport, OR, 97365, USA. E-mail: brett.dumbauld@ars.usda.gov

² Department of Biology, University of Washington, P.O. Box 35100, Seattle, WA, 98195, USA

³ Marine Resource Management Program, Oregon State University, 104 COAS Admin. Bldg., Corvallis, OR, 97331, USA

Two well documented ecosystem services for oysters in estuaries are their capacity to filter large quantities of phytoplankton and their ability to form extensive reefs that provide habitat for other fish and invertebrates. The native oyster, *Ostrea lurida* is no longer present in sufficient quantities to quantify these services, but has been replaced in many US West Coast estuaries with actively cultured Pacific oysters, *Crassostrea gigas*. We used information on filtering rates, as well as the present role of live oysters and shell as habitat for juvenile Dungeness crab (*Metacarcinus magister*), to contrast these two ecosystem services in Willapa Bay, Washington. Pacific oysters are now cultured and cover approximately 20% of the intertidal area of this estuary while native oysters were estimated to have covered 12% of the low intertidal area, however reef morphology and location of these two oysters in the estuary differ substantially. Native oysters were found primarily in lower intertidal areas and further from the mouth of the estuary than current Pacific oyster culture. We quantify the effect of these tradeoffs for crab production and filtering capacity which should be considered when defining goals for both aquaculture and native oyster restoration in this and other estuaries along this coast.

October 18, 16:15 (S6-7861)

Interactions between wild and farmed salmonids in Southern British Columbia: Pathogen transfer

Stewart **Johnson**¹, Michael Foreman², Kyle Garver¹, Brent Hargreaves¹, Simon R.M. Jones¹ and Chrys Neville¹

¹ Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, BC, V9T 6N7, Canada

E-mail: stewart.johnson@dfo-mpo.gc.ca

² Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada

It is generally accepted that pathogen transfers occur between wild and farmed salmonids, and that these transfers occur in both directions. What is not understood is the magnitude of these transfers and the risk that they pose to both wild and farmed salmonids. In British Columbia, oceanographers, physiologists, ecologists and fish health specialists are working closely together to address this complex issue. The pathogens being studied include ectoparasitic copepods (*Lepeophtheirus salmonis* and *Caligus clemensi*) and viruses (infectious hematopoietic necrosis virus (IHNV) and viral hemorrhagic septicemia virus (VHSV)). To facilitate our understanding we are: 1) conducting surveys of pathogens in wild salmonids, 2) conducting laboratory studies on pathogens and hosts, 3) developing improved diagnostic methods and 4) developing physical oceanographic models to predict pathogen movements within the environment. This new information and tools, along with fish health data from salmon farms, is providing insight into the biology of these pathogens, their distribution and movements within the environment and the risks posed to both wild and farmed salmonids. This presentation will provide an overview of our past activities and the new directions we are taking to understand this important issue.

October 18, 16:40 (S6-7858)

Environmental influences on harvesting from hanging plantations for *Laminaria* kelp

Tatiana **Krupnova**, Vladimir Pavlutcykov and Nina Shepel

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia

E-mail: krupnova@tinro.ru

Hanging plantations for *Laminaria* culture are used by fish and invertebrates as artificial reefs, so both kelps and sea urchins, scallops, mussels could be harvested from them. Moreover, the plantations suppress the energy of sea waves, slow water cycling, promote accumulation of nutrients, plankton and pelagic larvae, could be used as a substrate for eggs, larvae and algal zoospores, or as a shelter for fish juveniles. The settling of invertebrate larvae on the plantations, as well as the harvest of *Laminaria* and invertebrates, depends on oceanographic conditions. The highest yield of *Laminaria* from the plantations at Primorye coast (Japan Sea) could be harvested in the years with a short period of high water temperature (>18°C) and high nutrient concentration (total nitrogen >30 mg/l) that is conditioned by the strong Primorye Current. On the contrary, the settling of sea urchin and scallop larvae onto the plantations is more active in years with a weak Primorye Current, and their survival depends on wave height.

October 18, 17:05 (S6-7827)

GIS-based spatial models for Japanese kelp (*Laminaria japonica*) aquaculture site selection in the Southwestern Hokkaido, Japan

I Nyoman Radiarta^{1,2}, Sei-Ichi **Saitoh**¹, Toru Hirawake¹ and Hajime Yasui³

¹ Laboratory of Marine Bioresource and Environment Sensing, Faculty of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan. E-mail: ssaitoh@salmon.fish.hokudai.ac.jp

² Center for Aquaculture Research and Development, Agency for Marine Affairs and Fisheries Research and Development, Jl. Ragunan 20, Pasar Minggu, Jakarta Selatan, 12540, Indonesia

³ Laboratory of Science and Technology on Fisheries Infrastructure System, Faculty of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan

Japanese kelp, *Laminaria japonica*, is an important seaweed species cultured and harvested in Japan. To ensure long-term sustainability of providing kelp production, identification and selection of suitable sites is an important step in any aquaculture operation. This study was conducted to identify the most suitable site for hanging culture of Japanese kelp in southwestern Hokkaido, Japan using geographic information system (GIS)-based models. Remote sensing data (MODIS and ALOS AVNIR-2) were used to extract most of the parameters. Seven thematic layers were grouped into two basic requisites for kelp aquaculture, namely environment (SST, secchi disk depth, bathymetry and slope) and social-infrastructure (distance to town, pier and land-based facilities). A constraint layer was used to exclude the areas from suitability maps that cannot be allowed to develop kelp aquaculture, including harbor, and river mouth. A series of GIS models were developed to identify the most suitable areas for kelp culture using multi-criteria evaluation. Suitability scores were ranked on a scale from 1 (least suitable) to 8 (most suitable), and about 60% of the total potential area with bottom depths less than 60 m had higher scores (scores 7 and 8). Those areas had the optimum condition for kelp production in this region. Local sensitivity analysis was used to test the robustness of the model output. This analysis indicated that secchi disk depth was more important than SST in affecting model output.

October 18, 17:30 (S6-7580)

Ecological-economic assessment of monoculture and integrated multi-trophic aquaculture in Sanggou Bay, China

Wei **Zheng**^{1,2}, Honghua Shi², Xuelei Zhang^{1,2}, Mingyuan Zhu^{1,2} and Zongling Wang^{1,2}

¹ Key Lab for Science and Engineering of Marine Ecology and Environment, First Institute of Oceanography, SOA, Qingdao, 266061, PR China. E-mail: zhengwei@fio.org.cn

² First Institute of Oceanography, 6 Xian-Xia Ling Rd., Qingdao, 266061, PR China

Integrated multi-trophic aquaculture is an approach to mitigate the ecological effects of mariculture and its benefits are attracting increased interest among researchers and commercial growers worldwide. In order to promote polyculture, sufficient quantitative information associated with its implementation should be provided for decision makers, ecosystem managers and farmers. We apply an Emergy method and Cost-benefit analysis (CBA) to conduct an ecological and economic comparison between monoculture and IMTA. Three operation schemes are considered including monoculture of kelp, monoculture of scallop, and polyculture of kelp and scallop in Sanggou Bay, China. In the Emergy method, we develop an Emergy analysis framework of the mariculture ecosystem, and present an energy flow process of different culture modes. The Emergy analysis result shows that a polyculture ecosystem of kelp and scallop has the largest ESI (Environmental Sustainability Index) for the above three culture modes, so it is the most sustainable. In the CBA method, we propose a new index namely Relative Coefficient (RC) in order to balance the benefit and efficiency. It is shown from CBA that the polyculture of kelp and scallop is the most sustainable culture mode from both an economic and environmental aspect. Both results of CBA and Emergy analysis indicate that polyculture is a sustainable culture mode which could be utilized in and beyond the region.

S6 Session Posters

S6-7627

Absorption of carbon and nitrogen by culturing *Sargassum thunbergii* in coastal waters

Chunjiang **Guan** and Feng'ao Lin

Department of Marine Ecology, National Marine Environmental Monitoring Center, 42 Linghe St., Shahekou district, Dalian, 116023, PR China
E-mail: cjguan@nmemc.gov.cn

The supply of *Sargassum thunbergii* is unable to meet the demand in China where it is used as food for growing and cultivating sea cucumbers. Some experiments were conducted to explore raft culture of *Sargassum thunbergii*. Restoration of water quality by artificial culturing of *Sargassum thunbergii* can reduce the concentration of nutrients such as nitrogen and phosphorus in the waters, which can not only protect natural sources of *Sargassum thunbergii*, but also relieve pressure due to insufficient supply for use as food for sea cucumber culture. *Sargassum thunbergii* has very high biological production capacity in natural sea water. Due to its rapid growth, *Sargassum thunbergii* can absorb large amount of carbon, nitrogen and phosphorus, which can reduce the concentration of nutrients in coastal waters. The average amount of carbon and nitrogen in *Sargassum thunbergii* is 29.03% and 2.94% respectively. After oven-drying, the ratio of dry to wet weight of *Sargassum thunbergii* is 15.68%. The yield of *Sargassum thunbergii* reaches 27.36 t/ha in wet weight. Harvest of *Sargassum thunbergii* could thus remove 1,245 kg/ha of carbon and 126 kg/ha of nitrogen from the ocean, respectively. It seems that *Sargassum thunbergii* culture could be very helpful for restoring eutrophied sea waters, but also play an important role in absorbing CO₂ and prevent climate change.

S6-7728

The influence of salmon hatchery conditions on the physiological status of Amur sturgeon

Vera **Valova**

Laboratory of Fish Reproduction, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: valova@tinro.ru

Industrial fish culture can play a particularly important role in increasing the vitality of reared fingerlings and lowering the percentage of dangerous alimentary diseases. The purpose of this study was to appraise the physiological status of Amur sturgeon fry under salmon hatchery conditions. Our focus was on hemopoietic organs and hemopoiesis in Amur sturgeon and Kaluga fry under typical conditions at the Anuiskii salmon hatchery. Amur sturgeon fry were fed with imported ("Aller-Aqua") production fodder. Development of blood-making organs and formation of blood-making systems were investigated in both Amur sturgeon and Kaluga fry, which were raised from wild spawned eggs at the Anuiskii salmon hatchery. Results revealed that low water temperatures during egg incubation and free embryos do not influence blood-making organ development and blood-making system formation. Amur sturgeon and kaluga fry achieve a mass of 1-2 g before they are release into the river and blood-making organs were completely formed with complete and distinct morphology and structure. Yearling Amur sturgeon and Kaluga fry fed with exogenous dry granular fodder (Aller Futura) developed chronic liver lipid degeneration that could influence fingerling survival in their natural habitat.

S6-7741

Monitoring of potentially toxic microalgae in Severnaya Bight (Slavyanskii Bay, the Sea of Japan) in 2008, 2009Olga G. ShevchenkoA.V. Zhirmunsky Institute of Marine Biology, FEB RAS, 17 Palchevskogo St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: 713553@mail.ru

Slavyanskii Bay situated in south-west part of Amurskii Bay. Water area of Amurskii Bay is characterized by the high concentration of nitrites and nitrates as well as an increased phytoplankton primary production. The blooms of the toxic microalgae in Amurskii Bay were observed in the early 1990s. During the summer of 1991 an intensive bloom of the potentially toxic *Prorocentrum minimum* was recorded. In the summer period of 1992 mass development of *Pseudo-nitzschia* spp. was observed. Due to presence of potentially toxic microalgae, regular monitoring of phytoplankton is a necessity.

In 2004, a sea mollusk farm was organized in Severnaya Bight (Slavyanskii Bay). It is known that, blooms of toxic species of phytoplankton are often observed in areas of the sea occupied by mariculture installations; because of the vital functions cultivated invertebrates have an appreciable effect on microalgae. Monitoring of toxic phytoplankton on mollusk farm in Severnaya Bight was started in 2008. From May to November 2008, 2009 six species of microalgae known to be toxic were found: diatoms *Pseudo-nitzschia pungens* and *P. delicatissima*, dinoflagellates *Dinophysis acuminata*, *D. acuta*, *D. fortii* and *Prorocentrum minimum*. The massive development species of the genus *Pseudo-nitzschia* (108.5×10^3 cells/L) was observed in September 2009. The greatest density of *D. acuminata* was recorded in June 2009 (5×10^3 cells/L); it exceeded safety level concentration of potentially toxic *Dinophysis* cells for mollusk farm in some foreign countries. The maximum density of *P. minimum* (36×10^3 cells/L) was observed in July 2008.

S7 MEQ/FUTURE Topic Session

Land-sea interactions and anthropogenic impacts on biological productivity of North Pacific Ocean coastal ecosystems

Co-Sponsored by NOWPAP

Co-Convenors: Masahide Kaeriyama (Japan), Olga Lukyanova (Russia), Steven Rumrill (U.S.A.) and Thomas Therriault (Canada)

Invited Speakers:

Neil Banas (University of Washington, U.S.A.)

Takayuki Shiraiwa (Hokkaido University, Japan)

Vladimir Shulkin (NOWPAP/POMRAC, Russia)

Jing Zhang (East China Normal University, PR China)

Land-sea interactions are widely recognized as an important component of coastal ecosystem processes throughout the North Pacific Region. Anthropogenic activities in upland and coastal areas can significantly alter the productivity of coastal ecosystems and disturb the communities that depend on them. Human activities such as pollution or overfishing can result in immediate and direct impacts on biological productivity. However, there are an increasing number of indirect impacts such as altering the flow of ecosystem-transboundary materials (ETMs) that are responsible for the enriched productivity of many northern coastal systems. In Asia, the dissolved iron that is transported from the Amur River basin into the Sea of Okhotsk and Oyashio Region is now recognized as a major regulator of the primary productivity in these coastal waters. Similarly, disruptions in the timing and amplitude of riverine discharges from the Columbia River Basin (Pacific Northwest) result in significant alterations of salinity regimes, sediment transport, biological productivity, and fisheries returns throughout the region influenced by the Columbia River plume. Anthropogenic impacts such as changes in land use, artificial river channelization, hydropower structures, and urbanization disrupt and alter the flow of ETMs thereby reducing the productivity in these coastal ecosystems. Furthermore, these alterations can lead to the manifestation of other stressors in coastal ecosystems such as jellyfish blooms, hypoxia events, and harmful algal bloom (HAB) outbreaks. This session will focus on: 1) how ETMs (e.g., dissolved iron, carbon and other elements) are transported from upland ecosystems into coastal ones; 2) what mechanisms regulate the supply of ETMs and how the downstream transport of these impact the productivity (primary production) of coastal systems; 3) how anthropogenic impacts disrupt the ETM system and resulting changes downstream including increased ecosystem vulnerability; 4) how anthropogenic impacts directly reduce coastal productivity; and 5) exploration of potential adaptive management strategies based on the ecosystem-approach to protect the ETM system to ensure sustainability of coastal ecosystems and stability for the coastal societies depending on them.

Thursday, October 20 (9:00-18:00)

- 9:00 *Introduction by Convenors*
- 9:05 **Takayuki Shiraiwa**
 “Giant fish-breeding forest”: A new environmental system linking a continental watershed with open water (S7-7705), Invited
- 9:35 **Svetlana Belaya and Petr Tishchenko**
 Primary production of Amurskiy Bay (Japan Sea) in the winter season (S7-7761)
- 9:55 **Yousuke Koshino, Masao Minagawa, Hideaki Kudou, Yuxue Qin and Masahide Kaeriyama**
 Effect of salmon-derived nutrients and organic matter on riparian ecosystems in the Shiretoko World Natural Heritage area (S7-7561)
- 10:15 *Coffee/Tea Break*

- 10:40 **Neil S. Banas, Barbara M. Hickey, Eric P. Salathé and Parker MacCready**
Freshwater influences on productivity in the northern California Current System, present and future (S7-7913), Invited
- 11:10 **Thomas W. Therriault and Claudio DiBacco**
Does diet determine the impact of invasive tunicates in shellfish aquaculture?: Application of stable isotopes (S7-7906)
- 11:30 **Steven Rumrill, Alicia Helms and Adam DeMarzo**
Detection of pH shifts in the South Slough estuary (Oregon, USA): Exploration of relationships between changing carbonate chemistry, eutrophication, and net estuary ecosystem metabolism (S7-7745)
- 11:50 **Jennifer E. Purcell**
Jellyfish and ctenophore blooms coincide with human proliferations and environmental perturbations (S7-7590)
- 12:10 **Peter S. Ross and Steven Jeffries**
Marine mammals provide an integrated measure of spatial and temporal trends in coastal food web contamination by persistent environmental contaminants (S7-7643)
- 12:30 ***Lunch***
- 14:00 **Vladimir Shulkin**
The spatial dimension of the environmental problems existing in coastal zone due to land-sea interactions (S7-7595), Invited
- 14:30 **Pavel Tishchenko, Vladimir Zvalinsky, Tatiana Mikhajlik and Petr Tishchenko**
Assessment of eutrophication status of Amursky Bay (Japan/East Sea) (S7-7743)
- 14:50 **Ichiro Imai, Mineo Yamaguchi and Yutaka Hori**
Long-term changes in eutrophication and harmful algal blooms in the Seto Inland Sea of Japan (S7-7823)
- 15:10 **Tatiana L. Chizhova, Hisatoshi Nakase, Pavel Tishchenko and Kazuichi Hayakawa**
Distribution of polycyclic aromatic hydrocarbons in the North-western part of the Japan Sea (S7-7775)
- 15:30 ***Coffee/Tea Break***
- 15:50 **Jing Zhang and NSFC Task Team**
Remobilization of nutrients from watersheds and eutrophication in marine recipients (S7-7898), Invited
- 16:20 **Jianguo Du, Bin Chen, Qiulin Zhou, Quan Wen, Honghua Shi, Weiwei Yu and Hao Huang**
Strategies of marine biodiversity conservation based on integrated coastal zone management (S7-7782)
- 16:40 **Vladimir Ostrovskii**
Factors controlling the pink salmon (*Oncorhynchus gorbusha*) juvenile abundance in the Isky River (S7-7866)
- 17:00 **Sergey D. Ponomarev**
Influence of ecological factors on Pacific herring spawning efficiency (S7-7871)
- 17:20 **Vera Valova**
Reactions by Amur sturgeon fingerling to pollution within the Amur River (S7-7727)

17:40 **Satoshi Nakada, Yoichi Ishikawa, Toshiyuki Awaji and Sei-Ichi Saitoh**
Coupled land-ocean model for the coastal fisheries in a Region of Freshwater Influence (ROFI): A case study in Funka Bay (S7-7685)

18:00 Session ends

S7 Posters

S7-7559 **Lidiya T. Kovekovdova and Denis P. Kiku**
Assessment of levels of toxic elements (As, Hg, Pb, Cd) in the environment and commercial hydrobionts in coastal waters of the Russian zone of Japan/East and Okhotsk Seas

S7-7569 **Svetlana A. Ireykina**
Molecular biomarkers in monitoring of the coastal and estuarine zones of Peter the Great Bay (Japan/East Sea)

S7-7571 **Andrey P. Chernyaev and Anna S. Vazhova**
Petroleum hydrocarbon distribution in the Far Eastern Seas of Russia in 2010

S7-7572 **Anna S. Vazhova**
Wastewater pollutants discharge into Peter the Great Bay (Japan/East Sea) through estuaries of the rivers

S7-7608 **Aleksandra S. Kondakova and Andrey P. Chernyaev**
Levels of 4-NP in coastal waters in the Russian zone of Japan/East and Bering Seas

S7-7622 **Alexander Moshchenko, Tatyana Belan and Yuri Korostelev**
Long-term changes in the marine environment and benthic communities in the north part of Amursky Bay (Sea of Japan)

S7-7659 **Galina S. Borisenko and Galina V. Moyseychenko**
Estimation of the level of radioactive pollution in mollusks and bottom sediments in Posieta Bay (Japan/East Sea)

S7-7667 **Olga N. Lukyanova and Svetlana A. Ireykina**
Pollution of river-sea interaction areas in Peter the Great Bay (Japan/East Sea)

S7-7804 **T.P. Belova and Olga N. Selivanova**
Application of *Saccharina*-based sorbents for purification of sewage waters of metal mining industry

S7-7851 **Wang Yongzhi, Feng Aiping, Qiao Lulu, Yang Zuosheng and Bao Xianwen**
Research on the transport mechanism for suspended sediment along northeast Shandong Peninsula coast in summer and winter

S7-7891 **Zhen Wang, Ying Wang, Xindong Ma, Zhongsheng Lin, Guangshui Na and Ziwei Yao**
Probabilistic ecological risk assessment of typical PAHs in coastal water of the Bohai Sea

S7-7897 **Hong Chen, Jianbo Han and Chuanlin Huo**
Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in wastewater treatment plants and surface water in Dalian coastal area in China

S7-7917 **Irina R. Levenets and Anna V. Skriptsova**
Macrophyte seasonality in the Sobol Bay, Peter the Great Bay, Sea of Japan

S7 Session Oral Presentations

October 20, 9:05 (S7-7705), Invited

“Giant fish-breeding forest”: A new environmental system linking a continental watershed with open water

Takayuki Shiraiwa

Institute of Low Temperature Science, Hokkaido University, Kita 19, Nishi 8, Kitaku, Sapporo, 060-0819, Japan
E-mail: shiraiwa@lowtem.hokudai.ac.jp

The Amur-Okhotsk Project (AOP) introduced a new global environmental concept referred to as the “giant fish-breeding forest” (GFBF). The GFBF expands upon the traditional Japanese idea of uotsuki-rin (fish-breeding forest), which relates upstream forests with the coastal ecosystem both physically and conceptually. The AOP found that primary production in the Sea of Okhotsk and the Oyashio region depended on dissolved iron transported from the Amur River and its watershed. Therefore, the Amur River basin can be recognized as the GFBF for the Sea of Okhotsk and the Oyashio region. This hypothesis presents new perspectives on several global environmental issues: (1) an ecological linkage between the continent and the open sea; (2) relationships between stakeholders who are not necessarily dependent upon each other in the system; and (3) identification of environmental common-ground across coastlines and complex international boundaries. Multidisciplinary approaches are indispensable in studying and conserving the GFBF because stakeholders need to understand how to achieve a sustainable marine ecosystem in the Sea of Okhotsk and Oyashio region without limiting human activity on land. Connecting less-dependent stakeholders could be a first step in coping with complicated environmental issues. Establishment of the concept will help bring together people who have been separated for many years under political tensions.

October 20, 9:35 (S7-7761)

Primary production of Amurskiy Bay (Japan Sea) in the winter season

Svetlana Belaya¹ and Petr Tishchenko²

¹ Far Eastern Federal University, 27 Oktyabrskaya St., Vladivostok, 690091, Russia. E-mail: belaya41@mail.ru

² V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia

Biogeochemical surveys of Amurskiy Bay were carried out by Pacific Oceanological Institute during the winter seasons of 2008 and 2010. Sampling was conducted at 54 stations over the period from February 19 to March 4, 2008. An additional 4 stations were sampled on March 11, 2010 in the northern part of the bay which was covered by ice. At each station, we conducted profiles of CTD, fluorescence, and turbidity. In 2010, direct measurements of Primary Production (PP) were carried out by means of the radiocarbon method, and we were able to obtain assimilation numbers for this season. Using assimilation numbers the PP value of the bay was estimated for winter 2008. PP for the majority of the studied area averaged $0.05 \pm 0.028 \text{ gC m}^{-2} \text{ day}^{-1}$, revealing a low rate of organic matter production. The limiting factor in this case is weak light caused by presence of a thick snow layer on the ice in winter of 2008. At the same time, nutrient concentrations were sufficiently moderate. High values of PP occurred with an average of $0.91 \pm 0.75 \text{ gC m}^{-2} \text{ day}^{-1}$, and the maximum value of $2.5 \text{ gC m}^{-2} \text{ day}^{-1}$ was observed in the area around the Eastern Bosphor Strait where non-consolidated ice occurred. It is shown that river waters enriched by nutrients are spread along the west coast of the bay and form a narrow plume where PP values are high.

October 20, 9:55 (S7-7561)

Effect of salmon-derived nutrients and organic matter on riparian ecosystems in the Shiretoko World Natural Heritage area

Yousuke **Koshino**¹, Masao Minagawa², Hideaki Kudou³, Yuxue Qin¹ and Masahide Kaeriyama³

¹ Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minatocho, Hakodate, Hokkaido, 041-8611, Japan
E-mail: y-koshino516@mopera.net

² Faculty of Environmental Earth Science, Hokkaido University, N10W5, Sapporo, 060-0810, Japan

³ Faculty and Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minatocho, Hakodate, Hokkaido, 041-8611, Japan

Pacific salmon (*Oncorhynchus* spp.) transport marine-derived nutrients (MDN) and organic matter to inland ecosystems, and play a significant role in delivery of ecosystem services such as biodiversity and productivity in sea-land ecosystems of the North Pacific rim. Shiretoko Peninsula is one of the few regions where wild chum (*O. keta*) and pink (*O. gorbuscha*) salmon reproduce in Japan. Despite designation as a World Natural Heritage area, the Shiretoko Peninsula has many dams that interrupt salmon escapement. We evaluated the salmon MDN contributions for freshwater and riparian ecosystems in this area using carbon and nitrogen stable isotope analysis. At the spawning site, carbon and nitrogen stable isotopes of biofilm, aquatic invertebrates and fishes increased 1-6‰ and 1-8‰ respectively. Thus, their MDN enrichment was 21-30% in the river. Brown bears (*Ursus arctos*) exhibit four life-history patterns based on analysis of growth sections in the hair. Most bears fed on pink salmon as a source of overwintering energy. In terrestrial ecosystems, the riparian vegetation was enriched 24% MDN by the vector (e.g., brown bear) and by flooding. However, MDN enrichment in the Shiretoko Peninsula was equal or lower than the riparian ecosystems in North America. Pacific salmon function as a keystone species in sea-land interactions and during transport of ecosystem-transboundary materials (ETM) in the Shiretoko Peninsula. However, the anthropogenic impact of construction has harmed and disturbed the ETM system. Potential adaptive management strategies that are based on the ecosystem approach should be explored immediately to protect the ETM system in this area.

October 20, 10:40 (S7-7913), Invited

Freshwater influences on productivity in the northern California Current System, present and future

Neil S. **Banas**¹, Barbara M. Hickey², Eric P. Salathé³ and Parker MacCready²

¹ Applied Physics Laboratory, University of Washington, P.O. Box 355640, Seattle, WA, 98195, USA. E-mail: neil@apl.washington.edu

² School of Oceanography, University of Washington, Seattle, WA, 98195, USA

³ Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA, 98195, USA

It has traditionally been assumed that the strength and fate of biological production on the U.S. Pacific Northwest coast was regulated primarily by alongcoast wind stress, as in a classic eastern boundary system. It now appears that river plume dynamics and estuarine circulation complicate this picture in a number of ways. First, the Fraser and other Salish Sea rivers amplify primary production on the regional scale, not only by directly supplying a modest load of terrestrial nutrients, but also, more important, by driving a persistent estuarine circulation in the Strait of Juan de Fuca that approximately doubles the provision of oceanic nutrients to the shelf. Second, the increased stratification associated with the Columbia River plume increases cross-shelf export on the regional scale, such that 10-20% of total primary production is shifted from the inner shelf to the outer shelf and slope, where vertical carbon export is likely to be much more efficient. Finally, both river systems increase retention in the alongcoast direction, leading to older plankton communities and increased transfer to higher trophic levels. These freshwater-driven mechanisms suggest alternate lines of connection between global climate forcing and regional marine ecosystems. Competition among oceanic, atmospheric, and hydrological climate-change pathways is currently being explored through experiments in a regional biophysical model coupled to future atmospheric and hydrological forcing scenarios downscaled from IPCC global models. Early results suggest that freshwater processes may affect the phenology of coastal productivity, but largely serve to buffer the system against long-term change in coastal winds and stratification.

October 20, 11:10 (S7-7906)

Does diet determine the impact of invasive tunicates in shellfish aquaculture?: Application of stable isotopes

Thomas W. **Therriault**¹ and Claudio DiBacco²

¹ Pacific Biological Station, 3190 Hammond Bay Rd., Nanaimo, BC, Canada. E-mail: thomas.therriault@dfo-mpo.gc.ca

² Bedford Institute of Oceanography, 1 Challenger Dr., Dartmouth, NS, Canada

Aquatic invasive species continue to pose significant ecological and economic risks in coastal marine systems. Recently, invasive tunicates have received much attention due to their negative impacts on shellfish aquaculture around the globe, including Canada. Impacts have varied dramatically between Atlantic Canada where the blue mussel industry has been severely affected and Pacific Canada where the Pacific oyster industry has not. In order to better understand what might be driving differences in these tunicate invasions, we are investigating the trophic relationships between commercially important bivalves and invasive tunicates to characterize feeding dynamics and potential diet overlap. Stable isotope analyses were used to characterize delta-Carbon ($\delta^{13}\text{C}$) and delta-Nitrogen ($\delta^{15}\text{N}$) signatures of suspension feeding bivalves and tunicates to assess trophic overlap. Initial results show almost complete diet overlap between the highly invasive colonial tunicate *Didemnum vexillum* and blue mussel (*Mytilus* spp.) suggesting that should this tunicate reach already impacted blue mussel farms in Atlantic Canada, the consequences could be substantial. Current field studies will compare these signatures to isotopic signatures of different sources of suspended particulate organic matter (POM) available to filter feeding tunicate and mussel species, including (i) terrestrial derived riverine, (ii) brackish or estuarine, and (iii) coastal marine POM. Stable isotope signatures ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) of each food source will be employed along with mixture models to estimate the relative contribution of different sources of POM in the diet of bivalves and tunicates to determine if diet overlap is driving the impact of invasive tunicates in shellfish aquaculture.

October 20, 11:30 (S7-7745)

Detection of pH shifts in the South Slough estuary (Oregon, USA): Exploration of relationships between changing carbonate chemistry, eutrophication, and net estuary ecosystem metabolism

Steven **Rumrill**^{1,2}, Alicia Helms² and Adam DeMarzo²

¹ University of Oregon, Oregon Institute of Marine Biology, 63466 Boat Basin Rd., Charleston, OR, 97420, USA

E-mail: steve.rumrill@state.or.us

² South Slough National Estuarine Research Reserve, P.O. Box 5417, Charleston, OR, 97420, USA

Time-series analysis reveals a long-term directional shift in pH measurements within the tidal waters of the South Slough estuary (Oregon, USA). Dataloggers documented a shift toward increased median pH values over the period of 2002-2010, and the shift in pH values was consistent at four locations located along the estuarine gradient. Median pH values shifted from 7.9 in 2002 to 8.1 in 2010 within the marine-dominated region, from 7.4 to 8.0 within the mesohaline region, and from 7.2 to 7.4 in the riverine region. Substantial diel variability in estuarine pH values occurs with fluctuations over 0.4 pH units in a single day. We did not observe any consistent shift in pH values between the wet (winter) and dry (summer) seasons. It is possible that the shift toward increased pH values provides an early indicator of eutrophication within the shallow tidal slough. In addition, changes in median pH values may also occur in response to local increases in submersed aquatic vegetation (*Zostera marina*), coupled with increases in phytoplankton and/or macrobenthic algal communities. Long-term monitoring of an adjacent eelgrass bed reveals a slight increase in density and spatial cover, and we also observed an increase in water-column Chl-*a* concentrations over the period of 2004-2010. These observations indicate that the net ecosystem metabolism of the estuary is currently dominated by production rather than respiration. The trend toward increased alkalinity is influenced by many factors including freshwater inputs, tides, photosynthesis/respiration, dissolved oxygen concentrations, salinity, carbon cycling, nutrient availability, denitrification, and ocean acidification.

October 20, 11:50 (S7-7590)

Jellyfish and ctenophore blooms coincide with human proliferations and environmental perturbations

Jennifer E. **Purcell**

Shannon Point Marine Center, Western Washington University, 1900 Shannon Point Rd., Anacortes, WA, 98221, USA
E-mail: purcellj3@wwu.edu

Human populations have been concentrated along and exploiting the coastal zones for millennia. Of regions with the highest human impacts on the oceans (Halpern *et al.*, 2008), 6 of the top 10 have recently experienced blooms or problems with jellies. I review the time-lines of human population growth and their effects on the coastal environment. I explore evidence suggesting that human activities - specifically, seafood harvest, eutrophication, hard substrate additions, transport of non-indigenous species, aquaculture, and climate change - may benefit jelly populations. Direct evidence is lacking for most of these factors; however, numerous correlations show abundant jellies in areas with warm temperatures and low forage fish populations. Jelly populations fluctuate in ~10- and ~20-year cycles in concert with solar and climate cycles. Global warming will provide a rising baseline against which climate cycles will cause fluctuations in jelly populations. The probable acceleration of anthropogenic effects may lead to further problems with jellies.

October 20, 12:10 (S7-7643)

Marine mammals provide an integrated measure of spatial and temporal trends in coastal food web contamination by persistent environmental contaminants

Peter S. **Ross**¹ and Steven Jeffries²

¹ Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: peter.s.ross@dfo-mpo.gc.ca

² Washington Department of Fish and Wildlife, 7801 Philips Rd., Tacoma, WA, 98498, USA

While the importance of point source inputs of land-based contaminants into coastal waters adjacent to areas of high human density has long been recognized, the fate and consequences of persistent, bioaccumulative, and toxic (PBT) contaminants can often be unexpected. Moderate concentrations of such contaminants have been reported even in remote environments including the Arctic and the mid Pacific Ocean. Very high concentrations have been reported in high trophic level seabirds and marine mammals, reflecting the biomagnification of these fat-soluble chemicals in aquatic food webs. This duality of influences related to proximity to source and trophic position explains much of the variation in PBT concentrations observed in marine biota. Our studies on the harbour seal (*Phoca vitulina*) have provided an overview of temporal trends and spatial variation in the levels a number of legacy and emerging PBT contaminants in British Columbia (Canada) and Washington State (USA). We show that regulations have been effective in reducing the levels of PCBs, dioxins, furans, organochlorine pesticides, and a variety of flame retardants in harbour seals over a 40 year period. While long-lived, high trophic level species remain highly vulnerable to contamination by PBT contaminants, continued research and monitoring of such sentinel species can afford scientists and policymakers with integrated signals of coastal food web pollution. These findings are directly relevant to coastal ecosystem health, as several of these contaminants have been directly implicated in population-level impacts including reproductive impairment, increased incidence of disease and developmental abnormalities in certain marine mammal and seabird populations.

October 20, 14:00 (S7-7595), Invited

The spatial dimension of the environmental problems existing in coastal zone due to land-sea interactions

Vladimir **Shulkin**

Pacific Geographical Institute, FEB RAS, 7 Radio St., Vladivostok, Primorsky Kray, 690041, Russia. E-mail: shulkin@tig.dvo.ru

Proper determination of spatial scales of land-sea interaction is crucial for the understanding of links between watersheds, rivers, estuaries, and coastal ecosystems. There are obvious relationships of processes in these conjugated ecosystems. But it is equally obvious that we need criteria for the selection of localities with varying degrees of interaction, and for the evaluation of the spatial extent of these areas. This is especially true for ecosystem-based management of coastal regions. The spatial extent of the water area where the biogeochemical characteristics are controlled by the processes in the associated ecosystems is largely determined by physical and geographical features of specific areas. This limits the use of advanced models developed as universal for some coastal localities. It is possible to use some simple algorithms as alternatives to calculate the indicators evaluating the size and characteristics of coastal areas under the dominating influence of natural and anthropogenic processes at the catchments and estuaries. For example, we evaluated the role of river runoff and atmospheric deposition in the input of nutrients and some metals to the coastal waters of the Sea of Japan and Yellow Sea. Next, we developed a balanced-approach case-study to characterize the biogeochemical cycle of Fe in the Amur River estuary and Sakhalin Bay. Long-term observations of water quality present another way to estimate spatial aspects of environmental problems caused by the land-sea interactions. This approach will be illustrated by an example of coastal water areas within the north-western Pacific.

October 20, 14:30 (S7-7743)

Assessment of eutrophication status of Amursky Bay (Japan/East Sea)

Pavel **Tishchenko**, Vladimir Zvalinsky, Tatiana Mikhajlik and Petr Tishchenko

Hydrochemistry Laboratory, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: tpavel@poi.dvo.ru

Using available data about river runoff and waste water inputs into Amursky Bay (Japan/East Sea), the annual nutrient load was assessed. For assessment of eutrophication status of Amursky Bay we used the following criteria: a) an almost zero nutrient concentration in the photic layer with a thickness of 50m was set as a reference condition; b) we accept the threshold value of dissolved oxygen concentration (DO) as 76 μM which corresponds to hypoxia conditions. Using Redfield ratios in organic matter and $\text{DO}_{\text{th}} = 76 \mu\text{M}$, threshold values of dissolved inorganic nitrogen and dissolved inorganic phosphates were calculated. This approach of assessing the eutrophication status and literature data about the biological degradation of Amursky Bay suggests that the studied area has a current eutrophication status regarded as "High".

October 20, 14:50 (S7-7823)

Long-term changes in eutrophication and harmful algal blooms in the Seto Inland Sea of Japan

Ichiro **Imai**¹, Mineo Yamaguchi² and Yutaka Hori³

¹ Plankton Laboratory, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-machi, Hakodate, Hokkaido, 041-8611, Japan. E-mail: imai1ro@fish.hokudai.ac.jp

² Research Center for Environmental Conservation, National Research Institute of Fisheries and Environment of Inland Sea, Maruishi, Hatsukaichi, Hiroshima, 739-0452, Japan

³ Tajima Fisheries Technology Institute, Hyogo Prefectural Technology Center for Agriculture, Forestry and Fisheries, Kasumi, Kami, Mikata, Hyogo, 669-6541, Japan

The Seto Inland Sea is the largest enclosed coastal sea in Japan and is also a major fishing ground including aquacultures of fishes, bivalves and seaweeds. Along with serious eutrophication in the 1960s and 1970s, red tides increased markedly in frequency and scale. The maximum level of 299 incidents per year occurred in 1976, and the frequency decreased to about 100 per year in the late 1980s by virtue of legal regulations, and this level has been maintained thereafter. “Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea” was legislated in 1973, and loadings of organic matter and nutrients decreased to half the level of 1972. The important red tide organisms causing huge fishery damages by fish-kill are *Chattonella antiqua*, *C. marina*, *C. ovata* and *Heterosigma akashiwo* (Raphidophyceae), and *Karenia mikimotoi*, *Heterocapsa circularisquama* and *Cochlodinium polykrikoides* (Dinophyceae). The maximum fishery damage (death of 14.2 million yellowtails) was 7.1 billion yen (about \$90 million US) caused by *C. antiqua* in Harima-Nada in 1972. Among the important red tide organisms, *C. antiqua*, *H. circularisquama* and *C. polykrikoides* are extremely harmful species that can easily reach the warning level of fishery damages by consuming only small amounts of nutrients. The toxic dinoflagellate *Alexandrium tamarense* has become dominant in the spring season, and has made short-necked clams and cultured oysters toxic almost every year. The deposition of abundant cysts of *Alexandrium* spp. in sediments indicates the establishment of this toxic species in the Seto Inland Sea.

October 20, 15:10 (S7-7775)

Distribution of polycyclic aromatic hydrocarbons in the North-western part of the Japan Sea

Tatiana L. **Chizhova**¹, Hisatoshi Nakase², Pavel Tishchenko and Kazuichi Hayakawa²

¹ V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: chizhova@poi.dvo.ru

² Institute of Medical, Pharmaceutical and Health Science, Kanazawa University, Kakuma-machi, Kanazawa, 920-1192, Japan

Polycyclic aromatic hydrocarbons (PAHs) are widespread pollutants in the environment. Many PAHs have carcinogenic and/or mutagenic properties. Combustion of fossil fuels such as oil and coal is a main source of PAHs. The development of industries in countries surrounding the Japan Sea (People Republic of China, Japan, Republic of Korea and Russian Federation) results in an increase in the number of power stations and cars which produce PAHs into the environment. However, the detail of the present situation and future estimation of the pollution in the Japan Sea by PAHs is still poorly known. In this study we present data on PAHs concentrations in surface waters and water columns as well in the North-western part of the Japan Sea. The water samples were collected at 21 stations during the 46th cruise of R/V *Akademik M.A. Lavrentyev* in 2009. Concentrations of PAHs in the samples were determined by means of HPLC-fluorescence detection. It was found that the total concentrations of PAHs ranged from 2.3 to 7.9 ng/L, and the average was 4.3 ng/L. The vertical distribution of the total concentration of PAHs revealed three phases: maximum concentration at surface, sharp decrease to the minimum (2 ng/L) at 200 m, and almost homogeneous (6-7.5 ng/L) for deep waters (500-3500 m). The obtained data are discussed in the paper.

October 20, 15:50 (S7-7898), Invited

Remobilization of nutrients from watersheds and eutrophication in marine recipients

Jing **Zhang** and NSFC Task Team

State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 3663 Zhongshan Rd. North, Putuo, Shanghai, 200062, PR China. E-mail: jzhang@sklec.ecnu.edu.cn

The function and diversity of coastal ecosystem is affected by the influx of plant nutrients and other pollutants from adjacent watersheds. Remobilization of plant nutrients from watersheds can occur either due to natural forcing and/or anthropogenic perturbations, and the fate of land-source influx can result in coastal eutrophication, and hypoxia in some areas. The pathways of land-source input can be through river, ground water, as well atmospheric depositions. The bottom-up effect of such a land-source driving factor can result in changes in the phytoplankton community structure and primary production, which in turn affects the ecosystem function through complex interactions of food-web trophic levels. Such a change of coastal environment can be reconstructed through the examination of sediment cores.

October 20, 16:20 (S7-7782)

Strategies of marine biodiversity conservation based on integrated coastal zone management

Jianguo **Du**¹, Bin Chen¹, Qiulin Zhou¹, Quan Wen², Honghua Shi³, Weiwei Yu¹ and Hao Huang¹

¹ The Third Institute of Oceanography, State Oceanic Administration, Xiamen, 361005, PR China. E-mail: dujianguo999@gmail.com

² National Marine Environmental Monitoring Center, State Oceanic Administration, Dalian, 116023, PR China

³ First Institute of Oceanography, State Oceanic Administration, Qingdao, 266061, PR China

Biodiversity conservation is one of the most important issues in the world, the major threat of the marine biodiversity in China is analyzed, and the root cause analysis of biodiversity loss is carried out. Based on integrated coastal zone management (ICZM), a set of strategies on marine biodiversity conservation is put forward, including marine biodiversity conservation guidelines, establishment of conservation committees, boundary definitions, marine biodiversity assessment techniques, marine biodiversity conservation planning and management techniques, information management system of marine biodiversity conservation based of GIS, and other strategies.

October 20, 16:40 (S7-7866)

Factors controlling the pink salmon (*Oncorhynchus gorbusha*) juvenile abundance in the Isky River

Vladimir **Ostrovskii**

Khabarovsk Branch of TINRO-Center, 13-A Amursky Blvd., Khabarovsk, 680028, Russia. E-mail: ostrovkhv@mail.ru

A nonlinear multiplicative model describes the dependence of pink salmon juvenile abundance in the Isky River (the Okhorsk Sea) during its migration to the sea on parent abundance and meteorological factors. Model results indicate that parent abundance has the most significant influence on juvenile abundance, and 53.7 % of juvenile dispersion is explained by this factor. Meteorological factors such as air temperature in the beginning of winter (9.9 %) and amount of a summer precipitation (4.1 %) have a positive influence on juvenile abundance, and air temperature during spawning migration and spawning (13.8 %) has a negative influence. About 81.5 % of the variability in the abundance of downstream migrants is explained by all of these factors. When parent abundance is stable but meteorological factors exert influences, maximal juvenile abundance can be 10 times higher than minimal abundance.

October 20, 17:00 (S7-7871)

Influence of ecological factors on Pacific herring spawning efficiency

Sergey D. Ponomarev

Okhotsk Laboratory, Khabarovsk Branch of TINRO-Center, 13-A Amursky Blvd., Khabarovsk, 680028, Russia. E-mail: khv@tinro.khv.ru

Periods when Pacific herring approach spawning sites, their distribution in the spawning area, and spawning efficiency are dependent primarily on abiotic, biotic and anthropogenic factors. Among abiotic factors, hydro-meteorological conditions have a major influence, including: (1) total ice cover in the northern part of the Okhotsk Sea; (2) time of glade formation; (3) character and dynamics of an ice cover spreading in the spawning area; (4) water temperature dynamics before spawning; and (5) storms during the spawning period. Biotic factors are also important and include herring fatness at the end of winter, the rate of development for reproductive products that depend on fattening, wintering, and water temperature before the spawning period. It is often believed that an anthropogenic activity has a negative impact on the biosphere (*i.e.*, illegal fishing, environmental contamination, *etc.*). Anthropogenic activity has not only a negative influence on nature, but a positive influence as well. Thus, in the 1970s, artificial spawning sites were introduced to preserve abundance of the Pacific herring population and to increase its spawning efficiency. Due to this measure this species stock has recovered. In spring 2010, the vessel “*Komarovo*” helped to break an ice barrier in Aldoma Bay, and allowed herring to spawn in one of the largest biotopes in the north-western part of the Okhotsk Sea. Breaking the ice cover in Aldoma Bay prevented massive losses of herring, great number of which enter the bay to spawn.

October 20, 17:20 (S7-7727)

Reactions by Amur sturgeon fingerling to pollution within the Amur River

Vera Valova

Laboratory of Fish Reproduction, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: valova@tinro.ru

The ecological situation on the Amur River is currently unfavourable, with increasing water pollution from contiguous Chinese industrial enterprises. The purpose of this study is the assessment of the influence of Amur River pollution on the physiological status of Amur sturgeon fingerling. The investigation focused on age-groups of Amur sturgeon and Kaluga fingerling, which were captured in lower streams of the Amur River. Different age-groups of Amur sturgeon and Kaluga fingerling exhibited characteristic signs of cumulative polytoxicosis in response to exposure to anthropogenic pollutants. The following physiological responses were observed in relative order: (1) high erythrocyte settling-speed (> 2 mm/hour); (2) eosinophilia (62-72% eosinophils into leucocytic formula) and eosinophilopenia (0-0.5% eosinophils into leucocytic formula); (3) pathomorphology changes red blood and white blood cells (erythrocytes: poikilocytosis, anisocytosis, hypochromasia, hemolysis, adhesion or “monetary columns”; neutrophils cytoplasm vacuolization); (4) hepatocyte lipid and protein dystrophy; (5) microcirculation breaking; (6) portal stroma fibrosis; and (7) necrobiosis changes into liver parenchyma. Since the symptoms of cumulative polytoxicosis are exhibited by the Amur sturgeon fishes (which are captured in the lower Amur River reaches), it is possible to identify the critical levels of pollution.

October 20, 17:40 (S7-7685)

Coupled land-ocean model for the coastal fisheries in a Region of Freshwater Influence (ROFI): A case study in Funka Bay

Satoshi **Nakada**¹, Yoichi Ishikawa¹, Toshiyuki Awaji¹ and Sei-Ichi Saitoh²

¹ Department of Geophysics, Division of Earth and Planetary Sciences, Kyoto University, Kitashirakawa-Oiwake Cho, Sakyo-ku, Kyoto, 606-8502, Japan. E-mail: snakada@kugi.kyoto-u.ac.jp

² Laboratory of Marine Bioresource and Environment Sensing, Faculty of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan

Regions of Freshwater Influence (ROFIs) are characterized by complex physical and biological regimes between oceans and estuaries, and they are key areas for fishery resource management. To inform fishermen of the real-time ocean state, a coupled land-ocean model was developed as part of an operational ocean prediction system within a typical ROFI in Funka Bay, Northern Japan. Numerical procedures to evaluate daily runoffs into the bay are proposed by employing the distributed tank model and predicted meteorological datasets on the basis of heat and water mass balances in each watershed. The three-step nesting method using the ocean general circulation model is performed to reproduce the eddy-resolving circulation system in/around the bay. Our coupled model correctly reproduces physical features observed in the bay from 2008 to 2009. As a result, the realistic summer-time clockwise eddy essential for primary production is formed by buoyancy of freshwater discharge, and the circulation functions to flush out the oxygen-deficient bottom water. Further, the freshwater discharge simultaneously reaches a seasonal maximum associated with snow-melting events from March to June. These results indicate that the proposed procedure is of potential practical use and could be implemented for operational ocean models.

S7 Session Posters

S7-7559

Assessment of levels of toxic elements (As, Hg, Pb, Cd) in the environment and commercial hydrobionts in coastal waters of the Russian zone of Japan/East and Okhotsk Seas

Lidiya T. Kovekovdova and Denis P. Kiku

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia
E-mail: kovekovdova@mail.ru

Levels of As, Hg, Pb, Cd were measured in the soft tissues of several bivalves (*Mytilus trossulus*, *Crenomytilus grayanus*, *Mizuhopecten yessoensis*, *Crassostrea gigas*, *Anadara broughtoni*, *Corbicula japonica*) and bottom sediments of the Peter the Great Bay. We found a negative correlation between the concentrations of Cd and As in the soft tissues of *C. gigas* and Cd in *C. grayanus* and in bottom sediments from the sampling site. Concentrations of As, Pb, and Hg in commercial mussels were lower than the permissible level. The concentration of Cd in the tissues of *C. grayanus*, *A. broughtoni*, *C. gigas* and *M. yessoensis* individuals was higher than permissible level. Content of toxic elements was also estimated for the organs of fishes (*Clupea pallasii*, *Liopsetta pinnifasciata*, *Theragra chalcogramma*), and sea water from the Okhotsk Sea. Concentrations of heavy metals, except Hg, were at a minimum level in muscles of fish, in contrast to the liver. Fisheries regulations for toxic elements in marine fish and water were not exceeded. Predicting the fish quality in the Okhotsk Sea, it should be noted that if the same ecological situation in the areas of their habitat remains unchanged, the level of the toxic elements in the fish will not exceed the established norms.

S7-7560 (Cancelled)

Sea turtles in Iran: Population assessment, ecosystem health and conservation status

Rouhollah Zare

Marine Biology Faculty, Chabahar Maritime University, Daneshgah Blvd., Chabahar, Sistan and Baluchistan, 9971756499, Iran
E-mail: ru_zare@yahoo.com

In Iran, the location of most marine turtle rookeries is known. Most research has revealed that the primary nesting grounds for sea turtles are on islands, and smaller numbers are recorded along mainland coasts. Annual nesting numbers remain speculative due to lack of standardized monitoring on several nesting beaches. The hawksbill turtle (*Eretmochelys imbricate*) is the most important species, and nesting of this species has been documented for many islands of the Gulf. The second important species is the green turtle (*Chelonia mydas*) which spawns in some restricted areas of the Oman Sea. Globally, both species are categorized as endangered by the 2000 IUCN Red Data List. In this study, nesting activity of the hawksbill turtle was studied on some important islands (average nesting success; 58.4%). Nesting season of this species occurs from March to May. On some beaches, nests threatened by inundation were relocated to safe areas on the beach, and protective metal grids were placed over some nests to prevent predation. Unfortunately, egg harvesting and predation of adult females occurs at some beaches. In this work, efforts were made to raise public awareness of the biological and social importance of marine turtles in Iran. Severe development pressure exists along the coasts, and immediate conservation efforts should be implemented to ensure survival of the population of nesting turtles.

S7-7569

Molecular biomarkers in monitoring of the coastal and estuarine zones of Peter the Great Bay (Japan/East Sea)

Svetlana A. Ireykina

Lab. of Complex Research of Fish Resources of Japan/East Sea, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: ir_lana@live.ru

Molecular biomarkers in organisms may serve as useful tools for evaluating pollution effects in the environment and for early warning signals about environmental threats. The role of major antioxidant and xenobiotic-metabolizing enzymes and their sensitivity is of great interest for environmental toxicology studies. Among the regions of the Russian Far East, internal parts of the Peter the Great Bay (Japan/East Sea) are under the strongest anthropogenic stress. The main sources of pollution are shipping, industrial and municipal sewage and, via many rivers, agricultural chemicals. Pollutants stimulate a variety of toxicity mechanisms, including oxidative stress. Some fish species (flounder, haarder mullet, rudd, crucian) inhabiting estuarine zones of the Bay, were used as indicator organisms for monitoring polluted estuaries. A suite of biochemical indicators (superoxide dismutase, catalase, glutathione-S-transferase, reduced glutathione and lipid peroxidation level) was investigated in liver of fish from different sites. Biomarker responses were significantly different between species and locations. For example, flounder from more polluted sites had lower activity of catalase, but higher glutathione-S-transferase activity and lipid peroxidation level (up to 50%), that testifies to their depressed physiological status. Results suggest that the observed biochemical alterations can be used to assess toxic effects under stressful conditions. Because no single biomarker generally is able to describe the complexity of effects induced by environmental pollutants on the organisms, we propose that oxidative stress and biotransformation parameters should be used in a biomarker battery in coastal and estuarine monitoring programs.

S7-7571

Petroleum hydrocarbon distribution in the Far Eastern Seas of Russia in 2010

Andrey P. Chernyaev and Anna S. Vazhova

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: anna-vazhova@mail.ru

Hydrocarbon contamination is the one of the leading factors of anthropogenic impacts on marine ecosystems. Petroleum hydrocarbon (PH) includes the chemical compounds with toxic, mutagenic and cancerogenic effects. The Far Eastern Seas of Russia are vulnerable to PH pollution due to intensive oil and gas industry, fisheries, and marine transport. Consequently, the PH content of the sea waters is monitored continuously. Water samples were collected at the surface of the Okhotsk, Bering, and Japan/East Seas in autumn 2010. The PH content in the water from the Okhotsk Sea ranged from 0.4 mg/l to 4.425 mg/l with the highest concentration in the western part of the Sea, in the area of oil and gas fields. The concentration of PH in the Bering Sea ranged from 0.04 mg/l to 0.21 mg/l with the minimum in its northern region. The PH concentration in Peter the Great Bay (Japan/East Sea) ranged from 0.26 mg/l (Nakhodka Bay) to 0.935 mg/l (Amur Bay). Throughout Peter the Great Bay the PH concentration exceeded the critical level (0.05 mg/l), due to intensive anthropogenic impacts on this coastal water area. In comparison to previous years, the PH concentration increased at a few stations in the Okhotsk Sea only, but was stable in other areas.

S7-7572

Wastewater pollutants discharge into Peter the Great Bay (Japan/East Sea) through estuaries of the rivers

Anna S. Vazhova

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: anna-vazhova@mail.ru

Quantitative and qualitative composition of wastewater is defined, and the amount of pollutants released into the wastewater in the estuarine zone is calculated for the Barabashevka and Razdolnaya (rivers to the Amur Bay) and the Artyomovka, Shkotovka, Sukhodol (rivers to the Ussury Bay). The percentage of wastewater volume flowing into the rivers without any treatment or inadequately treated is estimated. The largest amount of wastewater flows into the Razdolnaya (14,567 thousand m³ per year), while the minimum volume of wastewater is discharged into the Sukhodol (5 thousand m³ per year). The maximum mass of pollutants enters into Amur Bay with the waters of the Razdolnaya (20,173 tons/year), and the lowest mass (5 tons/year) enters into Ussury Bay with the waters of the Sukhodol. These pollutant estimates are proportional to the volume of wastewater discharged into these rivers. Portion of wastewater entering to the Ussuri Bay through the Suhodol, Artyomovka, Shkotovka is only 3% of the total wastewater discharge into the bay, but 19.4% of the total mass of pollutants enter into the Ussury Bay through these rivers. Almost a half (41.8%) of the total amount of pollutants enters the Amur Bay with waters of the Razdolnaya and Barabashevka, although it is only 27% of the wastewater. The Artyomovka has the highest portion of cleared wastewater, but the wastes entering the Shkotovka and Suhodol have no treatment. Wastewater entering through the estuaries of the rivers influences to the ecological conditions in Peter the Great Bay.

S7-7608

Levels of 4-NP in coastal waters in the Russian zone of Japan/East and Bering Seas

Aleksandra S. Kondakova¹ and Andrey P. Chernyaev²

¹ Institute of Chemistry and Applied Ecology, Far Eastern Federal University, 27 Oktyabrskaya St., Vladivostok, Primorsky Kray, 690950, Russia. E-mail: petrovasasha@yandex.ru

² Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690090, Russia

The organic compound 4-nonylphenol (4-NP) is a breakdown product of nonylphenol ethoxylates (NPEs). NPEs have many uses including emulsifiers, wetting agents, in pesticide production, and as surfactants in detergent formulations for both industrial and domestic uses. The major part of the NPEs used as surfactants appear as pollutants in coastal water. NPEs are toxic and have an effect upon aquatic organisms including bioaccumulation in the tissues of fish. In anoxic conditions NPEs decompose to short-chain and degrade into NP. 4-NP has an estrogenic effect, which can cause the feminization of marine organisms. Therefore, determination of the levels of 4-NP in natural waters is very important. Levels of 4-NP were determined in seawater of the Bering and Japan/East Seas. Analysis has been developed using liquid-liquid extraction with methylene chloride, after concentration samples are analyzed by HPLC with fluorescence detection. Water samples were collected in summer and autumn of 2010. Concentrations of 4-NP in seawater ranged from levels below the detection limits up to 8.26 µg/L. According to the Baronti Classification, waters of the Japan/East Sea are classified as slightly contaminated and waters of the Bering Sea are classified as contaminated.

S7-7622

Long-term changes in the marine environment and benthic communities in the north part of Amursky Bay (Sea of Japan)

Alexander **Moshchenko**¹, Tatyana Belan² and Yuri Korostelev³¹ Institute of Marine Biology, FEB RUS, 17 Palchevskogo St., Vladivostok, 690041, Russia. E-mail: avmoshchenko@mail.ru² Far Eastern Regional Hydrometeorological Research Institute, Vladivostok, 690991, Russia³ Primorskhydromet, Vladivostok, 690600, Russia

Long-term observations in the northern part of Amursky Bay (1986-2005) indicated a marked improvement in marine environment quality in terms of chemical contamination. For example, in 1990-1995, bottom sediment pollution decreased to a level that does not affect benthic community structure. Other alterations registered over this time period include: (1) a slight water warming (associated with dissolved oxygen reduction); (2) desalination increase near the Razdolnaya River-mouth in late summer and early autumn of 2000-2005; (3) stabilization of water eutrophication; (4) increased phosphate concentrations; and (5) decreased silicate and nitrate content. Phosphate accumulation resulted in the change of water trophic status that stipulated the restructuring of the water community as a whole. Changes are expressed in putrefactive process intensification and, accordingly, in the increase of bacteria and microalgae quantities. As a whole, we identify three main factors that led to the changes of benthic communities over the past 20 years. The primary factors are chemical loading reduction, organic pollution increase, and probably global warming. Processes related to global warming led to the introduction and acclimatization of new and more thermophilic species. Recovery of the benthic fauna that is characteristic of the first half of the last century is prevented primarily by siltation of bottom sediments.

S7-7659

Estimation of the level of radioactive pollution in mollusks and bottom sediments in Posieta Bay (Japan/East Sea)

Galina S. **Borisenko** and Galina V. Moyseychenko

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia

E-mail: vera_borisenko@mail.ru

We investigated the pollution of mollusks and bottom sediments by radionuclide Cs-137 in Posieta Bay. Radionuclide Cs-137 is one of the basic dose-forming radioactive isotopes in the biosphere since atomic weapon testing. Acting as a reservoir, the artificial radionuclides are collected by all components of the hydrosphere and absorbed by organisms on the bottom. Posieta Bay is situated on the Southwestern part of the Great Peter Bay, and the environment is inhabited by a great variety of ichthyofauna and invertebrates. The bivalve mollusks *Anadara Broughoni* and *Spisula sahalinesis* are widespread in Primorye but only recently became objects of commercial interest. These bivalves occupy coastal sites, where they are buried in oozy (*Anadara*) and sandy-oozy (*Spisula*) sediments to a depth of 10-20 cm. It is known that radionuclide Cs-137 functions as an analogue of biogenic potassium and accumulates mainly in muscular tissues. Radiochemical analysis of the contents of radionuclide Cs-137 in soft tissues of *Anadara* and *Spisula* averaged 2.6 Bk/kg and 1.9 Bk/kg wet weight, respectively. Simultaneously, we use the gamma-spectrometric method to determine the concentration of radionuclide Cs-137 in bottom sediments in Posieta Bay. The content of radionuclide Cs-137 in oozy and sandy-oozy ground was 8.7 and 6.9 Bk/kg dry weight, respectively. Our data have shown that radioactive pollution of bottom sediments influences the levels of radioactivity of mollusks, and forms the body burden for organisms that inhabit the bottom sediments.

S7-7667

Pollution of river-sea interaction areas in Peter the Great Bay (Japan/East Sea)Olga N. **Lukyanova** and Svetlana A. Irekina

Laboratory of Applied Ecology and Ecotoxicology, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: onlukyanova@tinro.ru

Pollution of estuarine areas is often the critical factor among the high number of environmental parameters that influence organisms. Many rivers with different anthropogenic impacts run into Peter the Great Bay (Japan/East Sea). Acute toxicity of bottom sediments was determined by bioassays using crustaceans and mysids in the estuarine zones of eight rivers. Toxicity at river and estuarine sites was higher in comparison with marine sites, and provides evidence that effective sedimentation of pollutants occurs in the biogeochemical barrier area. The highest concentration of organochlorine pesticides (DDT+HCCH) were measured in muscles and liver of the Far Eastern dace were observed from the estuary of Razlol'naya River (1.7 mkg/g wet weight in liver). Molecular biomarkers of biotransformation and oxidative stress were determined in crab (*Eriocheir japonica*) collected at five estuaries of the Bay. The integrated biochemical index (IBCI) was calculated as a sum of enzymatic activity and lipid peroxidation level, expressed as a percentage of the maximal value. An integrated abiotic index (IAI) was computed based on acute toxicity and the content of petroleum hydrocarbons in bottom sediments and seawater from the same stations. The correlation coefficient between IBCI and IAI was 0.78. The Total Index of Pollution (TIP), calculated as IBCI + IAI, generated a range of values for the estuarine zones: Razdolnaya River = Artemovka River (TIP = 167); Tesnaya River, TIP = 126; Sukhodol River, TIP = 117; Shkotovka River, TIP = 92.

S7-7804

Application of *Saccharina*-based sorbents for purification of sewage waters of metal mining industryT.P. Belova¹ and Olga N. **Selivanova**²¹ Research Geotechnological Center, FED RAS, Petropavlovsk-Kamchatsky, Kamchatskii Krai, 683000, Russia² Kamchatka Branch of Pacific Institute of Geography, FED RAS, Petropavlovsk-Kamchatskii, Kamchatskii Krai, 683000, Russia
E-mail: oselivanova@mail.ru

Development of gold and cobalt-copper-nickel deposits in Kamchatka dramatically increases the threat of biodiversity loss in spawning water basins and negatively affects coastal ecosystems. In order to reduce risk of pollution by mining industry wastes, it is expedient to introduce filters with dried alga *Saccharina bongardiana*. Our studies showed effectiveness of these sorbents in combination with zeolite and pumice in sorption of non-ferrous metals. *S. bongardiana* is a mass brown alga in Kamchatka, its harvesting and processing is not difficult. Cast ashore material can also be used, so manufacturing of algal sorbents seems to be cost-effective. Combined *Saccharina*-based sorbents had larger sorptive capacity compared to mineral sorbents but somewhat worse filtration properties. In the process of Cu-ions sorption using combined sorbent with modified *Saccharina* groats and zeolite filtration was smooth which is more preferable. As a result of desorption we managed to concentrate the solution 29 times using mineral sorbent and 45 times using *Saccharina*-based sorbent. The valuable elements (Au, Ni, Co, Cu *etc.*) can be extracted from concentrates by any known method. Thus we can raise economic efficiency of the mining industry due to recycling of ions of non-ferrous metals. In addition, *Saccharina*-based sorbents can be applied to the purification of polluted sea waters to improve ecological conditions in the region.

S7-7851

Research on the transport mechanism for suspended sediment along northeast Shandong Peninsula coast in summer and winter

Wang **Yongzhi**¹, Feng Aiping¹, Qiao Lulu², Yang Zuosheng² and Bao Xianwen²

¹ The First Institute of Oceanography, SOA, 6 Songling Rd., Qingdao, Shandong, 266061, PR China. E-mail: wangyongzhi@fio.org.cn

² College of Geo-Marine Sciences, Ocean University of China, Qingdao, 2661003, PR China

Datasets generated by the National Coastal Sea Comprehensive Investigation and Evaluation (908ST02) allow for analysis of the suspended sediment transport mechanism along northeast Shandong Peninsula. Samples from summer and winter were analyzed for changes in temperature, salinity, density, and turbidity in combination with information from B1 and B2 sections, with a winter circulation simulation from the ECOM model, and with a shallow profile. It is concluded that the suspension transport mechanism along the northeast Shandong Peninsula coast is similar to the existing rule in East China Sea: summer deposition and winter transport. In summer, low sea water turbidity is combined with southwest wind and northerly coastal currents. A front occurs along the temperature gradient between the Yellow Sea cold mass and coastal water off the eastern Shandong Peninsula, and prevents the sediment carried by the coastal current from southwardly transport. Therefore sediment is deposited mainly in the summer in the survey sea. In winter, strong northeast winds result in greatly strengthened coast currents and waves along Shandong Peninsula, which could carry massive resuspension southwardly. However, a shear front can also develop due to the northwardly Yellow Sea warm current and southwardly coastal current, which prevents sediment transport seaward. Thus, a mud wedge, omega-shaped (Ω) is formed off the eastern Shandong Peninsula.

S7-7891

Probabilistic ecological risk assessment of typical PAHs in coastal water of the Bohai Sea

Zhen **Wang**, Ying Wang, Xindong Ma, Zhongsheng Lin, Guangshui Na and Ziwei Yao

National Marine Environmental Monitoring Center, SOA, 42 Linghe St., Shahekou District, Dalian, Liaoning, 116023, PR China

E-mail: z_wang@163.com

Pollution status of 16 polycyclic aromatic hydrocarbons (PAHs) was investigated in coastal water of the Bohai Sea, China, and ecological risks of the 4 typical PAHs were assessed using a probabilistic risk assessment technique. The average concentration of the 16 PAHs (Σ PAHs) in coastal water of the Bohai Sea was 3504 ng/L with a standard deviation of 4141 ng/L and a median value of 1879 ng/L. The composition of the median and low molecular weight species was dominant in the total PAHs. The high percent of these species in coastal water is due to the physico-chemical properties of various ring PAHs. The high molecular weight PAHs are prone to accumulation in sediment resulting from their higher octanol-water partition coefficient (K_{ow}), whereas more low and median molecular weight PAHs exist in water as a result of their lower values of K_{ow} . The probabilistic risks of the 4 typical PAHs (naphthalene, phenanthrene, fluoranthene and benzo(a)pyrene) were 0.004, 0.035, 0.135 and 0.010, respectively. The results indicate that the ecological risk was attributed to not only the toxicity but also the exposure concentration. The joint ecological risk of the 4 PAHs was higher than the summation of their individual ecological risks, which implied that the calculated ecological risk of PAHs may be lower than the actual risk under the condition of the mixture of PAHs in water.

S7-7897

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in wastewater treatment plants and surface water in Dalian coastal area in ChinaHong **Chen**, Jianbo Han and Chuanlin HuoDivision of Marine Chemistry, National Marine Environmental Monitoring Center, Linggong Rd. 42, Dalian, 116023, PR China
E-mail: hchen@nmemc.gov.cn

Recent studies have shown that wastewater treatment plants (WWTPs) are a significant source of perfluoroalkyl compounds (PFCs), which is considered as an emerging class of contaminants, in natural water. In this study, the compounds of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) were selected to represent this class of contaminants and investigated in various full-scale municipal sewage treatment plants. Samples of influent, final effluent, and sludge were collected. The WWTPs in this study include 8 plants, among which 6 plants received higher than 90% domestic wastewater and the other 2 plants received higher than 70% industrial wastewater. It was observed that industrial WWTPs contained high concentrations of PFOA whereas no obvious difference existed for PFOS. The fate of PFCs in WWTPs was related to the functional groups. The PFOA concentrations tended to increase after treatment, while PFOS decreased. In addition, concentrations of PFOS and PFOA in WWTP effluents were approximately 10-100 times higher than concentrations in Dalian coastal areas, indicating that WWTPs are potential sources of PFCs in the marine environment.

S7-7917

Macrophyte seasonality in the Sobol Bay, Peter the Great Bay, Sea of JapanIrina R. **Levenets** and Anna V. Skriptsova

A.V. Zhirmunsky Institute of Marine Biology, FEB RAS, 17 Palchevskogo St., Vladivostok, 690041, Russia. E-mail: iralevenetz@rambler.ru

The knowledge of macrophyte seasonal dynamic is important for ecological monitoring. Sobol Bay is a typical rocky shore within Peter the Great Bay and for the northwestern Sea of Japan. The samples were collected in the depths from 0.5 to 4 m. A total of 65 macrophyte species (10 of green, 17 of brown, 37 of red algae and one species of eelgrasses) were identified. Multivariate analyses were performed to detect spatial and temporal variations. Both the number of species and the biomass of macrophytes decreased with increasing depth. In the study area, species composition of the shallow-water algal assemblages was more stable throughout the year compared to that in deeper waters. In total, four macrophyte assemblages were identified in the bay. A *Phyllospadix iwatensis* and *Cocophora langsfordii* dominated assemblage occupied muddy-gravel bottoms throughout the year. Mixed algal assemblages occurred on the rock and boulder bottoms, but they were temporally separated. A comparison between the data of the present study and previous study of 1927 results shows that the macrophyte assemblages in Sobol Bay underwent little change.

S8 POC/FIS Topic Session

Linking migratory fish behavior to end-to-end models

Co-Sponsored by ICES

Co-Convenors: Enrique Curchitser (PICES/U.S.A.), Geir Huse (ICES/Norway), Shin-ichi Ito (PICES/Japan), Michio Kishi (PICES/Japan) and Skip McKinnell (PICES)

Invited Speakers:

Jerome Fiechter (University of California Santa Cruz, U.S.A.)

Kenneth Rose (Louisiana State University, U.S.A.)

In order to understand ecosystem response to climate impacts, End-to-End modeling (E2E) approaches are essential. One of the most difficult parts for E2E is the modeling of fish behavior migration. Fish behavior can be very complex; it is a consequence of genetics, physical, chemical and biological environments and their interaction. Learned behavior may also be a factor. Recently, new technology has been introduced to tagging equipment, and as a consequence data availability is vastly improved. Additionally, new technologies are used to investigate fish movements in laboratory settings. This new information is expected to improve our understanding of fish migration mechanism and contribute to the development of fish migration models. Furthermore, the development of high-resolution ecosystem models coupled to circulation models makes it possible to simulate fish migration in the context of realistic environmental fields. The purpose of this session is to understand the current state of development in modeling fish behavior and discuss future potential collaborations to improve fish migration models. This session anticipates presentations that discuss successes (and failures) in modeling migratory fish behavior. Presentations related to data availability for model evaluation of fish behavior are also welcome. Based on the results and opinions expressed at the session, the conveners would like to discuss the desirability of establishing a group that will focus its attention on developing and advancing the state of fish behavioral modeling.

Friday, October 21 (9:00-12:10)

- 9:00 *Introduction by Convenors*
- 9:05 **Kenneth A. Rose, Katherine Shepard, Haosheng Huang, Sean Creekmore, Paul Venturelli, Jerome Fiechter, Enrique N. Curchitser, Kate Hedstrom, Matthew Campbell and Dubravko Justic**
Modeling movement of fish over spatial and temporal scales: If fish were dumber and people were smarter (S8-7621), Invited
- 9:35 **Jerome Fiechter, Kenneth A. Rose, Enrique N. Curchitser, Kate Hedstrom, Miguel Bernal and Alan Haynie**
Behavioral cues for small coastal pelagic species in the California Current: Results from a fully-coupled end-to-end ecosystem model (S8-7592), Invited
- 10:05 **Shin-ichi Ito and Takeshi Okunishi**
Comparison of migration algorithms for Japanese sardine (*Sardinops melanostictus*) in the western North Pacific (S8-7893)
- 10:25 *Coffee/Tea Break*
- 10:50 **Chen-Yi Tu, Yu-Heng Tseng, Tai-Sheng Chiu, Mao-Lin Shen and Chih-Hao Hsieh**
Using coupled fish behavior-hydrodynamic model to investigate spawning migration of Japanese anchovy, *Engraulis japonicus*, from Taiwan to the East China Sea (S8-7892)
- 11:10 **Skip McKinnell**
Evolution's challenge to modeling sockeye salmon spawning migration (S8-7877)

- 11:30 **Kjell Rong Utne and Geir Huse**
Towards end-to-end modeling with a special focus on planktivorous fish (S8-7903)
- 11:50 **Shin-ichi Ito, Masatoshi Sato, Takeshi Terui, Michio J. Kishi, Daisuke Ambe, Takahiko Kameda, Satoshi Suyama, Masayasu Nakagami and Yasuhiro Ueno**
Euler-type and Individual Based modeling approaches for fish migration: An example of Pacific saury (S8-7887)
- 12:10 Session ends

S8 Session Oral Presentations

October 21, 9:05 (S8-7621), Invited

Modeling movement of fish over spatial and temporal scales: If fish were dumber and people were smarter

Kenneth A. **Rose**¹, Katherine Shepard¹, Haosheng Huang¹, Sean Creekmore¹, Paul Venturelli¹, Jerome Fiechter², Enrique N. Curchitser³, Kate Hedstrom⁴, Matthew Campbell⁵ and Dubravko Justic¹

¹ Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, 70803, USA. Email: karose@lsu.edu

² Institute of Marine Sciences, University of California, Santa Cruz, CA, 95064, USA

³ Institute of Marine and Coastal Sciences, Rutgers University, 71 Dudley Rd., New Brunswick, NJ, 08901, USA

⁴ Arctic Region Supercomputing Center, Suite 105, 909 Koyukuk Dr., Fairbanks, AK, 99775, USA

⁵ Mississippi Laboratories, NOAA-NMFS, 3209 Frederic St., Pascagoula, MS, 39567, USA

Realistically simulating the movement of fish in spatially-explicit models remains a major challenge, and is especially critical as we attempt to forecast climate change effects on fish. We report on our collective experience using a variety of movement modeling approaches focused on tracking individuals in population and multispecies models. Our models have ranged from using time steps of minutes to days, and from meter resolution cells within a 2-D grid to km resolution cells within a 3-D hydrodynamic grid. Approaches we have attempted include fitness-based neighborhood search, neural networks, game theory, kinesis, and versions of random walk. We also have investigated parameter estimation of these approaches using genetic algorithms. All of the methods can be configured to produce realistic looking spatial patterns of individuals. In some cases, simply including geographic location information as an input to movement algorithm was sufficient. However, we discovered that pattern matching can easily result in movement models that have very limited utility for simulating movement under new conditions. We also discovered other aspects of the methods that pose a challenge to the general use of movement models in population-level models. These include: (1) fixed parameters preventing adaptive and phenotypic variation in behavior, (2) edge effects, (3) stranding and oscillatory movements, (4) weakly convergent parameter values, (5) renegade individuals, (6) bifurcated movement patterns, (7) short-cut solutions that use geography, and (8) compromise behaviors from multiple cues. We illustrate some of these with examples from the specific models, and offer some advice on potential solutions.

October 21, 9:35 (S8-7592), Invited

Behavioral cues for small coastal pelagic species in the California Current: Results from a fully-coupled end-to-end ecosystem model

Jerome **Fiechter**¹, Kenneth A. Rose², Enrique N. Curchitser³, Kate Hedstrom⁴, Miguel Bernal⁵ and Alan Haynie⁶

¹ Institute of Marine Sciences, University of California, Santa Cruz, CA, 95064, USA. E-mail: fiechter@ucsc.edu

² Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, 70803, USA

³ Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ, 08901, USA

⁴ Arctic Region Supercomputing Center, Fairbanks, AK, 99775, USA

⁵ Institut de Ciències del Mar, Barcelona, 08003, Spain

⁶ NOAA-NMFS, Alaska Fisheries Science Center, Seattle, WA, 98115, USA

Central to the concept of integrated ecosystem studies is the ability to understand how spatial and temporal variability associated with predators, prey, and their environment affects trophic interactions and habitat utilization on daily to interannual timescales. In coastal upwelling systems such as the California Current off the U.S. West Coast, small pelagic forage fishes (*e.g.*, sardines, anchovies, herrings) represent a major link between the lower and higher trophic levels. Because of their position in the food chain, small pelagic fishes integrate their own natural variability with spatial and temporal changes in their environment (*e.g.*, temperature, plankton) and in the foraging of their predators. Recent advances in ocean circulation and marine ecosystem modeling have generated the necessary components to develop models, which dynamically combine physical and biological processes, as well as human activity. We present our progress to date on the development of a fully-coupled end-to-end ecosystem model focusing on small coastal pelagic fishes in the California Current. The ecosystem model is implemented within the ROMS (Regional Ocean Modeling System) framework and consists of four sub-models: (1) ROMS for the ocean circulation, (2) NEMURO for nutrient-phytoplankton-zooplankton, (3) an individual-

based multi-species model for forage fish and higher trophic level species, and (4) a fishing fleet component. We also discuss how different movement algorithms (fitness, kinesis) and environmental cues (temperature, food) affect the biomass distribution of small coastal pelagic fishes in the California Current, and how day-to-day behavior can potentially account for and influence seasonal migration patterns.

October 21, 10:05 (S8-7893)

Comparison of migration algorithms for Japanese sardine (*Sardinops melanostictus*) in the western North Pacific

Shin-ichi **Ito**¹ and Takeshi Okunishi²

¹ Tohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan
E-mail: goito@affrc.go.jp

² National Research Institute of Fisheries Science, FRA, Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

A two-dimensional individual-based fish movement model coupled with fish bioenergetics was developed in order to simulate the observed migration and growth of Japanese sardine (*Sardinops melanostictus*) in the western North Pacific by Okunishi *et al.* (2009). While the model successfully reproduced a reasonable migration pattern for the Japanese sardine, recent observations showed a northward migration across the Subarctic Boundary of Japanese sardine in autumn which had not been reproduced in the model. Three types of migration algorithms (fitness, kinesis and extended kinesis) were tested to explore whether the northern migration across the Subarctic Boundary is reproduced. In the model using satellite observed ocean-environmental data as the driving force, fish movement was investigated. Fitness and kinesis algorithms were not able to reproduce the northern migration across the Subarctic Boundary. In the extended kinesis algorithm, the model fish are assumed to slow down their migration speed when the environment is comfortable for them. The extended kinesis model reproduced the northern migration across the Subarctic Boundary. There is a difficulty in modeling the migration of small pelagic fish since it is difficult to observe real migration routes of individual small pelagic fish. Surveys to describe the whole population movement will be needed for small pelagic fish in order to develop their migration models.

October 21, 10:50 (S8-7892)

Using coupled fish behavior-hydrodynamic model to investigate spawning migration of Japanese anchovy, *Engraulis japonicus*, from Taiwan to the East China Sea

Chen-Yi Tu¹, Yu-Heng **Tseng**², Tai-Sheng Chiu³, Mao-Lin Shen² and Chih-Hao Hsieh⁴

¹ Institute of Oceanography, National Taiwan University, 1-Sec. 4 Roosevelt Rd., Taipei, Taiwan, 10617, Chinese-Taipei

² Department of Atmospheric Sciences, National Taiwan University, 1-Sec. 4 Roosevelt Rd., Taipei, Taiwan, 10617, Chinese-Taipei

³ Institute of Zoology, National Taiwan University, 1-Sec. 4 Roosevelt Rd., Taipei, Taiwan, 10617, Chinese-Taipei

⁴ Institute of Oceanography, National Taiwan University, 1-Sec. 4 Roosevelt Rd., Taipei, Taiwan, 10617, Chinese-Taipei
E-mail: chsieh@ntu.edu.tw

Adult Japanese anchovies (*Engraulis japonicus*) migrate from the East China Sea (ECS) to the coastal region of Taiwan to spawn around late winter and early spring, and later, their larvae constitute important fisheries in Taiwan. Their spawning migration is speculated to be related to the China Coastal Current (CCC). However, conducting field studies to investigate the onset of spawning migration and their possible migration routes is difficult because Japanese anchovies have many coastal spawning grounds neighboring the ECS. Here, a coupled fish behavior-hydrodynamic model is developed to investigate the spawning migration of Japanese anchovy. The physical component is simulated by the Pacific Ocean adaption of the Taiwan Multi-scale Community Ocean Model (TIMCOM), while the biological component uses a Lagrangian particle tracking program to simulate fish migration with a primarily approximation of fish swimming behavior. Simulation results suggest that the spawning migration of Japanese anchovy is likely aided by the CCC. In addition, the impacts of discharge reduction caused by completion of the Three Gorge Dam, 2006, are examined through the change of Changjiang runoff. Our results indicate that, without Changjiang discharge, the adult anchovies cannot easily reach Taiwan coasts. Moreover, adult anchovies cannot reach the spawning site with passive advection alone. Thus, the swimming behavior of anchovies is also crucial during spawning migration due to the aid of extra velocity and given correct orientation. We found that a physical model coupled with a simplified fish swimming behavior model can facilitate better understandings of the influences of physical environment on the migration of Japanese anchovies.

October 21, 11:10 (S8-7877)

Evolution's challenge to modeling sockeye salmon spawning migration

Skip **McKinnell**

North Pacific Marine Science Organization, c/o Institute of Ocean Sciences, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: mckinnell@pices.int

The sockeye salmon (*Oncorhynchus nerka* Steller 1743) is a species that migrates from freshwater nursery lakes to the sea and returns to spawn where it was born from one to several years earlier. This characteristic of fidelity to a natal stream has led to an opportunity for genetic divergence among reproductively isolated populations. As a consequence, sockeye salmon populations have evolved different times for spawning according to the selective pressures they encounter in freshwater. In most populations, the timing of migration to the spawning grounds is related to time of year when each population spawns. Northern populations, for example, migrate and spawn earlier than southern populations to allow additional time for the young to develop fully at colder temperatures. There are some significant outliers from this general pattern that warrant closer inspection because they suggest that contemporary behaviour of some members of this species were established by environmental factors that occurred in the distant past.

October 21, 11:30 (S8-7903)

Towards end-to-end modeling with a special focus on planktivorous fish

Kjell Rong **Utne** and Geir Huse

Department of Ecosystem Processes, Institute of Marine Research, 33 Nordnesgt, Bergen, 5004, Norway. E-mail: kjell.rong.utne@imr.no

End-to-End modeling (E2E) approaches are currently increasing in popularity due to their versatility with regards to understanding ecosystem function in relation to climatic forcing and anthropogenic pressures. One of the most difficult parts of E2E is the modeling of fish migration due to the considerable behavioral repertoire of adult fish. Here we present a coupled model system of the Norwegian Sea, including an ocean model, a phytoplankton model and individual based models of the copepod *Calanus finmarchicus* and planktivorous fish. The fish migration model is mainly driven by survey observations, but also the *C. finmarchicus* densities affect the fish migrations. This leads to a predation pressure on zooplankton by fish in time and space that mimics what is observed in nature. The predation exerted by fish on the zooplankton stock is calculated by modeling individual fish growth using bioenergetics models. We estimated that the major pelagic fish stocks in the Norwegian Sea, herring, mackerel and blue whiting, consumed a total of 82 million tons of zooplankton, including 35 million tons *C. finmarchicus* in 1997. We also analyzed how the spatial distribution of *C. finmarchicus* in June and August was affected by the fish predation. New ideas on how to develop the fish models further will also be briefly presented.

October 21, 11:50 (S8-7887)

Euler-type and Individual Based modeling approaches for fish migration: An example of Pacific saury

Shin-ichi **Ito**¹, Masatoshi Sato¹, Takeshi Terui², Michio J. Kishi², Daisuke Ambe³, Takahiko Kameda⁴, Satoshi Suyama⁵, Masayasu Nakagami⁵ and Yasuhiro Ueno³

¹ Tohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan
E-mail: goito@affrc.go.jp

² Faculty of Fisheries Sciences, Hokkaido University, N13 W8, Sapporo, Hokkaido, 060-0813, Japan

³ National Research Institute of Fisheries Science, FRA, Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

⁴ Seikai National Fisheries Research Institute Ishigaki Branch, FRA, Fukaiota, Ishigaki, Okinawa, 907-0451, Japan

⁵ Tohoku National Fisheries Research Institute Hachinohe Branch, FRA, Shimomekurakubo, Same, Hachinohe, Aomori, 031-0841, Japan

Two types of fish migration models have been developed for Pacific saury; An Euler-type model and an Individual Based Model (IBM). Both models were integrated using satellite derived environmental conditions as forcing; sea surface temperature (SST), prey density estimated from surface Chl-*a* concentration and surface current speed. Both models were coupled with a fish bioenergetics model (NEMURO.FISH) to calculate the growth of Pacific saury. A fitness algorithm was applied for feeding migration in both models for which the fish are assumed to be moving towards a place with optimal growth condition. Spawning migration was the most difficult part to reproduce in the models. After several trials, we adapted a larvae fitness algorithm in which the spawning fish moves to a place of the optimal growth of larvae. In the Euler-type model, the fish density of each grid box was solved by computing the convergence of the fish and a simple model of population dynamics. Therefore, it is possible to solve for the fish biomass with the Euler-type model. However, it is impossible to trace an individual fish migration route. The IBM is useful for investigating individual fish migration, however, the ability to represent fish biomass fluctuation is limited. Both model approaches will be compared at the presentation.

S9 MONITOR/POC/FUTURE Topic Session

How well do our models really work and what data do we need to check and improve them?

Co-Sponsored by IMBER

Co-Convenors: Jack Barth (U.S.A.), Dake Chen (China), Michael Foreman (Canada), Phillip Mundy (U.S.A.), Young-Jae Ro (Korea) and Sei-Ichi Saitoh (Japan)

Invited Speakers:

Nikolay Diansky (Institute of Numerical Mathematics, Russia)

Yoichi Ishikwa (Kyoto University, Japan)

Alexander Kurapov (Oregon State University, U.S.A.)

Shoshiro Minobe (Hokkaido University, Japan)

Kenneth Rose (Louisiana State University, U.S.A.)

Given the importance of models to FUTURE, it is crucial to examine their skill and utility through comparison with data. Models are being used to study and forecast physical (atmospheric and oceanic circulation and mixing), chemical (air-sea fluxes, dissolved oxygen), biological (primary production, trophic dynamics) and fisheries (individual based modeling, migration pathways) processes. Climate forcing and coupling between processes is of prime importance. Presentations are invited over the range of modeling scales, from local to global, and from hours to decades. Contributions are also welcome identifying data sets that we currently have that are helpful for assessing model skill and what new data sets are needed and might be obtained through ocean observing efforts. Discussions of uncertainty in model predictions and ways to reduce that uncertainty are also invited.

Day 1, Wednesday, October 19 (9:00-12:35)

- 9:00 **Introduction by Convenors**
- 9:05 **Nikolay A. Diansky and Vladimir Zalesny**
Numerical simulation of the large-scale ocean circulation with a multi-component splitting method (S9-7811), Invited
- 9:30 **Alexander Kurapov**
Oregon coastal ocean data assimilation system: Model performance and assimilated data assessment (S9-7833), Invited
- 9:55 **Pavel A. Fayman and Jong-Hwan Yoon**
The numerical simulation of seasonal variability of upper layer circulation in the Okhotsk Sea (S9-7767)
- 10:15 **John A. Barth, Sangil Kim, Christopher A. Edwards and Patrick T. Drake**
To where the currents flow - Larval dispersal and connectivity along the U.S. West Coast (S9-7832)
- 10:35 **Coffee/Tea Break**
- 10:50 **Kenneth A. Rose**
Combining hydrodynamic, NPZ, and fish models into climate-physics-fish-fisher models: Can the biology and people keep up with the computers? (S9-7620), Invited
- 11:15 **Angelica Peña and Diane Masson**
Modelling lower trophic level ecosystem dynamics in the Strait of Georgia (S9-7747)
- 11:35 **Youngjae Ro, Kwangyoung Jung and Baekjin Kim**
Ecosystem monitoring/modeling project in the Chunsu Bay, Yellow Sea, Korea (S9-7778)

- 11:55 **Xiangnan Wang, Changlei Ma, Songtang Liu, Jianjun Shi, Rui Zhu and Chuan Tian**
Development and application of marine ecological and environmental monitoring system in the Yellow Sea and Polar region (S9-7757)
- 12:15 **Jerome Fiechter, Jeremiah Brown, Williams Leeds, Radu Herbei, Ralph Milliff, Christopher Wikle, Andrew Moore, Thomas Powell and Mevin Hooten**
Parameter uncertainty in marine ecosystem models: What can we learn from ensemble calculations and Bayesian models? (S9-7594)
- 12:35 Session ends

Day 2, Thursday, October 20 (9:00-12:35)

- 9:00 *Introduction by Convenors*
- 9:05 **Shoshiro Minobe and Utaka Hosoya**
Regional secular trends in a new global gridded phosphate and oxygen dataset (S9-7742), Invited
- 9:30 **Takamitsu Ito, Yohei Takano and Curtis Deutsch**
Observed and modeled dissolved oxygen variability in the North Pacific (S9-7750)
- 9:50 **James R. Christian**
Effects of natural variability on biogeochemical processes in climate models (S9-7748)
- 10:10 **Takashi Mochizuki, Masahide Kimoto, Masayoshi Ishii, Yoshimitsu Chikamoto, Hiroaki Tatebe, Yoshiki Komuro, Takashi T. Sakamoto, Masahiro Watanabe and Masato Mori**
Decadal prediction using recent series of MIROC global climate model (S9-7808)
- 10:30 *Coffee/Tea Break*
- 10:50 **Yoichi Ishikawa, Toshiyuki Awaji, Masafumi Kamachi, Shuhei Masuda, Hiromichi Igarashi, Yoshihisa Hiyoshi, Yuji Sasaki, Shiro Nishikawa, Toshimasa Doi, Nozomi Sugiura, Norihisa Usui, Yosuke Fujii, Takahiro Toyoda, Sei-Ichi Saitoh, Mitso Sakai, Yoshiki Kato and Shin-ichi Sato**
Forecasting ocean circulation and fishery-resource variabilities for operational use (S9-7731), Invited
- 11:15 **Mohamed Rawidean MohdKassim**
Fish Forecasting System using Sea Surface Temperature and Chlorophyll satellite images: A statistical model approach (S9-7558)
- 11:35 **Michael Foreman, Kyle Garver, Dario Stucchi, Ming Guo and Darren Tuele**
Uncertainties in modeling water-borne disease transmission among salmon farms in the Discovery Islands, British Columbia (S9-7733)
- 11:55 **Xiutang Yuan, Zhifeng Zhang, Chuanlin Huo and Gengchen Han**
Environmental monitoring and assessment of mariculture zones in China: Status and prospects (S9-7901)
- 12:15 **V.F. Mishukoy, V.V. Kalinchuk, V.V. Plotnikov and A.V. Voytsytskiy**
Using satellite images for testing simulation models of contaminant transport in the Peter the Great Bay of the Sea of Japan (S9-7856)
- 12:35 Session ends

S9 Posters

- S9-7641 **Shin-ichi Ito, Naoki Yoshie, Takeshi Okunishi, Tsuneo Ono, Yuji Okazaki, Akira Kuwata, Taketo Hashioka, Kenneth A. Rose, Bernard A. Megrey, Michio J. Kishi, Miwa Nakamachi, Yugo Shimizu, Shigeo Kakehi, Hiroaki Saito, Kazutaka Takahashi, Kazuaki Tadokoro, Akira Kusaka and Hiromi Kasai**
Application of an automatic approach to calibrate the NEMURO nutrient–phytoplankton–zooplankton food web model in the Oyashio region
- S9-7651 **Vladimir V. Kulik and Igor V. Volvenko**
North Pacific database of pelagic and bottom trawl surveys from Russian EEZ applicable to Ecosystem Based Management
- S9-7681 **Naoki Yoshie, Xinyu Guo, Naoki Fujii and Tomohiro Komorita**
Phytoplankton and nutrient dynamics in the western Seto Inland Sea, Japan based on observation and a modified NEMURO model
- S9-7684 **Bunmei Taguchi, Hisashi Nakamura, Masami Nonaka, Nobumasa Komori, Akira Kuwano-Yoshida, Koutarou Takaya and Atsushi Goto**
Seasonal evolutions of atmospheric response to decadal SST anomalies in the North Pacific subarctic frontal zone: Observations and a coupled model simulation
- S9-7753 **Changshui Xia, Xingang Lv and Fangli Qiao**
Simulation of the tide and tidal current in the Qinzhou Bay

Day 1, S9 Session Oral Presentations

October 19, 9:05 (S9-7811), Invited

Numerical simulation of the large-scale ocean circulation with a multi-component splitting method

Nikolay A. Diansky and Vladimir Zalesny

Institute of Numerical Mathematics, Russian Academy of Sciences, 8 Gubkina St., Moscow, 119333, Russia
E-mail: nikolay.diansky@gmail.com

The Institute of Numerical Mathematics Ocean Model (INMOM), a so-called “terrain following” σ -coordinate ocean model, is presented. The model solves the primitive equations of ocean dynamics under Boussinesq and hydrostatic approximations, and is written in a generic spherical coordinate system. A splitting method where in the main parts of the model operator are selected and their numerical treatments are performed independently of one another, is used to solve the basic primitive equations. This technique facilitates the construction an adjoint subsystem for each separate splitting stage, and the set of subsystems yields a full adjoint model required for 4D-var data assimilation. The global version of the INMOM is used as the oceanic component of the IPCC climate model INMCM presented in the IPCC Fourth Assessment Report (2007). Some results obtained with the INMOM will be presented. Characteristics of the global ocean climatic circulation from a several-hundred year simulation are shown. The INMOM is also used for a simulation of pollutant transport into the Pacific Ocean from the shores of Japan and Kamchatka. This version of the INMOM was developed for the North Pacific from the Equator to Bering Strait with $1/8^\circ$ horizontal eddy-resolving resolution and 33 unevenly spaced vertical sigma-levels. The INMOM is also used for the numerical simulation of the Japan/East Sea (JES) dynamics with high spatial resolution ($<5\text{nm}$) and mesh refinements in the shelf zone. Strong eddy activity of the JES simulated circulation is shown and confirmed by observations. This eddy activity makes a substantial contribution to the formation of the JES large-scale circulation.

October 19, 9:30 (S9-7833), Invited

Oregon coastal ocean data assimilation system: Model performance and assimilated data assessment

Alexander Kurapov

College of Oceanic and Atmospheric Sciences, Oregon State University, 104 COAS Administration Bldg., Corvallis, OR, 97331-5503, USA
E-mail: kurapov@coas.oregonstate.edu

A high-resolution, nonlinear, primitive equation model based on the Regional Ocean Modeling System has been implemented to study and predict circulation in the coastal areas off Oregon (US West Coast). Process-oriented studies have been run without assimilation with a focus on wind-driven coastal upwelling, shelf-interior ocean exchange processes, and tides in the area. To assess the accuracy of the solutions, model estimates (SSH, SST, velocities) have been routinely compared to available observations (satellite SST, alongtrack altimetry, high-frequency (HF) radar surface currents, ship-borne sections of temperature and salinity, mooring velocities, *etc.*). These model estimates are shown to reproduce dynamics on the shelf, slope and in the adjacent interior ocean qualitatively correctly. To constrain the timing and location of jets and eddies in the interior ocean, where predictability is limited, a data assimilation system has been developed based on the sequential application of the variational (adjoint-based) method in a series of 3-6 day time windows. In different experiments, we have assimilated (in different combinations) satellite SST and alongtrack SSH, as well HF radar surface currents. In each case, the results have been verified against unassimilated data. We find that assimilation of the alongtrack SSH slope, as well as surface velocities near the coast, helps to improve the geometry of the upwelling front. Assimilation of SST from a geostationary satellite helps to improve the slope of SSH and reveals interesting dynamical structures, particularly in winter. Dynamics in early summer are strongly affected by the Columbia River fresh water discharge and that provides challenges to modeling and data assimilation.

October 19, 9:55 (S9-7767)

The numerical simulation of seasonal variability of upper layer circulation in the Okhotsk Sea

Pavel A. **Fayman**¹ and Jong-Hwan Yoon²

¹ Department of Engineering Oceanology and Ecological Designing, Far Eastern Regional Hydrometeorological Research Institute, 24 Fontannaya St., Vladivostok, 690600, Russia. E-mail: Pavel.Fayman@gmail.com

² Research Institute of Applied Mechanics, Kyushu University, 6-1 Kasuga, Fukuoka, 816-8580, Japan

The aims of the present study are the numerical simulation and research of sea water circulation in the Okhotsk Sea and exchanges with the Pacific Ocean. The Okhotsk Sea circulation model is based on the RIAM Ocean Model (RIAMOM) with 1/18° horizontal resolution. The model domain covers the entire Okhotsk Sea, the northern part of the Japan/East Sea and the north-western part of Pacific Ocean which is adjacent to the eastern coast of the Kamchatka Peninsula, Hokkaido and Kuril Islands. The primary circulation pattern is cyclonic with a large volume transport over the continental slope. The main currents that exist in most parts of the year are: i) in the west, the Kamchatka Current over north-Okhotsk continental slope, ii) in the middle north-Okhotsk, the East-Sakhalin current (both branches), and iii) in the north-east, the Soya Current. Other currents (Compensation, Penzhin, Yamskoye, Amur currents, north-Okhotsk countercurrent) are not so stable in time. Two other main features are anticyclonic circulation patterns in Shelihov Bay and over the Kuril Basin.

The volume transport of the Kuril-Kamchatka Current, the West-Kamchatka Current over the North-Okhotsk continental slope current, and the second branch of the East Sakhalin current are largest in winter and smallest in summer. The same volume transport behaviour is found in the Fourth Kuril Strait and Kruzenshterna Strait. Thus we can conclude that the circulation in the Okhotsk Sea partially depends on inflows from Pacific Ocean and from wind curl over the sea.

The volume transport of the Yamskoye current, the North-Okhotsk current, and the first branch of the East Sakhalin current are largest in autumn. This is an effect of arrested topography waves. An estimation of vorticity in the central part of the Okhotsk Sea shows the importance of geostrophic balance.

October 19, 10:15 (S9-7832)

To where the currents flow - Larval dispersal and connectivity along the U.S. West Coast

John A. **Barth**¹, Sangil Kim¹, Christopher A. Edwards² and Patrick T. Drake²

¹ College of Oceanic and Atmospheric Sciences, Oregon State University, 104 COAS Administration Bldg., Corvallis, OR, 97331-5503, USA
E-mail: barth@coas.oregonstate.edu

² Ocean Sciences Department, University of California, Santa Cruz, CA, 95064, USA

Regional ocean circulation models are used to study the dispersal patterns of marine organisms and the connectivity between adult populations along the U.S. West Coast. The goal is to understand the influence of ocean circulation patterns on marine ecosystems, with an eye toward aiding marine spatial planning. We use the Regional Ocean Modeling System (ROMS) on two regional scales, one spanning the U.S. west coast (30-48°N) and one focused off Oregon (40.6-47.5°N), both of which are forced by realistic winds. At lateral open boundaries, the ROMS solutions are matched to exterior fields, either monthly climatologies given by the World Ocean Atlas for the west-coast model or output from the Navy's Coastal Ocean Model for the Oregon model. Model fields compare well quantitatively with ocean measurements. Larvae are modeled as passive floats and are advected by the model's three-dimensional velocities. Settlement occurs when larvae are within a specified distance of the coast when they are competent to settle, 15-180 days after release. Connectivity matrices reveal the importance of depth-dependent and seasonally varying flows for determining dispersal patterns. Flow-topography interactions at coastal promontories and submarine banks are also critical for determining larval dispersal and connectivity. The Heceta Bank, Oregon, region has high probabilities as both a source and a destination for settled larvae. Point Conception, California, did not act as a barrier to dispersal for source regions in the Southern California Bight. Dispersal patterns are compared qualitatively to mussel recruitment in Oregon and to barnacle genetic patterns along the U.S. west coast.

October 19, 10:50 (S9-7620), Invited

Combining hydrodynamic, NPZ, and fish models into climate-physics-fish-fisher models: Can the biology and people keep up with the computers?

Kenneth A. **Rose**

Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, 70803, USA. Email: karose@lsu.edu

Until recently, NPZ (with physics) models and fish population models were developed separately. Zooplankton were included in the NPZ with a density-dependent mortality term for closure, and fish models either ignored or made unrealistic assumptions about the physics and the availability of prey. This schism was because oceanography and fisheries used to be considered two separate disciplines, with advances in each seeming to leap-frog out-of-phase with each other, and because computing power was inadequate for simply combining all of the models into a single model. Recently, the advances in physics and biology have created the needed pieces for climate-to-physics-to-fish-to-fishers modeling. The demand is being fueled by interest in forecasting climate effects on fish, and the perception of a crisis in fisheries management fueling the desire for new tools. We can overcome the computing issues; the serious challenges now relate to how to represent the biology and physics that permit their integration, obtaining sufficiently resolved measurements, and overcoming collaborative issues with large group efforts. I use several examples to illustrate the technical issues, such as how to couple the physics and fish models and the measurements needed for model evaluation. I then discuss how both the coupled modeling system and the group of interacting researchers are both complex systems, which complicates model analysis and people working together. I conclude with an optimistic view of how close we seem to be to forging physics to fish models, and a post-modernistic framework for overcoming the people issues.

October 19, 11:15 (S9-7747)

Modelling lower trophic level ecosystem dynamics in the Strait of Georgia

Angelica **Peña** and Diane Masson

Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: Angelica.Pena@dfo-mpo.gc.ca

The Strait of Georgia is a productive, semi-enclosed sea with strong estuarine circulation connected to the North Pacific by the Juan de Fuca Strait. Significant geographical and temporal variability has been observed in this region, making it challenging to understand and detect ecosystem changes based on observations only. To identify and understand key factors responsible for variability in plankton production, a coupled physical-biological model (ROMS-NPZD type model) has been developed for the region. In this study, the skill and utility of the model is examined by comparing model results with available observations. In particular, we focus on how well the model reproduces seasonal and year to year variability. Modeled phytoplankton biomass shows pronounced seasonal variability consistent with observations. Model and observations indicate maxima phytoplankton abundances in April, when the increase in solar radiation and abundance of nutrients provides optimal growing conditions. In the model, physical variability plays an important role in maintaining the high spatio-temporal variability of plankton abundance. For example, freshwater inflow and tidal mixing greatly influence the stability of the water column and the distribution and production of phytoplankton and zooplankton.

October 19, 11:35 (S9-7778)

Ecosystem monitoring/modeling project in the Chunsu Bay, Yellow Sea, Korea

Youngjae **Ro**, Kwangyoung Jung and Baekjin Kim

College of Natural Sciences, Chungnam National University, 220 Gung-dong, Yuseong-gu, Daejeon, 305-764, R Korea
E-mail: royoungj@cnu.ac.kr

This research project is aiming at better understanding of the ecosystem status in the Chunsu Bay and its impact from two Dam constructions since the early 1980s. The project is a multi-year (at least 5 year), multi-disciplinary approach to seek solutions to manage the local ecosystem as well as sustainable fishery.

The Chunsu Bay is a small coastal embayment, elongated in shape, 27 km long north to south and 16 km wide east to west, located in western side of Korean Peninsula (36°30'N, 126°46'E) where tidal range is very high, ranging from 5 to 12 meters. Constructions of two tidal embankments were completed in 1982 and 1984, respectively, to secure more land area for local agriculture.

Research themes focus on the generation mechanism of anoxia in the summer season due to intermittent release of nutrient-rich dam water. To monitor the water quality and other physico-chemico-bio elements, in-situ monitoring sensors with realtime capability are used. Modeling efforts include setup of a 3D circulation model plus eutrophication and other biological activities based on EFDC. Model initial and boundary conditions are being collected by seasonal and summertime-monthly field works along with realtime monitoring station.

October 19, 11:55 (S9-7757)

Development and application of marine ecological and environmental monitoring system in the Yellow Sea and Polar region

Xiangnan **Wang**, Changlei Ma, Songtang Liu, Jianjun Shi, Rui Zhu and Chuan Tian

National Ocean Technology Center, 219 Jieyuanxi Rd., Nankai District, Tianjin, 300112, PR China. E-mail: machanglei@sina.com

The health of marine ecosystems is suffering more and more challenges due to anthropogenic behaviors, especially in coastal areas, where economic activities are more frequent and more pollutants enters the ocean. The routine and operational marine environmental monitoring provides some fundamental inputs for various models simulating the status and predicting the trends of oceans in China. The periodic and cruise investigation of some marine ecological parameters are not as frequent as marine environmental monitoring, partly for the reasons of expensive sensors and inconvenient maintenance, *etc.* However, continuous and located marine ecological monitoring is necessary for understanding the productivity of local seas. The marine ecological and environmental monitoring system researched in the National Ocean Technology Center could continuously and timely monitor salinity, depth, temperature, current, chlorophyll, photosynthetically active radiation (PAR), pH, and oxidation-reduction potential (ORP). The system has been applied in the Yellow Sea in 2009 and in a polar region in 2010, and acquired numerous ecological and environmental data in real time, which could be used as inputs to some marine ecological models. The monthly and daily change of environmental conditions and ecological parameters such as chlorophyll and PAR in the Yellow Sea have been analyzed. The data in polar regions are comparatively studied also.

October 19, 12:15 (S9-7594)

Parameter uncertainty in marine ecosystem models: What can we learn from ensemble calculations and Bayesian models?

Jerome **Fiechter**¹, Jeremiah Brown², Williams Leeds³, Radu Herbei⁴, Ralph Milliff², Christopher Wikle³, Andrew Moore⁵, Thomas Powell⁶ and Mevin Hooten⁷

¹ Institute of Marine Sciences, University of California, Santa Cruz, CA, 95064, USA. E-mail: fiechter@ucsc.edu

² NorthWest Research Associates, Colorado Division, Boulder, CO, 80301, USA

³ Department of Statistics, University of Missouri, MO, 65211, USA

⁴ Department of Statistics, Ohio State University, OH, 43210, USA

⁵ Ocean Sciences Department, University of California, Santa Cruz, CA, 95064, USA

⁶ Department of Integrative Biology, University of California, Berkeley, CA, 94720, USA

⁷ Department of Fish, Wildlife and Conservation Biology, Colorado State University, CO, 80523, USA

Parameterization uncertainty is one of the well-known factors limiting the use of lower trophic level ecosystem models for predicting observed biological variability in the ocean, especially in the context of climate change. We present two complementary approaches for investigating how parameter uncertainty impacts ecosystem model solutions and how available observations can be used to estimate posterior distributions for these parameters. The first method uses ensemble calculations with a deterministic, data assimilative, coupled physical-biological model for the coastal Gulf of Alaska to characterize how uncertainty in fundamental biological processes controls the spatial and temporal accuracy and variability of ecosystem model predictions. The second method uses a relocatable Bayesian hierarchical model framework to update uncertain distributional knowledge about ecosystem process models and parameters in the presence of satellite and *in situ* observations. Posterior distributions from the Bayesian model can provide realistic quantitative estimates of central tendencies and uncertainties and are thus useful for summarizing ecosystem dynamics in various physical and biological regimes (*e.g.*, boundary current, upwelling zone). Together, these two approaches represent a significant first step towards being able to specify spatially- and temporally-dependent distributions for ecosystem model parameters and to determine how accuracy in model solutions relates to uncertainty in the parameterization of key biological processes for different regions of the North Pacific.

Day 2, Session 9 Oral Presentations

October 20, 9:05 (S9-7742), Invited

Regional secular trends in a new global gridded phosphate and oxygen dataset

Shoshiro **Minobe** and Utaka Hosoya

Graduate School of Science, Hokkaido University, N10, W8, Sapporo, Hokkaido, 060-0810, Japan. E-mail: minobe@mail.sci.hokudai.ac.jp

Given a wide range of ongoing marine environmental changes, it is important to understand that past and present variations in biogeochemical parameters in the world ocean. Recently, several regional studies using selected observation profiles revealed interesting changes in biogeochemical parameters, such as nutrients and dissolved oxygen. However, almost no study attempted to produce global gridded dataset of nutrients or oxygen to our knowledge. The lack of the gridded datasets prohibits not only the systematic retrospective analyses, but also the verifications of numerical biogeochemical simulations, which are essential tools for future projections.

In the present study, we have produced a new gridded dataset of phosphate and dissolved-oxygen on 1-degree horizontal resolution. Of course, the resultant gridded data have substantial data-missing regions, but still provide important information in the western and eastern North Pacific and Atlantic oceans. We focus on nutrient and oxygen variations in the western North Pacific, where data coverage is better. Prominent decreasing subsurface nutrient trends for the last 50-years are found in the subtropical gyre to the south of Japan accompanied by weak oxygen increase. Although near surface nutrient reduction are generally expected due to the global warming associated with the enhanced stratification, the spatial structure of the observed nutrient reduction is inconsistent to this scenario, but is likely to be related changes of gyre circulation and/or water masses. This underscores the importance of examination of past changes and its mechanisms in each region for a better understanding of future changes.

October 20, 9:30 (S9-7750)

Observed and modeled dissolved oxygen variability in the North Pacific

Takamitsu **Ito**, Yohei Takano and Curtis Deutsch

Georgia Institute of Technology, School of Earth and Atmospheric Sciences, Atlanta, GA, 30332, USA
E-mail: taka.ito.work@gmail.com

Dissolved oxygen concentration reflects a number of physical and biogeochemical processes including air-sea heat and gas exchange, net community production, respiration, circulation and mixing. We investigate its spatial and temporal variability using a conceptual model, time-series observations and three-dimensional numerical ocean biogeochemistry model. The conceptual model predicts that thermocline oxygen naturally integrates out the short-lived perturbations, leaving behind the decadal and longer-term variability. Observational data is consistent with the simple theory with the exception of the 15-20 year timescale. Hindcast simulations are performed using data-constrained ocean circulation fields. Simulations reproduce some aspects of the decadal oxygen variability including east-west asymmetry in the subpolar gyre. This low-frequency variability is likely driven by ocean circulation associated with the large-scale climate modes. Our results demonstrate that the utility of dissolved oxygen as a tracer of physical and biogeochemical variability, allowing us to evaluate climate and carbon cycle models on decadal timescales.

October 20, 9:50 (S9-7748)

Effects of natural variability on biogeochemical processes in climate models

James R. **Christian**^{1,2}

¹ Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: jim.christian@ec.gc.ca

² Canadian Centre for Climate Modelling and Analysis, University of Victoria, P.O. Box 3065 STN CSC, Victoria, BC, V8W 3V6, Canada

Climate variability exists at all time scales and well-defined modes or dominant frequencies exist for only small parts of the frequency spectrum. In the Pacific there are well-known modes of climate variability such as ENSO and the PDO that have strong and well-documented effects on biologically and biogeochemically relevant processes such as primary production and air-sea exchange of CO₂. Fidelity of representation of these modes in climate models is variable and potential changes under future greenhouse warming uncertain. I will review the performance of some recent climate model simulations with respect to known patterns of interannual to interdecadal variability in the Pacific and examine how these may change under future warming using projections with the latest group of IPCC emission scenarios (“Representative Concentration Pathways”).

October 20, 10:10 (S9-7808)

Decadal prediction using recent series of MIROC global climate model

Takashi **Mochizuki**¹, Masahide Kimoto², Masayoshi Ishii^{1,3}, Yoshimitsu Chikamoto², Hiroaki Tatebe¹, Yoshiki Komuro¹, Takashi T. Sakamoto¹, Masahiro Watanabe² and Masato Mori²

¹ Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanazawa-ku, Yokohama, 236-0001, Japan
E-mail: motizuki@jamstec.go.jp

² Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8568, Japan

³ Meteorological Research Institute, Japan Meteorological Agency, 1-1 Nagamine, Tsukuba, Ibaraki, 205-0052, Japan

In decadal climate prediction, we require knowledge of the future state of internal variations in the climate system together with the global warming signal. Recently, we performed ensemble decadal hindcast experiments with initialization and explored predictability of internal variations such as the Pacific Decadal Oscillation (PDO). Here, we build on our earlier experiences by using recent two versions of MIROC global climate model; MIROC4h (T213L56 AGCM and 1/6-1/4deg. 48levs. OGCM) has a higher-resolution and MIROC5 (T85L40 AGCM and 0.56-1.4deg. 50levs. OGCM) contains new calculation schemes to improve representation of several physical processes in atmosphere, ocean and land. Using MIROC4h and MIROC5, we perform sets of 10-year-long 9-ensemble hindcasts (3-members by MIROC4h and 6-members by MIROC5) with initialization every five years after 1961, in line with the experimental designs toward CMIP5 and IPCC-AR5. Results of these hindcast experiments validate our ability to enhance decadal predictability particularly of the PDO for a few years and of the Atlantic Multidecadal Oscillation (AMO) for almost a decade, while the most predictable component in decadal climate variations is the global warming signal. Overall quality of the initialized hindcasts represents higher levels of performance than the so-called global warming simulations without initialization. The initialization enables us to define the PDO and AMO as a predictable component in addition to the global warming signal. Large impacts of initialization are found over the mid- and high-latitudes of the North Pacific and the high-latitude of the North Atlantic, where the PDO and AMO signals are observed strongest.

October 20, 10:50 (S9-7731), Invited

Forecasting ocean circulation and fishery-resource variabilities for operational use

Yoichi **Ishikawa**^{1,2}, Toshiyuki Awaji^{1,2}, Masafumi Kamachi³, Shuhei Masuda², Hiromichi Igarashi², Yoshihisa Hiyoshi², Yuji Sasaki², Shiro Nishikawa², Toshimasa Doi², Nozomi Sugiura², Norihisa Usui³, Yosuke Fujii³, Takahiro Toyoda³, Sei-Ichi Saitoh⁴, Mitso Sakai⁵, Yoshiki Kato⁵ and Shin-ichi Sato⁶

¹ Graduate School of Science, Kyoto University, Kitashirakawa, Oiwake-cho, Kyoto, 606-8502, Japan. E-mail: ishikawa@kugi.kyoto-u.ac.jp

² Japan Agency of Marine-Earth Science and Technology, Showa-cho, Kanazawa-ku, Yokohama, 236-0001, Japan

³ Meteorological Research Institute, Japan Meteorological Agency, Nagamine, Tsukuba, 305-0052, Japan

⁴ Laboratory of Marine Environment and Resource Sensing, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato, Hakodate, Hokkaido, 041-8611, Japan

⁵ National Research Institute of Far Seas Fisheries, Fisheries Research Agency, Fukuura, Kanazawa-ku, Yokohama, 236-8648, Japan

⁶ Fisheries Research Institute, Aomori Prefectural Industrial Technology Research Center, Hiranai-cho, HigashiTsugaru, Aomori, 039-3381, Japan

Toward the clarification and forecast of new links between ocean/climate processes and both biogeochemical and fishery environments, a new forecast/analysis system is currently developed as a component of the on-going national research program “Research Program on Climate Change Adaptation” (RECCA). The major goal is a high-impact application of a 4D-VAR data assimilation system to the high-level stock assessment of neon flying squid in the North Pacific based on the accurate diagnosis of the spawning and feeding grounds, as well as the forecast of the potential fishing area using a high-resolution physical/bio-geochemical coupled model. The technical knowledge obtained here can offer a future vision for an optimal fishery stock management and adaptive fishery operation with low cost and low CO₂ emission, and thereby leads to a sustainable social system through enhanced Japanese fishery activity and multi-disciplinary decision making that adapts policy to ocean and climate variations.

October 20, 11:15 (S9-7558)

Fish Forecasting System using Sea Surface Temperature and Chlorophyll satellite images: A statistical model approach

Mohamed Rawidean **MohdKassim**

Malaysian Institute Of Microelectronic Systems (MIMOS), Technology Park Malaysia, Bukit Jalil, Kuala Lumpur, 57000, Malaysia
E-mail: dean@mimos.my

The paper attempts to develop a Fish Forecasting System (FFS) using a statistical modeling technique. Typically, spatial modeling techniques using oceanic fronts, in particular thermal front techniques are used for determining fish locations. Statistical modeling approaches for locating fishes in the sea before fishermen set out are rarely attempted. It is partly because of complexities involved in identifying parameters that are real determinants of fish locations and partly exorbitant cost of data collection. Moreover, such data collection and collation exercise also can be a time consuming process. Nonetheless, a pioneering effort was made in the East Coast of Peninsular Malaysia for forecasting pelagic fish locations in the South China Sea using statistical techniques. This model deployed Sea Surface Temperature (SST) and Chlorophyll satellite images, particularly to forecast potential pelagic fish locations. The FFS thus developed based on this approach also incorporates an Intelligent Feedback System (IFS) to improve the model over time especially using the feedback input from fishermen. The impact of climate change on fishing distribution pattern can be studied through such time-based modeling work. Furthermore, combining with other remote sensing data, the statistical model becomes richer with more information for better prediction purposes. Such research work is beneficial to wider Asian fishing community.

October 20, 11:35 (S9-7733)

Uncertainties in modeling water-borne disease transmission among salmon farms in the Discovery Islands, British Columbia

Michael **Foreman**¹, Kyle Garver², Dario Stucchi¹, Ming Guo¹ and Darren Tuele¹

¹ Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: mike.foreman@dfo-mpo.gc.ca

² Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, BC, V9T 6N7, Canada

A finite volume, ocean circulation model is used to simulate water-borne transmission of the *infectious hematopoietic necrosis virus* (IHNV) among Atlantic salmon (*Salmo salar*) farms in the Discovery Islands region of British Columbia. Viral “particles” released from farms in accordance with IHNV shedding rates estimated through laboratory experiments are dispersed by model oceanic flows and die in accordance with background water properties and ultra-violet radiation levels that are also determined through laboratory studies. Temporally-evolving viral concentration maps are produced and combined with lab-determined minimum infectious dosages to estimate how infections might spread among farms. The development and validation of the circulation and biological model components will be briefly discussed, along with uncertainties and the need for additional data to improve model credibility.

October 20, 11:55 (S9-7901)

Environmental monitoring and assessment of mariculture zones in China: Status and prospects

Xiutang **Yuan**, Zhifeng Zhang, Chuanlin Huo and Gengchen Han

Department of Marine Environmental Ecology, National Marine Environmental Monitoring Center, State Oceanic Administration (SOA), P.O. Box 303, Dalian, 116023, PR China, E-mail: xtyuan@nmemc.gov.cn

Aquaculture has shown great promise for meeting the increasing need for protein food sources and is now responsible for nearly half of the global production of aquatic organisms. In this context, marine aquaculture in China is by far the largest and the most renowned in the world and has undergone a rapid expansion over the past decades. However, environmental issues such as eutrophication, disease outbreak and algae blooms (red tides) in some mariculture zones have been of concern. In order to document the overall environmental conditions and potential ecological risks in marine aquaculture zones, the State Oceanic Administration organized and put into practice the work of monitoring and assessment of marine aquaculture zones starting in 2003. The monitoring and assessment results are issued in Bulletin of Marine Environmental Conditions of China every year (http://www.soa.gov.cn/soa/hygb/hjgb/A010901index_1.htm).

In this paper we will introduce the practice and experience of environmental monitoring and assessment of mariculture zones in China. In addition, the environmental conditions including water quality, sediment quality and integrated environmental quality of the monitored mariculture zones from 2003 to 2010 are presented. At last, future prospects for environmental monitoring and assessment of mariculture zones are also proposed.

October 20, 12:15 (S9-7856)

Using satellite images for testing simulation models of contaminant transport in the Peter the Great Bay of the Sea of Japan

V.F. **Mishukov**¹, V.V. Kalinchuk¹, V.V. Plotnikov¹ and A.V. Voytsytskiy²

¹ VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: vmishukov@poi.dvo.ru

² Far-Eastern National Fishing University, Vladivostok, Russia

On the Peter the Great Bay of the Sea of Japan, the intensification of passenger-and-freight transportation with the increased number and capacity of ports, and also increased anthropogenic loading from coastal cities are observed. For effective and operative carrying out of actions to minimize the consequences of the accidental input of oil to the gulf, operative simulation model is necessary.

For modeling the distribution and transformation of the oil pollution connected with emergency oil spills, the simulation model developed in POI FEB of the Russian Academy of Science is used. It is supposed that transportation of oil at sea depends on several dynamic factors, such as: speed and direction of the wind, tidal currents, and turbulent diffusion. During its drift the oil spot can meet a solid border. In real conditions, the behavior of oil near a coastal line will depend on the bottom slope and the character of the ground. A flat and sandy or marshy coast will promote more sedimentation of oil than will a steep and rocky coast. In the model, full sedimentation of oil on the coast is included.

Calculation of tide currents is made on the basis of date, time, coordinates of the spill, and also a map of depths and the coastline. Calculation of wind velocities is defined from the coordinates of the spill, hydrometeorological conditions and a map of depths and the coastline. Calculation of noncyclic and turbulent currents proceeds from the date, time, coordinates of the spill, and also a map of depths and the coastline. Result of modeling is a map of spatial drift of oil on the sea surface.

Spatial distribution of oil slicks was compared with images, determined using synthetic aperture on satellite ERS-1 and ERS-2, on 4 September and 10 October 1991, and 21 September 2005, and 28 June 2006 for northern and central parts of the Peter the Great Bay. These images were received from the European space agency under joint projects and are located at an archive of geographic information (www.gis.poi.dvo.ru).

When the information on wind was absent, a search of the needed information in accessible sources has been conducted. Sources of oil pollution were chosen. The Gold Horn Bay and the Ulis Bay were chosen as sources of oil pollution with the chemical properties similar to black oil (mazut). Mazut was input continuously at 10 liters per minute from each source in the water area of the Biosphere Vostochny Strait during all time of calculation, which for weak winds was 36 hours and for stronger winds was 24 hours. Trajectories of movement of spots of oil are deduced every 3 hours. Results of the calculation of the spatial distribution of oil on water areas in comparison with coincident satellite images in each of the years are in good agreement.

After simulations of slick drifts on sea surface under measured hydrometeorological parameters for these days, we observed that slick fields on the sea surface presented in images are in good agreement with picture of simulated fields of slick drifts which were formed from oil hydrocarbon sources.

S9 Session Posters

S9-7641

Application of an automatic approach to calibrate the NEMURO nutrient–phytoplankton–zooplankton food web model in the Oyashio region

Shin-ichi **Ito**¹, Naoki Yoshie², Takeshi Okunishi³, Tsuneo Ono⁴, Yuji Okazaki¹, Akira Kuwata¹, Taketo Hashioka⁵, Kenneth A. Rose⁶, Bernard A. Megrey⁷, Michio J. Kishi⁸, Miwa Nakamachi¹, Yugo Shimizu¹, Shigeo Kakehi¹, Hiroaki Saito¹, Kazutaka Takahashi⁹, Kazuaki Tadokoro¹, Akira Kusaka³ and Hiromi Kasai⁴

¹ Tohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan. E-mail: goito@affrc.go.jp

² Center For Marine Environmental Studies, Ehime University, Matsuyama, Ehime, 790-8577, Japan

³ National Research Institute of Fisheries Science, FRA, Kanazawa-Ku, Yokohama, Kanagawa, 236-8648, Japan

⁴ Hokkaido National Fisheries Research Institute, FRA, 116 Katsurakoi, Kushiro, Hokkaido, 085-0802, Japan

⁵ Frontier Research Center for Global Change, JAMSTEC, Yokohama, 236-0001, Japan

⁶ Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, 70803, USA

⁷ National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sandpoint Way NE, Seattle, WA, 98115-0070, USA

⁸ Faculty of Fisheries Sciences, Hokkaido University, N13 W8, Sapporo, Hokkaido, 060-0813, Japan

⁹ Graduate School of Agricultural and Life Sciences, University of Tokyo, Bunkyo-ku, Tokyo, 113-8657, Japan

The Oyashio region in the western North Pacific supports high biological productivity and has been well monitored. We applied the NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) model to simulate the nutrients, phytoplankton, and zooplankton dynamics. For the critically important determination of parameter values we used the automatic calibration software PEST (model-independent Parameter ESTimation), previously used with NEMURO, but in a system without ontogenetic vertical migration of the large zooplankton functional group. Five identical twin experiments demonstrated that PEST could recover the known model parameter values when vertical migration was included, and that over-fitting can occur as a result of slight differences in the values of the state variables. PEST recovered known parameter values when using monthly snapshots of aggregated state variables, but estimated a different set of parameters with monthly averaged values. Disaggregating the variables provided to PEST into functional groups did not solve the over-fitting problem, and including vertical migration seemed to amplify the problem. When we used the climatological field data, simulated values with PEST-estimated parameters were closer to these field data than with the previously determined ad hoc set of parameter values. When these same PEST and ad hoc sets of parameter values were substituted into 3-D-NEMURO (without vertical migration), the PEST-estimated parameter values generated spatial maps that were similar to the satellite data for the Kuroshio Extension during January and March and for the subarctic ocean from May to November.

S9-7651

North Pacific database of pelagic and bottom trawl surveys from Russian EEZ applicable to Ecosystem Based ManagementVladimir V. Kulik and Igor V. Volvenko

Laboratory of Applied Biocenology, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: vladicon82@gmail.com

The review covered published estimates of abundance of about 1037 species and higher taxons of fish, squids, jellyfish and other large zooplankton species. Published results of fishery-independent pelagic trawl surveys carried out by specialists from TINRO-Center 1977-2010 were averaged by 4 to 11 year periods and biostatistical regions or one degree trapeziums. The level of abstraction used for publication is not suitable for precise validating, or for initial conditions of mathematical dynamic ecosystem models. The database compiled at the Laboratory of Applied Biocenology of TINRO-Center, which is not directly accessible by the public, includes verified data collected from 62926 stations for the same period of time during pelagic and bottom trawl surveys. Our current work adds data sets about zooplankton abundance estimates and stomach contents of animals obtained from the same expeditions. The problem of connecting discrete biological data with continuous fields of environmental parameters at different spatial and temporal scales is discussed. More robust ecosystem models adapted for Ecosystem Based Management (EBM) are needed to fill the big gap between remote sensing data and information products for commercial fisheries management interests. Because of this gap our fishery managers are forced to estimate the amounts of allowable catches primarily by using single-species cohort models without environmental parameters. We outline our reliable biological spatiotemporal sets which can be used for EBM model development and validation.

S9-7681

Phytoplankton and nutrient dynamics in the western Seto Inland Sea, Japan based on observation and a modified NEMURO modelNaoki Yoshie¹, Xinyu Guo¹, Naoki Fujii² and Tomohiro Komorita³

¹ Center for Marine Environmental Studies, Ehime University, 2-5 Bunkyo-Cho, Matsuyama, 790-8577, Japan
E-mail: yoshie.naoki.mm@ehime-u.ac.jp

² Institute of Lowland and Marine research, Saga University, 1 Honjyo-Cho, Saga, 840-8502, Japan

³ Faculty of Environmental and Symbiotic Sciences, Prefectural University of Kumamoto, 3-1-100 Tsukide, Kumamoto, 862-8502, Japan

We studied the ecosystem and nutrient dynamics in the Seto Inland Sea using both field observations and numerical modeling. We investigated spatiotemporal variations in the group composition of phytoplankton and nutrient concentrations in the Iyo-Nada, Hoyo strait and Bungo Channel (parts of the Seto Inland Sea) with monthly field observations in 2009. From spring to early summer, nano- and pico-phytoplankton dominated in all three regions. From late summer to autumn, micro-phytoplankton (diatom) bloomed in the Iyo-Nada and Hoyo strait, while no pronounced bloom was observed in the Bungo Channel. This autumn diatom bloom was probably caused by nutrient supply associated with breakdown of the bottom cold water dome. For understanding the mechanisms of the nutrient cycle and plankton dynamics, we developed a plankton functional types model eNEMURO (4 Nutrient, 4 Phytoplankton, 4 Zooplankton, 3 Detritous), building on PICES' original lower-trophic-level marine ecosystem model, NEMURO. Model eNEMURO introduces the microbial food web, phosphorous cycles and dividing diatoms into two compartments according to temperature dependency. The nutrients and phytoplankton dynamics observed in both the Iyo-Nada and Bungo channel were successfully reproduced by eNEMURO.

S9-7684

Seasonal evolutions of atmospheric response to decadal SST anomalies in the North Pacific subarctic frontal zone: Observations and a coupled model simulation

Bunmei **Taguchi**¹, Hisashi Nakamura^{2,3}, Masami Nonaka³, Nobumasa Komori¹, Akira Kuwano-Yoshida¹, Koutarou Takaya³ and Atsushi Goto⁴

¹ Earth Simulator Center, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 3173-25 Showa-machi, Kanazawa-ku, Yokohama, Kanagawa, 236-0001, Japan. E-mail: bunmei@jamstec.go.jp

² Research Center for Advanced Science and Technology, University of Tokyo, Tokyo, 108-8477, Japan

³ Research Institute for Global Change, JAMSTEC, Yokohama, 236-0001, Japan

⁴ Office of International Affairs, Japan Meteorological Agency, Tokyo, 108-8477, Japan

It is a long-standing problem whether two-way interaction exists between the mid-latitude ocean and atmospheric circulations. Such two-way interaction can potentially provide additional multi-year predictability of the mid-latitude ocean-atmosphere system. Here we investigate impacts of pronounced decadal-scale variations in the North Pacific sea surface temperature (SST) that tend to be confined to the subarctic frontal zone (SAFZ) upon seasonally-varying atmospheric states, using 48-year observational data and a 120-year simulation with an ocean-atmosphere coupled general circulation model (CGCM). Both the observations and CGCM simulation provide a consistent picture between SST anomalies in SAFZ yielded by its decadal-scale meridional displacement and their association with atmospheric anomalies. Correlated with SST anomalies persistent in SAFZ from fall to winter, a coherent decadal-scale signal in the wintertime atmospheric circulation over the North Pacific starts emerging in November and develops into an equivalent barotropic anomaly pattern similar to the Pacific/North American (PNA) pattern. The PNA-like signal with the weakened (enhanced) surface Aleutian low correlated with positive (negative) SST anomalies in SAFZ becomes strongest and most robust in January, under the feedback forcing from synoptic-scale disturbances migrating along the Pacific storm-track that shifts northward (southward) in accord with the oceanic SAFZ. This PNA-like signal, however, breaks down in February. Despite its collapse in February, the PNA-like signal recurs in next January. This sub-seasonal evolution of the signal suggests that the PNA-like anomaly pattern may develop as a response to the persistent SST anomalies that are maintained mainly through ocean dynamics.

S9-7753

Simulation of the tide and tidal current in the Qinzhou Bay

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

Key Laboratory of Marine Science and Numerical Modeling, the First Institute of Oceanography, State Oceanic Administration, 6 Xianxialing Rd., Hi-tech Industry Park, Qingdao, 266061, PR China. E-mail: xiacs@fio.org.cn

Qinzhou Bay is located off the coast of Guangxi Zhuang Autonomous Region, China. It includes the Maowei Bay and the outer Bay. The bottom of the Maowei Bay is mainly mud. The local government plans to dredge the mud and increase the water depth by 2 meters. Princeton Ocean Model (POM) is used to study the tide and tidal current in the Qinzhou Bay and to evaluate the impact of the project on the tidal volume of Maowei Bay and Qinzhou Bay. The model simulated tide and tidal current agree well with presently available observations. The model result indicates that the mud-dredging project may increase the tidal volume of the Maowei Bay by 18.1%.

BIO Paper Session

Co-Convenors: *Michael J. Dagg (U.S.A.) and Atsushi Tsuda (Japan)*

This session invites oral and poster presentations on all aspects of biological oceanography in the North Pacific and its marginal seas that are not covered in Topic Sessions sponsored by the Biological Oceanography Committee (BIO).

Day 1, Thursday, October 20 (14:00-17:50)

- 14:00 *Introduction by Convenor*
- 14:05 **Xiuning Du and William T. Peterson**
Seasonal cycle of phytoplankton community composition in the coastal upwelling system off central Oregon in 2009 (BIO-P-7647)
- 14:25 **Elena A. Shtraikhert, Sergey P. Zakharkov, Tatyana N. Gordeychuk and Julianna V. Shambarova**
About the mechanism of the winter-spring phytoplankton bloom in Peter the Great Bay (Sea of Japan) (BIO-P-7699)
- 14:45 **Tatyana Belonenko and Alexey Koldunov**
Non-stationary cycles of primary productivity in the Northeastern Atlantic (BIO-P-7708)
- 15:05 **Jingfeng Fan, Lili Li, Jiangyu Li, Hao Guo and Xinzhen Lin**
Diversity and structure of bacterial communities in Fildes Peninsula, King George Island (BIO-P-7763)
- 15:25 *Coffee/Tea Break*
- 15:50 **Kyung-Il Chang and Heemang Park**
Time-series measurements of biogeochemical and physical parameters in the southwestern East/Japan Sea during the spring transition in 2010 (BIO-P-7787)
- 16:10 **Sang-Rae Lee, Jee Eun Lee, Jung Hyun Oak, Jin Ae Lee and Ik Kyo Chung**
Metagenomic analysis reveals cryptic plankton biodiversity in the Nakdong River Estuary in Korea (BIO-P-7794)
- 16:30 **Sayaka Matsumura, Hiroya Sugisaki, Hiroaki Saito, Yuji Okazaki and Tomohiko Kikuchi**
Vertical distribution of euphausiids in the Oyashio to Oyashio-Kuroshio Transition Region of the western North Pacific (BIO-P-7821)
- 16:50 **Rui Saito, Atsushi Yamaguchi, Ichiro Imai, Atsushi Tsuda and Ichiro Yasuda**
Spatial and temporal changes in the zooplankton community around the Aleutian Islands during the summer of 2009 (BIO-P-7574)
- 17:10 **Kohei Matsuno, Atsushi Yamaguchi and Ichiro Imai**
Body chemical contents and gut pigments of copepods in the western Arctic Ocean during summers of 2008 and 2010 (BIO-P-7575)
- 17:30 **Marina Yurieva, Artyom Lazhentcev, Aleksey Pavlovsky and Konstantin Gorbatenko**
The biochemical composition and energy content of zooplankton of the Okhotsk Sea (BIO-P-7723)
- 17:50 Session ends

Day 2, Friday, October 21 (9:00-12:30)

- 9:00 **Introduction by Convenor**
- 9:05 **Natalia T. Dolganova**
Euphausiids from Far-Eastern Russian waters: Composition, distribution, and seasonal dynamics (BIO-P-7610)
- 9:25 **Se-Jong Ju, Jinho Chae, Dongju Lee, Ah-Ra Ko, Hyungbeen Lee and Donhyug Kang**
Importance of the bottom cold-water mass as an over-summering refuge for *Euphausia pacifica* in the Yellow Sea (BIO-P-7704)
- 9:45 **Atsushi Yamaguchi, Jumpei Fukuda, Kohei Matsuno and Ichiro Imai**
Inter-annual and latitudinal changes in zooplankton abundance, biomass and size composition along the 180° transect in the North Pacific during summers: Analyses with an Optical Plankton Counter (BIO-P-7570)
- 10:05 **Akira Okuno, Tatsuro Watanabe, Naoto Honda and Katsumi Takayama**
Forecast of the giant jellyfish *Nemopilema nomurai* appearance in the Japan Sea (BIO-P-7683)
- 10:25 **Coffee/Tea Break**
- 10:50 **Changhoon Han and Wonduk Yoon**
Distribution and density of *Aurelia aurita* polyps on Saemangeum dike, Korea (BIO-P-7687)
- 11:10 **Elena A. Shtraikhert, Sergey P. Zakharkov, Tatyana N. Gordeychuk and Julianna V. Shambarova**
Influence of environment factors on phytoplankton blooms in Peter the Great Bay (Sea of Japan) in winter-spring (BIO-P-7700)
- 11:30 **Harold P. Batchelder, Jennifer Fisher and Alexander Kurapov**
Potential larval connectivity among nearshore marine reserves in Oregon: The importance of temperature dependent pelagic durations and vertical distribution (BIO-P-7749)
- 11:50 **Vjacheslav S. Labay**
Elements of seasonal dynamics of the macrobenthos on a shelf of northeast Sakhalin (Sea of Okhotsk) (BIO-P-7564)
- 12:10 **Anastasia S. Dolganova and R.G. Bezrukov**
Composition and distribution of macrobenthos in some coastal-estuary systems in Ussury Bay (Japan/East Sea) (BIO-P-7720)
- 12:30 Session ends

BIO Paper Session Posters

- BIO-P-7602 **Kyoungsoon Shin, Minchul Jang, Pungguk Jang and Woojin Lee, Bonggil Hyun and Seungho Baek**
Annual change in the mesozooplankton community of the western channel of the Korea Strait from 2006 to 2010
- BIO-P-7618 **Yongjiu Xu and Joji Ishizaka**
Abundance of giant jellyfish (*Nemopilema nomurai*) and spring sea surface temperature variability in the northern East China and Yellow Seas
- BIO-P-7624 **Tatyana Belan, Boris Borisoy, Ludmila Belan, Alexander Moshchenko and Tatyana Konovalova**
Long-term dynamics of some plankton and benthic characteristics at the Piltun-Astokhskoye field (NE Sakhalin Island Shelf)
- BIO-P-7630 **Alexander V. Zavolokin**
Jellyfish blooms in the Far Eastern Seas of Russia: Significance for ecosystems and social-economic consequences
- BIO-P-7712 **Kristin Cieciel, Jim Murphy, Lisa Eisner and Bruce Wing**
A comparison of trawl caught jellyfish in the eastern Bering Sea
- BIO-P-7715 **Jung-Hoon Kang, MinHo Seo, OhYoun Kwon and Woong-seo Kim**
Vertical distribution of the copepod *Calanus sinicus* before and after formation of Yellow Sea Bottom Cold Water (YSBCW) in the Yellow Sea
- BIO-P-7717 **Seungmok Roh, Joongki Choi and Youngju Lee**
Distribution and community structure of phytoplankton in the offshore waters around Korean Peninsula during autumn season
- BIO-P-7724 **Victor Nadtochy and Marina Yurieva**
Ecological characteristic of sublittoral bivalve communities of the Bering and Okhotsk Seas
- BIO-P-7793 **Sungeun Ju, Jiho Seo and Joongki Choi**
The distribution of Kuroshio indicator zooplankton around the IEODO Ocean Research Station in the East China Sea
- BIO-P-7799 **Yuji Okazaki and Kazuaki Tadokoro**
Biomass estimates of *Euphausia pacifica* using MOHT in the Oyashio region
- BIO-P-7806 **OhYoun Kwon, Woong-seo Kim, Jung-Hoon Kang, Kyunwoo Lee and Jin Hwan Lee**
Temporal and spatial variation of size-fractionated phytoplankton communities in the Yellow Sea, Korea
- BIO-P-7812 **Kaoru Aoki, Takuya Sirokiya, Kazuya Takeda Satoshi Yamada, Masaya Toyokawa and Tomohiko Kikuchi**
Spatiotemporal distribution and biomass of two abundant jellyfish in Ise and Mikawa Bay, Japan
- BIO-P-7824 **Seokgwan Choi, Kyumjoon Park, Hyunwoo Kim, Youngran Lee, Jieun Park, Daeyeon Moon and Yongroek An**
Finless porpoise, *Neophocaena phocaenoides*, Distribution in the South Sea of Korea
- BIO-P-7838 **Elena Dulepova and Natalya Kuznetsova**
Zooplankton production in the western zone of the Subarctic front in winter-spring 2011

Day 1, BIO-Paper Session Oral Presentations

October 20, 14:05 (BIO-P-7647)

Seasonal cycle of phytoplankton community composition in the coastal upwelling system off central Oregon in 2009

Xiuning **Du**^{1,3} and William T. Peterson²

¹ College of Environmental science and Engineering, Ocean University of China, Qingdao, Shangdong, 266100, PR China
E-mail: xiuningdu@gmail.com

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

³ Cooperative Institute for Marine Resource Studies, Hatfield Marine Science Center, Newport, OR, 97365, USA

This study discussed seasonality of phytoplankton biomass and species composition at a mid-shelf location on the Newport Hydrographic line (NH) off the central Oregon. The dataset including phytoplankton, hydrographic variables and nutrients were collected from the time-series of cruises at biweekly interval on NH line in 2009. Here we present our findings at the year round scale. We defined four ocean stages based on up/downwelling status and sea surface temperature: down+cold, up+cold, up+warm and down+warm. Based on phytoplankton species composition dataset, four clusters were identified: cold winter cluster, strong upwelling cold cluster, late upwelling season cluster and warm winter cluster. High phytoplankton production appeared from up+cold to down+warm ocean stages with up+warm as a transition between them. Diatoms showed a succession of dominant species but with a stable background of the species composition during the upwelling season; dinoflagellates likely formed mono-specific bloom, such as the autumn bloom caused by *Akashiwo sanguinea* which was the first large event of this species off the central Oregon coast. The significant environmental factors influencing phytoplankton community patterns were temperature, salinity and ammonium. Phytoplankton carbon biomass and chlorophyll *a* concentration as the proxies of the algal communities were not significantly related to any of the concerned environmental factors. However, the species community changes represented by x-axis scores based on non-metric multi-dimensional scaling (NMDS) analysis were correlated with bottom temperature (B_T), salinity (B_S) and sea surface salinity (SSS) though the relationships were weak.

October 20, 14:25 (BIO-P-7699)

About the mechanism of the winter-spring phytoplankton bloom in Peter the Great Bay (Sea of Japan)

Elena A. **Shtraikhert**, Sergey P. Zakharkov, Tatyana N. Gordeychuk and Julianna V. Shambarova

V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: straj@poi.dvo.ru

Mechanisms affecting the winter-spring phytoplankton bloom in Peter the Great Bay (PGB) in 2000-2007 are studied in this work. These mechanisms help to understand the reasons for variability in bloom initiation. We have considered the chlorophyll *a* concentration (Cchl-*a*) distributions from the SeaWiFS scanner for January - May, 2000-2007 utilizing to 8-day composite data. We distinguished 2 basic zones of phytoplankton bloom: 1) coastal (not shallow water) and 2) the zone of the Primorye Current. In zone 1, the Cchl-*a* maximum was observed in February - March, and in zone 2 - in April-May. Sea Surface Temperature (SST) from the MODIS-Aqua (2003-2007) and MODIS-Terra (2000-2002) spectroradiometers, and wind speed from the QuikSCAT satellite at the Cchl-*a* maximum in zone 1 were about (-1)-1°C and 6-8 m/s and in zone 2 - 2-6°C and 3-6 m/s. Photosynthetically Available Radiation (FAR) in zone 1 was 15-40 Einsteins/m²×day, and in a zone 2 - 25-50 Einsteins/m²×day. The goal of this work is to identify the mechanisms leading to phytoplankton blooms in these zones. A series of 8-day composite estimates on Cchl-*a*, FAR from SeaWiFS, SST from MODIS-Aqua and MODIS-Terra (obtained from <http://oceancolor.gsfc.nasa.gov> and processed by SeaDAS software), the sea-surface wind speed from QuikSCAT and the quantity of atmospheric precipitation from the TRMM satellite (obtained from <http://www.qscat.com> and <http://disc.sci.gsfc.nasa.gov> as 1-day data and composed to 8-day estimates) for January-May were compared for this goal. These estimates were preliminarily normalized by us to 1. Profiles of the water temperature and salinity, which were obtained during cruises of R/V "Lugovoye" (March 3-12, 2000) and "Akademik Lavrentiev" (February 26-March 9, 2003), were also used. Data for construction of these profiles were taken from the electronic archive of POI FEB RAS cruise observations. Investigations showed that the bloom begins at establishment of water

stratification due to the decrease of wind mixing and, for zone 1- the desalination of the superficial water layer, for zone 2 - the seasonal water warming. It is noted that the desalination of the superficial layer also influences the phytoplankton bloom in zone 2. Difference in timing of the appearance of the Cchl-*a* maximum in zones 1 and 2 is determined by the different salinity gradients between the surface and underlying layers. Variability in these mechanisms leads to variability of the Cchl-*a* maximum in PGB.

October 20, 14:45 (BIO-P-7708)

Non-stationary cycles of primary productivity in the Northeastern Atlantic

Tatyana **Belonenko**¹ and Alexey Koldunov²

Department of Oceanology, Faculty of Geography and Geoecology, Saint Petersburg State University, 33/35 10th Line, Saint Petersburg, 199178, Russia. E-mail: btvlisab@yandex.ru

Cycles of satellite-derived primary productivity (PP) in tropical, subtropical and temperate zones of the northeastern Atlantic (20-50° N and 5-40° W) are studied using wavelet analysis. Our results suggest that during the period of observations (2003-2007) the region was dominated by four periodicities: 0.5-year, 1-year, 2-year, and 4-year cycles. The 1-year cycle is a fundamental PP variability over the region. The 0.5-year PP cycle predominantly occurs in subtropics is characterized by a short spring bloom and an episodic autumn bloom. The 2- and 4-year cycles reflect variations in overall yearly productivity and are pronounced mostly in subtropics and mid-latitudes. Methodology of the wavelet analysis permits to discern significant interannual amplitude variation of the cycles. The spatial-temporal amplitude variations seem to be dependent on the strength of autumn-winter mixing, as well the rate of upper-ocean stratification recovery during the late winter and spring. Interannual variation of the PP was found to be dominated by interannual variability of the wind mixing strength in winter, as compared to that of the sea-surface vertical and horizontal buoyancy fluxes, forming a link between temporal variation of the PP and the North Atlantic Oscillation Index. In the northern part of the region, a downward increase of the horizontal buoyancy transport by the North Atlantic Current is considerably reducing the stability of the upper ocean, and enhances the 4-year PP cycle. The annual cycle is the dominant variability. Its intensity is governed by vertical mixing during the preceding winter. The semi-annual cycle reflects specificity of the spring and autumn blooms and is governed by the strength of wind mixing during the current and preceding months. The 2- and 4-year cycles are pronounced mostly in subtropics and southern mid-latitudes. The former is apparently generated and maintained by the physical and biological forcing, while the later may be associated with mixing strength in the late autumn-winter, as well with horizontal buoyancy advection by sea currents.

October 20, 15:05 (BIO-P-7763)

Diversity and structure of bacterial communities in Fildes Peninsula, King George Island

Jingfeng **Fan**, Lili Li, Jiangyu Li, Hao Guo and Xinzhen Lin

Department of Marine Environmental Ecology, National Marine Environmental Monitoring Center, SOA, 42 Linghe St., Shahekou District, Dalian, Liaoning, 116023, PR China. E-mail: jffan@nmemc.gov.cn

There is little information on the bacterial diversity of the Fildes Peninsula, King George Island. Bacterial diversity and community composition were analyzed using cultivation-dependent and -independent methods from 13 locations in the Fildes Peninsula, Antarctica. Using the culturable approach, bacterial 16S rRNA gene sequence analysis indicated that all isolates were >95% identical to their respective matches in the database. 57 strains were isolated and, isolates fell in five groups: *Actinobacteria*, *Bacteroidetes*, *Firmicutes*, *Gammaproteobacteria* and *Betaproteobacteria*. Major taxonomic groups of isolations represented by genera included *Pseudomonas*, *Acinetobacter*, *Bacillus*, *Sporosarcina*, *Psychrobacter*, *Shewanella*, *Polaromonas*, and *Arthrobacter*. Using DGGE, bacteria phyla were categorized into 8 groups: *Proteobacteria* (including the sub-phyla *Alpha*-, *Beta*-, *Gamma*-, and *Delta*-*proteobacteria*), *Bacteroidetes*, *Firmicutes*, *Chlorobi*, and *Deinococcus-Thermus*. Principal component analysis (PCA) and Cluster Analysis revealed the overall structure and composition of the bacteria of the soil and lacustrine sediment were significantly different from penguin ornithogenic sediments and marine sediments, but soil was similar to lacustrine sediment, and penguin ornithogenic sediment was similar to marine sediment. The *Gammaproteobacteria* was the dominant bacteria taxon identified by cultivation and DGGE.

October 20, 15:50 (BIO-P-7787)

Time-series measurements of biogeochemical and physical parameters in the southwestern East/Japan Sea during the spring transition in 2010

Kyung-Il **Chang** and Heemang Park

School of Earth and Environmental Sciences, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, 425-600, R Korea
E-mail: kichang@snu.ac.kr

Temporal variation of biogeochemical and physical properties of the upper layer in the southwestern East/Japan Sea is investigated using data from an ocean buoy station equipped with fluorometers, PAR sensors, temperature profilers, and current meters. The mooring was deployed in February and recovered at the end of May 2010, yielding a highly-resolved time series for the first time in the Ulleung Basin, which is characterized by the occurrence of spring and fall blooms, high primary production due to coastal upwelling and horizontal advection, redistribution of chlorophyll by mesoscale eddies, and the presence of a subsurface chlorophyll maximum layer. Chlorophyll measured at 30 m captured the spring bloom signal. Chlorophyll from a 25-hour moving average time series, remained below 1.5 mg/l from the deployment to April 7, and increased sharply up to 2.7 mg/l between April 7 and April 11. Afterwards, chlorophyll values showed low-frequency fluctuations ranging from 0.6 mg/l to 3.7 mg/l with periods of about 7-20 days until the end of the mooring deployment. The mixed layer depth (MLD) ranged from 20 m to 70 m, and temporal variation of the MLD corresponded to low-frequency fluctuations of chlorophyll. The data indicate the importance of offshore advection and the shoaling of MLD in causing temporal variation of chlorophyll concentration. Apart from those factors however, the mooring observations strongly suggest the importance of advection of the East Sea Intermediate Water in spring in triggering the spring bloom by uplifting subsurface isopycnals.

October 20, 16:10 (BIO-P-7794)

Metagenomic analysis reveals cryptic plankton biodiversity in the Nakdong River Estuary in Korea

Sang-Rae Lee¹, Jee Eun Lee², Jung Hyun Oak¹, Jin Ae Lee³ and Ik Kyo **Chung**²

¹ Marine Research Institute, Pusan National University, Busan, 609-735, R Korea

² Division of Earth Environmental System, Pusan National University, Busan, 609-735, R Korea. E-mail: ikchung@pusan.ac.kr

³ School of Environmental Science and Engineering, Inje University, Gimhae, 621-749, R Korea

The Nakdong River is the second largest river in Korea and the conservation and management of its estuarine ecosystem is important to keep this waterway in healthy condition. Biodiversity has been a critical measure for determining the status of water quality in the coastal ecosystem. In addition to traditional morphological studies using a microscope, molecular approaches have identified species diversity and unknown phylogenetic lineages. In this study, metagenomic analysis was adapted to monitor the biodiversity and community structure of eukaryotic plankton in the Nakdong River and its estuarine ecosystems. We developed an efficient method for isolating the eukaryotic plankton biodiversity from the environmental samples by constructing an 18S rDNA clone library. We also analyzed plankton biodiversity using microscopic observation. Total genomic DNAs were extracted directly from the freshwater and coastal seawater samples, and 18S rDNA clone libraries were constructed using environmental PCR, cloning and sequencing. Forty nine unique phylotypes were identified from a total of 170 randomly selected clones from the freshwater region and 25 phylotypes from 168 clones from the estuarine region. Results show the diverse species composition with unknown taxonomic lineages and cryptic species diversity. Moreover, we found distinct water-mass specific species diversity. Therefore, we would like to suggest that the metagenomic analysis is a novel, qualitative method to monitor plankton species diversity and community structure of eukaryotic plankton.

October 20, 16:30 (BIO-P-7821)

Vertical distribution of euphausiids in the Oyashio to Oyashio-Kuroshio Transition Region of the western North Pacific

Sayaka **Matsumura**¹, Hiroya Sugisaki², Hiroaki Saito³, Yuji Okazaki³ and Tomohiko Kikuchi¹

¹ Graduate School of Environmental Sciences, Yokohama National University, 79-1 Tokiwadai, Hodogaya-ku, Yokohama, 240-8501, Japan
E-mail: d10ta005@ynu.ac.jp

² National Research Institute of Fisheries Science, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, 236-8648, Japan

³ Tohoku National Fisheries Research Institute, Fisheries Research Agency, 3-27-5 Shinhama Town, Shiogama, 985-0001, Japan

The vertical distribution of euphausiids and the associated physical oceanographic structure were analyzed to clarify the euphausiid role in organic transport in the Oyashio to the Oyashio-Kuroshio Transition Region of the western North Pacific. A MOCNESS system with CTD sensors was used to collect krill specimens during eight cruises of the R/V Wakataka-Maru (Fisheries Research Agency of Japan) from May 2004 to March 2006. Day and night depth distribution of the adult euphausiids varied by species, season and hydrographic conditions. Most of the species tended to stay between 300 and 500 m during daytime. On the other hand, cold-water species, *i.e.* *Thysanoessa inspinata*, *T. longipes*, *Euphausia pacifica* and *Tessarabrachion oculatum*, mainly appeared in the shallower layers between the surface and 500m in daytime. Analysis of hydrographic data showed the day and night vertical distribution pattern of several abundant species became deeper from the Oyashio region towards the Kuroshio region. Seasonal variation of daytime distribution depth was observed in two abundant species, *E. pacifica* and *T. longipes*. The vertical migration range of euphausiids was shallower than that of other micronektonic vertical migrants, such as shrimps and myctophids. These results suggest that diel vertical migration of euphausiids was effectively controlled by spatio-temporal changes of hydrographic conditions in the region, and that euphausiids play a more important role in the biological pump between the surface and the upper mesopelagic zone than other active migrants.

October 20, 16:50 (BIO-P-7574)

Spatial and temporal changes in the zooplankton community around the Aleutian Islands during the summer of 2009

Rui **Saito**¹, Atsushi Yamaguchi¹, Ichiro Imai¹, Atsushi Tsuda² and Ichiro Yasuda²

¹ Plankton Laboratory, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido, 041-8611, Japan. Email: ruis@fish.hokudai.ac.jp

² Atmosphere and Ocean Research Institute, University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8564, Japan

The water around the Aleutian Islands, located between the Bering Sea and the North Pacific, is known to be highly productive and important for climate change, influencing the entire subarctic Pacific. Recent studies in physical oceanography in this region revealed unique oceanographic conditions (*e.g.*, inter-annual changes in the Alaskan Stream, mesoscale anticyclonic eddies and turbulent flows across the straits). These oceanographic conditions are expected to have an impact on zooplankton abundance and distribution. The objective of this study is to clarify the spatial and temporal changes in the zooplankton community around the Aleutian Islands during the summer of 2009. Zooplankton was sampled by vertical hauls of a 100 mm mesh-sized NORPAC net from the bottom or 150 m to the surface at 27-29 stations during June and August-September 2009. In a laboratory, zooplankton was counted by taxonomic group, and calanoid copepods were identified to copepodid stages. Based on the abundance data, cluster analysis was done to group the sampling stations. While zooplankton abundance was greater in June, the species diversity index was higher during August-September. As a result of cluster analysis, the sampling stations were divided into three to four groups. These groups were distributed in the eastern, central and western Aleutian Islands water throughout the study period. The mean copepodid stage of the large copepods *Eucalanus bungii*, *Metridia pacifica* and *Necalanus plumchrus* was higher during August-September. Overall, the zooplankton community around the Aleutian Islands during the summer of 2009 showed an east-west difference, and large copepods were further developed in August-September than in June.

October 20, 17:10 (BIO-P-7575)

Body chemical contents and gut pigments of copepods in the western Arctic Ocean during summers of 2008 and 2010

Kohei **Matsuno**, Atsushi Yamaguchi and Ichiro Imai

Laboratory of Marine Biology, Graduate School of Fisheries Science, Hokkaido University, 3-1-1 Minatomachi, Hakodate, Hokkaido, 041-8611, Japan. E-mail: k.matsuno@fish.hokudai.ac.jp

To evaluate the effect of drastic sea-ice reduction on copepods, we studied body chemical contents (water and ash-free dry mass content) and gut pigments of large copepods in the western Arctic Ocean during September to October, 2008 and 2010. Inter-species comparisons showed that *Calanus glacialis* had the highest ash-free dry mass, *Calanus hyperboreus* the highest water content, and *Metridia longa* the highest gut pigment. These species-specific differences in gut pigments may be related to copepod life cycle patterns. Regional comparisons showed that the ash-free dry masses of copepods in the western area were higher than in the other areas. In terms of inter-annual change, ash-free dry masses of copepods in 2008 were higher than those in 2010. Since lipid-rich copepods are known to have high ash-free dry mass, lipid accumulation may be high in the western area and in 2008. Hydrography in the western area in 2008 was characterized by high salinity, and nutrients may be high because of less ice-melt water. Increase of ice melt water (which contains low nutrient concentrations) in the surface layer may depress the nutrients and decrease primary production. In the middle and eastern areas during 2010, increased sea-ice reduction may have caused an increase of ice-melt water, decreased nutrients and primary production, and resulted in decreased lipid accumulation by the copepods. Therefore, drastic sea-ice reduction in the Arctic Ocean may have a negative effect (decrease in nutrients, primary production and lipid accumulation by copepods) in the marine ecosystem.

October 20, 17:30 (BIO-P-7723)

The biochemical composition and energy content of zooplankton of the Okhotsk Sea

Marina **Yurieva**, Artyom Lazhentcev, Aleksey Pavlovsky and Konstantin Gorbatenko

Laboratory of Biochemistry of Water Organisms, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky kray, 690091, Russia. E-mail: yureva@tinro.ru

Information on the organic composition and energy content of various marine organisms is an important element in understanding the distribution, seasonal variations and complex interchange in matter and energy within ecological communities. The biochemical composition of 23 zooplankton species, representing six taxonomic groups, was studied. They were collected in the Okhotsk Sea from 2003 to 2010 years. Proteins, lipids, carbohydrates, water and ash content were determined, and caloric content was calculated. It was revealed that macrozooplankton species collected in the same season but different years had similar values of these organic constituents and similar energy content. Changes of macrozooplankton biochemical composition by season, and specific patterns in some species, were observed. Proteins appeared to be the major organic constituents in zooplankton. Euphausiids contain the largest amount of protein and the highest energy content compared with other zooplankton irrespective of season and habitat area. Lipids are highly variable zooplankton compounds that are bound up with life history and seasonal changes. The euphausiid *Thysanoessa longipes* had the most variable lipid values. High lipid content occurred in the copepods *Neocalanus plumchrus* and *Neocalanus cristatus*, but it changed insignificantly by season. Chaetognaths are characterized by low protein and lipid content and the lowest energy value in comparison with other macrozooplankton. Caloric content of macrozooplankton increases from spring to fall. In coelenterates carbohydrates, along with proteins, form the main parts of the organic matter, and their caloric content shows a wide range of values. This information is summarized in view of its utility in trophodynamic studies.

Day 2, BIO-Paper Session Oral Presentations

October 21, 9:05 (BIO-P-7610)

Euphausiids from Far-Eastern Russian waters: Composition, distribution, and seasonal dynamics

Natalia T. **Dolganova**

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia
E-mail: dolganova@tinro.ru

Based on long-term (1985-2010) plankton survey data from the TINRO-Center complex expeditions (over 30,000 samples), we present the species composition and quantitative distribution of euphausiids in the Far-Eastern Seas and the Pacific. We investigated seasonal dynamics of abundance in the coastal, shelf and deepwater areas, variability of quantitative characteristics, size-age structure of dominant species and vertical migration. The role of euphausiids in the diet of the dominant species of nekton, including Pacific salmon was also examined. The Sea of Okhotsk had the highest biomass of euphausiids in all seasons—three times higher than in the Bering Sea, and 5-7 times higher than in the Sea of Japan and the Pacific.

October 21, 9:25 (BIO-P-7704)

Importance of the bottom cold-water mass as an over-summering refuge for *Euphausia pacifica* in the Yellow Sea

Se-Jong **Ju**¹, Jinho Chae², Dongju Lee², Ah-Ra Ko¹, Hyungbeen Lee¹ and Donhyug Kang¹

¹ Deep-Sea and Marine Georesources Research, Korea Ocean Research and Development Institute (KORDI), 787 Haean-ro, Sangrok-gu, Ansan, 425-600, R Korea. E-mail: sjju@kordi.re.kr

² Korea environmental Research Center for Hydrosphere, 634-1 Yi-dong, Sangnok-gu, Ansan, 426-862, R Korea

Euphausia pacifica, known as a key species in the Yellow Sea, should utilize the bottom cold water mass (YSBCM: $\leq 10^{\circ}\text{C}$) as a refuge to survive through the hot summer (subsurface water temperature: $> 25^{\circ}\text{C}$) because their upper tolerance level for water temperature is 15°C . However, no solid evidence has been reported yet to confirm this distribution. Therefore, we investigated their horizontal and vertical distribution using net and acoustic surveys during spring (YSBCM not formed) versus summer (YSBCM well developed) in 2010 and 2011. Even though the spatial distribution of *E. pacifica* showed interannual variation, eggs and gravid females generally predominated in spring with an active diel vertical migration over the whole water column. In summer, juveniles and adults were concentrated in the YSBCM of the central region with a limited diel vertical migration (below the thermocline). Furthermore, detailed profiles of the dietary lipid biomarkers and gut contents suggest that *E. pacifica* diet shifted from diatoms/dinoflagellates in the spring to microzooplankton such as protozoa in summer. These results suggest that *E. pacifica* may not only utilize the YSBCM as an over-summering site but also switch their diets to survive through the hot summer.

October 21, 9:45 (BIO-P-7570)

Inter-annual and latitudinal changes in zooplankton abundance, biomass and size composition along the 180° transect in the North Pacific during summers: Analyses with an Optical Plankton Counter

Atsushi Yamaguchi, Jumpei Fukuda, Kohei Matsuno and Ichiro Imai

Laboratory of Marine Biology, Graduate School of Fisheries Sciences, Hokkaido University, 3-1-1 Minato, Hakodate, Hokkaido, 041-8611, Japan. E-mail: a-yama@fish.hokudai.ac.jp

To evaluate zooplankton inter-annual and latitudinal changes, Optical Plankton Counter analyses were made on preserved net zooplankton samples collected from 35°N-51°N along 180° in the central North Pacific during early-mid June 1981-2000. Mean zooplankton abundance at each station ranged between 19,200 and 84,300 inds. m⁻² and showed no latitudinal changes. However, highly significant latitudinal changes were observed in mean zooplankton biomass, which ranged from 1.44 to 13.2 mg DM m⁻², with higher values in the transitional region (TR). The high biomass in the TR was caused by the dominance of large-sized zooplankton with ESD of 2-4 mm, which corresponds to late copepodid stages of *Neocalanus* spp. The dominance of late copepodid stages of *Neocalanus* spp. in the TR is considered to be caused by their faster development, which is accelerated by higher temperature. Both the slope and intercept of Normalized Biomass Size Spectrum (NBSS) also showed significant latitudinal changes: with a moderate slope and low intercept in the TR caused by the dominance of *Neocalanus* spp. On the other hand, little or no inter-annual change was observed in hydrography, zooplankton abundance, or biomass. These results suggest that the variability in zooplankton community in the central North Pacific is mainly governed by latitudinal changes rather than the inter-annual changes.

October 21, 10:05 (BIO-P-7683)

Forecast of the giant jellyfish *Nemopilema nomurai* appearance in the Japan Sea

Akira Okuno, Tatsuro Watanabe, Naoto Honda and Katsumi Takayama

Fisheries Oceanography Division, Japan Sea National Fisheries Research Institute, Fisheries Research Agency, 1-5939-22 Suido-cho, Niigata, 951-8121, Japan. E-mail: okuaki@affrc.go.jp

Recently, massive blooms of the giant jellyfish, *Nemopilema nomurai*, have frequently occurred, and fisheries in the Japan Sea have suffered severe damages from every bloom. Hence, we developed a numerical forecasting system that predicts the appearance of the jellyfish in the Japan Sea, in order to warn fishers of the jellyfish appearance. The numerical system consists of a hydrographic model and a particle tracking simulator. The hydrographic model is JADE (Japan sea Data assimilation Experiment), an ocean prediction system now operated weekly at our institute. The particle tracking simulator uses the forecast of the oceanic velocity computed by JADE to predict transport of the jellyfish due to oceanic currents. In the particle tracking simulation, virtual particles which mimic the jellyfish are released in the Tsushima Strait, the upstream-most region of the currents in the Japan Sea, then tracked to forecast the jellyfish appearance in the downstream region. The release time is configured by sighting surveys of the jellyfish in the Tsushima Strait, and by reports of the jellyfish appearance from fishers. Horizontal movement of particles is totally passive to the oceanic currents but vertical movement of particles is modeled by the diel migration of the jellyfish so that influence of vertical shear in the oceanic velocity is taken into account. In 2009, a massive bloom of *N. nomurai* occurred and the forecasting model was run. The system showed notable skill in prediction, and successfully made forecasts of jellyfish appearance with quite small errors.

October 21, 10:50 (BIO-P-7687)

Distribution and density of *Aurelia aurita* polyps on Saemangeum dike, Korea

Changhoon **Han** and Wonduk Yoon

National Fisheries Research and Development Institute (NFRDI), MIFAFF, 152-1 Haean-ro, Gijang-eup, Gijang-gun, Busan, 619-705, R Korea
E-mail: chhan@nfrdi.go.kr

Increase of polyp attachment-sites by marine construction has been considered a possible cause of jellyfish outbreaks, since it provides opportunity for jellyfish polyps to increase medusae abundance via asexual reproduction (*i.e.* budding, podocyst formation and strobilation). Saemangeum is the largest artificial dike in the world (length of dike: *ca.* 34 km). Frequent mass occurrence of *Aurelia aurita* medusae has been reported by local fishermen after embankment construction in 2004. Thus, we investigated the distribution and density of *A. aurita* polyps in the Saemangeum dike to evaluate its contribution to *A. aurita* blooms. Research was conducted by scuba diving in November 2009. The distribution and density of polyps was estimated by analysis of underwater photographs. Polyps were distributed throughout the dike, except for southern part. Most polyps were attached on the underside of ripraps and basal rocks. The average density of polyps was 2.7 ± 0.2 polyps cm^{-2} in 2009. Vertically, densities of polyp colonies in the shallow water layer (from 6.1 ± 0.9 to 1.8 ± 0.1 polyps cm^{-2} in 1-3 m) were higher than those of the deep layer (from 1.8 ± 0.5 to 1.0 ± 0.1 polyps cm^{-2} in 4-7 m), probably due to a sediment effect. The estimated gross number of polyps on the dike arithmetically calculated from the densities of polyps and their horizontal and vertical distribution is about 1.5 billion. Therefore, Saemangeum dike is an enormous source of *A. aurita* medusae and our study is direct evidence that the increase of artificial substrate is the cause of medusae blooms.

October 21, 11:10 (BIO-P-7700)

Influence of environment factors on phytoplankton blooms in Peter the Great Bay (Sea of Japan) in winter-spring

Elena A. **Shtraikhert**, Sergey P. Zakharkov, Tatyana N. Gordeychuk and Julianna V. Shambarova

VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: straj@poi.dvo.ru

Both natural environmental processes and anthropogenic processes can influence phytoplankton growth. A series of 8-day composite estimates of chlorophyll *a* concentration (Cchl-*a*) from the SeaWiFS scanner in three areas of Peter the Great Bay (PGB) – Amur Bay, Ussuri Bay, and the zone of the Primorye Current – for January to May, 2000-2007 are considered in this work. The influence of natural processes such as seasonal warming, wind mixing, desalination of the superficial layer, and variability of Photosynthetically Available Radiation (FAR) at the sea surface are analyzed. The time course of Fluorescence Line Height and Chromophoric Dissolved Organic Matter index from the MODIS-Aqua spectroradiometer in the study areas was used to estimate anthropogenic influence and the Cchl-*a* errors. A series of 8-day composite estimates of Cchl-*a*, FAR from SeaWiFS, Fluorescence Line Height, Chromophoric Dissolved Organic Matter index, Sea Surface Temperature (SST) from MODIS-Aqua (2003-2007) and MODIS-Terra (2000-2002) (obtained from <http://oceancolor.gsfc.nasa.gov> and processed by SeaDAS software), the sea-surface wind speed from the QuikSCAT satellite and the quantity of atmospheric precipitation from the TRMM satellite (obtained from <http://www.qscat.com> and <http://disc.sci.gsfc.nasa.gov> as 1-day data and composed to 8-day estimates) were used in this work. Profiles of the water temperature and salinity, which were obtained at the cruises of R/V “*Lugovoye*” (March 3-12, 2000) and “*Akademik Lavrentiev*” (February 26-March 9, 2003), were also used. Data for construction of these profiles were taken from electronic archive of POI FEB RAS cruises observations.

October 21, 11:30 (BIO-P-7749)

Potential larval connectivity among nearshore marine reserves in Oregon: The importance of temperature dependent pelagic durations and vertical distribution

Harold P. **Batchelder**¹, Jennifer Fisher² and Alexander Kurapov¹

¹ College of Oceanic and Atmospheric Sciences, 104 COAS Administration Bldg., Oregon State University, Corvallis, OR, 97331-5503, USA
E-mail: hbatchelder@coas.oregonstate.edu

² Cooperative Institute for Marine Resource Studies, Hatfield Marine Science Center, Newport, OR, 97365, USA

Most benthic and demersal marine species have tiny pelagic larvae that develop pelagically for weeks to months. Distant populations of relatively sessile species (crabs, barnacles, rockfish) are connected to each other only through dispersal during this phase. Connectivity of populations has important consequences for the management of commercial species, the extinction probability of local populations, and the design of marine reserve networks. A network of marine reserves (MR) has been established recently in Oregon's territorial seas. Using ocean velocities and temperatures from a 3 km ROMS model and a particle tracking model we compare the connectivity among reserves in the Oregon network between simulations with temperature-independent larval durations and passive transport and simulations having temperature-dependent pelagic larval durations, depth preferences, or vertical distribution behaviors (sometimes varying ontogenetically), or all of these simultaneously. Simulations are initialized throughout the February-August period when many nearshore invertebrates off Oregon spawn. The results of these simulations provide insights on the sensitivity of potential connectivity to intraseasonal variation in temperature and circulation, spatial variation in initial location, and differences in overall PLD, depth preference and diel vertical migrations of different species.

October 21, 11:50 (BIO-P-7564)

Elements of seasonal dynamics of the macrobenthos on a shelf of northeast Sakhalin (Sea of Okhotsk)

Vjacheslav S. **Labay**

Hidrobiologiya, Sakhalin Research Institute of Fisheries and Oceanography (SakhNIRO), 196 Komsomolskaya St., Yuzhno-Sakhalinsk, Sakhalin, 693023, Russia. E-mail: Labay@sakhniro.ru

Faunal sampling was done on various polygons on a shelf of northeast Sakhalin in the ice-free periods during 2008, 2009 and 2010. Seasonal changes in indicators of abundance and structure of the macrobenthos varied with depth. Increases in density and biomass at the coast and at the continental border (the maximum depths sampled) were observed both in summer and in autumn. In the summer, the depth zone of maximum indicators of abundance was 100-110 m, whereas in the autumn the greatest values were at depths of 50-60 m. On a sandy littoral area macrobenthos was found only in the summer. Variety, density and biomass of benthos sharply increased from summer to autumn at 50-60 m. In contrast, at 100-110 m maximum values of indicators of abundance and variety characterize the summer period and decreased considerably by autumn. Similar changes were observed at 150-160 m: decreases in variety, density and biomass of benthos from summer to autumn. At depths of more than 230 m variety and density of benthos decreased from summer to autumn, but the biomass increased.

October 21, 12:10 (BIO-P-7720)

Composition and distribution of macrobenthos in some coastal-estuary systems in Ussury Bay (Japan/East Sea)

Anastasia S. **Dolganova** and R.G. Bezrukov

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia
E-mail: dolganova@tinro.ru

In estuarine ecosystems, located in the zone between marine and fresh water, specific communities are formed. Their structure, dynamics and functioning of are not explored sufficiently. The purpose of this work is to study the current status of benthos in the estuarine - coastal area of Ussury Bay and to compare the composition and quantitative characteristics of the macrobenthos from different parts of the Bay. Samples were collected in the summer of 2010 by snapper "Van Wines" and a scraper Dulkeyt (0.1 m²) in the depth range between 0.2 - 40 m (82 stations).

The average biomass in the coastal part of Ussury Bay was 484.4 ± 175.4 g/m². Of the 25 taxonomic groups found there, most of the macrobenthos biomass consisted of only five: *Bivalvia* (67%), polychaetes, phoronids, sea urchins and higher plants. Biomass of macrobenthos in the offshore section of the estuarine waters did not exceed 60 g/m². Of the 8 taxonomic groups of macrozoobenthos found here, *Bivalvia* (mainly *Ruditapes philippinarum*) was dominant at 96.9%. The average biomass of macrobenthos in the river Artemivka was 235.6 g/m². Five taxonomic groups of macrobenthos were noted there. The most important group was *Bivalvia* (mainly *Corbicula japonica*) at 97%. In the river Suhodol the average benthic biomass was 30.1 g/m². Of the 7 taxonomic groups observed, *Bivalvia* - *Macoma balthica* at 60%, gastropods *Asimenea lutea* (17%) and the coastal crab *Hemigrapsus sanguineus* (21%) were most important.

BIO-Paper Session Posters

BIO-P-7602

Annual change in the mesozooplankton community of the western channel of the Korea Strait from 2006 to 2010

Kyoungsoon **Shin**, Minchul Jang, Pungguk Jang and Woojin Lee, Bonggil Hyun and Seungho Baek

South Sea Environment Research, Korea Ocean Research and Development Institute (KORDI), 391 Jangmok-ri, Jangmok-myon, Geoje, Gyung-sangnam-do, 656-830, R Korea. E-mail: ksshin@kordi.re.kr

Seasonal changes of environmental and biological factors at Stn. M in the western channel of the Korea Strait were surveyed monthly from March, 2006 to November, 2010. The annual profiles of temperature and salinity were divided into two periods, the mixing period (winter to spring) and the stratification period (summer to fall).

Mesozooplankton were classified into 128 taxa from March 2006 to November 2010. Mesozooplankton abundance varied remarkably from 257 to 12,587 inds. m⁻³ and total abundance showed a tendency to decline gradually. During the observation period, predominant species of mesozooplankton were the copepods *Paracalanus parvus* s.l., *Paracalanus elegans*, *Oithona similis*, *Oncaea* spp., and chordates *Oikopleura dioica* and salps. *Paracalanus parvus* s.l. was the dominant species during the mixing period. However, as thermal stratification developed, other species became dominant and dominance varied according to depth. Neritic calanoid copepods were abundant between February and June, whereas oceanic species from warm water regions were common between July and November.

BIO-P-7618

Abundance of Giant Jellyfish (*Nemopilema nomurai*) and Spring Sea Surface Temperature variability in the northern East China and Yellow Seas

Yongjiu **Xu**¹ and Joji Ishizaka²

¹ Graduate School of Environmental study, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Aichi, 464-8601, Japan
E-mail: xu.yongjiu@b.mbox.nagoya-u.ac.jp

² Hydrospheric Atmospheric Research Center, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Aichi, 464-8601, Japan

In the East China Sea, Yellow Sea and Japan Sea population explosions of *Nemopilema nomurai* have become more frequent over the last decade, except in 2008 and 2010. It is expected that strobilation and ephyral liberation takes place in spring and early summer because the young medusa are found in those seasons. Temperature elevation may be one of the triggers for the strobilation and liberation and may affect abundance. It is hypothesized that SST can be used as an indicator of jellyfish abundance variations. Thus, SST during January to June in pre-jellyfish years (PJY: 1997-2001), jellyfish years (JY: 2002-2007, 2009) and non-jellyfish years (NJY: 2008, 2010) was examined. From spring to early summer, in all the coastal and middle areas of the East China Sea and Yellow Sea, mean SST was higher in PJY and JY, compared with NJY. SST reached 15°C in early May for the Jiangsu coastal area and in late May for the Shandong Peninsula and Korean coastal waters in JY and PJY. SST was lower, and the timing of SST becoming 15°C was delayed about 8-10 days in NJY, especially 2010. These results indicate that since 2002, low temperature may be one of the reasons for lower jellyfish abundance in NJY (2008, 2010). There may also be other factors that trigger the jellyfish explosions from PJY to JY.

BIO-P-7624**Long-term dynamics of some plankton and benthic characteristics at the Piltun-Astokhskoye field (NE Sakhalin Island Shelf)**

Tatyana Belan¹, Boris **Borisov**¹, Ludmila Belan², Alexander Moshchenko² and Tatyana Konovalova³

¹ Oceanography and Marine Ecology, Far Eastern Regional Hydrometeorological Research Institute (FERHRI), 24 Fontannaya St., Vladivostok, Primorsky Krai, 690091, Russia. E-mail: Tbelan@ferhri.ru

² Institute of Marine Biology, FEB RAS, Vladivostok, 690041, Russia

³ Sakhalin Energy Investment Company Ltd., Yuzhno-Sakhalinsk, 693020, Russia

Phyto- and zooplankton distribution patterns in the fall of 1998-2008 shows significant inter-annual variability. The average biomass of phytoplankton (0-30 m layer) over the observation period was greater than 500 mg/m³, with the maximum value of 5.1 g/m³ observed in October of 2002. Diatom microalgae dominated the biomass in 1998-2008 (up to 95.5% in 2002 due to a strong bloom of *Skeletonema costatum*). The highest phytoplankton densities were recorded in 1999 and in 2002 (2.0 and 2.5 x 10⁶ cell l⁻¹, respectively).

Quantitative parameters and composition of zooplankton have been affected by oceanographic conditions in the local study area and the annual temperature regime (warm-cold years). For zooplankton biomass, the period of observation can be divided into 2 categories: high-productive years (2000-2001, 2004, 2006 and 2008) and low-productive years (1998-1999, 2002 and 2007).

Leading taxonomic groups of benthos, those contributing the most to the total biomass in 1998-2008, were echinoderms (sea urchin *Echinarachnius parma*), cumaceans (*Diastylis bidentata*) sea anemones (*Halcamoides purpurea*, *Epiacis arctica*), bivalve molluscs (*Megangulus luteus*, *Mactromeris polynyma*) and polychaetes. The structure and distribution of benthic communities in the examined area (depth range 25-55 m) are determined by the type of bottom sediment.

BIO-P-7630**Jellyfish blooms in the Far Eastern Seas of Russia: Significance for ecosystems and social-economic consequences**

Alexander V. **Zavolokin**

Agency of Fishery, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: zavolokin@tinro.ru

Recently, jellyfish blooms have occurred in many regions of the world. Increasing jellyfish abundance can have significant consequences for marine ecosystems, fisheries, industries and tourism. Jellyfish blooms in the Far-Eastern Seas and Northwest Pacific in comparison with other regions of the World Ocean were studied. Potential impacts of jellyfish on marine communities and human societies were examined. It is shown that jellyfish biomass and abundance in the Far-Eastern Seas and adjacent waters are relatively low and their blooms don't have large-scale negative ecological and social-economic consequences.

BIO-P-7712

A comparison of trawl caught jellyfish in the eastern Bering SeaKristin **Cieciel**, Jim Murphy, Lisa Eisner and Bruce WingAuke Bay Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 17109 Pt. Lena Loop Rd., Juneau, AK, 99801, USA
E-mail: kristin.cieciel@noaa.gov

The annual BASIS (Bering Aleutian Salmon International Survey) surface trawl survey targets juvenile forage fish, as well as lower trophic levels in the eastern Bering Sea in August through October. Since 2004, all jellyfish caught by the trawl have been measured, weighed, and identified to the lowest taxonomic level possible. Five genus/species are typically encountered with the surface trawl: *Aequorea* sp., *Chrysaora melanaster*, *Cyanea capillata*, *Aurelia labiata*, and *Staurophora mertensi*. *Phacellocephora camtschatica* is also occasionally caught in the trawl but in very low numbers. The dominant species in abundance and biomass for each year sampled is *Ch. melanaster*. *Aequorea* sp. and *Cy. capillata* follow but order is year dependent. Changes in species diversity and catch per unit effort (CPUE) were identified starting in 2006 based on 2004 and 2005 catches. There has been an observable shift to single species dominant catches, *Ch. melanaster*. The causes for these shifts in biomass and distribution do not seem to be related to changes in physical ocean factors (temperature and salinity) alone but may be due to environmental forcing earlier in the growing season or during an earlier life history stage, possibly influencing large medusae biomass and abundances. Trends in bell size varied between species and location but seemed relatively constant between years despite the changes in CPUE. Data collection is ongoing and will continue in the Eastern Bering and include the Chukchi in August 2012 and 2013.

BIO-P-7715

Vertical distribution of the copepod *Calanus sinicus* before and after formation of Yellow Sea Bottom Cold Water (YSBCW) in the Yellow SeaJung-Hoon **Kang**¹, MinHo Seo³, OhYoun Kwon¹ and Woong-seo Kim²¹ South Sea Branch, Korea Ocean Research and Development Institute (KORDI), 391 Jangmok-ri, Jangmok-myon, Geoje, Gyungsangnam-do, 656-830, R Korea. E-mail: jhkang@kordi.re.kr² Office of the Senior Vice President, KORDI, Ansan, P.O. Box 29, 425-600, R Korea³ Faculty of Marine Technology, Chonnam National University, Dundeok-dong, Yeosu, Jeollanam-do, 550-749, R Korea

To understand effects of the Yellow Sea Bottom Cold Water (YSBCW) on the vertical distribution of the copepod *Calanus sinicus*, we surveyed diel vertical migration (DVM) of *C. sinicus* at a fixed station in the Yellow Sea before and after formation of the YSBCW. Cold water (<10°C) was observed in the bottom layer when the water column was thermally stratified in summer, while the water column was thermally well-mixed in spring. Samples were collected from five different layers at 3 hour intervals with an opening-closing net. Identified developmental stages of *C. sinicus* were from copepodite I (CI) to adults (CVI). Adult females (1-155 inds.m⁻³) showed clear DVM through the whole water column in spring, whereas adult males did not migrate. DVM of CV was not clear, while CI-CIV showed maximum residence in the upper 10-20m layer with high concentration of chlorophyll *a* (Chl-*a*). Conversely, clear DVM was not found in adult females (< 30 inds.m⁻³) and adult males in summer. Maximum abundances of CI-CIV also occurred consistently in the subsurface layer (20-40m) with high concentration of Chl-*a*. CV (1-272 inds.m⁻³) moved upward nocturnally to the near-surface layer (10-20m) with average temperature of 25.74°C, while it was not found in the surface layer (0-10m) with 28.31°C. These results indicated that existence of the YSBCW affected the vertical distribution of all developmental stages of the copepod, and changed the food-rich depths that were preferred by the earlier developmental stages before and after formation of the cold waters in the Yellow Sea.

BIO-P-7717**Distribution and community structure of phytoplankton in the offshore waters around Korean Peninsula during autumn season**Seungmok Roh, Joongki Choi and Youngju Lee

Department of Oceanography, Inha University, 253 Yonghyun-dong, Nam-gu, Incheon, 402-751, R Korea. E-mail: jkchoi@inha.ac.kr

Field observations of the distribution and community structure of phytoplankton were carried out at 16 stations in offshore waters in the Yellow Sea, South Sea and the East China Sea from September to December 2010. Surface chlorophyll *a* concentrations ranged from 0.4-1.1 $\mu\text{g l}^{-1}$ with a mean of 0.7 $\mu\text{g l}^{-1}$ in the South Sea, 0.3-0.9 $\mu\text{g l}^{-1}$ with a mean of 0.6 $\mu\text{g l}^{-1}$ in the Yellow Sea, 0.7-1.7 $\mu\text{g l}^{-1}$ with a mean of 1.3 $\mu\text{g l}^{-1}$ in the ECS, respectively. HPLC pigment analysis showed fucoxanthin (diatom-marker pigment) in relatively high concentration in the offshore waters and southern part of Jeju Island, and showed zeaxanthin (cyanobacteria marker pigment) in higher concentration in the southern part of the Yellow Sea and the ECS. *Prochlorococcus* was limited to some parts of South Sea and ECS, while *Synechococcus* (6,703 - 255,347 cells ml^{-1}) was relatively abundant in the offshore waters of the Yellow Sea, coastal waters of the South Sea and northern waters of the ECS. The distribution of pico-eukaryotes was similar to *Synechococcus*. We found that pico- and nano-sized phytoplankton dominated in the Yellow Sea and South Sea of Korea during the early autumn season, while micro-sized phytoplankton dominated in the ECS during the late autumn season. This result suggests that stratification and mixing are major factors affecting the distribution of phytoplankton.

BIO-P-7724**Ecological characteristic of sublittoral bivalve communities of the Bering and Okhotsk Seas**Victor Nadtochy and Marina Yurieva

Laboratory of Biochemistry of Water Organisms, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky kray, 690091, Russia. E-mail: yureva@tinro.ru

This survey is part of investigations of the stock dynamics and benthic productivity in the Far-East Seas of Russia. 146,600 km^2 of the Bering Sea shelf and 176,260 km^2 of the Okhotsk Sea were surveyed. Bivalves are one of the dominant macrozoobenthos groups in these seas and are distributed almost everywhere within the investigated areas. The bivalve biomass varied from 0.1 to 1,880.0 g/m^2 with an average biomass of $125.6 \pm 46.6 \text{ g/m}^2$ in the Bering Sea and from 0.1 to 5,152.8 g/m^2 with an average biomass of $94.1 \pm 27.5 \text{ g/m}^2$ in the Okhotsk Sea. Depending on the area, bivalves were 9-49% of the total benthic biomass in the Bering Sea and 11-28% in the Okhotsk Sea. Specific bivalve species were observed in each of the Seas. Bivalves living in loose substratum and collecting detritus such as *Macoma calcarea* (up to 567.0 g/m^2), *Megayoldia thraciaeformis* (up to 407.0 g/m^2) and *Nuculana pernula* (up to 248.0 g/m^2) predominate in the sublittoral regions of the Bering Sea. In the sublittoral regions of the Okhotsk Sea, *Serripes groenlandicus* (up to 629.8 g/m^2), a loose substratum sestonophage, along with *Macoma calcarea* (up to 345.2 g/m^2) and *Yoldia myalis* (up to 110.3 g/m^2) appeared as the dominant species. Distribution and dominance patterns of bivalves in these seas are determined by the nature of the substrate, topography, characteristics of water dynamics and processes of sedimentation. Data on caloric content of the dominant bivalve species was obtained.

BIO-P-7793

The distribution of Kuroshio indicator zooplankton around the IEODO Ocean Research Station in the East China SeaSungeun **Ju**, Jiho Seo and Joongki ChoiMarine Ecology Laboratory, Department of Oceanography, Inha University, 253 Yonghyun-dong, Nam-gu, Incheon, 402-751, R Korea
E-mail: jkchoi@inha.ac.kr

To study characteristics of the water mass containing zooplankton indicators of the Kuroshio Current around IEODO, we surveyed in January and August 2008 in the Yellow Sea, in May 2008 and 2010 at IEODO and in June, August and October 2008 in the southern east Yellow Sea. The water masses around IEODO were classified by the distribution of salinity. Discharged water from the Yangtzu River formed the low salinity waters, Kuroshio Current water had high salinity, and the other waters were characteristic of mixed waters from the Yangtzu River and the Kuroshio Current. IEODO is located in the mixed zone with Kuroshio Current and discharged water from Yangtzu River. The IEODO Ocean Research Station could be a good monitoring station for determining the influence of the Kuroshio Current and the Yangtzu River discharge. To study the input of the Kuroshio Current, we analyzed its indicator plankton. We identified 14 Kuroshio zooplankton species as indicators (*Sagitta enflata*, *Lucifer intermedius*, *Acartia negligens*, *Canthocalanus pauper*, *Clausocalanus minor*, *Clausocalanus furcatus*, *Eucalanus subcrassus*, *Euchaeta marina*, *Temora stylifera*, *Paracalanus aculeatus*, *Lucicutia flavicornis*, *Oithona plumifera*, *Oncaea venusta*, *Oncaea mediterranea*). The distribution of indicator zooplankton has moved towards the eastern part of Korea and western part of China around IEODO. Kuroshio indicators of zooplankton contributed 8.8% of total abundance in autumn, 5.3% in spring, 7.3% in summer and 6.7% in winter. This research was a part of the project titled "Study on application of IEODO Ocean Research Station" funded by the Korea Hydrographic Oceanographic Administration.

BIO-P-7799

Biomass estimates of *Euphausia pacifica* using MOHT in the Oyashio regionYuji **Okazaki** and Kazuaki TadokoroTohoku National Fisheries Research Institute, FRA, 3-27-5 Shinhama-cho, Shiogama, Miyagi, 985-0001, Japan
E-mail: okazakiy@affrc.go.jp

Quantitative estimates of krill biomass or abundance are important issues in marine ecology. However, conventional plankton nets are not sufficient for the quantitative estimates of krill because of net avoidance. We sampled krill seasonally (March, April, May, June, July and November) in the Oyashio region along the A-line and its surrounding water using MOHT (1.59mm mesh size with a mouth area of 5m²) during 2006 to 2007. The MOHT was towed from a depth of *ca.* 500m to the surface. Previous studies suggested that small juveniles of *Euphausia pacifica* (less than 7mm TL) were not retained by the large mesh size of the MOHT. Thus the samples collected by the MOHT include large juveniles and adults (individuals greater than 7mm TL). In this study, *E. pacifica* was the most abundant krill in the Oyashio region (84.3% of total krill biomass, on average). The biomass of *E. pacifica* ranged from 0.1 to 190.6 ww g/ m² during the survey period. Monthly mean biomass of *E. pacifica* was the highest in June (36.4 ww g/ m²). Annual mean biomass was 19.5 ww g/ m². This value was similar to a previous study of krill biomass based on an acoustic survey in the western North Pacific (Murase *et al.*, 2007). The results suggest that the MOHT is able to quantitatively sample *E. pacifica*.

BIO-P-7806

Temporal and spatial variation of size-fractionated phytoplankton communities in the Yellow Sea, KoreaOhYoun **Kwon**^{1,2}, Woong-seo Kim³, Jung-Hoon Kang², Kyunwoo Lee² and Jin Hwan Lee¹¹ Department of Biology, Sangmyung University, Jongno-gu, Seoul, 110-743, R Korea. E-mail: koy00@kordi.re.kr² South Sea Environment Research Department, KORDI, 391 Jangmok-ri, Jangmok-myon, Geoje, 656-830, R Korea³ Office of the Senior Vice President, KORDI, Ansan, P.O. Box 29, Seoul, 425-600, R Korea

We investigated phytoplankton biomass and composition to understand latitudinal differences of size-fractionated phytoplankton structure before (spring) and after (summer) formation of bottom cold waters in the Yellow Sea in 2010 and 2011. The surveyed stations were selected along lines from coastal to off-shore waters (124.5 and 125.5°E) located at two latitudes (34.5 and 36°N). Based on the thermocline depth in summer, two depth strata (0-20m, 20-80m) were considered for analysis of latitudinal differences of the phytoplankton community. Water temperature in the surface waters differed before and after formation of bottom cold waters, whereas cold waters (<10°C) in the bottom layer existed consistently. Total Chl-*a* concentration of surface waters, representing the standing crop of phytoplankton, was higher in spring (Ave. 2.20 µg L⁻¹) than in summer (Ave. 1.06 µg L⁻¹) at both latitudes. Micro-sized (>20 µm) phytoplankton dominated numerically at the north and south latitudes in spring. Small centric diatoms were abundant at the north latitude, while nanoflagellates predominated at the south latitude, in summer. In the bottom waters, total Chl-*a* concentration was higher in summer (Ave. 1.12 µg L⁻¹) than in spring (Ave. 0.67 µg L⁻¹). Nanoflagellates dominated the total Chl-*a* concentration of bottom cold waters at both latitudes in summer, whereas *Paralia sulcata* and *S. costatum* dominated the entire phytoplankton community at both latitudes in spring. Consequently, nano-sized phytoplankton (nanoflagellates) occurred abundantly in the two sampled depths of all stations in summer, while micro-sized phytoplankton dominated both depths at both latitudes in spring.

BIO-P-7812

Spatiotemporal distribution and biomass of two abundant jellyfish in Ise and Mikawa Bay, JapanKaoru **Aoki**¹, Takuya Sirokiya², Kazuya Takeda³, Satoshi Yamada⁴, Masaya Toyokawa⁵ and Tomohiko Kikuchi¹¹ Graduate School of Environment and Information Sciences, Yokohama National University, Yokohama, 240-8501, Japan
E-mail: d09ta001@ynu.ac.jp² Aichi prefecture government Nagoya, Aichi, 460-8501, Japan³ Aichi Fisheries Research Institute, Gamagohri, 443-0021, Japan⁴ Marine Resources Research Center, Aichi Fisheries Research Institute, Aichi, 470-3412, Japan⁵ Seikai National Fisheries Research Institute, Fisheries Research Agency, Nagasaki, 851-2213, Japan

Ise and Mikawa Bay is a typical semi-enclosed bay in Japan. In this area, mass breakouts of two species of jellyfish, the moon jelly (*Aurelia aurita*) and the brown jelly (*Chrysaora melanaster*), have become a serious environmental problem in recent years. This study was aimed at elucidating the actual spatiotemporal distribution of these two jellyfish, and at identifying species interactions with environmental factors. During the study period the wet biomass of the brown jelly was markedly low compared to the moon jelly. However, the horizontal distribution pattern of the brown jelly was similar to the moon jelly. Between March and May of 2008, the brown jelly was 26 % of the total biomass of jellyfish but was reduced to 3% in June. In 2009 and 2010, a similar trend was observed. Throughout the survey years, we observed that the brown jelly disappeared from the water column after July and its appearance was at its peak one to three months earlier than that of the moon jelly. When there was an early decline of the brown jelly population, the moon jelly tended to have a prolonged appearance in the water column. These results have important implications for clarification of life history and population control of jellyfish in the bay.

BIO-P-7824**Finless porpoise, *Neophocaena phocaenoides*, Distribution in the South Sea of Korea**

Seokgwan **Choi**, Kyumjoon Park, Hyunwoo Kim, Youngran Lee, Jieun Park, Daeyeon Moon and Yongrock An

Cetacean Research Institute, National Fisheries Research and Development Institute (NFRDI), MIFAFF, 139-29 Maeam-dong, Nam-gu, Ulsan, 680-050, R Korea. E-mail: sgchoi@nfrdi.go.kr

To confirm the distribution of finless porpoise, *Neophocaena phocaenoides*, in the South Sea of Korea, data on bycatch, stranding, and drifting from 1999 to 2009 were used, and sighting surveys were conducted from the R/V *Tamgu No. 9* and *10* in June and November, 2009 and March, 2010. The total number of bycaught, stranded, and drifting finless porpoises was 607, with position being known for 186 of these. At the center of Yeosu, there were few position data on bycaught, stranded, and drifting finless porpoises, and data could not confirm their distribution. Thus, there were limits on the usefulness of bycaught, stranded, and drifting data for confirming the distribution of finless porpoises. In the three sighting surveys, the sighting rate was highest at 0.231 ind./n.m. in the western South Sea in June, 2009. Sighting rate was less than 0.1 ind./n.m. in November, 2009 and March, 2010. This is likely due to seasonal migration in the western South Sea. All sighting rates in the eastern South Sea were over 0.13 ind./n.m.. According to the results of the sighting survey, finless porpoises are distributed around the islands and inner bay along the path of the research vessel in the South Sea. There were numerous finless porpoises in the offshore areas of Mokpo, Yeosu, Tongyeong, Dadaepo, and Gaduk-do. This study will be utilized as part of a future abundance assessment of finless porpoise in the South Sea of Korea.

BIO-P-7838**Zooplankton production in the western zone of the Subarctic front in winter-spring 2011**

Elena **Dulepova** and Natalya Kuznetsova

Laboratory of Applied Bioecology, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: dep@tinro.ru

The Subarctic frontal zone is a very important region for the migration of nekton fishes, especially salmon. Every year large numbers of pink and chum salmon undertake a feeding migration to this zone. Therefore the estimation of zooplankton production, forage for pelagic fishes, is of great importance. We analyzed community structure and spatial distribution patterns of zooplankton from February-April 2011 in the western zone of the Subarctic front. Copepods, hyperiid amphipods, euphausiids, and chaetognaths dominated the epipelagic zooplankton community. The zooplankton species were divided into two trophic groups. The first group is phyto- and euryphagous zooplankton (mainly copepods and euphausiids). The second group is predatory zooplankton (hyperiid and chaetognaths). In 2011, production of phyto- and euryphagous zooplankton was greater than 140g m⁻², and production of predatory zooplankton did not exceed 30 g m⁻². On average zooplankton community production available for fish was estimated to be 74 g m⁻². These results indicated that this zone is very productive in winter-spring and feeding conditions are favorable for pelagic fishes at this time.

FIS Paper Session

Co-Convenors: *Gordon H. Kruse (U.S.A.) and Mikhail Stepanenko (Russia)*

This session invites papers addressing general topics in fishery science and fisheries oceanography in the North Pacific and its marginal seas, except those covered by Topic Sessions sponsored by the Fishery Science Committee (FIS).

Day 1, Tuesday, October 18 (9:00-12:30)

- 9:00 **Introduction by Convenors**
- 9:05 **Hyemin Park, Youngseok Seo and Chulwoong Oh**
Reproductive biology of *Argis lar* from the East Sea of Korea (FIS-P-7604)
- 9:25 **Sergey E. Kulbachny and Sergey F. Zolotukhin**
Chum spawning migration in the north-western part of the continental coastline of the Okhotsk Sea (FIS-P-7869)
- 9:45 **Masayuki Chimura, Yuuho Yamashita and Satoshi Honda**
Why did the northern Japan Sea walleye pollock stock experience high survival in 2006? (FIS-P-7702)
- 10:05 **Motomitsu Takahashi, Chiyuki Sassa and Youichi Tsukamoto**
Growth-selective recruitment from pelagic to demersal habitats for juvenile jack mackerel in the East China Sea: Implications for year-class strength (FIS-P-7801)
- 10:25 **Coffee/Tea Break**
- 10:50 **Ming-Ming Zhang, Chulwoong Oh, Wanok Lee, Jaemin Back and Jonghun Na**
Comparison of scales, whole otoliths and sectioned otoliths for estimating age and growth of largemouth bass, *Micropterus salmoides* (FIS-P-7692)
- 11:10 **Sergey F. Zolotukhin**
Contribution of Pacific salmon from the Amur River to the total salmon biomass of the North Pacific Ocean (FIS-P-7867)
- 11:30 **Soojeong Lee, Jaebong Lee, Hyeokchan Kwon and Changik Zhang**
Population ecological parameters of elkhorn sculpin (*Alcichthys alcicornis*) along the Uljin area of Korea (FIS-P-7650)
- 11:50 **Oleg A. Bulatov**
Walleye pollock: Fishery and stock dynamics (FIS-P-7568)
- 12:10 **Jennifer L. Boldt, Thomas W. Therriault, Douglas E. Hay, Jacob Schweigert and Matthew Thompson**
Nearshore fish community dynamics in the Strait of Georgia: Information from juvenile herring surveys (FIS-P-7830)
- 12:30 Session ends

Day 2, Wednesday, October 19 (9:00-12:30)

- 9:00 ***Introduction by Convenors***
- 9:05 **Alexey A. Khoruzhiy**
Species composition and abundance of the nekton community in the upper epipelagic layer of the Northwest Pacific Ocean during summer 2004-2010 (FIS-P-7563)
- 9:25 **Mary E. Hunsicker, Lorenzo Ciannelli, Kevin M. Bailey and Stephani Zador**
The influence of climate and demography on predator-prey interactions between walleye pollock and arrowtooth flounder in the eastern Bering Sea (FIS-P-7752)
- 9:45 **Nadezhda L. Aseeva, Andrey B. Savin and Marina B. Shedko**
Dynamics of demersal fish community structure on the shelf of West Kamchatka (FIS-P-7601)
- 10:05 **William R. Bechtol, Gordon H. Kruse, Joshua Greenberg and Hans Geier**
Reduced minimum size limits improve Tanner crab fishery management in the eastern Bering Sea (FIS-P-7557)
- 10:25 ***Coffee/Tea Break***
- 10:50 **Keith R. Criddle and James Strong**
Dysfunction by design: Consequences of limitations on transferability of catch shares in the Alaska pollock fishery (FIS-P-7711)
- 11:10 **Heewon Park, Jaebong Lee, Youngil Seo and Changik Zhang**
Management strategies in a marine ranching ecosystem based on an integrated fisheries risk analysis method for ecosystems (IFRAME) framework (FIS-P-7656)
- 11:30 **Elizabeth A. Logerwell and Mary Campbell Baker**
A conceptual model for determining oil fate and effects on habitat and wildlife in the Arctic (FIS-P-7619)
- 11:50 **Yoshiki Kato, Mitsuo Sakai, Takaya Namba, Toshie Wakabayashi, Shuhei Masuda, Hiromichi Igarashi, Yoichi Ishikawa, Masafumi Kamachi and Toshiyuki Awaji**
Effect of water-temperature transition on hatching in the neon flying squid and numerical simulation of larval migration (FIS-P-7735)
- 12:10 **Chingiz M. Nigmatullin, Alexander Arkhipkin, John C. Field and Unai Markaida**
Jumbo squid population structure and ecosystem role in variable environment of the Eastern Pacific (FIS-P-7831)
- 12:30 Session ends

FIS Paper Session Posters

- FIS-P-7555 **Victor F. Bugaev**
Correlation between the distribution of plerocercoid *Diphyllobothrium* sp. in sockeye salmon *Oncorhynchus nerka* smolts and adults with the abundance of parental stocks in the Kamchatka River
- FIS-P-7577 **Ekaterina V. Golovashchenko and Oleg Z. Badaev**
Efficiency increase of marine bioresources usage based on the example of some trades
- FIS-P-7578 **Ekaterina V. Golovashchenko**
Efficiency increase of marine bioresources usage based on the example of some trades economic value of ecosystem services of Eastern and Western Sakhalin fishery zones' shelf
- FIS-P-7582 **Peng Sun and Zhenlin Liang**
The effect of the trawl selective parameters on the phenotypic traits of fish stocks
- FIS-P-7609 **Anna V. Dakus, Helen V. Kashchenko, Sergey D. Ponomarev and Evgeny Denisenko**
The use of molecular techniques for population genetic analysis of the Pacific herring (*Clupea pallasii*) in the Okhotsk Sea
- FIS-P-7628 **Chiyyuki Sassa, Seiji Ohshimo, Hiroshige Tanaka and Youichi Tsukamoto**
Reproductive biology of *Benthoosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China Sea
- FIS-P-7655 **Jaebong Lee, Jonghee Lee, Kwangho Choi, Inja Yeon and Dongwoo Lee**
Recent distribution and migration patterns of Pacific cod (*Gadus macrocephalus*) in Korean waters
- FIS-P-7657 **Changik Zhang, Heewon Park, Youjung Kwon, Jaebong Lee, Youngil Seo, Heeyong Kim, Inja Yeon and Dongwoo Lee**
Fisheries risk assessment in a marine ranching ecosystem based on integrated fisheries risk analysis method for ecosystems (IFRAME) framework
- FIS-P-7662 **Changik Zhang, Jaebong Lee and Soojeong Lee**
Stock assessment of elkhorn sculpin (*Alcichthys alcicornis*) along the Uljin area of Korea
- FIS-P-7666 **Wongyu Park, Yujin Jeon, Junghwa Choi and Dongwoo Lee**
Spatial and temporal variations of sea surface temperature, zooplankton abundance and anchovy harvest in western waters of the Korean Peninsula during the last three decades
- FIS-P-7670 **Jungnyun Kim, Junghwa Choi, Kangseok Hwang, Taegyun Oh, Kwangho Choi and Dongwoo Lee**
Seasonal variations of species composition and abundance in the decapod crustacean assemblage in the coastal waters of Geoje Island and Namhae Island, Korea
- FIS-P-7675 **Alexander V. Lysenko**
Snow crab (*Chionoecetes opilio*) in the western Kamchatka: A new target fishery?
- FIS-P-7680 **T.A. Shatilina and A.A. Goryainov**
Climatic changes above the Far East and returning of chum salmon into the South Primorye rivers
- FIS-P-7691 **Ming-Ming Zhang, Chulwoong Oh, Wanok Lee, Jonghun Na and Jaemin Back**
Aging method comparison and growth of Amur barbell, *Hemibarbus labeo* from Goe-san Lake in Korea

- FIS-P-7695 **Andrew N. Deminov**
 Occurrence of deep snow crab *Chionoecetes japonicus* on the shelf of the northwestern Sea of Japan
- FIS-P-7710 **Alexei M. Orlov**
 Northwestern Pacific and southeastern Asia chondrichthyan fishes: Major threats and conservation status
- FIS-P-7718 **Minkyong Shin, Wongyu Park, Changuk Park and Thomas Shirley**
 Distribution and timing of larval Tanner crab *Chionoecetes bairdi* in Glacier Bay and neighboring strait in southeastern Alaska, USA
- FIS-P-7795 **Sachihiko Itoh, Toshiro Saruwatari, Haruka Nishikawa, Ichiro Yasuda, Kosei Komatsu, Atsushi Tsuda, Takeshi Setou and Manabu Shimizu**
 Exploring impacts of environmental history on larval growth: Combination of otolith microstructure analyses and particle-tracking experiments
- FIS-P-7805 **Jinho Bae, Hyemin Park, Hyeonggi Kim and Chulwoong Oh**
 Age and growth of Conger eel *Conger myriaster* (Brevoort) using UV light from Korean waters
- FIS-P-7848 **Youngil Seo, Hyungki Cha, Sunkil Lee, Heeyong Kim, Jinyeong Kim and Changik Zhang**
 Stock assessment by risk analysis of ecosystem indicators in the southern sea of Korea
- FIS-P-7882 **Graham E. Gillespie, Tammy Norgard, Sean MacConnachie, Lily Stanton and Jessica Finney**
 Program to assess the conservation status of the Olympia oyster, *Ostrea lurida*, in Canada
- FIS-P-7883 **Suzanne Kohin, Heidi Dewar, John Childers, Karen Nieto, Eric Prince, Barbara A. Block and Rosa Runcie**
 Movements of albacore, swordfish and shortfin mako sharks in pelagic environments: Electronic tagging reveals the influence of oceanography on vertical and horizontal behavior

Day 1, FIS-Paper Session Oral Presentations

October 18, 9:05 (FIS-P-7604)

Reproductive biology of *Argis lar* from the East Sea of Korea

Hyemin **Park**¹, Youngseok Seo² and Chulwoong Oh¹

¹ Department of Marine Biology, Pukyong National University, 599-1 Daeyeon 3-dong, Nam-gu, Busan, 608-737, R Korea
E-mail: shrimppark@gmail.com

² Gyeongsangbuk-do Fisheries Resources Development Institute, 5-98 Geomuyeok-ri, Byeonggok-myeon, Yeongdeok-gun, Gyeongsangbuk-do, 766-851, R Korea

Total sample consisted of 4,172 shrimps, 40 males (size range: 9.91-24.11 mm carapace length, CL) and 2,797 non-ovigerous females (size range: 7.22-38.33 mm CL) and 1,335 ovigerous females (size range: 19.70-37.43 mm CL). Size differed significantly among females, males, and ovigerous females. Ovigerous females of *A. lar* appeared every month in variable percentages, with minimum of 2.48% in August, 2009. The extended reproductive period indicated that multiple spawnings occur in *A. lar*. Non-ovigerous females showed all ovarian stages, whereas the ovigerous females existed only in spent ovarian stages. There are two modes in the percentage of females within each ovarian stage. In the first mode, females in a mature ovarian condition were highest in September (61.98%), whereas females in spent ovarian condition was highest in November (32.52%). The GSI of non-ovigerous females and ovigerous females differed significantly with month. The percentage of ovigerous females with non-eyed eggs was 32.06%, eyed egg stage was 25.69%, and with hatching stage was 42.05%. Females with hatching eggs occurred through November-June. The relationship between CL and ovary weight differed significantly for ovigerous females with non-eyed egg and with eyed stage. Our results show that females between 27.1 and 33.0 mm CL had higher values of the index of reproductive potential (IRP, =278).

October 18, 9:25 (FIS-P-7869)

Chum spawning migration in the north-western part of the continental coastline of the Okhotsk Sea

Sergey E. Kulbachny and Sergey F. **Zolotukhin**

Khabarovsk Branch of TINRO-Center, 13-A Amursky Blvd., Khabarovsk, 680028, Russia. E-mail: khv@tinro.khv.ro

Chum spawning migration in the northwestern part of continental coastline of the Okhotsk Sea was studied. It was revealed that there are two types of spawning migrations to the rivers of the Ayan-Maysky, Tugur-Chumikan and Nikolaevsk areas. The spawning migration comes to the Tugur river from the northeast, and from the southeast to the rivers of Ulbansky bay. These spawning migrations are confirmed by chum salmon fisheries in the rivers and in the northwestern coastline of the Okhotsk Sea. Dynamics of a chum run from the southern Tugur Peninsula shows that the majority of the run arrives from the 3rd week of July to the 1st week of August, whereas the majority of the chum runs in the northern peninsula occur from the 2nd to 3rd weeks of August. It is obvious that differences in these migration times are caused by climatic and hydrological factors in the chum spawning areas. The bays situated in the south part of the Tugur Peninsula warm up earlier; as a result, spawners return there earlier so there is plenty of time for embryonic and larval development and juvenile appears earlier in the south.

October 18, 9:45 (FIS-P-7702)

Why did the northern Japan Sea walleye pollock stock experience high survival in 2006?

Masayuki Chimura¹, Yuuho Yamashita¹ and Satoshi Honda²

¹ Hokkaido National Fisheries Research Institute, Fisheries Research Agency, 116 Katsurakoi, Kushiro, Hokkaido, 085-0802, Japan
E-mail: chimchim@fra.affrc.go.jp

² National Fisheries Research Institute of Fisheries Science, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

The northern Japan Sea stock (JSS) of walleye pollock (*Theragra chalcogramma*) is mainly distributed in the Sea of Japan off Hokkaido Island, Japan. Considerable interannual variation in the abundance of juvenile JSS pollock was detected by acoustic surveys in May during 2006-2010. The estimated number of juveniles in 2006 was 20 to 600 times as many as that in 2007-2010. The number of age-2 recruits per unit of spawning stock biomass in 2006 was highest after 1989. JSS pollock spawn between December and March, but the hatch dates for the juveniles collected in 2006 were concentrated at late February to middle March. On the other hand, hatch dates for the juveniles collected in 2008 and 2010 extended longer and ranged from January to March. In 2007 and 2009, a few juveniles were collected and they mainly hatched after late March. The overall mean growth rates from hatching to capture for juveniles (*G*s) were highest in 2007 and lowest in 2010. The mean *G*s for the juveniles in 2007-2009 were not significant higher than that for the juveniles in 2006. Water temperature around the spawning grounds started rising in middle February to early March and continued increasing until late May during 5 years of the study. Low temperature may reduce starvation mortality during first-feeding period and predation mortality throughout the larval period. In 2006, larvae hatched intensively during the period when temperatures were low seemed to result in high early survival.

October 18, 10:05 (FIS-P-7801)

Growth-selective recruitment from pelagic to demersal habitats for juvenile jack mackerel in the East China Sea: Implications for year-class strength

Motomitsu Takahashi, Chiyuki Sassa and Youichi Tsukamoto

Seikai National Fisheries Research Institute, Fisheries Research Agency, 1551-8 Taira-machi, Nagasaki, Nagasaki, 851-2213, Japan
E-mail: takahamt@fra.affrc.go.jp

Juvenile jack mackerel *Trachurus japonicus* changes habitat from pelagic to demersal waters; however, the recruitment processes to the demersal habitat remain unclear in the East China Sea (ECS). We examined growth patterns of pre-recruits in pelagic waters in April and recruited juveniles in demersal habitats in May-June using otolith microstructures in three year-classes with differential recruit abundance; small in 2005, middle in 2008 and large in 2009 in the ECS. Since hatch dates of pre-recruits ranged from February to April were comparable with those of recruited juveniles, we assumed that recruited juveniles originated from pre-recruits. Pre-recruits from year-classes with smaller recruit abundance had slower growth rate during larval stage in pelagic waters, although recruited juveniles had constant growth rate among the three survey years. This indicates that selection depending on larval growth rate acted stronger in 2005 than in 2009. Only a few pre-recruits had growth rate > 1.0 mm d⁻¹ during the transformation stage in pelagic waters, but most of recruited juveniles did, indicating that transforming *T. japonicus* with faster growth rates had higher probability of successful recruitment to demersal habitats in the ECS. Recruited juveniles in 2009 had the fastest growth rate during transformation and juvenile stages from pelagic to demersal habitats among the survey years. Thus, *T. japonicus* with faster growth rate throughout larval and juvenile stages had higher probability of successful recruitment to demersal habitat than did those with slower growth rate, and hence growth rate during the early life stages might be a critical determinant of recruit abundance in the ECS.

October 18, 10:50 (FIS-P-7692)

Comparison of scales, whole otoliths and sectioned otoliths for estimating age and growth of largemouth bass, *Micropterus salmoides*

Ming-Ming **Zhang**¹, Chulwoong Oh¹, Wanok Lee², Jaemin Back² and Jonghun Na¹

¹ Department of Marine Biology, Pukyong National University, 45 Yongso-ro, Nam-Gu, Busan, 608-737, R Korea
E-mail: zhangmingm44ok@163.com

² Inland Fisheries Research Institute, National Fisheries Research and Development Institute (NFRDI), 151-1 Haean-ro, Gijang-eup, Gijang-gun, Busan, 619-705, R Korea

Largemouth bass (*Micropterus salmoides*) is an important freshwater fish belonging to the sunfish family. Scales, whole otoliths and sectioned otoliths were used to determine age and growth of largemouth bass of sizes ranging from 98.8 to 413.8 mm standard length (SL) during April to November in 2010. Monthly changes in the ratio of numbers of opaque and hyaline zones and the marginal index (MI) calculation indicated that a single ring was formed once per year in both sexes. MI also indicated that annulus formation in scales occurred in April, while analysis using whole and sectioned otoliths indicated formation in May. Aging precision on whole otoliths (81%) and sectioned otoliths (78%) were higher than scales (70%). However, the scale method was non-lethal, less costly and provided higher precision with better agreement for fish less than 5 years old compared to other methods. The back-calculated relationship between standard length L_t (mm) and age t (years old) was expressed using the von Bertalanffy growth equation: $L_t = 464.21(1 - e^{-0.126(t+0.416)})$ for whole otoliths, $L_t = 459.01(1 - e^{-0.174(t+0.335)})$ for sectioned otoliths and $L_t = 448.76(1 - e^{-0.234(t+0.527)})$ for scales. The choice of methods for age and growth estimation with different hard part structures needs to consider fish condition, such as age. This study will be useful to supply some guidance and reference for fishery management, as well as a basis for comparison with different fish populations in other geographical areas.

October 18, 11:10 (FIS-P-7867)

Contribution of Pacific salmon from the Amur River to the total salmon biomass of the North Pacific Ocean

Sergey F. **Zolotukhin**

Khabarovsk Branch of TINRO-Center, 13-A Amursky Blvd., Khabarovsk, 680028, Russia. E-mail: sergchum2009@yandex.ru

Eleven salmonid species have been recorded in Amur River, but only three are anadromous: pink, chum, and masu salmon. Masu salmon is not as abundant as pink or chum salmon. Two chum salmon runs occur in the river - summer and fall, with return time separated by about a month. A proportion of pink, chum, and masu salmon growing in the ocean return annually to Amur River to spawn. No estimates of salmon runs existed for Amur River in the 20th century. The biggest chum salmon catch (about 100 thousand mt) occurred in 1910, and the largest catch of pink salmon (about 20 thousand mt) occurred in 1926. Experts thought that fishing removed 50% or more of salmon runs from the river basin, but tagging studies in the 2000s showed that the proportion was only about 15%. Using this harvest rate, salmon runs in Amur River were estimated retrospectively between 1950 and 2010. Results will be presented.

October 18, 11:30 (FIS-P-7650)

Population ecological parameters of elkhorn sculpin (*Alcichthys alcicornis*) along the Uljin area of Korea

Soojeong Lee¹, Jaebong Lee², Hyeokchan Kwon¹ and Changik Zhang¹

¹ Marine Production System Management, Pukyong National University, 599-1 Deayeon-3dong, Nam-gu, Busan, 608-737, R Korea
E-mail: sjlee83@pknu.ac.kr

² National Fisheries Research and Development Institute, 408-1 Sirang-ri, Gijang-gun, 619-705, R Korea

Population ecological parameters of elkhorn sculpin were estimated along the Uljin area of Korea. Age and growth of elkhorn sculpin were examined. Ages were estimated from otolith assuming that annuli are formed once per year in January. A generalized von Bertalanffy growth function provided the best fit based on AIC and BIC statistics among four alternative functions. Estimated growth parameters for this species were $L_{\infty} = 29.41$ cm, $K = 0.247$ /year and $t_0 = -0.609$ year. The GSI for both sexes was the highest in February, indicating February as the main spawning month. Based on bootstrapped data, lengths at which 50% of the female and male fish had attained maturity were 14.30 cm and 17.42 cm, respectively. Survival rate and total mortality was estimated to be 0.334 and 1.096/year, respectively. Natural mortality (M) estimates for the elkhorn sculpin were derived from a meta-analysis of seven different M estimators. The overall M estimate was based on a random effects inverse variance weighting of each method. M was estimated to be 0.467/year for the elkhorn sculpin along the Uljin area of Korea. The age at first capture of this species was estimated to be 2.41 years.

October 18, 11:50 (FIS-P-7568)

Walleye pollock: Fishery and stock dynamics

Oleg A. Bulatov

Fishery Biology Department, Russian Federal Research Institute of Fisheries and Oceanography, 17 V. Krasnoselskaya St., Moscow, 107140, Russia. E-mail: obulatov@vniro.ru

Walleye pollock (*Theragra chalcogramma*) is one of the most valuable fish species in the Far Eastern Seas. The large-scale fishery started in the 1960s and the first historical maximum occurred in 1975-1976 when 5.0 million t of pollock were landed. The second period of large catches (> 6,500,000 t) occurred in 1985-1987. Discovery of a new fishing grounds in the northern part of the Sea of Okhotsk and in the open part of the Bering Sea (the Donut hole area) contributed to the increase in catches. These successful years in the fishery were followed by a period of low landings with the minimum (2,654,000 t) in 2002. The following years saw an increase in landings (up to 2,900,000 t). The main fishing grounds are located in the Sea of Okhotsk and in Bering Sea. The history of the pollock fishery shows that considerable inter-annual variability in yield introduces large uncertainty in planning and management of this fishery. A 10-12 year periodicity in occurrence of the maximum and minimum stock abundance has been identified. Water temperature has a significant impact on year-class success in the first year of the pollock life history. Recruitment strength influences the growth and therefore the size of fishable and spawning biomass. The Pacific Decadal Oscillation (PDO) is one of the most important climatic events that influence sea temperature experienced by pollock. The pollock stock biomass will probably rebound in 2013-2014.

October 18, 12:10 (FIS-P-7830)

Nearshore fish community dynamics in the Strait of Georgia: Information from juvenile herring surveys

Jennifer L. **Boldt**, Thomas W. Therriault, Douglas E. Hay, Jacob Schweigert and Matthew Thompson

Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, BC, V9T 6N7, Canada

E-mail: Jennifer.Boldt@dfo-mpo.gc.ca

As science moves towards an ecosystem-based approach to management, survey time series initially designed to sample a single species can be re-examined to increase our understanding of the ecosystem. In British Columbia (BC), Pacific herring recruitment forecasts are an important element of the herring stock assessment. Purse seine surveys have been utilized to assess juvenile herring abundance and predict recruitment to the Strait of Georgia (SOG) stock. In addition to herring, however, many other nearshore species are successfully sampled during this survey. We hypothesized that these incidental captures could be used to detect possible temporal and spatial changes in nearshore fish communities, potentially reflective of environmental change within the SOG. Ten “core” transects perpendicular to shore with five sampling stations each, have been surveyed annually in late summer and early fall since 1991. Sampling stations are located in open water and more confined sites within wide channels. Basic community metrics were calculated for each station in each year including species richness, Shannon-Weiner diversity index, Simpson’s diversity index, evenness, and total abundance and herring abundance. Metrics were then compared among transects, habitat (open water and channel sites), and years, and in relation to environmental changes in the SOG. Most metrics varied among stations and transects. The abundance of young-of-the-year herring appeared to be related to sea surface temperature and subsequent recruitment to the adult population. These juvenile herring surveys provide valuable measures of community change in the SOG and recruitment predictions for the commercially important SOG herring stock.

Day 2 FIS-Paper Session Oral Presentations

October 19, 9:05 (FIS-P-7563)

Species composition and abundance of the nekton community in the upper epipelagic layer of the Northwest Pacific Ocean during summer 2004-2010

Alexey A. Khoruzhiy

Pacific Research Institute of Fisheries and Oceanography (TINRO-Centre), 4 Shevchenko Alley, Vladivostok, 690950, Russia
E-mail: alex.khoruzhiy@gmail.com

Structure of the nekton community in the upper epipelagic layer was characterized from trawl survey data collected in the North-West Pacific and adjacent waters during the early summers of 2004-2010. Intra-seasonal succession of the community and its changes under environmental conditions are described. The nekton community included 71 species of fish and 24 species of cephalopods. Nekton biodiversity was lower in coastal areas and higher in deep waters. Mesopelagic species dominated the nekton biomass and amounted to 40-60% ($47.5 \pm 5.2\%$) of the total, and the proportion contributed by Pacific salmonids was 16-50% ($28.5 \pm 4.9\%$). Species that composed the low-boreal and subtropical fish complex made up a small proportion ($7.2 \pm 2.6\%$) of the nekton community. The cephalopod community was composed of several species of squid (*Boreoteuthis borealis*, *Watasenia scintillans*, *Todarodes pacificus* and *Gonatus kamtschaticus*), and the cephalopods were dominated by *B. borealis* ($73.4 \pm 2.1\%$) which contributed $9.6 \pm 0.9\%$ of the overall nekton community. Mean biomass of nekton in the epipelagic layer within the studied area was $2,370 \pm 368$ thousand tons, although it was much lower in the last year of the study (2010).

October 19, 9:25 (FIS-P-7752)

The influence of climate and demography on predator-prey interactions between walleye pollock and arrowtooth flounder in the eastern Bering Sea

Mary E. Hunsicker, Lorenzo Ciannelli, Kevin M. Bailey and Stephani Zador

College of Oceanic and Atmospheric Sciences (COAS), Oregon State University, 104 Ocean Administration Bldg., Corvallis, OR, 97331, USA
E-mail: mhunsicker@coas.oregonstate.edu

Climate influences on marine ecosystems are largely manifested by changes in species spatial distributions. The potential consequences of distribution shifts on ecosystem structure and function are myriad, and a key concern is the impact on predator-prey interactions. Changes in species interactions can have unpredictable effects on the population dynamics of marine fishes, particularly those that are subjected to heavy fishing pressure. The goal of our work is to better understand the influence of climate and demography on the strength of spatial overlap between arrowtooth flounder (*Atheresthes stomias*) and juvenile walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea. Arrowtooth flounder currently exerts a modest source of mortality on the ecologically and economically important pollock population. However, this interaction could intensify with increasing abundance of arrowtooth flounder and climate-induced expansions of their spatial distribution. We develop spatial overlap indices from fisheries independent data and use variable coefficient GAMs to evaluate the spatial effect of the predator-prey overlap. We present our findings on the locations of greatest overlap and how the magnitude and extent of overlap varies with changes in demographic and environmental conditions. We also discuss the potential implications of our findings on the trophic interactions between these key species. This work provides a strong foundation for improving our ability to predict the predatory impact of arrowtooth flounder on juvenile pollock under different scenarios of climate and fishing regimes.

October 19, 9:45 (FIS-P-7601)

Dynamics of demersal fish community structure on the shelf of West Kamchatka

Nadezhda L. **Aseeva**¹, Andrey B. Savin¹ and Marina B. Shedko²

¹ Far-Eastern Seas Fisheries Resources, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: aseeva_n@hotmail.com

² Institute of Biology and Soils, Russian Academy of Science, 159 Stoletiya Vladivostoka, Vladivostok, 690022, Russia

Bottom trawl survey data collected during 1980-2010 are used to evaluate the dynamics of bottom fish structure on the West Kamchatka shelf. Most of the community biomass is represented by flatfishes, gadids, and sculpins. Among 92 species recorded in 2010, most species were represented by brown sole, great sculpin, yellowfin sole, flathead sole, Bering flounder, saffron cod, yellow-bellied flounder, graypurple sculpin, Pacific cod, white-bellied flounder, snake prickleback, and plain sculpin. Flatfishes dominate in the demersal fish community; their portion was 49-53% of total biomass in the 1980s, increased to 70-75% in 1996-1997, and decreased again to 41-66% in 1998-2010. Fishing pressure was not very large during these three decades, so these fluctuations were caused by natural causes. We suppose that the biomass reduction of the main flounder species in the late 1990s was caused by worsening of their reproduction after bottom waters cooled in 1993 (a 6-7-year lag between fall temperature and biomass corresponds to the age of maximal biomass for flounders). Among flounders, yellowfin sole typically dominates in terms of biomass, but brown sole has begun to dominate in the most recent years (2008-2010); flathead sole is third in biomass. Gadids and sculpins are the most important minor groups of bottom fishes. Gadidae took the second place among taxonomic groups of the fish community in 1980-1990s, but their portion decreased in the last decade (to 8.2% in 2001). In recent years, sculpins comprise the second most important biomass. These changes are caused by several weak year classes of Pacific cod and saffron cod and increasing of sculpins biomass in 2000s. The structure of the bottom fish community was reorganized twice during the last three decades: from a flatfish-gadid community to monodominant flatfish community in the early 1990s; and from this monodominant community to polydominant one in the late 1990s. Both qualitative reorganizations were accompanied by successive quantitative changes: total biomass of demersal fish decreased step-by-step. Total biomass was the highest in 1980s and became the lowest in the last decade.

October 19, 10:05 (FIS-P-7557)

Reduced minimum size limits improve Tanner crab fishery management in the eastern Bering Sea

William R. Bechtol¹, Gordon H. **Kruse**², Joshua Greenberg³ and Hans Geier³

¹ Bechtol Research, P.O. Box 3426, Homer, AK, 99603, USA

² School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 17101 Point Lena Loop Rd., Juneau, AK, 99801, USA
E-mail: Gordon.Kruse@alaska.edu

³ School of Resources Management, University of Alaska Fairbanks, P.O. Box 757200, Fairbanks, AK, 99775, USA

Historically, the eastern Bering Sea supported the largest commercial fishery for Tanner crabs (*Chionoecetes bairdi*) in the world with peak catches of 30,210 mt in 1978. The stock experienced several boom and bust cycles and a rebuilding plan is being developed to promote stock recovery. Management measures include male-only restrictions, a minimum size limit of 138-mm carapace width (CW), and separate fishery quotas for Bristol Bay and Pribilof Islands areas. Declines in female size of maturity and the proportion of males reaching legal size since the 1970s raised questions about the size limit. Because the maturity molt is a terminal molt for this species, smaller maturity size leads to reduced legal male catch-per-unit-effort (CPUE), disproportionately high fishing mortality on the largest-growing males, and greater handling and at-sea discard rates of females and sublegal males. We analyzed the merits of a reduced size limit for this Tanner crab fishery using data from assessment surveys, fishery landings, and at-sea observations of discards. Yield-per-recruit and stock biomass-per-recruit analyses reveal a tradeoff between spawning biomass and fishery yield over a range of alternative size limits and harvest rates. Increased CPUE of legal males, coupled to reduced catch sorting, would greatly improve fishery viability, particularly in the Pribilof Islands area, where the decline in size of maturity is greatest. Based on our analysis, in March 2011 the Alaska Board of Fisheries reduced the size limit to 112 and 122 mm CW for the Pribilof and Bristol Bay areas, respectively.

October 19, 10:50 (FIS-P-7711)

Dysfunction by design: Consequences of limitations on transferability of catch shares in the Alaska pollock fishery

Keith R. **Criddle** and James Strong

Fisheries Academic Program, University of Alaska, Fairbanks, 17101 Pt. Lena Loop Rd., Juneau, AK, 99801, USA
E-mail: kcriddle@sfos.uaf.edu

The American Fisheries Act of 1998 (AFA) ushered in a bold experiment in rights-based fisheries management. The AFA granted permanent partitions of the eastern Bering Sea pollock Total Allowable Catch to four fishery sectors and to western Alaska Community Development Quota entities. In addition, the AFA granted authority for the formation of harvesting cooperatives within the sectors and renewed the authority of the CDQs to lease their quota to any sector. The AFA cooperatives and CDQs have prospered. Product recovery rates have increased by 150%, the mix of products has shifted from high throughput product forms, such as fillets and mince, to higher per-unit value product forms such as fillets. In addition, the development of markets for fillets and surimi in the U.S. and Europe has reduced dependency on Japanese demand for surimi. Rising fuel prices and imposition of management measures that reduce salmon bycatch and minimize putative adverse impacts of fishing on Steller sea lions cause fishing vessels to travel greater distances from port, increase operating costs per ton harvested, and increase the likelihood that portions of the inshore B-season allocation will be left unfished. Allowing intersectoral leasing could provide increased revenues for inshore and at-sea sectors as well as consumers who would benefit from increased supplies of surimi and fillets.

October 19, 11:10 (FIS-P-7656)

Management strategies in a marine ranching ecosystem based on an integrated fisheries risk analysis method for ecosystems (IFRAME) framework

Heewon **Park**¹, Jaebong Lee², Youngil Seo³ and Changik Zhang¹

¹ Division of Marine Production System Management, Pukyong National University, Busan, 608-737, R Korea
E-mail: hwpark@pknu.ac.kr

² Fisheries Resources Management Division, National Fisheries Research and Development Institute, Busan, 619-705, R Korea

³ Fisheries Resources and Environment Division, Southwest Sea Fisheries Research Institute, NFRDI, Yeosu, 556-823, R Korea

An integrated fisheries risk analysis method for ecosystems (IFRAME) framework is applied to manage fisheries resources in a marine ranching ecosystem. We suggested two management options based on the IFRAME framework. In the first option, optimum fishing level and acceptable biological catch (ABC) were estimated and then the management strategy was proposed. In the second option, the carrying capacity of the marine ranching ecosystem was estimated and optimum stocking densities of released fish were also assessed. We suggested two scenarios. In the first scenario, the optimum number of released fish was estimated, which can produce the level of current catch. In the second scenario, the expected increase in biomass from the previously released fish was estimated to project the expected catch of the next year. In the Jeonnam marine ranching ecosystem, the biomass of black sea bream (*Acanthopagrus schlegeli*) was estimated at 675 mt. The optimum fishing mortality (F_{opt}) was 0.249/year and the acceptable biological catch (ABC) was calculated at 130 mt. In the first option, the management strategy was to reduce the current catch to the ABC level. In the second option, first, the optimum number of released fish was estimated to be 2,280,939 individuals, which can produce the level of the current catch. Second, the expected increase in biomass from the previously released fish (650,000 individuals) was 975 mt, and so the expected catch of the next year was projected to be 181 mt.

October 19, 11:30 (FIS-P-7619)

A conceptual model for determining oil fate and effects on habitat and wildlife in the Arctic

Elizabeth A. **Logerwell**¹ and Mary Campbell Baker²

¹ Resource Ecology and Fishery Management, Alaska Fisheries Science Center, NMFS, NOAA, P.O. Box 15700 F/AKC2, Seattle, WA, 98115, USA. E-mail: Libby.Logerwell@noaa.gov

² NOS-Office of Response and Restoration, 7600 Sand Point Way NE, Seattle, WA, 98115, USA

We developed a conceptual model to support planning for Natural Resource Damage Assessment (NRDA) from oil spills in the Arctic Ocean. The model describes habitats and taxa exposed, exposure mechanisms and injury to natural resources at the individual, population and ecosystem levels. For example, in the case of a release from an offshore platform in the sea during the ice-free season, one potential pathway for exposure is that oil rises towards the surface and is entrained into the water column. This would expose the pelagic habitat. Taxa potentially exposed include zooplankton including ichthyoplankton, pelagic fish, seabirds and marine mammals. Exposure mechanisms could be ingestion, inhalation, adsorption and/or fouling. Injury to individuals could be manifested through oil toxicity and/or impacts of oil on behavior, respiration, growth, and reproduction. The model elements and examples are drawn primarily from the North American Arctic, but the principles and framework are likely to be generally applicable to other Arctic systems. We illustrate potential exposure and injury at the individual, population, and ecosystem level for one key taxa of the Arctic ecosystem, the Arctic cod (*Boreogadus saida*). The model can be used to prioritize NRDA data collection efforts pre- and post-oil spill, and identify key restoration projects. This prioritization is especially important in the Arctic where logistics are particularly challenging and may limit NRDA efforts. In addition, graphical representations of the model can be used to facilitate communication of damage assessment and restoration priorities to stakeholders and the public.

October 19, 11:50 (FIS-P-7735)

Effect of water-temperature transition on hatching in the neon flying squid and numerical simulation of larval migration

Yoshiki **Kato**¹, Mitsuo Sakai¹, Takaya Namba¹, Toshie Wakabayashi¹, Shuhei Masuda², Hiromichi Igarashi², Yoichi Ishikawa², Masafumi Kamachi³ and Toshiyuki Awaji²

¹ National Research Institute of Far Seas Fisheries, 2-12-4 Fuku-ura, Kanazawa-ku, Yokohama, Kanagawa, 236-8648, Japan
E-mail: kyoshiki@affrc.go.jp

² Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanazawa-ku, Yokohama, Kanagawa, 236-0001, Japan

³ Meteorological Research Institute, Japan Meteorological Agency, Nagamine, Tsukuba, 305-0052, Japan

The neon flying squid, *Ommastrephes bartramii*, is widespread in subtropical and temperate regions. The oceanic squid species is economically important, and has been commercially harvested by Japan since 1974, and more recently by Korea and China. The population in the North Pacific Ocean is comprised of two spawning cohorts; the autumn cohort and winter-spring cohort. Interestingly, despite their apparently contiguous hatching periods, there is a marked difference in the mantle length of each of the cohorts. The optimum spawning zone for this species, which undergoes latitudinal shifts over the course of a year due to the presence of climatic systems, is considered to be at sea surface temperatures of 21 to 25°C. This transition in the spawning zone affects the horizontal migration of eggs and larvae, which in turn can affect the recruitment of these species. Thus, transitions in the optimal water temperature for hatching were investigated using a four-dimensional variational (4D-VAR) data assimilation method to more accurately define the mean seasonal state of the North Pacific Ocean. The horizontal resolution of the 4D-VAR data was 0.1° for 27 vertical levels of monthly data. These data were combined with Lagrangian particle-tracking models and hydrographic data, such as current velocity and water temperature after hatching. Taken together, these data could be used to clarify the relationship between the water temperature during the larval stage, the growth of neon flying squid larvae, and recruitment.

October 19, 12:10 (FIS-P-7831)

Jumbo squid population structure and ecosystem role in variable environment of the Eastern Pacific

Chingiz M. **Nigmatullin**¹, Alexander Arkhipkin², John C. Field³ and Unai Markaida⁴

¹ Atlantic Research Institute of Fisheries and Oceanography (AtlantNIRO), 5 Donskoy St., Kaliningrad, 236022, Russia
E-mail: chingiznigmatullin@rambler.ru

² Falkland Islands Government Fisheries Department, P.O. Box 598, FIPASS, Stanley, FIQQ 1ZZ, Falkland Islands, UK

³ Southwest Fisheries Science Center, NOAA Fisheries, Santa Cruz, CA, USA

⁴ El Colegio de la Frontera Sur, CONACYT, Calle 10 - 264, 2400, Campeche, Mexico

The jumbo squid (*Dosidicus gigas*) is one of the largest and abundant nektonic squids with a mean standing biomass estimated to be on the order of 8-12 million tons. It is one of the key species in the ecosystems of tropical and subtropical Eastern Pacific. The intraspecific population structure is quite complicated, with at least two large northern and southern hemisphere meta-populations. In both meta-populations, at least two intra-population forms might be distinguished based on the size-at-maturity: middle-size form, MF (24-40 cm mantle length, ML) and large-size form, LF (40-120 cm ML). Supposedly, these forms represent alternative adaptive phenotypes based on the same gene pool. Activation of either MF or LF ontogenetic programs may be triggered during early life cycle stages by alternative sets of environmental factors (mainly water temperature and food supply). It is hypothesized that both phenotypic forms correspond to two habitat/ecosystem sets of environmental factors. As a result, this “two-faced” population has an improved survival in sharply changing environment. In both hemispheres, there have been observed periods of different duration with absolute predominance of either form. These alternative periods have their own sets of characteristic features in the size of population ranges, peculiarities of distribution, biomass size, squid size structure and place and role in the ecosystem. In particular, MF are consumers up to III-IV trophic levels, whereas LF reach to top-predator level of consumers of V-VI trophic levels. The synecological role of MF and LF and community trophic structure in periods of their predominance are discussed.

FIS Paper Session Posters

FIS-P-7555

Correlation between the distribution of plerocercoid *Diphyllbothrium* sp. in sockeye salmon *Oncorhynchus nerka* smolts and adults with the abundance of parental stocks in the Kamchatka River

Victor F. **Bugaev**

Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO), 18 Naberezhnaya St., Petropavlovsk-Kamchatsky, 683000, Russia. E-mail: bugaevv@kamniro.ru

Azabachye Lake is one of the principle nursery and spawning sites for sockeye salmon in the Kamchatka River watershed. There is a native stock («A» stock) of sockeye salmon in the lake, as well as juvenile sockeye salmon that migrate to the lake for feeding from the upper and intermediate reaches of the Kamchatka River («E» group). Smolts of the «A» stock leave Azabachye Lake at age 2+, whereas smolts of the «E» group leave as age 1+. Data were collected on the distribution of the parasite-indicator *Diphyllbothrium* sp. among smolts of the «A» stock and «E» group from the Azabachye Lake in 1979-2007 and on the abundance of mature individuals of the «A» stock (the most abundant age group 2.3) caught in the lake in 1982-2010. For particular periods (in the same generation), a statistically significant correlation exists between the distribution of the plerocercoid among smolts and mature individuals of the «A» stock and «E» group and the oceanic abundance of the mature parental fish of the «A» stock and «E» group.

FIS-P-7577

Efficiency increase of marine bioresources usage based on the example of some trades

Ekaterina V. **Golovashchenko** and Oleg Z. Badaev

Prognosticate and Regulation Regional Trade Fishery, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: golovashenko@tinro.ru

Based on monitoring conducted aboard vessels fishing different gear types during 2001-2007, we accounted for biological and economic resources available to fishing operations. Economic value takes into account both the income from food production and taxes. We estimated the income of potential realized production based on the amount of bycatch of commercial species, final production output indices and average prices for each relevant unit on the Russian market. Based on just 10 fishing trips of the Far-Eastern fisheries, the lost benefit from discarded bycatch amounted to more than 850 tons worth US\$1389 thousand plus taxes worth US\$35 thousand. The harvest of these additional marine resources can result in a significant increase the fishing efficiency, create the opportunity for additional profit, and provide additional production of food for human consumption.

FIS-P-7578

Efficiency increase of marine bioresources usage based on the example of some trades economic value of ecosystem services of Eastern and Western Sakhalin fishery zones' shelf

Ekaterina V. **Golovashchenko**

Prognosticate and Regulation Regional Trade Fishery, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: golovashchenko@tinro.ru

Based on the amount of total biomass of commercial species and average (2010) prices in the Russian market, the potential value of marine biological resources on the continental shelf is US\$1007 million (fish–85.5%, invertebrates–13.2%, seaweeds–1.3%) for the Eastern Sakhalin fishery zone and US\$659 million (fish–21.8%, invertebrates–77.8%, seaweeds–0.4%) for shelf of Western Sakhalin fishery zone. The potential gross value (not counting expenses) of marine biological resource production for the shelf of Eastern and Western Sakhalin fishery zone amounts to 6% and 14% of the total value of ecosystem services. The high value of annual hydrocarbon production of this region should not form the only basis for future development decisions. The evaluation of ecosystem services shows that the well-being of the whole natural ecosystem is also important.

FIS-P-7582

The effect of the trawl selective parameters on the phenotypic traits of fish stocks

Peng **Sun** and Zhenlin Liang

College of Fisheries, Ocean University of China, Room 213, Rd. 5, Qingdao, Shandong, 266003, PR China. E-mail: sunbird1103@sina.com

As the main tool in fishing work, the long-term use of trawl has a huge impact on the phenotypic traits of fish populations, which will result in the tendency of length shorter of the fish stocks. In this paper, a virtual population of the genetic characteristics is designed with the help of the method of numerical simulation, which simulates the long-term trawl fishing. It also studies the impact of the changes of such selective parameters as selective range and 50% selected length on the development of phenotypic traits of fish populations in the course of trawl fishing. The results show that under the circumstance of long-term fishing and within the specified selective parameters, the smaller the selection rate is or the longer the fish 50% curve length is, the higher the length shortening rate of the fish populations. It is generally believed that the more intense the selectivity trawl is or the longer of the fish 50% length is, the more large fish you can catch, which would consequently protect small fish and therefore the whole fish resource. The result that is gained by this paper is not the same as what we have known about the traditional trawl selective parameters. Therefore, more studies are expected to be done hereafter.

FIS-P-7609

The use of molecular techniques for population genetic analysis of the Pacific herring (*Clupea pallasii*) in the Okhotsk SeaAnna V. **Dakus**¹, Helen V. Kashchenko², Sergey D. Ponomarev³ and Evgeny Denisenko³¹ Laboratory for Pelagic Resources, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: anna.dakus@gmail.com² Magadan Research Fisheries Institute (MagadanNiro), 36/10 Portovaya St., Magadan, Russia³ Khabarovsk branch of Pacific Research Fisheries Centre, Amursky Blvd. 13 A, Khabarovsk, Russia

Molecular techniques are widely used in genetic identification of various marine species and populations. We applied restriction fragment length polymorphism of 16S rRNA gene of mitochondrial DNA (mtDNA) and short tandem repeats analysis (microsatellites) with the purpose to reveal intraspecific genetic variation and differences among spawning aggregations of the Pacific herring (*Clupea pallasii*) from the Okhotsk Sea. Haplotype frequencies varied greatly, and heterogeneity among herring samples has been observed. Genetic variability was the highest in herring spawning along the northwestern Sakhalin, somewhat lower in fish from the northern Okhotsk Sea. Unique haplotypes, found in some samples, could be used as markers for identifying herring in high seas, e.g., from wintering or foraging aggregations. Microsatellites have demonstrated temporally stable genetic divergence among some Pacific herring populations over a small spatial scale in Okhotsk Sea. This divergence is remarkable, given that mutational constraints in microsatellite DNA should increase homoplasmy. Large population sizes should minimize genetic drift and high stray rates should counteract genetic differences accumulating among spawner groups and maintained by natal homing. We hypothesize that temporal and spatial isolation promoted reproductive isolation in Okhotsk Sea spawner groups, fostering genetic divergence. We also hypothesize that straying promoted genetic cohesion among groups with similar spawn timing.

FIS-P-7628

Reproductive biology of *Benthoosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China SeaChiyuki **Sassa**, Seiji Ohshimo, Hiroshige Tanaka and Youichi Tsukamoto

Seikai National Fisheries Research Institute, Fisheries Research Agency, 1551-8 Taira-machi, Nagasaki, 851-2213, Japan

E-mail: csassa@fra.affrc.go.jp

Benthoosema pterotum is a dominant myctophid in the shelf region of the East China Sea (ECS). They are a key species linking secondary producers and upper trophic levels, but information on their reproduction is limited. We examined the sex ratio, sexual maturity, spawning period, oocyte development, and batch fecundity of *B. pterotum* in the ECS, based on 3,065 specimens [10.7-54.8 mm standard length (SL)] sampled in 1999 and 2004-2009. Between 15 and 30 mm SL, the ratio of females to males was ca. 40%; it increased with SL and all individuals ≥ 45 mm SL were females. The gonadosomatic index (GSI) at 50% sexual maturity of females and males was 3.91 and 0.24, respectively. Based on this criterion for GSI, females and males can mature larger than 28 mm and 24 mm SL, respectively. Although mature females having $GSI \geq 3.91$ occurred during May-January, mean GSI of females peaked sharply during August-September, i.e., the primary spawning period. The hepatosomatic index peaked during April-July, and declined during August-September, indicating storage of materials and energy for reproduction. Based on data from seasonal bottom trawl surveys, small individuals of *B. pterotum* began to occur abundantly in autumn, and modal body lengths increased progressively during spring-summer, corresponding with the above reproductive seasonality. Oocytes at various sizes were found in mature ovaries, indicating that they are multiple spawners. Egg size at hydration ranged from 0.57-0.91 mm. Batch fecundity was positively correlated with SL, and ranged from 253-1,942 eggs in fish from 30.1-54.8 mm SL.

FIS-P-7655**Recent distribution and migration patterns of Pacific cod (*Gadus macrocephalus*) in Korean waters**Jaebong **Lee**, Jonghee Lee, Kwangho Choi, Inja Yeon and Dongwoo Lee

Fisheries Resources Management, National Fisheries Research and Development Institute (NFRDI), MIFAFF, 512-1 Haean-ro, Busan, 619-705, R Korea. E-mail: leejb@nfrdi.go.kr

Distribution and migration are critical life history considerations of a stock rebuilding plan for Pacific cod (*Gadus macrocephalus*) in Korean waters. Recent interest in conservation of sub-population stock structure around the Korean Peninsula has placed a renewed emphasis on juvenile dispersal patterns and adult migration behavior. Numerical modeling of drift trajectories in major spawning areas of Pacific cod were used to describe the dispersal pattern of larval cod. In Jinhae Bay, located in south-eastern Korean waters, 35.4% of 1200 particles were retained in the spawning ground while 64.6% were exported to the East Sea of Korea during the first 60 days. Based on the results of drift trajectory models, hydroacoustic as well as surface and bottom trawl-net surveys were conducted to search for larvae and juvenile Pacific cod during March to June in the Jinhae Bay. Schools of juvenile cod were found in late April and moved out from the spawning grounds between mid May and early June. A pop-up satellite archival tag, which was released in the Jinhae Bay on March 4, explained the migration behavior of adult cod as well as swimming depth and seawater temperature during a 90 day period. The information and data on the recent distribution and migration patterns of Pacific cod will contribute to understand fishery behavior and to develop management recommendations, such as a closed season, capture size limit, and optimal catch in the spawning areas for this species in Korean waters.

FIS-P-7657**Fisheries risk assessment in a marine ranching ecosystem based on integrated fisheries risk analysis method for ecosystems (IFRAME) framework**Changik **Zhang**¹, Heewon Park¹, Youjung Kwon¹, Jaebong Lee³, Youngil Seo², Heeyong Kim², Inja Yeon³ and Dongwoo Lee³¹ Division of Marine Production System Management, Pukyong National University, Busan, 608-737, R Korea. E-mail: cizhang@pknu.ac.kr² Fisheries Resources and Environment Division, Southwest Sea Fisheries Research Institute, NFRDI, Yeosu, 556-823, R Korea³ Fisheries Resources Management Division, National Fisheries Research and Development Institute (NFRDI), Busan, 619-705, R Korea

An integrated fisheries risk analysis method for ecosystems (IFRAME) was adopted to manage fisheries resources at the ecosystem level. IFRAME framework has three components, i.e., assessment, forecasting and management. In the assessment component, we identified the ecosystem structure using the ecosystem models, and assessed risks using the ecosystem-based fisheries assessment model which contains 4 management objectives concerning sustainability, biodiversity, habitat quality and socio-economic benefits. At the Jeonnam marine ranching ecosystem, black seabream (*Acanthopagrus schlegeli*) is one of target species mainly taken by stationary gillnets. In this study, we compared the status of the marine ecosystems before (2003) and after (2010) the construction of marine ranch. The objectives risk indices (ORI) were 1.005, 1.282, 0.514 and 1.667 for sustainability, biodiversity, habitat quality and socio-economic benefit and the species risk index (SRI) was 1.117 in 2003. However, the ORIs in 2010 became significantly smaller than those in 2003, i.e., 0.825, 0.088, 0.400 and 0.750 for sustainability, biodiversity, habitat and socio-economic benefits. The species risk index (SRI) also became smaller as 0.516 in 2010.

FIS-P-7662

Stock assessment of elkhorn sculpin (*Alcichthys alcicornis*) along the Uljin area of KoreaChangik **Zhang**¹, Jaebong Lee² and Soojeong Lee¹¹ Pukyong National University, 599-1 Deayeon 3-dong, Nam-gu, Busan, 608-737, R Korea. E-mail: cizhang@pknu.ac.kr² National Fisheries Research and Development Institute (NFRDI), 408-1 Sirang-ri, Gijang-gun, Busan, 619-705, R Korea

To assess the stock status of the elkhorn sculpin along the Uljin area of Korea, yield per recruit (YPR) and spawning biomass per recruit (SBPR) analyses were performed. Estimates of F_{max} and $F_{0.1}$ were 2.10/year and 0.48/year, respectively, and $F_{35\%}$ and $F_{40\%}$ were estimated to be 0.66/year and 0.54/year, respectively. Current fishing mortality was estimated to be 0.63/year and the current age at first capture is 2.41 years. The target reference point of the stock was set to be $F_{40\%}$. SBPR at $F_{40\%}$ and current SBPR were estimated to be 41.85 g and 37.77 g, respectively. Estimated F_{OTY} which is the fishing mortality for the overfished threshold yield was 0.49/year. The ratio of SBPR/SBPR_{MSY} was calculated as 0.90 and that of F/F_{OTY} was 1.05. Therefore, the current stock condition of elkhorn sculpin along the Uljin area of Korea is not overfished, but light overfishing is occurring for this stock.

FIS-P-7666

Spatial and temporal variations of sea surface temperature, zooplankton abundance and anchovy harvest in western waters of the Korean Peninsula during the last three decadesWongyu **Park**¹, Yujin Jeon¹, Junghwa Choi² and Dongwoo Lee²¹ Department of Marine Biology, Pukyong National University, 599-1 Daeyon-3dong, Nam-gu, Busan, 608-737, R Korea
E-mail: wpark@pknu.ac.kr² Fisheries Resources Research Division, National Fisheries Research and Development Institute (NFRDI), Busan, 619-705, R Korea

Spatial and temporal variations of sea surface temperature (SST), abundances of copepods, euphausiids, amphipods, chaetognaths and anchovy harvests were investigated in the western waters of the Korean Peninsula. Zooplankton and SST were monitored at 63 stations arrayed in six transects (124°00'–126°30' E, 34°00'–37°00' N) in February, April, June, August, October, and December during 1978–2010 and anchovy harvest data were obtained from the National Fisheries Research and Development Institute (NFRDI) database. In general, SST increased 0.7–3.8°C during the last three decades with spatiotemporal variations. SST was lowest in February and highest in August. SST was highest in the northernmost transect and declined gradually along transects to the south. The general pattern of interannual variations of SST was similar to the global pattern, which has been increasing. Trends of abundances of all zooplankton groups and anchovy slightly increased interannually and peaked seasonally in June and August, except chaetognaths, which fluctuated around the long-term mean value with a seasonal peak in August and October. Abundances of zooplankton groups were highest in the northernmost transect while those of euphausiids were highest in the southern transect. We discuss the distribution patterns of SST, zooplankton groups and anchovy in relation to oceanographic characteristics in the study area.

FIS-P-7670**Seasonal variations of species composition and abundance in the decapod crustacean assemblage in the coastal waters of Geoje Island and Namhae Island, Korea**Junngyun **Kim**, Junghwa Choi, Kangseok Hwang, Taegyun Oh, Kwangho Choi and Dongwoo Lee

Fisheries Resources Management Division, National Fisheries Research and Development Institute (NFRDI), 151-1 Haeon-ro, Gijang-eup, Gijang-gun, Busan, 619-705, R Korea. E-mail: crangonk@nfrdi.go.kr

Seasonal variations of abundance and species composition of the decapod crustacean assemblage in the coastal waters of Geoje Island and Namhae Island, Korea were investigated. Samples were seasonally collected by shrimp beam trawls from May 2010 to February 2011 at sampling sites. Off Geoje Island, a total of 22,874 individuals of 31 species from 13 families were caught. Off Namhae Island, a total of 7,955 individuals of 15 species from 9 families were collected. In both sites, *Crangon hakodatei* was the most abundant species in total number (79% off Geoje Island, 83% off Namhae Island) and biomass (54% off Geoje Island, 55% off Namhae Island). The next abundant species were *Trachysalambria curvirostris* and *Palaemon gravieri* off Geoje Island, and *Plesionika izumiae* and *Charybdis bimaculata* off Namhae Island. Total abundance (number of individuals) and biomass were the highest off Geoje Island in summer and off Namhae Island in winter, as a result of patterns of *C. hakodatei* at each site. However, the dominant species, community structure, and seasonal variation varied among sampling sites. Cluster analysis separated decapods crustaceans in the sampling sites into four different groups. Principal component analysis verified that seasonal variations in the decapod crustacean assemblage of both sites were different.

FIS-P-7675**Snow crab (*Chionoecetes opilio*) in the western Kamchatka: A new target fishery?**Alexander V. **Lysenko**

Laboratory of the Commercial Crustaceans, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: Phlord@yandex.ru

Snow crab (*Chionoecetes opilio*) has occurred at very low abundance along western Kamchatka unlike the North Okhotsk Sea shelf where it is the most numerous commercial crab species. During trawl surveys of the shelf in 2009-2010 data were obtained indicating that this species has markedly increased in abundance and began to form commercially viable stocks (at an average density of 700 individuals/km²) in the shelf areas from 53° to 55°N at depths from 50 to 450 m. These stocks are adjacent to stocks of Tanner crab (*Chionoecetes bairdi*), resulting in numerous hybrid individuals. The maximum catch of snow crab of 43 individuals/30 min of trawling was recorded at a depth of 122 m and average catches of 10 individuals/30 min of trawling are typical for the depths of 200-250 m. The total number of commercial-sized males (100 mm or more in carapace width) is estimated at 11.28 million individuals. Perhaps the growth of this species is associated with the sharp decrease in stocks of red king crab (*Paralithodes camtschaticus*). There is reason to believe that snow crab can partially occupy the vacant niche of red king crab and therefore increase its numbers. If so, this would be similar to the situation in the Primorye Region where, against the backdrop of falling numbers of red king crab, the number of snow crab has increased. This change in snow crab abundance could form the basis for a commercial fishery in the coming years.

FIS-P-7680

Climatic changes above the Far East and returning of chum salmon into the South Primorye riversT.A. **Shatilina** and A.A. Goryainov

Fisheries Oceanography, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: Shatilina@tinro.ru

Population abundance of chum salmon in the South Primorye rivers was depressed during the 1950s-1970s. After a subsequent increase, chum populations declined to minimum levels in the mid 1990s. This latter decline was experienced not only by wild populations, but also by farmed populations of chum salmon, despite large investments in fish-farming. In the beginning of 21st century chum salmon abundance in South Primorye rivers again started to increase, although their abundance was reduced in several years. To explain such phenomena, we analyzed climatic data on air temperature, precipitation in the watershed above the area of reproduction, and water temperature in the Sea of Japan over migration areas during 1982-2010. There were extremely cold summer and autumn air and water temperatures in the 1980s. On the other hand, a characteristic feature of the 1990s was very warm summers. In the beginning of 21st century summer air and water temperatures started to decline again, but extremely warm autumns persisted. The general pattern of years with high or low returns of chum salmon recorded in July and August was connected to the magnitude of fluctuations in the Far Eastern summer monsoons. Water supply to the rivers in Primorye is provided mainly by rain during July, August and September.

FIS-P-7691

Aging method comparison and growth of Amur barbell, *Hemibarbus labeo* from Goe-san Lake in KoreaMing-Ming **Zhang**¹, Chulwoong Oh¹, Wanok Lee², Jonghun Na¹ and Jaemin Back²¹ Department of Marine Biology, Pukyong National University, 45 Yongso-ro, Nam-Gu, Busan, 608-737, R Korea
E-mail: zhangmingm44ok@163.com² Inland Fisheries Research Institute, National Fisheries Research and Development Institute (NFRDI), 151-1 Haean-ro, Gijang-eup, Gijang-gun, Busan, 619-705, R Korea

Amur barbell, *Hemibarbus labeo*, is a common freshwater species distributed in eastern Asia, from Vietnam to Russia, and prefers deep pools with running water at lower and middle reaches. Age composition is fundamental to understand the population dynamics and productivity of a fish stock. Growth characteristics and age estimation based on scales and otoliths were studied on 287 specimens of Amur barbell in the Goe-san Lake from April to December in 2010. Scales were fixed between glass slides and whole otoliths were used after baking (60°C, 24 h). The population was represented by 6 age groups (0⁺ to 5⁺) from 107.5-374.6 mm total length (L). Ages estimates based on scales were significantly higher than those estimated by otoliths. They showed 46.7% agreement. A marginal index (MI) calculation revealed that the annual ring is formed in May. Growth was estimated using scales. The regression equation between the scale radius (R) and age (t) was $R=0.724t+1.953$ ($R^2 = 0.574$), and the regression equation between scale radius and the total length was $L=4.142R+0.103$ ($R^2 = 0.602$). The regression equation between weight and length was $W=0.0006L^3.147$ ($R^2 = 0.995$), which was fitted to von Bertalanffy growth equation $L_t = 404.7(1 - e^{-0.126(t+0.227)})$. This study improves understanding of age and growth of Amur barbell, and provides some information useful to management of inland fisheries.

FIS-P-7695**Occurrence of deep snow crab *Chionoecetes japonicus* on the shelf of the northwestern Sea of Japan**Andrew N. **Deminov**

Laboratory of Commercial Invertebrates of the Far Eastern seas, Pacific Research Institute of Fisheries and Oceanography (TINRO-centre), Vladivostok, Primorsky Krai, 690091, Russia. E-mail: deminov@tinro.ru

In the northwestern part of the Japan Sea deep snow crab (*Chionoecetes japonicus*) occur to depths of 2060 m with highest commercial concentrations at depths of about 1000 m. In the southern Primorye the main habitats and fishing areas of snow crab are depths of 800-1500 m from Peter the Great Bay to the northeast into Tatar Strait. Trawl surveys indicate the presence of *Chionoecetes japonicus* on the mainland shelf. In 1988, four males of commercial size were found at depths of only 120 m. In the spring of 2011 trawl catches of *Chionoecetes japonicus* occurred at depths of 320 m to 360 m. Catches at 400 m were dominated by males of size 20-39 mm carapace width (CW) and small females (13-69 mm CW). In the range of 400-600 m, catches were dominated by males 21-135 mm CW and mature males of size 82-104 mm CW predominated deeper areas. Females of size 13-69 mm CW are found ubiquitously, but they are concentrated at depths of 370-730 m. These data suggest that *Chionoecetes japonicus* off the coast of Primorye can occur on the continental shelf and upper reaches of the continental slope from 320 m.

FIS-P-7710**Northwestern Pacific and southeastern Asia chondrichthyan fishes: Major threats and conservation status**Alexei M. **Orlov**

International Fisheries Cooperation, Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 V. Krasnoselskaya St., Moscow, 107140, Russia. E-mail: orlov@vniro.ru

Conservation status of chondrichthyan fishes in the northwestern Pacific and southeastern Asia is presented based on evaluations made by experts during a number of workshops of IUCN Shark Specialist Group. The total number of species recorded in the southeastern Asia and northwestern Pacific whose conservation status is currently assessed is 359. The species were distributed by category in the following way: Critically Endangered (CR) 11, Endangered (EN) 16, Vulnerable (VU) 59, Near Threatened (NT) 57, Least Concern (LC) 71, Data Deficient (DD) 143, and Not Evaluated (NE) 2. Thus, the preliminary results show that 24% of chondrichthyans in southeastern Asia and northwestern Pacific are endangered (CR, EN, VU), 16% more are near such status (NT), and the status of 20% of species does not cause concern (LC). Finally, for estimation of the status of 40% of species of this region information is scarce (DD). The majority of species in categories CR, EN, and VU, *i.e.*, endangered, are inhabitants of fresh waters and marine coastal areas (most species of the families Pristidae, Dasyatidae, Myliobatidae, and Carcharhinidae). This is not surprising, because intensive and detrimental chondrichthyans fisheries occur in fresh and coastal marine waters of this region. In addition, their environment within these areas is highly exposed to the other human activities (pollution, habitat destruction, navigation, agriculture, forestry, amelioration, mining, coastal developments, excessive logging, *etc.*). Undoubtedly, these other activities also influence populations of chondrichthyans living in these waters.

FIS-P-7718

Distribution and timing of larval Tanner crab *Chionoecetes bairdi* in Glacier Bay and neighboring strait in southeastern Alaska, USAMinkyong **Shin**¹, Wongyu Park¹, Changuk Park¹ and Thomas Shirley²¹ Department of Marine Biology, Pukyong National University, 599-1 Daeyon-3dong, Nam-gu, Pusan, 608-737, R Korea
E-mail: hello_marine@naver.com² Harte Research Institute, Texas A&M University-Corpus Christi, 6300 Ocean Dr., Unit #5869, Corpus Christi, TX, 78412-5869, USA

Climate changes affect the habitats of aquatic animals including commercial species. Glacier Bay is a glaciated fjord located within Glacier Bay National Park and Preserve in southeastern Alaska, USA. The Tanner crab, *Chionoecetes bairdi* supports valuable commercial fisheries in Glacier Bay and throughout the Gulf of Alaska and eastern Bering Sea. The distribution and timing of larval Tanner crab, *Chionoecetes bairdi*, were investigated in the bay. Tanner crab larvae were collected from late May to mid-August in 2004, using an NIO net during daylight hours at three inner and two outer Glacier Bay stations at the two different depths in the water column, above and below the thermocline. A total of 703 Tanner crab larvae were collected: Zoea I (ZI) = 454; Zoea II (ZII) = 239; Megalopa (M) = 10. ZI and ZII occurred from late-May to mid-June, and M appeared during June and July. Densities of ZI and ZII above and below the thermocline were not significantly different, whereas M were collected only from below the thermocline. The densities of ZI at outer bay stations were higher than those of inner bay stations while those of ZII and M at inner and outer bay stations were not different. We compared the larval timing and duration of all species of the genus *Chionoecetes* species in the world to infer changes in larval distributions and development of *Chionoecetes* spp. resulting from a changing global climate.

FIS-P-7795

Exploring impacts of environmental history on larval growth: Combination of otolith microstructure analyses and particle-tracking experimentsSachihiko **Itoh**¹, Toshiro Saruwatari¹, Haruka Nishikawa², Ichiro Yasuda¹, Kosei Komatsu^{1,3}, Atsushi Tsuda¹, Takeshi Setou⁴ and Manabu Shimizu⁴¹ Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8564, Japan
E-mail: itohsach@aori.u-tokyo.ac.jp² Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanazawa-ku, Yokohama-shi, Kanagawa, 236-0001, Japan³ Graduate School of Frontier Sciences, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8564, Japan⁴ National Research Institute of Fisheries Science, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa, 236-8648, Japan

Growth rate is one of most important determinants for larval survival, as it is negatively related to mortality rate directly or indirectly through increasing body size. Although some field studies suggested linkage between the larval growth rates and environmental factors such as temperature and food abundance, they were based only on data obtained at the times when larval samples were collected; this is primarily because environmental information is only available at the time of capture, whereas larval growth rates can be estimated backwards hatching investigating otolith microstructure. To examine the relationship between environment and growth rate from hatching to capture, in the present study we combined otolith microstructure analysis and numerical particle-tracking experiment. In spring 2007, samples of larval sardine and anchovy were collected around the Kuroshio area. Daily ages at capture and growth rates at daily ages were estimated from otolith microstructure. Spawning grounds and temperature histories were calculated by numerical back-tracking using the outputs of a high-resolution data assimilation system and considering observed egg production. Errors of the calculation and possible applications will also be discussed.

FIS-P-7805

Age and growth of Conger eel *Conger myriaster* (Brevoort) using UV light from Korean watersJinho **Bae**, Hyemin Park, Hyeonggi Kim and Chulwoong OhDepartment of Marine Biology, Pukyong National University, 599-1 Daeyeon3-dong, Nam-gu, Busan, 608-737, R Korea
E-mail: jhbae2007@gmail.com

The common conger eel, *Conger myriaster* is distributed from the East China Sea to the waters of Korea and Japan, and predominantly inhabits shallow coastal waters as commercially important fish. Analysis of otoliths is one of the most popular methods to determine age and growth for population dynamics and the fisheries management. In general, the sagittal otoliths from fish are directly removed to determine the age and growth pattern. In recent years, new techniques and methods, such as the EDTA etching method, three dimension image analysis, Burnt and UV light observation, have been used for more accurate age determination. Various methods have been proposed, but size and shape of otoliths vary by species. Therefore, the otolith processing method should be developed on a species-specific basis. An initial study of UV light observation was reported in Japan to determine the age of Conger eel in 2002. In this study, age was determined under UV light and the growth relationship was estimated based on total length, weight and otolith readings. Samples were collected by trap and bottom trawl monthly from August 2009 to July 2010 from the South Sea off Korea where average depth was around 100m. Otoliths from 501 specimens were separated, washed and dried. After treatment, they were processed by embedding, cutting and polishing. Samples were examined under a Carl Zeiss microscope. Otoliths were baked by UV light that makes observation easier between opaque and translucent zone. The standard range of 50 samples was compared to those of before and after treatment. Illumination wave lengths used were 380-420 nm. Age data were analyzed for the von Bertalanffy Growth Function (VBGF) by non-linear regression (SYSTAT12), and growth parameters were used to estimate the growth performance index. Results were compared to other species. Total length (TL) and weight (TW) ranged from 25.7 to 106.3 cm and from 35.0 to 2572.7 g, respectively. The length-weight relationship was $TW = 0.0011TL^{3.12}$ ($r^2 = 0.99$, $p < 0.05$). Size and weight of otolith increased with individual somatic growth. The otolith morphologic measurement was $TL = 22.26OR - 16.65$ ($r^2 = 0.79$, $p < 0.05$). Otolith age ranged from 1-10 years old. The VBGF equation was: $L(t) = 185.1(1 - \text{EXP}[-0.06(t + 0.732)])$. Growth Performance Index was estimated with $\Phi' = 3.31$. Our VBGF estimates indicated that conger eel can grow to large sizes with a relatively slow growth rate. In fact, body growth increments of around 10 cm year⁻¹ were observed, although the growth rates seemed to be slow down for fish above 6 years old.

FIS-P-7848

Stock assessment by risk analysis of ecosystem indicators in the southern sea of KoreaYoungil Seo¹, Hyunki Cha¹, Sunkil Lee¹, Heeyong Kim¹, Jinyeong Kim¹ and Changik Zhang²¹ South Sea Fisheries Research Institute, NFRDI, MIFAFF, 347 Anpo-ri, Hwayang-myeon, Yeosu, Cheollanam-do, 556-823, R Korea
E-mail: seoyi@nfrdi.go.kr² Pukyong National University, 599-1 Daeyeon-3dong, Nam-gu, Busan, 608-737, R Korea

Fishery scientists have recently recognized the potential of ecosystem-based fisheries management to improve the sustainability of fisheries resources. Given the depressed condition of many fisheries resources in Korea, this recognition has been expanded and more effort has been taken to improve this approach. Therefore, a comprehensive ecosystem-based fisheries management approach requires holistic consideration of ecological interactions of target species with other species, the complex interactions between fishes and their habitat, and the effects of fishing on fish stocks and their ecosystem. Changes in ecosystem risks were evaluated using the ecosystem-based fisheries assessment (EBFA) approach of Zhang *et al.*, (2009) and the comprehensive ecosystem-based fisheries management (EBFM) plan was made for the southern sea of Korea in this study. The risk assessment of the southern sea ecosystem was conducted by establishing ecosystem management objectives and by estimating risk scores (RS) for indicators. To conduct this analysis a number of indicators and their reference points for assessing these risk scores were developed in this study. The number of indicators in the risk analysis was 28 for the quantitative tier 1 analysis and 30 for the qualitative tier 2 analyses. The objective risk index (ORI), species risk index (SRI), fisheries risk index (FRI), and ecosystem risk index (ERI) were calculated from the risk scores. Comparing past (1988) and current (2008) status of fisheries resources, management implications were discussed. In this study target fisheries in the southern sea of Korea were selected for the risk analysis including large purse seines, large pair trawls, anchovy drag nets, and inshore traps. Main target species were also selected including chub mackerel, jack mackerel, hairtail, yellow croaker, yellow goose fish, and anchovy. The ERI of the southern sea of Korea decreased substantially from 1.036 in 1988 to 0.851 in 2008, and the management status indices (MSIs) showed that there was an improvement in the management of fisheries operated in the southern sea of Korea. ERI was assumed to improve as a result of effects of offshore fisheries and ecosystem conditions. However, more research is needed regarding inshore ecosystem indicators, such as harmful gear, ghost fishing and harbor construction, so that the ERI index can be improved.

FIS-P-7882

Program to assess the conservation status of the Olympia oyster, *Ostrea lurida*, in Canada

Graham E. Gillespie, Tammy Norgard, Sean MacConnachie, Lily Stanton and Jessica Finney

Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, BC, V9T 6N7, Canada
E-mail: Graham.Gillespie@dfo-mpo.gc.ca

The Olympia oyster, *Ostrea lurida*, is the only oyster native to the Pacific Coast of North America. Olympia oysters supported commercial fisheries in the US and Canada until the early 1900s, but were quickly overharvested and production shifted to culture of Pacific oysters, *Crassostrea gigas*. Olympia oysters were designated Special Concern by the Committee on the Status of Endangered Species in Canada (COSEWIC) in 2000 (confirmed 2010) and listed under the Species At Risk Act in 2003. In response, Fisheries and Oceans Canada published a Management Plan and developed monitoring and research programs. The Management Plan outlines protection, management, research, monitoring and outreach activities. Research included field surveys to verify historic distribution, development of quantitative survey protocols, selection of index sites for long-term monitoring, and collaborative work with the Royal British Columbia Museum to explore population structure using genetic techniques. Monitoring included baseline quantitative surveys of proposed index sites. Outreach included collaborative work with stewardship groups (both in Canada and the US), aquaculturists and academics. In 2009 and 2010, 152 sites were surveyed to confirm Olympia oyster presence, 13 index sites were designated and 9 baseline surveys were conducted. Tissue samples were collected from 103 sites and work is ongoing to explore population structure in Canada. Results from the program informed an updated COSEWIC Status Report in 2010, confirming the species' status of Special Concern.

FIS-P-7883

Movements of albacore, swordfish and shortfin mako sharks in pelagic environments: Electronic tagging reveals the influence of oceanography on vertical and horizontal behavior

Suzanne Kohin¹, Heidi Dewar¹, John Childers¹, Karen Nieto¹, Eric Prince², Barbara A. Block³ and Rosa **Runcie**¹

¹ Fisheries Resources Division, Southwest Fisheries Science Center, NOAA Fisheries, 8604 La Jolla Shores Dr., La Jolla, CA, 92037, USA
E-mail: suzanne.kohin@noaa.gov

² Southeast Fisheries Science Center, NOAA Fisheries, 75 Virginia Beach Dr., Miami, FL, 33149, USA

³ Tuna Research and Conservation Center, Hopkins Marine Station, Stanford University, Oceanview Blvd., Pacific Grove, CA, 92950, USA

Tunas, billfish and pelagic sharks are large, mobile pelagic fish distributed throughout seemingly unbounded oceanic environments. Recently, electronic tags have dramatically increased our understanding of how oceanography influences movements and abundance in the World's oceans. Horizontal and vertical behavior of albacore, swordfish and shortfin mako sharks are likely driven by both oceanography and prey availability. For north Pacific albacore, horizontal movements occur throughout the temperate North Pacific with focal areas of high use occurring in productive areas of the California Current and North Pacific Transition Zone. In focal areas, nighttime swimming depth is largely confined to above the thermocline, while daytime swimming depth varies regionally; albacore are more surface oriented where the thermocline is shallower and Chlorophyll-*a* concentrations are higher. For swordfish in both the eastern Pacific and western Atlantic, daytime hours are spent predominately below the thermocline with maximum daytime depth significantly correlated with light penetration; vertical movements closely paralleled movements of the deep sound scattering layer (DSL) suggesting a dependence on DSL organisms. Shortfin mako sharks in the northeast Pacific show seasonal fidelity to California Current waters off the North America West Coast. New quantitative methods to identify mesoscale fronts and filaments from satellite-derived temperature data have been developed to examine mako shark movement with respect to these features. This poster will highlight our efforts to combine electronic tagging and oceanographic data to better understand the effects of mesoscale features on the behavior of large pelagic fish and help define their habitats within the broader oceanic realm.

POC Paper Session

Co-Convenors: *Kyung-Il Chang (Korea) and Michael G. Foreman (Canada)*

Papers are invited on all aspects of physical oceanography and climate in the North Pacific and its marginal seas, except those covered by Topic Sessions sponsored by the Physical Oceanography and Climate Committee (POC).

Day 1, Tuesday, October 18 (14:00-18:05)

- 14:00 *Introduction by Convenors*
- 14:05 **Elena I. Ustinova, Yury D. Sorokin and Svetlana Yu. Glebova**
Regional and seasonal inhomogeneity of climatic variability in the Far-Eastern Seas (POC-P-7862)
- 14:25 **Alexander Lazaryuk, Boris Burov and Vladimir Ponomarev**
Evolution of the thermohaline structure of water under ice of Amurskii Bay (POC-P-7860)
- 14:45 **Anastasiya Abrosimova, Igor A. Zhabin and Igor M. Belkin**
Distribution of the Amur River discharge in the Okhotsk and Japan seas (POC-P-7772)
- 15:05 **Pavel A. Fayman, Vladimir Ponomarev and Vyacheslav Dubina**
Simulation of the mesoscale circulation in the Peter the Great Bay and adjacent Japan Basin area (POC-P-7768)
- 15:25 *Coffee/Tea Break*
- 15:45 **Igor A. Zhabin**
Tidally driven system around the Shantar Islands (the Sea of Okhotsk) (POC-P-7565)
- 16:05 **Jaehun Park, Hojin Lee, Younggyu Park, Hongsik Min, Chan Joo Jang and Kyungtae Jung**
Tidal impacts on spatio-temporal variabilities of intermediate and deep waters in the East/Japan Sea (POC-P-7762)
- 16:25 **Oleg Zaitsev, Cuauhtemoc Turrent-Thompson and Jean Linero Cueto**
Intense sea-breeze currents in the coastal zone of the southern Baja California peninsula, Mexico (POC-P-7645)
- 16:45 **Hanna Na and Kwang-Yul Kim**
Decadal variability of the upper-ocean heat content in the Northwestern Pacific (POC-P-7852)
- 17:05 **Takao Kawasaki, Hiroyasu Hasumi and Masao Kurogi**
A modeling study of the North Pacific shallow overturning circulation (POC-P-7756)
- 17:25 **Talgat R. Kilmatov and Olga I. Trinko**
Modeling the subarctic–subtropical boundary and possible climatic changes (POC-P-7653)
- 17:45 **Tatyana Belonenko, Victor Foux, Victor Koldunov, Alexey Koldunov and Dmitriy Staritsyn**
Sea-surface levels in the Northwestern Pacific as indicators of local and global tendencies in climate change (POC-P-7709)
- 18:05 Session ends

Day 2, Wednesday, October 19 (9:00-12:25)

- 9:00 ***Introduction by Convenors***
- 9:05 **Howard J. Freeland**
 An analysis of the time-varying heat, salt and volume budget in an oceanic control volume (POC-P-7879)
- 9:25 **Michael Foreman, Wendy Callendar, Diane Masson, John Morrison, Badal Pal and William Merryfield**
 A regional climate model for the British Columbia continental shelf (POC-P-7734)
- 9:45 **Enrique N. Curchitser, Justin Small, Kate Hedstrom, Mike Alexander and Brian Kaufman**
 Regional and global ramifications of eastern boundary upwelling (POC-P-7902)
- 10:05 **Rong-shuo Cai, Hong-jian Tan and Rong-hui Huang**
 The impacts of thermal anomalies in the East China Sea and its adjacent seas on East Asian atmospheric circulation and climate change in East China (POC-P-7583)
- 10:25 ***Coffee/Tea Break***
- 10:45 **Fangli Qiao, Guansuo Wang, Xingang Lv and DeJun Dai**
 Drift characteristics of green macroalgae in the Yellow Sea in 2008 and 2010 (POC-P-7693)
- 11:05 **Taewook Park, Chan Joo Jang, Minho Kwon, Hanna Na and Kwang-Yul Kim**
 Sea surface salinity variability in the Yellow and East China Seas and its relation to ENSO (POC-P-7834)
- 11:25 **Yanzhou Wei, Daji Huang and Xiaohua Zhu**
 Temporal and spatial variability of the Kuroshio at PN/TK sections during 1955–2010 (POC-P-7890)
- 11:45 **Wang Rong, Xiao Yuzhang, Yang Fan, Song Pingping and Wang Hefeng**
 Analysis and forecasting of wind field characteristics on the northern and open-ocean borders of the South China Sea (POC-P-7807)
- 12:05 **Xiaomeng Wang and Jianbo Han**
 An overview of the development of technical and legal issues of carbon dioxide ocean storage and the progress in China (POC-P-7900)
- 12:25 Session ends

POC Paper Session Posters

- POC-P-7588 **Dmitrii S. Strobykin, Yury N. Morgunov, Yury A. Polovinka, Vladimir V. Bezotvetnykh and Evgeny A. Voytenko**
Shallow water acoustic tomography of hydrophysical processes in the Korea Strait
- POC-P-7596 **Hong-jian Tan and Rong-shuo Cai**
Possible impact of tropical El Niño Modoki on SST of China's offshore and its adjacent waters
- POC-P-7611 **Alexander A. Nikitin and Irina L. Tsypysheva**
Upwelling in the coastal areas of the Primorye according to satellite observational data
- POC-P-7612 **Larisa S. Muktepavel**
Special features of spatial-temporal distribution of ice in the basic commercial zone and spawning areas of the Okhotsk Sea in 2006-2010
- POC-P-7615 **T.A. Shatilina, G.Sh. Tsitsiashvili and T.V. Radchenkova**
Intrinsic features of regional circulation and climate above the Far East in the summer period of 1980–2009
- POC-P-7623 **Elena I. Yaroshchuk**
The study of patterns of energy transformation of surface wind sea waves into energy of microstrains of the Earth's crust
- POC-P-7626 **Nadezda M. Dulova and Fedor F. Khrapchenkov**
Short-term variability of currents and sea level fluctuations in the coastal zone of the Posyet Bay (the Sea of Japan/East Sea)
- POC-P-7629 **Galina Pavlova and Pavel Tishchenko**
Alkalinity of the Japan Sea: A new look
- POC-P-7649 **Vadim V. Novotryasov and Anatoliy E. Filonov**
Observations of highly nonlinear internal tidal waves in the Northern Gulf of California
- POC-P-7652 **Polina Lobanova and Dmitriy Staritsyn**
On a possibility to forecast interannual variability of sea level in the Japan and Okhotsk Seas
- POC-P-7664 **Evgeniya Tikhomirova and Vladimir Luchin**
Typical distributions of oceanographic parameters in Peter the Great Bay (Japan Sea)
- POC-P-7674 **Valentina V. Moroz**
The intermediate water hydrology-acoustical characteristics forming peculiarities in the Kuril-Kamchatka area
- POC-P-7690 **Viktoria A. Platonova and Larisa S. Chernushova**
Climatic trends from characteristics of the cold half-year on the coast of the Russian Far East
- POC-P-7696 **Alexandr Figurkin**
Variability of thermohaline characteristics in the 0-1000 m water layer of the deep part of the Okhotsk Sea

- POC-P-7697 **Svetlana Shkorba and Elena Dmitrieva**
Linkages between anomalies of ice extent in the Japan/East Sea, Pacific SST and atmospheric indices
- POC-P-7701 **Nadezda M. Vakulskaya**
A study of time changes of ice regime characteristics in the Bering Sea
- POC-P-7722 **Irina Mashkina**
Multi-scale variability of water structure in the northwestern part of the Sea of Japan using Argo drifters
- POC-P-7771 **Pungguk Jang, Kyoungsoon Shin, Okmyung Hwang, Minchel Jang, Woojin Lee, Bongkil Hyen and Dongchll Jeon**
Seasonal effect of Tsushima Current Warm Water in the South Sea of Korea
- POC-P-7780 **Svetlana N. Taranova and Igor A. Zhabin**
Seasonal and interannual sea surface temperature variability in the Japan/East Sea
- POC-P-7789 **Kwangyoung Jung, Youngjae Ro and Baekjin Kim**
Impact of the freshwater release on the tidal circulation in the Chunsu Bay, Yellow Sea, Korea based on numerical modeling
- POC-P-7790 **Eduard A. Spivak and Anatoly N. Salyuk**
Winter hydrography and periodic shallow water dynamics in the southeastern part of Laptev Sea—Results of the POI FEB RAS expedition in April 2011
- POC-P-7814 **Yongchao Pang and Zhuoying Zhao**
On research status and application of China Standard Seawater
- POC-P-7818 **Kirill Kivva, Anna S. Vazhova and Sergey Dudkov**
Influence of eddy structures on nutrients distribution in the western Bering Sea from September-October 2010
- POC-P-7820 **Vladimir Ponomarev, Pavel A. Fayman and Vyacheslav Dubina**
Simulation of mesoscale circulation over the continental slope of the Northwest Japan/East Sea
- POC-P-7835 **Taewook Park, Chan Joo Jang, Johann H. Jungclaus, Helmuth Haak, Wonsun Park and Im Sang Oh**
Changjiang freshwater effects on summer sea surface warming in the Yellow and East China Seas
- POC-P-7843 **Anatoli Erofeev, John A. Barth, R. Kipp Shearman and Zen Kurokawa**
Thermal Mass Correction Method for Conductivity-Temperature-Depth measurements on gliders
- POC-P-7894 **Rosa Runcie, Jonathan Phinney and Harold P. Batchelder**
Pacific Coast Ocean Observing System (PaCOOS) scientific objectives and recent activities
- POC-P-7916 **Dongfeng Xu and Mingquan Xu**
The improvement of the Kuroshio path in Luzon Strait by assimilation of Argo data into numerical modelling

Day 1, POC-Paper Session Oral Presentations

October 18, 14:05 (POC-P-7862)

Regional and seasonal inhomogeneity of climatic variability in the Far-Eastern Seas

Elena I. Ustinova, Yury D. Sorokin and Svetlana Yu. Glebova

Laboratory of Fisheries Oceanography, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690950, Russia. E-mail: eustinova@mail.ru

This paper summarizes our studies on inhomogeneity of climatic variability in the Japan/East, Okhotsk and Bering Seas. We used historical and contemporary sources of regional data of the observations on various thermal and atmospheric circulation parameters. We estimated the regional and seasonal features of climatic variability. Among the Far-Eastern Seas, the most significant reduction of the ice extent occurred in the Okhotsk Sea, while in the Bering Sea a negative trend in ice cover was not statistically significant. Over the past 55 years (1957–2011), the mean winter value of ice cover in the Okhotsk Sea has decreased by 4% per decade. However, in the areas to the north from the Okhotsk Sea and in Chukotka, weak negative (or insignificant) winter trends of air temperature are observed, while maximal warming in winter and spring occurs over the southern part of the Russian Far East and over the coast of Japan. In the last 15 years, the redistribution of quasi-periodical components contributing to the total variance of ice cover has occurred in the Far-Eastern Seas: the relative contribution of shorter components (with time-scale ≤ 10 years) had increased. Integrated impacts of cyclones on the thermal variability depending on spatial scales of the atmospheric processes are discussed, too. Recent estimates confirm the tendency of decreasing differences between summer and winter air temperatures over the Japan/East Sea and increasing differences in the northwestern Okhotsk Sea; *i.e.* the continentality increases in the northern part of Far East and decreases in its southern part.

October 18, 14:25 (POC-P-7860)

Evolution of the thermohaline structure of water under ice of Amurskii Bay

Alexander Lazaryuk, Boris Burov and Vladimir Ponomarev

V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia
E-mail: lazaryuk@poi.dvo.ru

Variation of the seawater temperature, salinity and density stratification in the Amurskii Bay in the cold season are studied. CTD observations in the Amurskii Bay from October 2010 to March 2011 show four periods with a different thermohaline structure. From mid fall to early January, a quasi-homogeneous thermohaline structure is formed basically due to thermal convection. Its temperature reaches the freezing point of about -1.8°C . When the ice cover becomes stable, the evolution of seawater structure is primarily associated with brine rejection and salt convection. The heat and salt are released due to the crystallization of seawater. Part of this heat goes into the atmosphere through the ice and the other part remains in the seawater under the ice. Salt is left in the seawater. Layered convection increases the temperature and salinity of the seawater column. In addition, part of the brine reaches the sea bottom and forms a water layer of high salinity (35 psu). The temperature of this layer gradually increases due to the heat flux from the bottom. In the absence of ice growth, its subsequent melting stops the supply of salt in the seawater. In this case, seawater near the bottom is heated and moves upwards. Vertical convection promotes the removal of various substances from the sediments. These substances can have both a beneficial and adverse impact on the environment. Horizontal inhomogeneity of the brine bottom layer and its evolution are associated with river runoff and circulation processes controlled by bottom topography in the bay.

October 18, 14:45 (POC-P-7772)

Distribution of the Amur River discharge in the Okhotsk and Japan seas

Anastasiya **Abrosimova**¹, Igor A. Zhabin¹ and Igor M. Belkin²

¹ Laboratory of Hydrological Processes and Climate, Department of General Oceanology, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia. E-mail: amber@poi.dvo.ru

² Graduate School of Oceanography, University of Rhode Island, 215 South Ferry Rd., Narragansett, RI, 02882-1197, USA

The Amur River is Northeast Asia's largest river, discharging 360 km³/yr into the Amurskiy Liman connecting the Okhotsk and Japan seas. The bulk of the discharge spreads within the Okhotsk Sea, albeit a substantial part escapes into the Japan Sea. We investigated partitioning of the Amur River discharge between the Okhotsk and Japan seas from visible and infrared satellite imagery and from *in situ* hydrographic data. During the ice-free season (June–October), the discharge largely flows northward into the Okhotsk Sea. During the spring–summer flood (June–July), a complex dynamic regime with a steady anticyclonic circulation (“bulge”) forms in the Sakhalin Bay (Okhotsk Sea), driven by the southerlies. In autumn (September–October) the Amur discharge spreads from the eastern Sakhalin Bay around the northern tip of Sakhalin Island and feeds the East Sakhalin Coastal Current. In autumn, strong northerlies drive the Amur discharge southward through Nevelskoy Strait into Tatar Strait (Japan Sea). Partitioning of the Amur River discharge between the northern and southern routes is determined largely by local winds, with a minor role played by sea level differences between the Japan and Okhotsk seas.

October 18, 15:05 (POC-P-7768)

Simulation of the mesoscale circulation in the Peter the Great Bay and adjacent Japan Basin area

Pavel A. **Fayman**¹, Vladimir Ponomarev² and Vyacheslav Dubina²

¹ Department of Engineering Oceanology and Ecological Designing, Far Eastern Regional Hydrometeorological Research Institute, 24, Fontannaya St., Vladivostok, 690600, Russia. E-mail: Pavel.Fayman@gmail.com

² Pacific Oceanological Institute, FEB RAS, 43 Baltiyskaya St., Vladivostok, Russia

Formation and evolution of eddies with different scale in time and space in the Peter the Great Bay and adjacent Japan Basin area are studied by using the MHI numerical layered model (Shapiro, 1998, 2001) of ocean circulation. We simulate the nonlinear mesoscale eddy dynamics over the shelf, continental slope, and Japan Basin taking into account realistic bottom topography and daily mean external atmospheric forcing. The model domain is the Japan Basin area with high horizontal resolution grid (about 1.2 km). The near-surface atmospheric fields were formed based on NCEP/NCAR Reanalysis.

The numerical experiments with minimized coefficients of the horizontal and vertical viscosity show the intensive mesoscale dynamics, particularly, synoptic scale variability of anticyclonic/cyclonic eddies and streamers over the shelf and continental slope. The anticyclonic eddies generated over the shelf break and continental slope and moving southwestward along the slope with prevailing velocity of about 2-5 cm/s. The spatial scale of the anticyclonic eddies is usually increased near the Peter the Great Bay shelf where it exceeds significantly the baroclinic Rossby deformation radius.

The current system and mesoscale dynamics over the continental slope and Peter the Great Bay shelf is substantially changing from summer to winter. The strong northeastward boundary jet current is formed near the western coast of the Peter the Great Bay from late October to November when the monsoon is already changed from the summer type to the winter one.

The simulation results are compared with the data of the oceanographic and satellite observations.

October 18, 15:45 (POC-P-7565)

Tidally driven system around the Shantar Islands (the Sea of Okhotsk)

Igor A. **Zhabin**

Department of Oceanology, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: zhabin@poi.dvo.ru

The Shantar Islands are located in the southwestern part of the Sea of Okhotsk (Russia, Khabarovsk Region). The Shantar Islands area is a unique marine ecosystem that features complex oceanographic processes and maintains a high biological diversity of marine life (the Shantar Islands National Park). The oceanographic processes on the southwestern Okhotsk Sea shelf are investigated using satellite data (AVHRR NOAA, MODIS Terra/Aqua, Landsat TM/ETM), bottle and CTD measurements. These features and processes include: strong vertical mixing by tides, a seasonal cycle of heating and cooling, and buoyancy input from rivers. Tidal currents in the Shantar Islands area are among the highest in the Sea of Okhotsk. Tidal mixing exerts a strong influence on the spatial pattern of hydrographic structures, nutrient delivery to the euphotic zone, and biological productivity in the Shantar Islands region. The region around the Shantar archipelago forms a complex system where circulation is driven by tidal currents, freshwater runoff and wind. Tidally-induced mixing of nutrient-rich water in conjunction with an important freshwater outflow from rivers maintains a high concentration of nutrients at the surface during the ice-free season ("nutrient pump"). Satellite observations provided high-resolution views of the submesoscale processes within the tidally dominated coastal region: the formation of headland fronts and eddies, tidal jets, interaction between of tidal currents, and river discharge.

October 18, 16:05 (POC-P-7762)

Tidal impacts on spatio-temporal variabilities of intermediate and deep waters in the East/Japan Sea

Jaehun **Park**¹, Hojin Lee², Younggyu Park¹, Hongsik Min¹, Chan Joo Jang¹ and Kyungtae Jung¹

¹ Korea Ocean Research and Development Institute, Ansan, P.O. Box 29, Seoul, 425-600, R Korea. E-mail: jhpark@kordi.re.kr

² Division of Marine environment and Bioscience, Korea Maritime University, 1813 Taejong-ro, Yoon-do-ku, Busan, 606-791, R Korea

The East/Japan Sea (EJS), a marginal sea of the northwestern Pacific Ocean, has been considered a miniature ocean because its circulation system and intermediate- and deep-water formation are similar to those of the major oceans. It has therefore been chosen as an ideal basin for high-resolution modeling studies of oceanic processes. Using an eddy-resolving ocean general circulation model that can take account of semi-diurnal and diurnal tides as well as oceanic flows, this study investigates the impact of tides on the formation and circulation of intermediate and deep waters in the EJS. Vertical mixing by semi-diurnal internal tides and internal residual currents by diurnal tides enhance ventilation of intermediate and deep waters in the EJS, which brings water mass characteristics closer to those observed. When tides are included in the numerical simulation, intermediate and deep waters show interdecadal variation, which has been observed in the EJS.

October 18, 16:25 (POC-P-7645)

Intense sea-breeze currents in the coastal zone of the southern Baja California peninsula, Mexico

Oleg **Zaitsev**, Cuauhtemoc Turrent-Thompson and Jean Linero Cueto

Interdisciplinary Center on Marine Science, National Polytechnic Institute, IPN Ave., Playa Palo de Santa Rita, La Paz, B.C.S., 23096, Mexico
E-mail: ozaytsev@ipn.mx

Vertical structure of currents was examined at different locations along the shelf of the southern Baja California peninsula using Acoustic Doppler Current Profilers (ADCP) deployed during the period 2007–2011. Rotary spectral analysis, harmonic analysis and a rotary multiple filter Wavelet-type technique were applied to investigate temporal variations in currents and local winds. Diurnal variability of currents at all locations was generated by two dominant mechanisms: sea-breeze and gravitational (tidal) forcing. In the Bay of La Paz the first mechanism was responsible for the generation of surface-intensified counterclockwise (CCW) rotary diurnal and semidiurnal currents in the upper mixed layer while the second was responsible for the relatively weak quasi-barotropic clockwise (CW) rotary tidal currents observed throughout the remainder of the water column. Diurnal currents were comprised of three major tidal gravitational constituents (K_1 , O_1 and P_1), and one strong radiational CCW constituent S_1 in the upper 30 m layer that was coherent with the CCW local sea-breeze. A significant semidiurnal S_2 constituent was also highly coherent with the wind. In contrast to the cross-bay orientation prevalent in tidal ellipses of other constituents, tidal ellipses for the S_1 and S_2 bands were oriented normal to the entrance of the bay. Coherent (“deterministic”) tidal currents account for roughly 65% (59% for S_1) of the total diurnal kinetic energy in the surface layer, while incoherent tidal motions account for 18% and background noise for 17% of the kinetic energy. Below 30 m depth, the corresponding estimates are 40%, 32% and 28%, respectively.

October 18, 16:45 (POC-P-7852)

Decadal variability of the upper-ocean heat content in the Northwestern Pacific

Hanna **Na** and Kwang-Yul Kim

School of Earth and Environmental Sciences, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, 151-742, R Korea
E-mail: hanna.ocean@gmail.com

Upper-ocean (0–400 m) heat content variability in the Northwestern Pacific is investigated using a 40-year reanalysis dataset from 1967 to 2006. The first and second modes of the upper-ocean heat content variability represent the seasonal cycle and a cooling signal, respectively. The cooling signal during the 40 years is large along the latitude band between 30°N and 45°N. The third mode shows decadal variability with positive and negative anomalies in different regions of the Northwestern Pacific. Southern regions to the south of about 35°N, including the East/Japan Sea, exhibit significant warming related to this decadal variability during the 40 years, while northern regions show cooling during the same period. Physical aspects of the decadal variability are examined by regression analysis using sea surface height, sea surface temperature and subsurface temperature in the Northwestern Pacific.

October 18, 17:05 (POC-P-7756)

A modeling study of the North Pacific shallow overturning circulation

Takao **Kawasaki**¹, Hiroyasu Hasumi¹ and Masao Kurogi²

¹ Atmosphere and Ocean Research Institute, University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8568, Japan
E-mail: kawasaki@aori.u-tokyo.ac.jp

² Japan Agency for Marine-Earth Science and Technology, 25-3173 Showacho, Kanazawa, Yokohama, Kanagawa, 236-0001, Japan

It is well known that dense shelf water is formed by the sea surface cooling at the northern end of the Okhotsk Sea. Locally enhanced vertical mixing caused by tides is observed around the straits at the southern end of the Okhotsk Sea (Kuril Straits). As the nutrient-rich intermediate water originating from the Okhotsk Sea spreads to the North Pacific Ocean, the shallow overturning circulation should be investigated to understand the North Pacific Ocean ecosystem. However, a precise picture of it is not clear, since its description is difficult to determine by observations. We describe the North Pacific shallow overturning circulation in a non-eddy-resolving ocean general circulation model (the horizontal resolution is 1 degree).

The pathway of the dense shelf water originating from the Okhotsk Sea to the North Pacific Ocean is well reproduced. Strong vertical mixing induces local downwelling around the Kuril Straits, which leads to the enhancement of northward and southward flows in the shallow and intermediate layers when viewed longitudinally, respectively (shallow meridional overturning circulation). The overturning consists of the enhancement of the Kuroshio, its extensions, and subarctic gyre in the shallow layer, while the southward cross-gyre transport of intermediate water originating from the Okhotsk Sea is intensified. Since the latitude of the Kuroshio separation is too high, the mixing-inducing horizontal currents cannot be precisely obtained in this non-eddy-resolving model. We will also report the result of our ongoing eddy-resolving modeling which can reproduce the Kuroshio separation.

October 18, 17:25 (POC-P-7653)

Modeling the subarctic–subtropical boundary and possible climatic changes

Talgat R. **Kilmatorov** and Olga I. Trinko

Far Eastern Federal University (FEFU), 27 Oktaybrskaya St., Vladivostok, 690950, Russia. E-mail: talgat_k@mail.ru

An analytical model of the climatic zonal band 37°–42°N between heating and cooling regions is presented. This area is «a hot line» between the subtropical and subarctic waters and represents the Oyashio/Kuroshio extension double front (thermohaline subarctic and density fronts) in the Northern Pacific. The stationary model is based on the next simplifications – a zonal channel on the f-plane, the geostrophic approach along the channel, and the hydrostatics equation to the vertical direction. The density difference, advection and turbulence forces across the channel are functions of climatic parameters. The stationary condition of this system is defined by the minimum of the mechanical energy E as a sum of available potential (APE) and kinetic (KE) energy: $E = APE + KE = \min$. There are two types of modeling consequences owing to climatic changes. One is a bordering movement as a whole shape in the north–south direction and the other is instability of a cross-section frontal structure owing to a climatic density gradient reduction. Stability loss follows as a consequence of a fold catastrophe in terms of bifurcation theory. The estimation of the APE production owing to the effect of cabbelling is presented. The influence of cabbelling to climatic parameters of the subarctic front is discussed.

October 18, 17:45 (POC-P-7709)

Sea-surface levels in the Northwestern Pacific as indicators of local and global tendencies in climate change

Tatyana **Belonenko**, Victor Foux, Victor Koldunov, Alexey Koldunov and Dmitriy Staritsyn

Department of Oceanology, Faculty of Geography and Geology, Saint Petersburg State University, 33/35 10th Line, Saint Petersburg, 199178, Russia. E-mail: btvlisab@yandex.ru

Our investigations based on satellite altimetry information for the Northwestern Pacific, including the Japan Sea, Okhotsk Sea, and Bering Sea, focuses on the following:

1) Principal mechanisms governing the interannual variation of the sea level; 2) Climatic trends in sea-level oscillations; 3) Statistical analysis of interannual sea-level variation; 4) Wavelet analysis of interannual sea-level variation; 5) Non-linear effects of interannual and seasonal sea-level variation in the Pacific; 6) Connection between sea-level oscillations and other various processes in the framework of the Ocean–Atmosphere system; 7) Steric sea-level oscillations and the assessment of their contribution to the seasonal and interannual variation of the sea level. 8) Applicability of altimeter information in fishery operations.

Convincing proofs have been obtained that sea levels in the Northern Pacific are reflecting the local and global changes of climate.

The thermodynamic interpretation of altimeter survey data of the ocean are suggested. The technique of kinematic analysis of along-track altimeter measurements is theoretically explained and developed. The interannual variation of the sea level was studied in several regions of the Northwestern Pacific, including the Japan, Okhotsk, and Bering seas. Linear and parabolic trends in sea level change were discovered and estimated, and their association with atmospheric and oceanic circulation indices was established.

Substantially new regional results were received for relative contributions by steric and dynamic mechanisms in interannual sea-level variability. By means of the wavelet-analysis, the nonlinear effects defining energy transfer from seasonal sea-level variability to interannual variability were investigated. Alternation of the steric sea-level oscillations in the Northwestern Pacific was considered for various climatic scenarios. Correlation of interannual and seasonal sea-level oscillations with the geophysical and hydro-meteorological indices of atmospheric and oceanic circulation was fixed.

Distribution, migration, and size of the commercial fish population were shown to depend on the speed of sea-level change, defining the location and intensity of zones of the convergence or divergence of sea currents.

Day 2, POC-Paper Session Oral Presentations

October 19, 9:05 (POC-P-7879)

An analysis of the time-varying heat, salt and volume budget in an oceanic control volume

Howard J. **Freeland**

Institute of Ocean Sciences, Fisheries and Oceans Canada, 9860 W. Saanich Rd., P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: howard.freeland@dfo-mpo.gc.ca

This talk continues the analysis of a control volume in the Gulf of Alaska that was first presented one year ago. In the previous talk, analysis was shown that it was possible to use the Argo array to compute the horizontal divergences of heat, salt and volume in a control volume away from boundary currents. This talk will look at the time variability of these balances. Specifically, the time variable part of the volume divergence allows a direct computation of the vertical velocity varying over a period of 8 years. Geostrophic calculations allow computation of the horizontal divergence of heat and salt which, when coupled with the fluxes through the bottom of the control volume, allow the time variability of the total salt content to be related to the divergence and vertical velocity. Both of these are necessary to balance the heat budget; the two terms (horizontal divergence and vertical flux) contribute 50% each to the total variability in the system.

October 19, 9:25 (POC-P-7734)

A regional climate model for the British Columbia continental shelf

Michael **Foreman**¹, Wendy Callendar¹, Diane Masson¹, John Morrison¹, Badal Pal² and William Merryfield²

¹ Institute of Ocean Sciences, Fisheries and Oceans Canada, P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: mike.foreman@dfo-mpo.gc.ca

² Canadian Centre for Climate Modelling and Analysis, Environment Canada, University of Victoria, P.O. Box 3065, Stn CSC, Victoria, BC, V8W 3V6, Canada

A regional, ocean-only, climate model for the British Columbia continental shelf has been developed and preliminary future scenario simulations have been carried out. The 3 km model takes future atmospheric forcing from one or more regional, atmosphere-only, climate models and estimates future coastal freshwater discharges in twenty-two sub-basins by downscaling the precipitation, temperature and snowpack projections provided by these same regional models. Initial and lateral boundary oceanic conditions for salinity and temperature are computed by adding anomalies from one or more global climate models to more highly-resolved present-day fields. Model results will be presented and both future work and the impact on regional ecosystems will be briefly discussed.

October 19, 9:45 (POC-P-7902)

Regional and global ramifications of eastern boundary upwelling

Enrique N. **Curchitser**¹, Justin Small², Kate Hedstrom³, Mike Alexander⁴ and Brian Kaufman²

¹ Institute of Marine and Coastal Sciences, Rutgers University, 71 Dudley Rd., New Brunswick, NJ, 08901, USA
E-mail: enrique@marine.rutgers.edu

² National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO, 80307-3000, USA

³ University of Alaska Fairbanks, P.O. Box 757500, Fairbanks, AK, 99775, USA

⁴ Earth System Research Laboratory, NOAA, 325 Broadway, Boulder, CO, 80305-3337, USA

We present results from a climate model integration with a multi-scale ocean component capable of locally enhancing resolution. The model is the NCAR Community Earth System Model (CESM), in which the ocean component contains a high-resolution ROMS nest for the California Current System. In this presentation we will discuss the latest results from a century-long integration showing that the better representation of coastal upwelling has both regional and global ramifications to the climate system. We will present a prototype two-way boundary condition between the global and regional ocean models and distinguish between the role of atmospheric tele-connections and oceanic advection in propagating the upwelling signal.

October 19, 10:05 (POC-P-7583)

The impacts of thermal anomalies in the East China Sea and its adjacent seas on East Asian atmospheric circulation and climate change in East China

Rong-shuo **Cai**¹, Hong-jian Tan¹ and Rong-hui Huang²

¹ Key Laboratory of Global Change and Marine-Atmospheric Chemistry, Third Institute of Oceanography, SOA, 178 Daxue Rd., Xiamen, Fujian, 361005, PR China. E-mail: rscai@163.com

² Center for Monsoon System Research, Institute of Atmospheric Physics, Chinese Academy of Science, Beijing, 100190, PR China

In view of the pronounced interannual and interdecadal variations of thermal anomalies (sea surface temperature, SST anomalies) in the East China Sea and its adjacent seas (ECS), which also exhibit a clear rising trend and have a significant impact on the marine environment and ecology (Cai R. *et al.*, 2010a; 2010b; 2010c; 2011), a regional climate model (RegCM3) is used to examine the impacts of thermal anomalies in ECS on East Asian atmospheric circulation and climate change in East China. Numerical experiment results clearly indicate that the warm (cold) state in ECS in summer has remarkably different effects on zonal and meridional circulation over East Asia and on regional climate change in East China.

Numerically simulated results show that when SST in ECS is above normal in summer, a downward motion with a divergence in the lower level and a convergence in the upper level can appear over the middle and lower reaches of the Yangtze River and the Yangtze River/Huaihe River valley in East China and most of Northeast China, which contributes to the decrease in summer rainfall in these areas, in addition to an upward motion with a strong convergence in the lower level and a remarkable divergence in upper level over the region to the east of these seas. An upward motion with strong convergence in the lower level and remarkable divergence in upper level also occurs in South China, the southern part of Northeast China and the Korean Peninsula. Thus, there is an obvious increase in summer precipitation in these regions. When SST in ECS is below normal, the opposite phenomena appear in the above mentioned areas.

Furthermore, the processes of atmospheric circulation variability over East Asia caused by the SST anomalies in these sea regions are explored, based on NCEP/NCAR reanalysis and HadISST datasets from 1979 to 2008, by using the methods of composite and correlation analyses. The relationship between the SST anomalies in ECS and the interannual variations of summer precipitation in East China is also examined by using the same analyzing methods and daily data of summer precipitation at 752 stations in China, and also using GPCP 2.1 and HadISST datasets. The analyzed results basically verified the numerical experimental results, *i.e.*, the impacts of thermal anomalies in ECS on East Asian atmospheric circulation and regional climate change in East China.

Consequently, it is suggested that the thermal state of ECS not only has an important impact on the marine environment and ecological system in ECS, but also has obvious effect on East Asian atmospheric circulation and regional climate change in East China.

October 19, 10:45 (POC-P-7693)

Drift characteristics of green macroalgae in the Yellow Sea in 2008 and 2010

Fangli **Qiao**, Guansuo Wang, Xingang Lv and DeJun Dai

First Institute of Oceanography, SOA, 6 Xian-Xia Ling Rd., Hi-Tech Park, Laoshan District, Qingdao, Shandong, 266061, PR China
E-mail: qiaofl@fio.org.cn

In order to investigate the aggregation mechanism of green macroalgae (*Enteromorpha prolifera*) on the Qingdao coastline, the macroalgal drift characteristics in the Yellow Sea during June and July in 2008 and 2010 were simulated using a three-dimensional wave-tide-circulation coupled model. In June 2008, the monthly-mean surface current flowed onshore and its direction was almost perpendicular to the Qingdao coastline, which was identified as the main reason for a huge accumulation of algae in the coastal waters off Qingdao. The current became parallel to the coastline in July 2008; this shift in current direction led to little accumulation of algae near Qingdao and thus relieved the environmental pressure on the 2008 Olympic sailing events. By using the coupled model, we predicted that there would be no serious algal accumulation at Qingdao in late June 2010, which was later confirmed by observations. This study demonstrated that the drift path of macroalgae near Qingdao is mainly controlled by the surface current, which is primarily driven by wind. Regional climate change is therefore one of the means by which physical processes affect marine ecosystems.

October 19, 11:05 (POC-P-7834)

Sea surface salinity variability in the Yellow and East China Seas and its relation to ENSO

Taewook **Park**¹, Chan Joo Jang¹, Minhoo Kwon¹, Hanna Na² and Kwang-Yul Kim²

¹ Korea Ocean Research and Development Institute, 1270 Sadong, Ansan, 426-744, Republic of Korea. E-mail: twpark.kr@gmail.com

² School of Earth and Environmental Sciences, Seoul National University, Seoul, 151-742, Republic of Korea

This study investigates interannual variability of sea surface salinity (SSS) in the Yellow and East China Seas (YECS) using a global ocean general circulation model with regional focus on the YECS. A cyclostationary EOF analysis finds that the interannual variability of the SSS in the YECS is mainly attributable to a Changjiang river discharge (CRD) variability. The CRD variability is linked to El Niño–Southern Oscillation (ENSO)-related precipitation over east China. That is, composite precipitation patterns in El Niño and La Niña years show that when El Niño events occur in winter, more rainfall is observed over central China in the rainy season of the following years. The heavy precipitation leads to a large amount of CRD, which results in decreasing SSS in the YECS. This suggests that summer SSS variability in the YECS is closely linked to ENSO via the summer precipitation system over east China.

October 19, 11:25 (POC-P-7890)

Temporal and spatial variability of the Kuroshio at PN/TK sections during 1955–2010

Yanzhou Wei¹, Daji **Huang**^{1,2} and Xiaohua Zhu^{1,2}

¹ State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, State Oceanic Administration, Hangzhou, 310012, PR China

² Department of Ocean Science and Engineering, Zhejiang University, Hangzhou, 310058, PR China. E-mail: djhuang@sio.org.cn

The temporal and spatial variability of the Kuroshio in the East China Sea is studied, based on the longest velocity and Kuroshio volume transport (KVT) records established, from temperature/salinity profiles at the PN section during 1955–2010 and the TK section during 1987–2010, using an inverse method. The established KVT shows mass balance between the PN and TK sections, fits well with available moored current observations, the Kuroshio net transport in the upper 10m has good linear correlation with sea level difference across the Tokara Strait, and the estimated velocity exhibits a uniform and decrease variance from surface to bottom. From these results, the variability of the KVT, KVT per unit width (uKVT) and the sectional velocity, on the interannual to decadal scale in particular, are investigated using Empirical Orthogonal Function (EOF) and Wavelet Spectrum methods. The KVT is predominant, with interannual variability at a 2- to 5-year period with an amplitude of 2.86Sv, followed by interdecadal variability at about a 20-year period with an amplitude of 0.33Sv, and an increasing trend at a rate of about 0.09Sv per 10 years. The mean uKVT structures exhibit a single peak at PN while they double peak at the TK section. The Kuroshio axis, defined by the position of the largest uKVT at a section, is generally stable but may fluctuate dramatically around some years at the PN section, while it exhibits an interannual fluctuation at the TK section. The principal EOF modes of velocity at the PN and TK sections indicated adjacent to the mean velocity core is the critical area of the variability of velocity on the interannual-decadal scale, modulated by different mechanisms: KVT leading velocity core extends rightward at the PN section while the Kuroshio axis has a northward fluctuation at the TK section. The second EOF modes show a sea-saw like variability mode at the PN section related to the Kuroshio axis fluctuation while an in-phase variability mode at the TK section is related to the KVT variation.

October 19, 11:45 (POC-P-7807)

Analysis and forecasting of wind field characteristics on the northern and open-ocean borders of the South China Sea

Wang **Rong**¹, Xiao Yuzhang², Yang Fan^{1,3}, Song Pingping¹ and Wang Hefeng³

¹ South China Sea Marine Prediction Center, SOA, 353 XingangZhong Rd., Guangzhou, Guangdong, 510310, PR China
E-mail: wwwrwr@163.com

² South China Sea Environmental Monitoring Center, SOA, Guangzhou, 510300, PR China

³ Zhuhai Marine Environmental Monitoring Central Station of State Oceanic Administration, SOA, Zhuhai, 519015, PR China

The South China Sea borders East Asia on the north and faces a wide ocean area (or: maritime space), which has a special geographic location. It has a typical monsoon character. This paper makes a correlation analysis of the near-ocean area's wind field and macroscale atmospheric circulation character, showing the impact of abnormal atmospheric circulation to the wind field of the northern South China Sea area. It confirms that the distribution of the wind field has a strongly zonal and seasonal character. Because of the change of climate yearly, for example, of El Niño and ENSO circulation, the South China Sea's warm-pool area index changes, and has a correlation to the near-ocean area's wind field intensity. With the exception of traditional statistics, prophase diagnosis analysis, prophase strong signal of atmospheric outer force factor, composite use of numerical forecasting, and composite diagnosis analysis, are effective measures of enhancing and improving on the medium-range and short-range forecasting results.

October 19, 12:05 (POC-P-7900)

An overview of the development of technical and legal issues of carbon dioxide ocean storage and the progress in China

Xiaomeng **Wang** and Jianbo Han

National Marine Environmental Monitoring Center, State Oceanic Administration, 42 Linghe St., Dalian, 116023, PR China
E-mail: xmwang@nmemc.gov.cn

Carbon Capture and Storage (CCS) is increasingly being considered a significant way to mitigate global climate change, but ocean storage has not been widely applied due to the problems of technology and law.

An analysis of CO₂ ocean storage development indicates that effective methods of storage capacity estimation, separation, capture and transport technology, storage site selection, monitoring of leakage and environmental effects, and how to ensure the safe and long-term storage of CO₂, *etc.*, have become main technology challenges in the development of CCS in the future.

From a legal perspective of CO₂ ocean storage, there are some relevant provisions, amendments and supplements in the international conventions and directives, such as UNCLOS, London Convention/London Protocol, OSPAR Convention, UNFCCC, Tokyo Protocol, *etc.*, but there are still some legal issues that need to be resolved. For example, London Protocol is reviewing the CO₂ Sequestration Guidelines, and addressing the issue of transboundary movement of CO₂.

In recent years, CO₂ ocean storage has been actively researched in China, and initial progress has been made, for instance, in 1) the establishment of a method of estimating CO₂ storage capacity, and the calculation of the storage capacity of major sedimentary basins in China, 2) the simulation of CO₂ leakage from the deep sea in the laboratory, and the preparation of "Guidelines of survey and monitoring of CO₂ seabed geological storage (draft)", and 3) the establishment of a database of coastal point sources of CO₂ emissions.

POC-Paper Session Posters

POC-P-7588

Shallow water acoustic tomography of hydrophysical processes in the Korea Strait

Dmitrii S. **Strobykin**, Yury N. Morgunov, Yury A. Polovinka, Vladimir V. Bezotvetnykh and Evgeny A. Voytenko

V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: doom46@yandex.ru

This paper presents the results of acoustic tomography theoretical and experimental studies that were conducted in the Korea Strait in conditions of shallow sea and high levels of variability in tidal states. Since the use of conventional direct measurements of hydrophysical parameters of the water medium is a labour intensive, expensive, and sometimes unexecutable process, the use and development of remote acoustic methods for solving problems in the reconstruction of water medium parameters is a pressing issue. However, many problems require complicated and expensive systems. The most effective way of realizing monitoring is by developing hardware systems with sources and receivers mounted permanently on the sea bottom. The purpose of this study is to appropiate the development of methods and equipment for hydroacoustic monitoring under conditions of shallow depths (less than 10 meters), noticeable or high tide levels, sludgy bottom, and currents resulting from tidal variations.

POC-P-7596

Possible impact of tropical El Niño Modoki on SST of China's offshore and its adjacent waters

Hong-jian Tan and Rong-shuo **Cai**

Key Laboratory of Global Change and Marine-Atmospheric Chemistry, Third Institute of Oceanography, SOA, 178 Daxue Rd., Xiamen, Fujian, 361005, PR China. E-mail: rscai@163.com

El Niño Modoki, a new type of tropical Pacific phenomenon, which is similar but different from the canonical El Niño, has been observed since the late 1970s, followed by its unique influence on global climate. In this paper, relationships between SST during the four seasons in the offshore area of China and its adjacent waters and El Niño Modoki have been comparatively analyzed based on the HadISST dataset and NCEP\NCAR wind data, respectively. The results indicate that (1) a significant negative correlation is found between El Niño Modoki in summer and SST in the offshore area of China and its adjacent waters in autumn, with the significant regions located east of the Kuroshio and (2) during the El Niño Modoki period, anomalous northerlies prevail over the northern part of the Philippines to the offshore area of China. It is therefore suggested that the northerlies are unfavorable for the transport of warm water from the western tropical Pacific to the mid-latitude area. Consequently, El Niño Modoki in summer may contribute to cold SSTs in the offshore area of China and its adjacent waters in autumn by the Kuroshio, with a lag response of the ocean to the atmospheric wind field.

POC-P-7611**Upwelling in the coastal areas of the Primorye according to satellite observational data**Alexander A. Nikitin and Irina L. TsypyshevaPacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky kray, 690090, Russia. E-mail: nikitin@tinro.ru

The difficulty in studying local upwelling in separate seas by satellite methods arose comparatively recently, which set the need for investigation. The following tasks were formulated during coastal upwelling studies in the Japan/East Sea: to determine the regions in which the phenomenon of coastal upwelling occurs; to determine spatial sizes and position of the frontal zones; to estimate the upwelling intensity (by the temperature differences between the upwelling waters and the surrounding waters, and according to the horizontal gradient values of the sea surface temperature in the upwelling zone); to clarify the role of the bottom topography and coastline orography in the determination of upwelling and in the appearance of the specific special features during its development; to determine the frequency of the upwelling observations in the coastal areas of the Primorye; to characterize the basic phases of upwelling development in the coastal areas of the Primorye, and the inert periods. The analysis of satellite data and literary sources showed that in the coastal areas of southern Primorye, the most favorable conditions for upwelling development are created during the establishment of winter monsoon winds, starting in October. Strong north-western winds are considerably strengthened under the influence of the coastline and contribute to the upwelling development in Peter the Great Bay and along the Primorye coast. Comparisons of coastal upwelling in different regions of the Primorye, with the development of large-scale circulation in the far eastern region, confirms the predictability of this phenomenon.

POC-P-7612**Special features of spatial-temporal distribution of ice in the basic commercial zone and spawning areas of the Okhotsk Sea in 2006-2010**Larisa S. MuktepavelCosmic Methods of Ocean Research Laboratory, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Kray, 690950, Russia. E-mail: Larisamk@tinro.ru

The task of remote sensing and operational observation of ice conditions is currently to understand the importance of the shelf zone of the Okhotsk Sea for local commercial fishing and spawning areas. The individual genetic scenario of ice cover formation is characterized for each region. In this paper we identify the tendency and reasons for ice formation in the northeastern sector of the Okhotsk Sea (Western Kamchatka commercial zone) and in the region of quasi-stationary shore polynyas of the Northwestern part (according to the distribution of basic spawning areas of Okhotsk herring) in the period from 2006 to 2010. The period from 2006 to 2009 is characterized by a decrease in ice cover in the Western Kamchatka commercial zone. The lightest ice conditions were noted in 2007. The distinctive special feature of the 2009/2010 season in the subzone was the presence of steady, extensive polynyas in the center part of the Shelikhov Gulf and in the Penzhinskaya Gulf. The ice season of 2010 in the northeastern sector of the Sea (in Western Kamchatka) can be classified as the highest ice year since 2006. It was caused by baric field anomalies over the northeastern sector of Okhotsk Sea. Monitoring shore polynyas on basic spawning grounds of Okhotsk herring in the Northwestern part of the Sea is continuing. A favorable ice regime in the spawning areas from 2006 to 2007 was noted. This was indicated by the early, average periods of appearance and the steady development of extensive shore polynyas which remained sufficiently stable in space and time. The 2010 season was the latest for the "northern" type of steady extensive shore polynyas to make an appearance (April 16). The frequency of occurrence for this type of polynya during the period of observations since 1980 is 19 percent (in 6 seasons: 1979, 1995, 2005-2007, 2010). In the 2008 and 2009 seasons, the development of shore polynyas was extremely unstable during April-May when their areas were sharply decreased, being blocked by shore ice.

POC-P-7615

Intrinsic features of regional circulation and climate above the Far East in the summer period of 1980–2009T.A. **Shatilina**¹, G.Sh. Tsitsiashvili² and T.V. Radchenkova²¹ Fisheries Oceanography, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, Primorsky Krai, 690091, Russia. E-mail: Shatilina@tinro.ru² Institute of Applied Mathematics, Far Eastern Branch of Russian Academy of Sciences, Russia

In this paper some specific variabilities of the Summer Far Eastern Depression (SFED) and Okhotsk Anticyclone (OA) in the summer period of 1948–2009 regimes were analyzed, being important in the variability of atmospheric circulation above the Far East (FE). The initial data for estimation of SFED and OA were provided by the archives of NCEP/NCAR re-analysis of atmospheric pressure fields at sea level and geo-potential H-500 with resolution of 2.5° by 2.5° from 1948–2009. It was found that the center of SFED shifted to the Northeast and OA increased during the 1980s but weakened after 2000. Alterations in the regional centers of circulation above FE was one of the reasons for weakening in the first (cold) and the second (warm) phases of the summer monsoon in temperate latitudes and sub-tropical branch of the FE monsoon. Weakening of the FE monsoon produced peculiarities in the alteration of air temperatures and in the field which resulted in the lessening of significant trends in July and August and enlargement of inter-annual variability in the summer. Variability of atmospheric temperature parameters was determined by the estimation of significant trends of normal magnitudes relative to the geo-potential () thickness field above the Sea of Japan and air temperature at FE stations from 1980–2009. To analyze the air temperatures for 1948–2009, the archives of www.gis.nasa.gov/data/update/gistemp/station_data/ were used.

POC-P-7623

The study of patterns of energy transformation of surface wind sea waves into energy of microstrains of the Earth's crustElena I. **Yaroshchuk**

Laboratory of Physics of Geospheres, Department of Ocean Acoustics, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: e.yaroshchuk@poi.dvo.ru

Investigation of the processes caused by the sea wind waves in coastal areas, which play a significant role in shaping the structure and configuration of the surface zone and beaches, as well as affecting human activity in the ports and waters, are essential to address research and applications. So far, there is no working theory, which gives clear answers regarding the origin and properties of microseisms and the elastic oscillations caused by sea wind waves. In connection with this valuable knowledge is the amount of wind-wave energy needed to be transformed into energy of elastic vibrations of the Earth's crust.

The purpose of this work is to study the pattern of surface wind energy transformation of waves into energy of crustal microdeformations.

This topic is impossible to study without the use of highly sensitive equipment, which has wide frequency and dynamic ranges. Such equipment includes the first, installation, based on modern laser interference methods. Application of these techniques allows the development of equipment that measures variations in key parameters on the level of background hesitation of the geosphere, which is critical in obtaining accurate experimental estimates of the amount of transformed energy at the interface. To measure the variations in crustal microdeformations, a laser strainmeter is used. A laser nanobarograph and a laser measuring hydrosphere pressure variation are used for measuring the variations of atmosphere and hydrosphere pressure, respectively.

During field work in May–June 2007 at the Pacific Oceanological Institute's marine experimental station "Shultz" in the Bay of Vityaz, experimental data were obtained. Laser measuring strainmeter variations of atmosphere pressure change was observed. The period of wind waves from the recording laser measuring hydrosphere pressure variation from 6.0 to 5.3 seconds corresponded to the change in the period of microseisms recorded by an onshore strainmeter. This laser pattern can be explained by the dependence of offshore wind waves of low frequency atmosphere processes.

POC-P-7626**Short-term variability of currents and sea level fluctuations in the coastal zone of the Posyet Bay (the Sea of Japan/East Sea)**Nadezda M. **Dulova** and Fedor F. KhrapchenkovVI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: nadydul@poi.dvo.ru

This paper analyzes data from observations taken in Vityaz Bay, in Trinity Bay, and in the coastal zone of Posyet Bay in the summer–autumn period of 2009–2010. Measurements were taken continuously in Vityaz Bay and in the coastal zone of Posyet Bay in 2009 for 38 days (August 13–September 19) and in 2010 for 34 days (August 27–September 30), at 2 and 1 minute intervals, respectively. Measurements were taken continuously in Trinity Bay for 2 days in November 2010 at 15 minute intervals. In Vityaz Bay, average current velocity measured about 20–30 cm/s, and sea level fluctuations reached 40 cm. In the coastal zone of Posyet Bay, the average current velocity was about 15 cm/s, and fluctuations in the sea level in September reached 30 cm. In Trinity Bay, the average current velocity was about 10 cm/s, and fluctuations in the sea level reached 36 cm. Results of spectral analysis of the measured data show that in the area of low frequencies there are significant peaks corresponding with the periods of 24h, 12h, 6.2h, 3.4h and 1.5h. Statistically significant peaks at periods of 12 to 85 minutes are present in the spectrum of sea-level variability in Vityaz and Trinity Bays; this can be attributed to the periodicity of seiche oscillations of Posyet Bay and contiguous bays. This is confirmed by numerical modeling results obtained previously for the evaluation periods of seiche oscillations in the area.

POC-P-7629**Alkalinity of the Japan Sea: A new look**Galina **Pavlova** and Pavel TishchenkoGeochemistry, VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: pavlova@poi.dvo.ru

The most important feature in the distribution of alkalinity and calcium in the Japan Sea is considered: potential alkalinity increases with depth for conditions when waters are supersaturated in relation to calcium carbonate. It is demonstrated that this fact cannot be explained by formation/dissolution of calcium carbonate.

A new concept explaining the alkalinity distribution in the sea is offered in which the basic process responsible for alkalinity transport from the euphotic layer into interior of the sea is the biological pump. Photosynthesis is the driver. The active element transporting alkalinity is EPS (Extracellular polysaccharides) which is produced by phytoplankton. EPS bind with calcium and other cations forming Transparent Exopolymer Particles (TEP). Settling and decaying of TEP release alkalinity and calcium in the deep layers of the sea. This offered concept explains: a) a vertical flux of calcium carbonate which is independent from the supersaturation/undersaturation state regarding no calcium carbonate of surrounding water; b) the flux of calcium carbonate occurring even when plankton have no calcium carbonate skeletons; c) nonstoichiometric relation between alkalinity and calcium fluxes.

POC-P-7649

Observations of highly nonlinear internal tidal waves in the Northern Gulf of CaliforniaVadim V. **Novotryasov**¹ and Anatoliy E. Filonov²¹ V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: vadimnov@poi.dvo.ru² Physics Department, University of Guadalajara, Apartado Postal 4-079, Guadalajara, Jalisco, 44421, México

In our work we study a semidiurnal nonlinear internal tide in the Northern Gulf of California (NGC), based on temperature and currents fluctuation spectral analysis from moored instruments and analytical simulation. It was observed that (a) the spectrum of kinetic energy has a quasilinear structure with peaks located at frequencies where is the frequency of the tidal harmonic M_2 and $n = 1, 2, \dots$ is the number of subharmonics; (b) the amplitude of even subharmonics M_4, M_8 and of the following uneven subharmonics M_6, M_{10} has the same order; (c) energy of the subharmonics with an increase in their numbers n decreased like ω_n^{-3} . These features of measured spectra were simulated by the analytical model spectrum of a highly nonlinear internal tide (NIT) for hydrological conditions of the NGC. The model spectrum of the NIT has a line structure formed by the subharmonics with frequencies and energy depending on the distance traveled by the NIT from the area of its generation. It is shown that in the breaking area of the NIT, the spectrum in the approximation of the quadratic nonlinearity is asymptotically \sim close to the asymptotic behavior of \sim , and allowance for cubic nonlinearity leads to non monotonic decay of the energy subharmonics depending on its parity.

POC-P-7652

On a possibility to forecast interannual variability of sea level in the Japan and Okhotsk SeasPolina **Lobanova** and Dmitriy Staritsyn

Department of Oceanology, Faculty of Geography and Geology, Saint Petersburg State University, 33/35 10th Line, Saint Petersburg, 199178, Russia. E-mail: pl19@mail.ru

At the moment our predictive capability for climate change is still lacking reliable knowledge of particular mechanisms and their inter-connections. As for the variability of sea level in marginal seas, it is determined by a number of factors which is hard to evaluate quantitatively. Meanwhile, some of these factors can be represented by climatic indices that characterize a state of the atmosphere and ocean and thus can evaluate the connections between sea level variations and global and regional changes. In this paper we examine statistical models of the connections between sea level variability of the Japan and Okhotsk Seas obtained from satellite altimetry data and suitable climatic indices. A mutual correlation analysis was used to determine a degree of desynchronization and to estimate an advance time of the sea level variations forecast for most closely correlated processes. We found that they can be represented by such climatic indices as the Solar activity index (Wolf number), Trans-Niño Index (TNI), The Pacific/ North American teleconnection index (PNA), Earth angular rotation index and Quasi-Biennial Oscillation of zonal wind index (QBO). Then we examined a multi-regression model to forecast sea level variability for 1-4 years advance time. The highest and most stable statistical estimates of regression models were obtained for the Japan Sea ($R_0 = 0.95$). A sea level rise is forecast for the coming years. Over the major part of the Okhotsk Sea there is an opposite tendency for sea level, decreasing with a speed from 0.6 to 1.7 mm/yr with the exception of the most southwestern part where sea level rises with a speed of up to 1.3 mm/yr. Because of nonstationarity of hydrometeorological factors which control sea level variability, the regression forecasting models should be adopted to assimilate updated information.

POC-P-7664**Typical distributions of oceanographic parameters in Peter the Great Bay (Japan Sea)**Evgeniya **Tikhomirova** and Vladimir Luchin

Laboratory of Hydrological Processes and Climate, V.I. Il'ichev Pacific Oceanological Institute, FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: tikhomirova@poi.dvo.ru

The study is based on available oceanographic data collected from 1952 to 2009. We compared a surface dataset to describe surface water temperature during maximum warming (12,468 stations for July–September) and a subsurface dataset consisting of 9,762 stations (for January–June) to describe water temperature between 15-m depth and sea bottom (in the deep-water part of the bay at 15–100 m depth). Considering the thermal state of surface waters, 1952, 1958, 1960, 1967, 1968, 1973, 1975, 1978, 1984, 1988, 1991, 2000, 2006, 2007, 2008 were classified as warm years; 1953, 1969, 1970, 1971, 1972, 1976, 1977, 1981, 1982, 1985, 1986, 1987, 1989, 1990, 1992, 1994, 1997, 1999, 2001, 2003, 2004, 2005 as normal years; 1954, 1957, 1962, 1974, 1979, 1980, 1983, 1993, 1995, 1996, 1998, 2002, and 2009 as cold years. Considering the thermal state of subsurface waters, 1953 was an extremely warm year; 1968, 1974, 1976, 1981, 1989, 1991, 1992, 2002, 2004, and 2008 were classified as warm years; 1952, 1954, 1957, 1958, 1960, 1964, 1967, 1971, 1975, 1977, 1979, 1982, 1983, 1984, 1986, 1990, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2005, 2007, and 2009 as normal years; 1962, 1972, 1973, 1978, 1980, 1985, 1987, 1988, and 2006 as cold years, and 2003 was an extremely cold year. We compared datasets and resulting typical (cold, normal, warm) distributions of water temperature and salinity, dissolved oxygen content, and concentration of phosphates and silicates for the allocated groups of years.

POC-P-7674**The intermediate water hydrology-acoustical characteristics forming peculiarities in the Kuril -Kamchatka area**Valentina V. **Moroz**V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: moroz@poi.dvo.ru

These studies were based on the resources of the Pacific Oceanological Institute (POI) FEB RAS data bank, including the archive materials of national research cruises in the Kuril-Kamchatka area, data of modern field observations carried out by POI, as well as a global array of average long-term hydrological data of more than a semi-centennial period. The Kamchatka Peninsula East, Kuril Archipelago Straits and Pacific Ocean adjacent area are the zones of the Kuril-Kamchatka Current formation which determines, to a high degree, the hydrological regime in the entire northwestern part of the Pacific Ocean. We examined the sound velocity field characteristics that form peculiarities as related to intermediate layer thermohaline water variability in the investigation area. Specific peculiarities of sound speed in the research region are disclosed in the current stream zone and in the straits zone. Here, the location of homogenous cores of minimal temperature is observed in the cold intermediate layer coinciding with the zone of current maximal speed. On the planes of thermohaline cross-sections, these zones converge with areas restricted by closed isotherms. For sound velocity the same picture is observed in which these zones converge with areas restricted by closed isotaha. New information about thermohaline structure formation peculiarities and hydrology–acoustical characteristics variability in the Kuril-Kamchatka area was obtained.

POC-P-7690

Climatic trends from characteristics of the cold half-year on the coast of the Russian Far EastViktoria A. **Platonova** and Larisa S. Chernushova

Department of Meteorology and Climatology, Far Eastern Federal University (FEFU), 8 Sukhanova St., Vladivostok, Primorsky Krai, 690600, Russia. E-mail: platonova@meteo.dvgu.ru

The dynamics of the sum of air temperatures below 0°C and average temperatures of the periods identified in the cold half of the year (pre-winter, winter, pre-spring) are identified. Linear trends of these characteristics were evaluated by correlation coefficients of each variable for the study period. The main purpose of the study was to determine the direction of changes to the most informative characteristics of the intensity of the cold half-year and to determine to what degree these characteristics are responsible for trends during the cold season. In the average long-term, the sum of the temperatures is determined by the duration of the cold half-year, but in some years, this relationship is largely corrected by the level of temperature. The dynamics of the duration and sum of the temperatures varies. It was found that most fluctuations in the amounts sum of temperatures below 0°C and average temperatures of the cold half-year period defined trends with temperatures below -10°C. A warming trend was identified from various characteristics of the cold half-year of the 20th century, and was formed during the main recovery phases of 20-year and 40-year cycles over the last thirty 30 years of the 20th century. By the end of that century, almost everywhere there was a reduction phase in the dynamics of mean temperatures of the cold half-year, winter, and the sum of air temperatures below 0°C. These variables changed to the opposite direction almost everywhere, although a steady trend during this period was not formed. As a result, the authors believe that the presence or absence of trend components for different meteorological variables is determined to some extent only by the ratio of duration and intensity of the phases of recession and recovery cycles in the oscillatory process at different stages.

POC-P-7696

Variability of thermohaline characteristics in the 0-1000 m water layer of the deep part of the Okhotsk SeaAlexandr **Figurkin**

Fishery Oceanography Laboratory, Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia. E-mail: figurkin@tinro.ru

The seasonal and interannual variability of temperature and salinity in the 0–1000 m water layer and the characteristics of the dichothermal and mesothermal layers in the Okhotsk Sea (south of the 54°N) in 1975–2010 were examined. Two anomalies of the usual seasonal changes were found: (1) An annual minimum salinity in the 50–500 m layer of the shelf and slope of western Kamchatka was formed not in fall but in the winter–spring as a result of ice melting in the area of the northern branch of the Western Kamchatka Current. Winds and currents have an opposite direction in winter which contributes to the low water salinity accumulation along the northern and eastern slopes of the TINRO Basin.

(2) There was a decrease in temperature caused by dense bottom water displacement from the northern shelf isobaths at 50–140 m in spring to 300–500 m in fall. This “cold wave” was also observed in the central part of the sea in the intermediate 300–500 m layer, where temperatures were reduced by 0.1–0.2°C from spring to fall. The interannual water temperature changes in the 0–500 m water layer were correlated with ice area changes, which confirms the role of winter cooling in producing temperature anomalies.

The temperature in the 500–1000 m layer generally increased from fall to spring, confirming the fall–winter increase of warm water advection to the north. The highest temperature was found in the mesothermal layer, at its minimum depth, suggesting that the most active warm Pacific waters inflowing through the Kuril Straits occur in autumn and winter, and are associated with straits north of Simushir Island. The time of maximum temperature shifts to summer in the western part of the sea.

Significant negative anomalies of mesothermal water temperature in the 650–900 m layer dominated from 1975 to 1990 (excluding 1983–84); maximal values and positive anomalies were observed from 1992 to 2001; temperature close to the mean has prevailed in recent years.

POC-P-7697**Linkages between anomalies of ice extent in the Japan/East Sea, Pacific SST and atmospheric indices**Svetlana **Shkorba** and Elena Dmitrieva

Ice Research Laboratory, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia. E-mail: sshkorba@yandex.ru

Statistical relationships between anomalies of ice extent in the Japan/East Sea (JES) and SST in JES and Pacific Ocean north of 30° S, as well as atmospheric circulation/climatic indices are studied. The correlation between maximal JES ice extent in mid February and other time series mentioned above are estimated with lags of 0, 1, 3, 6, 9 and 12 months, when the atmospheric circulation indices and Pacific SST anomalies are leading. It is found that the time series (1981–2008) of the JES ice extent has the best correlation with the Wangengejm, Blinova, and Ilyinsky indices of atmospheric circulation in comparison with other circulation indices. The significant negative lagged/unlagged correlation between JES Ice Extent and SSTA prevails in most of the Pacific areas. The core of maximal negative correlations shifts from the equatorial region and eastern extratropical North Pacific area to the subarctic Northwest Pacific and western subarctic frontal zone while the lag decreases from 8 to 0 months. The cores of positive correlation with lag of 6 months are found in the northern tropical area, while a similar correlation with 0 and annual lags is found in the eastern Bering Sea. Finally, the forecasting importance of different characteristics was checked in the statistical prognostic model. Thus, the SST anomalies in different Pacific areas from equatorial to subarctic regions can be used as predictors in the statistical prognostic models for the JES Ice Cover characteristics.

POC-P-7701**A study of time changes of ice regime characteristics in the Bering Sea**Nadezda M. **Vakulskaya**Ice Research Laboratory, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: vakulskaya@poi.dvo.ru

Characteristics of sea ice cover can serve as indicators of seasonal and long-term climatic variability. Sea ice cover influences the formation of power streams in the ocean–atmosphere system and, therefore, on the dynamics of regional and global climate. The ice cover variability of the Bering Sea is considered within the A.N. Chetyrbotskii large-scale model of sea ice evolution. The study of time changes of ice-integrated indicators allows us to reveal the integrated tendencies of their formation and destruction processes and consideration of interannual variations allows us to reveal the latent periodicity for large-scale climatic processes of an atmosphere–ice cover–hydrosphere system. A more natural way of studying ice modes of the sea is a joint consideration of distributions of sea ice characteristics. The search for dependencies between initial parameters and their functions is important for real situations. An analysis of seasonal changes of mean square deviation of ice characteristics and their mean values, and also joint changes of mean values of ice characteristics is carried out. Statistically significant trends are revealed. The dynamics of ice concentration, thickness and predominant floe size are almost identical and have a smooth character indicative of an inertial condition of ice cover. The mean square deviations of ice characteristics at an exit on a certain level are stabilized. The absence of significant correlations between concentration and thickness in the spring, and between form and concentration during all periods, is revealed. A one-for-one conformity of values of thickness and ice form is shown.

POC-P-7722**Multi-scale variability of water structure in the northwestern part of the Sea of Japan using Argo drifters**Irina **Mashkina**

V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: i-val-mash@poi.dvo.ru

Our work concerns estimates of the variability in the drift velocity of Argo floats in the intermediate (deep) layers of the northern Sea of Japan, as well as variability in temperature and salinity profiles measured by the profiling sensors rising and sinking with the float to the surface. Particular attention is paid to the assessment of profiles of temperature and salinity, and speed of the drifting buoys, captured by different dynamic structures in the Sea of Japan. Data used in this study were derived from profiling Argo floats, which were acquired from the website <http://www.nodc.noaa.gov>. The observation period extends from 1999 to 2009. The time interval from the parking depth to the sea surface is typically 9 to 10 days. In the course of this study we identified a medium-sized cyclonic vortex in the region between 41°N and 135°E to 42°N and 136°E and an anticyclonic vortex southeast of the Bogorov Ridge. These vortices were located at a depth of 800dbar, with diameters 144 and 105 km and average orbital speed of 4.27 and 4.02 cm/sec, respectively. The results obtained in this study may be useful for verification of numerical models of circulation at both large and synoptic scales.

POC-P-7771**Seasonal effect of Tsushima Current Warm Water in the South Sea of Korea**Pungguk **Jang**¹, Kyoungsoon Shin¹, Okmyung Hwang¹, Minchel Jang¹, Woojin Lee¹, Bongkil Hyen¹ and Dongchll Jeon²

¹ Department of Southern Coastal Environment Research, KORDI, 391 Jangmok-ri, Jangmok-myon, Geoje, Gyeongsangnam-do, 656-830, R Korea. E-mail: pgjang@kordi.re.kr

² Climate Change and Coastal Disaster Research Department, KORDI, Ansan, 426-600, R Korea

To understand the effect of Tsushima Current Warm Water (TCWW) in the study area, we investigated physical parameters, nutrients, and chlorophyll *a* in two stations, the coastal area (station R) and the continental shelf area (station M) from March 2006 to November 2010. TCWW was the dominant water mass at station M in winter and spring, and at station R in winter. Other seasons were affected by coastal waters and mixed water with the coastal and open sea. But they might be influenced by different coastal waters; station R by the nutrient enriched water in Nakdong River of Korea and station M by the nutrient depleted water in Changjiang Diluted Water from China. Nutrients showed obvious seasonal variation with high values in winter at both stations, and low values in summer at station M and in spring at station R. High Chl-*a* concentration in the mixing periods was triggered by the enhanced stability of the water mass rather than the increasing temperature because the warm current of TCWW is always flowing in the study area. The temperature front existed between stations M and R, which approaches closer to the coastal area in summer. It may interrupt the diffusion of coastal water, with the strong vertical thermocline also making the water mass of station R stable. The phenomena may play an important role for the accumulation of phytoplankton biomass in R station during summer. Therefore, the seasonal distribution of nutrients and Chl-*a* concentration in the study area is strongly affected by the seasonal variation of TCWW and its effect on coastal waters.

POC-P-7780**Seasonal and interannual sea surface temperature variability in the Japan/East Sea**Svetlana N. **Taranova** and Igor A. Zhabin

Laboratory of Hydrological Processes and Climate, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia. E-mail: taranova@poi.dvo.ru

The Japan/East Sea (JES) is located in the region of a high warming trend. Sea surface temperatures (SSTs) in the JES have increased as much as two times the world average over the past century, partly due to global warming. SSTs increase more in the winter season. In this study we used NCEP Reynolds optimally interpolated SST data from 1982–2010 to investigate JES temporal and spatial variabilities and their relation to the volume transport across the Korea/Tsushima Strait. It is found that temporal and spatial variations of SST are very strong. In order to examine the characteristics of SST variability, an EOF analysis is carried out. EOF decomposition shows three dominant modes, explaining 57%, 14% and 9% of total variance, respectively. The first EOF mode of SST has a maximum in the subpolar front. The spatial variation of the second mode mainly indicates the variation the Tsushima Current region. The third EOF mode of SST indicates JES southern (negative) and northern (positive) opposite structure. The temporal variation of the first mode in the summer seems to be consistent with the volume transport through the Korea/Tsushima Strait. This study demonstrates that spatial and temporal variations of SST are closely related to circulation in the JES.

POC-P-7789**Impact of the freshwater release on the tidal circulation in the Chunsu Bay, Yellow Sea, Korea based on numerical modeling**Kwangyoung **Jung**, Youngjae Ro and Baekjin KimDepartment of Oceanography, Chungnam National University, 220 Gung-dong, Yuseong-gu, Daejeon, 305-764, R Korea
E-mail: kyjung@cnu.ac.kr

The Chunsu Bay (CB), a semi-enclosed coastal embayment surrounded by the islands of Anmyeondo and Seosan A- and B-district tide-embankment, intermittently experiences the freshwater release through floodgates from two lakes, Kanwolho (KW) and Bunamho (BN). During the summer season, discharge takes place twice a day for 3–4 hours with discharge rates of 400 (KW) and 200 (BN) m³/sec, respectively. This study investigates the change in the local tidal current, residual currents, and density current by conducting numerical experiments based on the 3D numerical model, ECOM3D. Four major tidal constituents (M2, S2, K1 and O1) were imposed at the southern open boundary. Observed data sets of sea level elevation (E), current (V), temperature (T) and salinity (S) were used for calibration and validation of the model results. Model performances were evaluated in terms of skill score for E, V, T and S, and with scores at the observed stations, most of them exceed 90%. The tidal current in the CB is mostly north/southward rectilinear following isobaths. Yet, locally it shows rotational motions where eddies are formed around scattered small reefs and islands. In the southern part of the CB, currents become intensified due to narrowing of the channel. The distribution of tidal currents can be divided into three areas: in southern part of the CB, high speed currents are from 2 to 3 m/sec, medium range current speeds of 0.5 to 1 m/sec prevail in the central part, and the lowest-level area in the northern part ranges from 0.1 to 0.5 m/sec. Tidal residual currents have a speed of 0.4 to 0.5 m/sec in the southern part. The density currents caused by freshwater release reach up to 0.2–0.4 m/sec in the northern part near the KW and BN. The orientation of the major axes of tidal ellipses is parallel with the local isobath in most of the CB. The impact of freshwater discharge into the CB is well pronounced on the change of tidal ellipse characteristics, so that the inclination angle of tidal ellipse axes of four major tidal constituents were changed by 7.5, 7.4, 24.8 and –7.0 degrees, respectively and the ratio of minor to major axes were increased by 4.2, 4.4, 8.4 and 12.8%, respectively, in the northern part of the CB.

POC-P-7790

Winter hydrography and periodic shallow water dynamics in the southeastern part of Laptev Sea—Results of the POI FEB RAS expedition in April 2011Eduard A. Spivak and Anatoly N. SalyukLaboratory of Arctic Research, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: stilo@poi.dvo.ru

In April 2011 a series of complex oceanographic and ADCP observations in the Buor Khaya Bay at the southeastern part of Laptev Sea and estuarine zone of the Lena River were carried out within the framework of the POI FEB RAS Arctic Drilling expedition. CTD profiles (temperature, salinity, density) at 14 oceanographic stations were executed. From 22–28 April, current data time series were collected under 100% fast ice coverage of 1.4 m thickness and at a water depth of 12 m. Power spectrum density data analyses of the currents showed strong semidiurnal changes. The maximum change of current speed was observed in the 2–4 m layer and was caused by tidal waves. Integration of total movement of water particles showed northwestern transport for a total distance of 4–12 km for different layers. Water flow at this point roughly followed the direction of isobaths. Compared with the POI FEB RAS 2007 winter ice expedition, we observed that the two-layer vertical water structure was less pronounced, and surface and bottom waters were warmer and fresher in 2011.

POC-P-7814

On research status and application of China Standard SeawaterYongchao Pang and Zhuoying Zhao

National Center of Ocean Standards and Metrology, Jieyuanxi Rd. 219, NanKai District, Tianjin, 300112, PR China. E-mail: zzy_sky@163.com

As reference material of salinity value, standard seawater is widely used in the calibration of salinity measuring devices. China Primary Standard Seawater and China Series Standard Seawater, which are, respectively, national primary and secondary reference materials, can improve the comparability of salinity data and are widely applied at national major oceanographic bodies and marine institutes. In recent years, the demand for standard seawater is increasing year by year. China Primary Standard Seawater achieves the same accuracy as that of IAPSO Standard Seawater. China Primary Standard Seawater and China Series Standard Seawater are mainly introduced in this thesis. This paper gives a detailed and systematic introduction of the preparation, packaging process and storage method of standard seawater. Matters needing attention during use are introduced in the paper.

POC-P-7818

Influence of eddy structures on nutrients distribution in the western Bering Sea from September–October 2010Kirill Kivva¹, Anna S. Vazhova² and Sergey Dudkov²¹ Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 V. Krasnoselskaya St., Moscow, 107140, Russia
E-mail: marecol@vniro.ru² Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia

Eddy structures are important features of the ocean current field, causing significant vertical water exchange and forming nutrients fields. Combined analysis of *in situ* data on T, S, dissolved oxygen and nutrients collected between 23 September and 15 October 2010 in the western Bering Sea, and satellite altimetry data for the same time interval, has been done in order to describe possible ways the nutrient field was transformed by specific eddy structures. Four apparent eddies have been observed: three anticyclonic types and one cyclonic type. Five more eddies (3 anticyclonic and 2 cyclonic) were present as features of surface dynamic topography, but were not evident from some of the thermohaline, dissolved oxygen and nutrients fields. The eddies—deepening or shallowing of isolines—reached as deep as about 400 m in all cases. In most cases, eddy structures were better reflected in dissolved oxygen and nutrients fields. However, oxygen saturation was observed to be >100% everywhere in the observational area, suggesting observed cyclonic eddies to be not of high efficiency. Nevertheless, high oxygen saturation levels have been observed down to 150–200 m in the anticyclonic eddies. This work illustrates the importance of eddy structures for nutrient redistribution. However, it may be continued successfully with a proposed special survey focusing on eddy dynamics which should have a higher spatial distribution of data.

POC-P-7820**Simulation of mesoscale circulation over the continental slope of the Northwest Japan/East Sea**Vladimir **Ponomarev**, Pavel A. Fayman and Vyacheslav Dubina

Physical Oceanography, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia. E-mail: ponomarev@poi.dvo.ru

The main features of mesoscale eddy dynamics over the shelf and continental slope in the Northwest Japan/East Sea (JES) are investigated based on numerical simulation and data analyses of satellite infrared images. The MHI quasi-isopycnal ocean circulation model developed by N.B. Shapiro and E.N. Mikhaylova at the Marine Hydrophysical Institute, Sevastopol, Ukraine, is applied. It belongs to a class of 3D layered models in the Z coordinate system with a free surface boundary condition. Interfacial surfaces between the layers can freely move up and down and layers can deform, physically outcrop and restore. The model domain is 39°N–44°N, 129°E–138°E occupying the southern and central area of the Japan Basin and JES cyclonic gyre. It is much more than the area studied and numerical solution for the mesoscale circulation over the continental slope and shelf is practically independent of the condition on the open boundary. The initial conditions for realistic summer isopycnal interfaces, temperature and salinity distribution in the model layers have been taken from a 1999 POI oceanographic survey. Variability of eddy scale in time and space, moving velocity, and vertical structure are analyzed using results of the numerical experiments and satellite images. Typical anticyclonic eddies are usually propagated southwestward along the thin Primorye shelf, shelf break, and continental slope downstream of the Primorskoye Current. The behavior of eddies and streamers in the wide shelf of Peter the Great Bay is quite different. The evolution of eddies described by the model is confirmed by the analyses of satellite images.

POC-P-7835**Changjiang freshwater effects on summer sea surface warming in the Yellow and East China Seas**Taewook **Park**¹, Chan Joo Jang¹, Johann H. Jungclaus², Helmuth Haak², Wonsun Park³ and Im Sang Oh⁴¹ Korea Ocean Research and Development Institute, 1270 Sadong, Ansan, 426-744, Republic of Korea. E-mail: twpark.kr@gmail.com² Max Planck Institute for Meteorology, Bundesstrasse 53, 20146 Hamburg, Germany³ Leibniz Institute of Marine Sciences (IFM-GEOMAR), Duesternbrooker Weg 20, D-24105 Kiel, Germany⁴ School of Earth and Environmental Sciences, Seoul National University, Seoul, 151-742, Republic of Korea

This study explores the effects of Changjiang river discharge (CRD) on the density stratifications and associated sea surface temperature (SST) changes using a global ocean general circulation model with regional focus on the Yellow and East China Seas (YECS). The regressed field of SST on CRD shows that the CRD contributes to surface warming in August. Heat budget analysis finds that the warming is attributable to the formation of a CRD-induced barrier layer, which tends to enhance stratification at the mixed layer base, thereby reducing both vertical mixing and entrainment cooling. The SST difference map between the composites of flood and drought years shows warming patterns over the freshening area, which confirms CRD-induced surface warming. This result suggests that the barrier layer formation due to CRD is an important contributor to the surface heat budget in the YECS in summer.

POC-P-7843

Thermal Mass Correction Method for Conductivity-Temperature-Depth measurements on glidersAnatoli **Erofeev**, John A. Barth, R. Kipp Shearman and Zen KurokawaCollege of Oceanic and Atmospheric Sciences (COAS), Oregon State University, 104 COAS Administration Bldg., Corvallis, OR, 97331, USA
E-mail: aerofeev@coas.oregonstate.edu

Six years (2005-2011) of extensive glider observations off Oregon are used to describe the seasonal variability of subsurface hydrographic and bio-optical fields. Two different types of gliders are used: Slocum gliders to sample the water column from 0-200 m and as close inshore as the 25-m isobath; Seagliders to sample 0-1000 m offshore of the 200-m isobath. The gliders sample in regions of strong wind-driven currents, steep bottom topographic features, and a large range of density due to salty, upwelled deep water and fresh, Columbia River-influenced surface water. Nearly 160,000 profiles of water-column properties (temperature, salinity, dissolved oxygen, chlorophyll and colored dissolved organic matter fluorescence, light backscatter, photosynthetically active radiation, depth-averaged velocity) collected along over 44,000 km of track are used to describe seasonal upwelling (spring transition, strength of upwelling versus along-shore wind stress) and downwelling (fall transition, northward wind- and buoyancy-driven currents). A thermal mass correction method to minimize the error in the measurement of conductivity due to thermal lag in data from unpumped conductivity-temperature-depth (CTD) sensors is described. The minimization is carried out by finding the minimum of a constrained nonlinear multivariable function. A Sequential Quadratic Programming optimization method is used. The method finds values for four correction parameters that minimize the area between two temperature-salinity curves from two consecutive CTD profiles (down/up pairs). Such correction is important for accurate salinity and density measurements, but also because salinity is used to correct measurements of dissolved oxygen. This leads to more accurate estimation of hypoxia areas off Oregon.

POC-P-7894

Pacific Coast Ocean Observing System (PaCOOS) scientific objectives and recent activitiesRosa **Runcie**¹, Jonathan Phinney¹ and Harold P. Batchelder²¹ Directors Office, Southwest Fisheries Science Center, NOAA Fisheries, 3333 North Torrey Pines Court, La Jolla, CA, 92037, USA
E-mail: rosa.runcie@noaa.gov² College of Oceanic and Atmospheric Sciences, 104 COAS Administration Bldg., Oregon State University, Corvallis, OR, 97331-5503, USA

PaCOOS was designed to provide coast wide coordination and integration of regional ocean survey activities to ensure sustained information to support an ecosystem-based approach to the management of the California Current Large Marine Ecosystem (CCLME) under a changing climate. We emphasize: (1) ship-based observations that focus on biological variables (phytoplankton, zooplankton, fish, birds, mammals); (2) transboundary (Canada-U.S.-Mexico) climate and ecosystem issues; and (3) multi-scale and cross-disciplinary data integration and synthesis. PaCOOS is also the government backbone for the three west coast Regional Associations (RAs): the Northwest Association of Networked Ocean Observing Systems (NaNOOS), the Central and Northern California Ocean Observing System (CeNCOOS), and the Southern California Coastal Ocean Observing System (SCCOOS). The unique aspects of PaCOOS are a focus on ecosystem questions that are geographically beyond the scope of the RAs, such as the synthesis of transboundary stocks (*e.g.*, hake, sardine), and (2) a focus on biological observations, many of which are still best (or only) possible to obtain from ship based sampling.

Recent activities include funding the merger and online access to the historical biological and physical data of CalCOFI and developing a series of GIS map overlays of ongoing ocean surveys carried out in the CCLME. Since 2008, PaCOOS has published a quarterly review of climate and ecosystem conditions in the CCLME for public distribution (www.pacoos.org). PaCOOS plans for 2011 include continued coordination with the RAs on joint proposal development with an emphasis on data management, ecological forecasting and assessment, and increasing ocean observing data when opportunities arise.

POC-P-7916

The improvement of the Kuroshio path in Luzon Strait by assimilation of Argo data into numerical modelling

Dongfeng **Xu** and Mingquan Xu

State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, SOA, 36 Baochubei Rd., Hangzhou, Zhejiang, 310012, PR China. E-mail: xudongfengyhcn@yahoo.com.cn

3D numerical modelling of the current system in the Northwest Pacific, based on an MITgcm, was carried out. The seasonal cycle of the volume transport of the Kuroshio was well reproduced, but the loop path of the Kuroshio in Luzon Strait and problem of overshooting in the Kuroshio Extension System (KES) occurred, as in a previous model.

After assimilating monthly Argo data into the numerical model, the shortcomings of the Kuroshio path in Luzon Strait and KES were overcome, although there was a sparse distribution of Argo data near the Luzon Strait area. The reason for the overall improvement was that the North Equator Current System performed better after assimilating the Argo data.

GP

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GP-7599

An indicator of productive estuarine ecosystems and fisheries using macrophytesNatsuki **Hasegawa**¹, Toshihiro Onitsuka¹, Hiroya Abe², Michio J. Kishi², Masahiro Nakaoka³ and Toyomitsu Horii¹¹ Hokkaido National Fisheries Research Institute, FRA, 116 Katsurakoi, Kushiro, Hokkaido, 085-0802, Japan
E-mail: hasena@fra.affrc.go.jp² Graduate School of Environmental Science, Hokkaido University, N10W5 Sapporo, Hokkaido, 060-0810, Japan³ Akkeshi Marine Station, Field Science Center for Northern Biosphere, Hokkaido University, 5 Aikappu, Akkeshi, Hokkaido, 088-1113, Japan

Seagrass beds characterize environments and primary production, which support active fisheries in estuarine and coastal areas. Through the analysis of current velocities, we assessed the seasonal effects of seagrass beds as an ecosystem indicator and evaluated the impact of dynamics of seagrass beds on ecosystem functions and fisheries productivity in Akkeshi-ko estuary at Hokkaido, Japan. Velocity varied seasonally in seagrass beds, increasing during the seagrass decay season in autumn while remaining low during the seagrass growing season in summer among flood and ebbing tides. Therefore, developed seagrass beds changed to broad current and material flows, including the pathway of riverine inputs to the estuary. In this estuary, with a seagrass bed and high retention time during summer, fine clam harvesting is maintained with enough natural recruitment from planktonic larvae and warm estuarine water to compensate oyster spawning for enhancing marketability. If seagrass beds are partly lost or seagrass does not grow enough by some natural or anthropogenic cause, seagrass might fall to other competitors, such as epiphytic and ephemeral algae, with an increase of direct input of riverine nutrients to the estuary. This could cause the current pattern and estuarine ecosystem to change drastically, which would negatively affect fisheries. Therefore, seagrass beds characterize estuarine ecosystems which support high fisheries production through the modification of broad currents, and act as an indicator of these ecosystems in itself. Moreover, velocity would be the easier indicator of seagrass status than general environmental indices such as salinity, temperature and chl. *a*, which principally vary in estuary.

GP-7614

Effects of elevated $p\text{CO}_2$ on early development and settlement of the turban snail *Turbo cornutus* and abalone *Haliotis diversicolor*Toshihiro **Onitsuka**¹, Ryo Kimura², Hideki Takami³, Tsuneo Ono¹ and Yukihiro Nojiri⁴¹ Hokkaido National Fisheries Research Institute, Fisheries Research Agency, 116, Katsurakoi, Kushiro, Hokkaido, 085-0802, Japan
E-mail: onitsuka@affrc.go.jp² Fisheries Research Agency, 2-3-3 Minato Mirai, Yokohama, Kanagawa, 220-6115, Japan³ Tohoku National Fisheries Research Institute, Fisheries Research Agency, 3-27-5 Shinhamma, Shiogama, Miyagi, 985-0001, Japan⁴ Center for Global Environment Research, National Institute for Environmental Study, 16-2 Onogawa, Tsukuba, Ibaraki, 305-8506, Japan

Ocean acidification will seriously impact calcifiers with a calcium carbonate skeleton compared to other organisms, especially in the early life history. In this study, we tried to evaluate the effects of elevated partial pressures of carbon dioxide ($p\text{CO}_2$) seawater on early development and settlement of commercially-important gastropods, *Turbo cornutus* and *Haliotis diversicolor*, using the up-to-date CO_2 manipulation system with high accuracy. In larvae of *T. cornutus*, delay in embryonic development was detected at 2 hr after fertilization by exposure to 1000, 1500, and 2000 ppm $p\text{CO}_2$ seawater compared with control seawater (400 ppm $p\text{CO}_2$), and the developmental delay was also observed at 24–26 hr after fertilization. Lower hatching rates and higher malformed rates were detected in the 1500 and 2000 ppm $p\text{CO}_2$ seawater than in the control seawater. Larval shell length at 48 hr after hatching was smaller in higher $p\text{CO}_2$ seawater. Settlements of larval *H. diversicolor* were induced in $p\text{CO}_2$ -conditioned seawater of 400, 1000, 1500, and 2000 ppm by crustose coralline algae (CCA) which had been exposed to each of the $p\text{CO}_2$ -conditioned seawater for 3 weeks. However, there were no differences in metamorphosis rates of the larvae among all of the $p\text{CO}_2$ -conditioned seawater. These results suggest that ocean acidification potentially impacts directly to the marine calcifiers and to marine ecosystems via interspecific interactions, but those effects may be species- and/or developmental stage-dependent.

GP-7646

Land-sea breeze in the Bay of La Paz, Mexico: Numerical modelingCuauhtemoc **Turrent-Thompson** and Oleg Zaitsev

Interdisciplinary Center on Marine Science, National Polytechnic Institute, IPN Ave., Playa Palo de Santa Rita, La Paz, B.C.S., 23096, Mexico
E-mail: cturrent@ipn.mx

We present results of four month-long numerical simulations of the troposphere over the Bay of La Paz, to describe basic seasonal features of the local system of land-sea breezes. The non-hydrostatic Weather Research and Forecasting (WRF) regional atmospheric model was used to downscale the North American Regional Reanalysis (NARR) temperature, specific humidity and wind fields from their 32 km native horizontal resolution to 10.6 km and 3.5 km nested grids that adequately resolve breeze fronts. The NARR data were assimilated into the model solution using a Newtonian relaxation scheme with a weak temporal adjustment coefficient of 1 day^{-1} . This was done to produce realistic large-scale wind fields while still allowing the model's own solar radiation scheme to activate the local breeze system, which is not well resolved in the NARR data. Numerical simulations were carried out for January, April, July and October 2010. The nocturnal offshore breeze, which flows from the Baja California peninsula towards the Gulf of California, was found to be dominant over the Bay of La Paz during most of the year. Its influence decreased markedly in winter, when a weaker onshore breeze was observed. The model results clearly show the interaction over the Baja California peninsula of the onshore breezes coming from both the Pacific Ocean and the Gulf of California, with a convergence line forming during daytime hours over the peaks of the peninsula's mountain range. The spatial structure of the breeze front over the Bay of La Paz is complex and highly variable throughout the seasonal cycle.

GP-7658

Air-sea CO₂ flux and its related parameters over the Bering Slope CurrentZhongyong **Gao**^{1,2}, Liqi Chen^{1,2,3} and Heng Sun^{1,2}

¹ Key Laboratory of Global Change and Marine-Atmospheric Chemistry, Third Institute of Oceanography, SOA, 178 Daxue Rd., Xiamen, Fujian, 361005, PR China. E-mail: zgao@263.net

² Third Institute of Oceanography, SOA, Xiamen, 361005, PR China

³ Chinese Arctic and Antarctic Administration, Beijing, 100860, PR China

Underway measurements of surface seawater and atmospheric partial pressure of CO₂ ($p\text{CO}_2$) along the BR section in the Bering Sea were conducted during the 3rd Chinese National Arctic Research Expedition (CHINARE-2008) in July 2008. CO₂ system parameters were detected from discrete water column sampling stations as well. Latitudinal distributions of $p\text{CO}_2$ in the Bering Sea and their relationships with physical and chemical parameters are discussed. According to the CO₂ uptake capacity, the Bering Sea is divided into 4 regions, the Bering Shelf Region (BS), Bering Slope Current Region (BSC), Northern Bering Basin Region (NBB) and Southern Bering Basin Region (SBB). The air-sea CO₂ fluxes of the BSC Region was up to $-18.72 \text{ mmol}/(\text{m}^2 \cdot \text{d})$, which is two times as much as that of the NBB and one order of magnitude higher than that of the SBB. $p\text{CO}_2$ in the NBB and slope increased with temperature, showing a positive correlation. However, the relationship between $p\text{CO}_2$ in the slope and SBB and temperature was indistinct, suggesting that temperature was not the dominant controlling factor there. $p\text{CO}_2$ in the NBB and shelf exhibited a positive correlation with salinity, indicating that they were mainly affected by mixing of water masses, whereas an indistinct relationship existed in the SBB and slope. The main reasons for higher $p\text{CO}_2$ in the SBB are well-mixed water masses with higher temperature; more saline, higher total dissolved inorganic carbon (DIC) and total alkalinity (TA). In contrast, water masses in the slope were significantly different from those of other regions in the Bering Sea, with obvious lower temperature, and fresher, lower DIC and TA, leading to lower $p\text{CO}_2$ in the surface seawater.

GP-7676

An oceanographic information system on “Natural ecosystems exploitation, state and tendencies of marine environment changing in coastal areas of Russia in the Japan/East Sea”

Vladimir Rostov, Natalia **Rudykh**, Igor Rostov and Elena Dmitrieva

Laboratory of Ocean Information and Ocean Monitoring, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia. E-mail: rudykh@poi.dvo.ru

Coastal water is the interzone where economic and nature-conservation activities are contiguous, as in the sphere of the national jurisdictions and beyond. Integrated Coastal Zone Management (ICZM) or Integrated Coastal Area Management (ICAM) is a challenging process, defined by stakeholder engagement and underpinned by knowledge on the integrated behaviour of coastal systems. The V.I. Il'ichev Pacific Oceanological Institute (POI) is conducting a research effort oriented to supporting coast studies and coastal area management. One of the goals of a special Russian project on the development of a Unified System on the State of the World Ocean (ESIMO – <http://esimo.ru/>) for the oceanographic information collection, storage, processing and delivery. Regional institutes (POI, Far East xxxxx (FERHRI) and the Pacific Research Institute of Fisheries and Oceanography (TINRO-Centre), Vladivostok) carry out their own activities for development of independent regional segments of ESIMO and departmental databases for the Far Eastern Region of Russia. We present current works of POI on the ESIMO “Natural ecosystems exploitation, state and tendencies of marine environment changing in coastal areas of Russia in the Japan/East Sea” (<http://pacificinfo.ru/data/cdrom/11/>). The System provides quick access to raw and gridded data and specially selected information which is stored on CD-ROMs and reachable in the “on-line” mode. Implementation of the project provides access to results of complex studies of the processes, characteristics and resources of the Russian Far Eastern Seas, dynamics of the ecosystems, control for coastal zone conditions for the rational nature management, *etc.*

GP-7758

Study on the vertical mixing of oil droplets by breaking waves

Baonan **Sun**, Yongzeng Yang, Yeli Yuan and Lei Han

Key Laboratory of Marine Science and Numerical Modelling, First Institute of Oceanography, State Oceanic Administration, No.6, XianXiaLing Rd., Qingdao, 266061, PR China. E-mail: sunbn@fio.org.cn

Oil spills at sea can be dispersed by a variety of natural processes in which the influence of breaking waves is dominant. Breaking waves are able to split the slick into small droplets, facilitating oil mixing in the water column. When droplet Reynolds numbers are large, the dynamic pressure force of turbulence flows is the cause of droplet breakup. When droplet Reynolds numbers are small, however, viscous shear associated with small turbulent eddies is the cause of breakup. Based on the theoretical statistical model of Yuan Yeli (2009), using dimensional analysis and similarity theory, we deduce an expression of oil droplets entraining rate. We further deduce a relation between the number of oil droplets entrained by breaking waves and droplet radius, turbulence energy dissipation rate, and surface tension coefficient. Therefore, droplet formation, size distribution and the quantitative expression of dynamics are the central issues of this paper. The results are in a good agreement with the observation data.

GP-7857

Distribution of methane gases in seawater and its fluxes on the border of water–atmosphere in some regions of the Sea of Okhotsk

G.I. Mishukova, V.F. **Mishukov** and A.I. Obzhirov

VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Kray, 690041, Russia
E-mail: vmishukov@poi.dvo.ru

From long-term data (1993-2008) the spatial variability of methane gases in seawater of the Sea of Okhotsk was investigated. Simulation of methane fluxes between seawater and atmosphere were numerically modelled. Areas of active methane intrusions were determined in the Sea of Okhotsk at regions of oil and gas deposits. In marine areas of the Sea of Okhotsk, methane absorption from the atmosphere was measured. Anomalous methane gases were observed in regions with gas bubble intrusions on shelf areas of Sakhalin and in the Derugin Basin. These intrusions caused a drop in oxygen concentration in deep sea waters and an upwelling of subbottom water to the upper layers. The natural phenomenon of formation of plane water layers with highest methane concentrations was determined at different depths. Maximal spatial extent of these layers was observed at depth in the subsurface cold layer of seawater which was formed by hydrophobic hydration of natural gas molecules.

GP-7880

The current status of the international Argo project

Howard J. **Freeland**

Institute of Ocean Sciences, Fisheries and Oceans Canada, 9860 W. Saanich Rd., P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
E-mail: howard.freeland@dfo-mpo.gc.ca

This poster will illustrate the current status of the international Argo project and will outline challenges and changes that will be faced in the near future. The poster is being presented on behalf of the Argo co-chairs. At the time of writing, 32 nations are tracking more than 3200 floats in near real-time. These are supplying about 10,000 high quality CTD profiles in near real-time and these are all accessible in a unique format. The array is global and samples are being acquired from all ocean of the world.

Some problems do remain. Coverage in the deep southern ocean remains below the target levels and strategies are being developed to address this deficit. Over the last 12 months many float deployments were delayed because of the need to repair floats that had been fitted with pressure sensors which turned out to be faulty. For a few months the premature failure rate climbed to about 30% of deployments, which we considered to be unacceptable.

An increasing number of floats are now reporting through the Iridium satellite communication system and through Argos-3. Each of these allows much faster data transmission than the older Argos system, and carries various other advantages. New developments to watch for will be the availability of smaller and lighter floats with increased depth capability; Argo now can consider the possibility of having a sub-set of floats sampling the complete water column.

GP-7905

On the dynamics of the fishing grounds of *Chionoecetes opilio* in the southern Primorye (Sea of Japan)Valery N. Koblikov and Aleksey G. SlizkinPacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: koblikov@tinro.ru

At the end of the 1990s, the snow crab resources of *Chionoecetes opilio* and king crab *Paralithodes camtschaticus*, to the south of 47°20'N, were undermined by excessive fishing. From 2002 to 2010 catches of *Ch. opilio* were banned. From 2009 to 2011 stocks of commercial males (CM) on the order exceeded the level prior to the ban. Since the mid-2000s the number began to increase and in 2011 reached 30-35 million individuals with an average density of 1.5 thousand inds./km², an average size of 120-130 mm, and average weight of about 1 kg.

In the Far Eastern seas *Ch. opilio* generally occurs at depths from 10-600 m. In Peter the Great Bay CM are concentrated mainly at a depth of 150-220 m. In 2010-2011 there was an increase, in numbers in the Bay to a previously uncharacteristic depth—20-50 m. Thus, near the Gamow peninsula CM density reaches 20 thousand inds./km² at 30-80 m depth, and in Ussuri Bay density reaches 25 thousand inds./km² at a depth of 40-50 m.

The increase in the number of *Ch. opilio* and the extension of their fishing grounds may be caused by a number of complex factors. In recent years there has been a significant trend in the reduction of wind velocity and higher water temperatures in the northern part of the Sea of Japan. It is known that temperature underlies the structuring of water, and on building sustainable communities of plankton, to ensure the survival of pelagic larvae of the crab. But the main factor, in our opinion, is the dramatic decline of its main competitor – *P. camtschaticus*, which has led to the partial replacement of the ecological niche by *Ch. opilio*. In addition, the fishing ban has helped to increase the number of broodstock of *Ch. opilio* so that, ultimately, their formation is ensured and they are now at their historically highest population.

GP-7907

Isolation and potential applicability of UV-absorbing materials from marine organismsYeon-Kye Kim¹, Ho-Dong Yoon¹, Irina A. Kadnikova² and Natalia Aminina²¹ Food and safety research division, National Fisheries Research and Development Institute, 408-1 Sirang-ri, Gijang-gun, Busan, 619-705, R Korea. E-mail: yeonkyekim@korea.kr² Pacific Scientific Research Fisheries Centre, 4 Shevchenko Alley, Vladivostok, 690950, Russia

Some marine organisms have UV-protecting mechanisms to minimize the harmful effects of UV exposure. The UV-absorbing materials of 107 marine organisms, including 23 species from Russia and 84 species from Korea, were screened and analyzed by using the scanning spectroscopic method. Most of the shell fish, coral and starfish were negligible in UV-absorbing materials, whereas most of UV-absorbing materials were detected in seaweeds. Some seaweeds showed dramatically high UV-absorbing materials but some seaweeds did not. When the maximum wavelength of the seaweed extracts was checked, mainly the 271nm, 290nm, 328nm, 335nm and 410nm peaks were detected. Each major peak was different with seaweed species and dependent on the amount of water in extraction solvents. Among the tested seaweeds, we selected 3 target seaweed samples from Korea (*Prionitis cornea*, *Codium intricatum*, *Ulva pertusa*) and 3 from Russia (*Mastocarpus papilatys*, *Gloipeltis*, *Alaria marginata*). UV-absorbing materials, covering whole the UV range, UVA, UVB and UVC, were separated, tested and their basic structure was elucidated by using several analytical methods. To know the potential applicability as UV-protecting cosmetics, the separated UV-absorbing materials were mixed in three combinations. The first combination will mainly cover the UVB area, the second combination will cover the UVB and UVA areas and the third combination will cover the whole range of UVA, UVB and UVC. Based on the information, it is supposed that the seaweed extracts can be used as potentially functional cosmetics.

GP-7914**NOWPAP activities related to the marine and coastal environment of the Northwest Pacific Ocean**Sangjin Lee

Northwest Pacific Action Plan of the United Nations Environment Programme, Regional Coordinating Unit, Busan, R Korea
E-mail: sangjin.lee@nowpap.org

The “Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region” (NOWPAP) was adopted at the First Intergovernmental Meeting held in Seoul, Republic of Korea, in September 1994 as part of the UNEP Regional Seas Programme. Four member states of NOWPAP are the People’s Republic of China, Japan, the Republic of Korea and the Russian Federation. Geographical boundaries of NOWPAP are from 33 to 52°N and from 121 to 143°E.

In 2002, four NOWPAP Regional Activity Centers were established, one in each member state. The Regional Coordinating Unit, co-hosted by Toyama (Japan) and Busan (Korea) has become operational since 2005.

In the poster, current NOWPAP activities are described, which are related to data and information network and several databases (maintained by NOWPAP DINRAC, based in Beijing, China; <http://dinrac.nowpap.org>), harmful algal blooms and remote sensing applications (addressed by NOWPAP CEARAC, based in Toyama, Japan; <http://cearac.nowpap.org>), pollutants input to the marine environment and integrated coastal and river basin management (dealt with by NOWPAP POMRAC, based in Vladivostok, Russia; <http://pomrac.nowpap.org>), and oil and chemical spills (addressed by NOWPAP MERRAC, based in Daejeon, Korea; <http://merrac.nowpap.org>).

Some other NOWPAP activities are also briefly presented (related to biodiversity assessments and marine litter, among others) as well as partnership building and public awareness-raising efforts.

GP-7915**The setae structures of the gill-clogging diatom genus *Chaetoceros***Sang Deuk Lee, Joon Sang Park, Jun Mo Lee and Jin Hwan Lee

Department of Green Life Science, Sangmyung University, Seoul, 110-743, R Korea. E-mail: jhlee@smu.ac.kr

Harmful algal blooms occur frequently by toxin-producing dinoflagellates and some diatoms in Korean coastal waters. In addition gill-clogging diatoms with setae, *Chaetoceros concavicornis* and *C. convolutes*, are known to appear in many temperate seas. In sufficient concentrations, they can cause great fish mortalities by physical damage through gill-cloggings. To discover the mechanism of gill-clogging by *Chaetoceros* spp., we attempted research in order to understand the fine structures of setae which are the main taxonomic characteristics of the genus *Chaetoceros*.

Chaetoceros specimens were collected monthly or seasonally during the period from August 2008 to September 2009 in Korean coastal waters. Specimens were observed in permanent mounts in LM and SEM after being cleaned of organic matter, and micrographs were taken. Results showed the fine structures of setae of 13 *Chaetoceros* species involving *C. concavicornis* and *C. convolutus*. All 13 *Chaetoceros* species showed a similar structure of the setae, and they have common characteristics as follows: (1) The setae shape is a large and robust; (2) the spines on the setae are well developed, robustly shaped, and align in a straight arrangement; (3) In cross-section the setae have a polygonal shape. The fine setae structures of *C. concavicornis* and *C. convolute*, known to gill-clog, are similar to those of 11 *Chaetoceros* species. In conclusion, the structures of *Chaetoceros* setae may be important characteristics to understand the mechanism of gill-clogging.

GP-7921**Maps, milestones, and destinations: Managing outcomes in the ecosystem-scale ‘Bering Sea Project’ marine research program**Michael F. Sigler¹, Thomas I. Van Pelt² and Francis K. **Wiese**²¹ NOAA Alaska Fisheries Science Center, 17109 Pt. Lena Loop Rd., Juneau, AK, 99801, USA. E-mail: mike.sigler@noaa.gov² North Pacific Research Board, 1007 West Third Ave., Suite 100, Anchorage, AK, 99501, USA

Over the past half-century, in parallel with increasing awareness of ecosystem-scale conservation and science issues in the world’s oceans, ecosystem-scale marine research programs have increased in scope and ambition. But the larger the scale of a marine research program, the larger the challenge faced in ensuring ambitious goals are met and broad hypotheses and predictions are fully addressed. The Bering Sea Project provides a current example: this six-year US\$52M integrated ecosystem research program, involving nearly 100 principal investigators working to understand how climate-driven changes in ice cover affect the Bering Sea ecosystem, is currently in the final, “synthesis” phase of its lifespan. To manage the challenge of fully addressing original program goals and objectives, the Bering Sea Project’s steering committee and program managers have developed a public, real-time tool we call the “Road Map”, designed to (1) put the progress made so far (published or planned papers) in the framework of the Project hypotheses; (2) identify information gaps that need to be filled for hypotheses to be fully addressed, and (3) for each hypothesis, evaluate whether or not “synthesis” has been achieved, and if not, plan how to achieve it within the program timeline. We will describe how this Road Map has been developed and applied, and show its utility in managing outcomes of this large-scale research program.

GP-7922**Communicating ocean science – The North Pacific Research Board’s education and outreach program**Nora L. Deans, Francis K. Wiese and Cynthia **Suchman**

North Pacific Research Board, 1007 West Third Ave., Suite 100, Anchorage, AK, 99501, USA. E-mail: Cynthia.suchman@nprb.org

The North Pacific Research Board supports research that builds a clear understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems to enable effective management and sustainable use of marine resources. “These research priorities are informed in part by the interests of those who live and work in the region, making education, outreach and community involvement a vital element of an effective science plan,” the National Research Council stated in the NPRB Science Plan.

NPRB requires funded scientists to engage in outreach to share the outcomes of their research with a broad range of diverse audiences, from journalists to educators and coastal communities, among others. NPRB has also created a multi-faceted program to share research stories using a variety of tools, ranging from websites to new media, radio programs, blogs, podcasts, broadcast and print, magazine-style research summaries, traveling displays, photo contests, and communication workshops. We also send teachers to sea with researchers and engage scientists in community events in remote coastal communities.

Through individual project outreach to complex communication strategies for ecosystem studies, NPRB helps scientists share firsthand the excitement and obstacles of conducting research in remote icy seas. Our strategies include different products and mechanisms for different audiences, capitalizing on existing partnerships and responding to new opportunities. Because people relate to other people more easily than to scientific concepts, giving scientists new tools for sharing their research grips audiences and inspires interest in ocean science programs.

W1

BIO Workshop

MEMIP-IV: Quantitative comparison of ecosystem models applied to North Pacific shelf ecosystems--humble pie or glee?

Co-Convenors: Harold P. Batchelder (U.S.A.), Shin-ichi Ito (Japan), Angelica Peña (Canada) and Yvette Spitz (U.S.A.)

Invited Speakers:

Jerome Fiechter (University of California Santa Cruz, U.S.A.)

Yvette Spitz (Oregon State University, U.S.A.)

The objective of the Marine Ecosystem Model Inter-comparison Project (MEMIP) is to compare the performance of various lower trophic level marine ecosystem simulation models at predicting the abundance and distribution of coastal zooplankton functional groups. During the series of workshops, three test beds (Newport, Seward, and A-Line) were selected, and eight potential ecosystem models (NPZD+, NAPZD+, NEMURO, COSINE, NPZD-Fe, Nemuro-Fe, Nemuro-K5 and Biology) were identified to be embedded in ROMS-2D models. The focus of this 4th MEMIP workshop will be quantitative model-model and model-data analysis and comparison of the results of the simulations. Prior to this workshop, different ecosystem models embedded in ROMS-2D will have simulated several 3-4 specific years at each test bed. At the workshop, the results of different ecosystem models within each test bed will be compared. The combination of different years, multiple ecosystem models and three regions should provide sufficient runs to enable ensemble-based estimates of the uncertainty of ecosystem hindcasts, which will provide information needed for assessing FUTURE coupled ecosystem-physical forecast products.

Day 1, Friday, October 14 (9:00-18:00)

- 9:00 *Introduction by Convenors*
- 9:10 **Jerome Fiechter, Christopher A. Edwards, Andrew Moore, Nicole Goebel and Kaustubha Raghukumar**
How accurately can we predict chlorophyll concentrations in the Northeast Pacific: The role of ecosystem model complexity and data assimilation? (W1-7593), Invited
- 9:40 **Yvette H. Spitz**
Intercomparison of pelagic ecosystem models for the Oregon Shelf: "The devil is in the details" (W1-7716), Invited
- 10:10 **Guimei Liu, Fei Chai and Hui Wang**
Comparison of air-sea CO₂ flux and biological productivity in the South China Sea, East China Sea, and Yellow Sea: A three-dimensional physical-biogeochemical modeling study (W1-7721)
- 10:30 *Coffee/Tea Break*
- 10:50 **Harold Batchelder and Shin-ichi Ito**
Updates on data progress since PICES-2010
- 11:05 **Yvette Spitz and Shin-ichi Ito**
Physical test bed updates
- 11:35 **Guimei Liu**
Ecosystem models
- 11:45 **Angelica Peña**
Ecosystem models

11:55	Yvette Spitz Ecosystem models
12:05	Jerome Fiechter Ecosystem models
12:15	Shin-ichi Ito Ecosystem models
12:25	Harold Batchelder Ecosystem models
12:35	Lunch
14:00	Individual/small group work Ecosystem model results and analysis
15:30	Coffee/Tea Break
15:50	Yvette Spitz A skill assessment primer
16:20	Small groups Individual model assessments and intercomparisons of models
18:00	Workshop ends

Day 2, Saturday, October 15 (9:00-12:30)

9:00	Recap and next tasks by Convenors
9:15	Brainstorm lessons learned; recommendations for future North Pacific ecosystem modeling; recommendations about generality of ecosystem models applied to coastal systems
10:30	Coffee/Tea Break
10:50	Individual/small group work Continuation of MEMIP tasks
11:50	Workshop Wrap-up: Timeline, Products, Final Report
12:30	Workshop ends

W1 Workshop Oral Presentations

October 14, 9:10 (W1-7593), Invited

How accurately can we predict chlorophyll concentrations in the Northeast Pacific: The role of ecosystem model complexity and data assimilation?

Jerome **Fiechter**¹, Christopher A. Edwards², Andrew Moore², Nicole Goebel² and Kaustubha Raghukumar²

¹ Institute of Marine Sciences, University of California, Santa Cruz, CA, 95064, USA. E-mail: fiechter@ucsc.edu

² Ocean Sciences Department, University of California, Santa Cruz, CA, 95064, USA

Accurate predictions of zooplankton abundance in the Northeast Pacific will require equally accurate predictions of phytoplankton concentrations, not only in terms of overall magnitude, but also in terms of partitioning between different size-classes (*e.g.*, nanophytoplankton vs. diatoms). We present results from three lower trophic level ecosystem model of various complexity coupled to ROMS (Regional Ocean Modeling System) models configured for the coastal Gulf of Alaska and California Current system. The three lower trophic level ecosystem models are: (1) a 4-component NPZD model, (2) the 11-component NEMURO model, and (3) the self-assembling, 78-phytoplankton Darwin model. The models are compared against satellite-derived (SeaWiFS) and *in situ* (GLOBEC, CALCOFI) datasets to evaluate the accuracy with which they reproduce spatial and temporal variability in observed chlorophyll concentrations in both regions. We also discuss the role of physical data assimilation to improve lower trophic level ecosystem predictions in the Northeast Pacific, especially in relation to the impact of mesoscale processes (eddies, filaments, *etc.*) on primary production.

October 14, 9:40 (W1-7716), Invited

Intercomparison of pelagic ecosystem models for the Oregon Shelf: “The devil is in the details”

Yvette H. **Spitz**

College of Oceanic and Atmospheric Sciences, Oregon State University, 104 COAS Administration Bldg., Corvallis, OR, 97331, USA
E-mail: yvette@coas.oregonstate.edu

Traditionally, simple to complex ecosystem models are first calibrated in one and two-dimensional (vertical plane) mode before being coupled to high-resolution three-dimensional circulation models. This approach allows multiple runs with various parameter sets and limited computational cost. The extent to which this method is adequate is examined for the Oregon Coast. Time-dependent, two and three-dimensional responses of the ecosystem to upwelling off the Oregon coast are studied using the Regional Ocean Model (ROMS) and a coupled five-component ecosystem model (NNPZD) (Spitz *et al.*, 2005) as well as a 11 component model (Spitz *et al.* 2001) including an implicit microbial loop. We consider the summer 2000-2002 when observations from the COAST and GLOBEC projects are available for locations with different shelf widths. The relative contributions of physical and biological forcing to the ecosystem response for the two- and three-dimensional simulations will be compared in detail and the implications to the calibration of the ecosystem model will be addressed.

October 14, 10:10 (W1-7721)

Comparison of air-sea CO₂ flux and biological productivity in the South China Sea, East China Sea, and Yellow Sea: A three-dimensional physical-biogeochemical modeling study

Guimei **Liu**^{1,2}, Fei Chai² and Hui Wang¹

¹ National Marine Environmental Forecasting Center, State Oceanic Administration (SOA), 8 Dahuisi Rd., Beijing, HaiDian District, 100081, PR China. E-mail: liugm@nmefc.gov.cn

² School of Marine Sciences, University of Maine, Orono, ME, 04469, USA

Marginal seas play an important role in regulating global carbon budget, but there are great uncertainties in estimating carbon sources and sinks in the continental margins. A Pacific basin-wide physical- biogeochemical model was used to estimate primary productivity and sea-to-air CO₂ flux in the South China Sea (SCS), the East China Sea (ECS), and the Yellow Sea (YS). The model was forced with daily air-sea fluxes derived from the NCEP reanalysis between 1990 and 2004. During the period of 1990-2004, the modeled monthly-mean sea-to-air CO₂ fluxes in these three marginal seas ranged from an atmospheric carbon sink in winter (Dec.-Feb.) to a source in summer (Jun.-Aug.). On the annual-mean basis, the SCS acted as a weak source of carbon to the atmosphere, and the ECS and the YS were sinks for atmospheric carbon. The model results suggest that the sea surface temperature (SST) controlled the spatial and temporal variations of the oceanic *p*CO₂ in the three marginal seas. Moreover, biological removal of carbon played a compensating role in modulating the variability of the oceanic *p*CO₂ and determining its strength in each sea, especially in the YS and the ECS. The modeled depth-integrated primary production (IPP) over the euphotic zone varied seasonally with the annual-mean value of 240, 245, and 329 mg C m⁻² d⁻¹ in the SCS, the ECS, and the YS, respectively. The model-integrated annual-mean new production (uptake of nitrate), as in carbon units, is 63, 93, and 97 mg C m⁻² d⁻¹, which yield the *f*-ratio of 0.26, 0.38, and 0.3 for the SCS, the ECS, and the YS, respectively. Comparing to the productivity in the ECS and the YS, the seasonal variation of biological productivity in the SCS is the weakest. The atmospheric *p*CO₂ increased from 1990 to 2004, consistent with the anthropogenic CO₂ input to the atmosphere. The oceanic *p*CO₂ increased in response to the atmospheric *p*CO₂ that drives sea-to-air CO₂ flux in the model. The modeled rate of oceanic *p*CO₂ increase is 1.74 μatm yr⁻¹ in the YS, 1.86 μatm yr⁻¹ in the ECS, and 2.04 μatm yr⁻¹ in the SCS, respectively. The role of the Pacific Decadal Oscillation (PDO), SST, and biological activity on the control of *p*CO₂ changes are examined in the China seas.

W2 FIS Workshop

Remote sensing techniques for HAB detection and monitoring

Co-Sponsored by NOWPAP

Co-Convenors: *Tatiana Orlova (PICES/Russia), Vera Trainer (PICES/U.S.A.) and Takafumi Yoshida (NOWPAP/Japan)*

Invited Speakers:

Joji Ishizaka (Nagoya University, Japan)

Raphael Kudela (University of California Santa Cruz, U.S.A.)

Monitoring harmful algal blooms (HABs) and the environmental factors associated with their occurrence can often be improved by remote sensing. Satellite imagery can be used to help: (1) detect and identify HAB species or the oceanic features in which they reside, and (2) in mitigation of damage to fisheries and human health by HABs. However, the effective use of the data from these sensors is often hindered by a lack of skills to acquire, process, and interpret them. The goal of the workshop is to teach the basic skills needed to work independently with data from a variety of satellite sensors (e.g., SeaWiFS, MODIS, MERIS, AVHRR, and CZCS). This workshop may also include such themes as the fundamentals of bio-optics, pigment algorithms, primary production algorithms and, to a lesser extent, the underlying physical principals leading to the measurement of sea surface temperature, ocean wind speed and ocean topography. A series of lectures will describe research and monitoring efforts that currently use remote sensing for the study of HABs. The workshop will take place following the NOWPAP/PICES/WESTPAC young investigator training course on "Remote sensing data analysis" held on October 8-12, 2011, in Vladivostok, Russia.

Saturday, October 15 (9:00-17:30)

- 9:00 *Introduction by Convenors*
- 9:05 **Raphael M. Kudela, Mati Kahru, John P. Ryan and David G. Foley**
Linking changes in dinoflagellate blooms along the US west coast to short and longterm restructuring of the California Current System (W2-7654), Invited
- 9:45 **Sergey P. Zakharkov, Tatyana N. Gordeychuk, Elena A. Shtraikhert and Julianna V. Shambarova**
Study of diatom succession in the Sea of Japan based on satellite and ship data (W2-7632)
- 10:05 **Lijian Shi, Bin Zou, Yingni Shi and Maohua Guo**
The application of HJ-1A/1B CCD data to *Enteromorpha Prolifera* monitoring over the Yellow Sea and East Sea (W2-7802)
- 10:25 *Coffee/Tea Break*
- 10:50 **Joji Ishizaka, Kazuyoshi Miyamura, Ken Furuya and Shigeru Itakura**
Status and perspective remote sensing data use to reduce the damage caused by red tides (Harmful Algal Bloom) in Japan (W2-7637), Invited
- 11:30 **Chao Liang**
A preliminary study on the application of the wave degree of polarization in marine oil spill monitoring (W2-7813)
- 11:50 Discussion, Introduction to the afternoon session
- 12:30 *Lunch*

- 14:00 **Workshop**
Remote sensing data availability
Merit or demerit of each satellite sensor
Issues specific to HABs and eutrophication
- 15:30 ***Coffee/Tea Break***
- 15:50 **Workshop**
What kind of software is available for analysis of remote sensing data
How to analyze and manipulate remote sensing data
Some demos of advanced methods
Brief primer on time series analysis
- 17:30 Workshop ends

W2 Workshop Oral Presentations

October 15, 9:05 (W2-7654), Invited

Linking changes in dinoflagellate blooms along the US west coast to short and longterm restructuring of the California Current System

Raphael M. **Kudela**¹, Mati Kahru², John P. Ryan³ and David G. Foley⁴

¹ Ocean Sciences Department, University of California Santa Cruz, 1156 High St., Santa Cruz, CA, 95064, USA

E-mail: kudela@ucsc.edu

² Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, 92093, USA

³ Monterey Bay Aquarium Research Institute, Moss Landing, CA, 95039, USA

⁴ NOAA Southwest Fisheries Science Center, Environmental Research Division, Pacific Grove, CA, 93950, USA

We are witnessing a global shift in marine phytoplankton communities within Eastern Boundary Current systems (EBCs), characterized by increasing biomass, increasing productivity, and potentially, increasingly abundant dinoflagellates. Associated with these changes are increasing frequency and duration of negative impacts to both human and wildlife health since most organisms classified as Harmful Algal Blooms are also dinoflagellates. Time series from the US west coast suggest that true red tides have increased dramatically since 2005 coincident with mesoscale changes in depth and intensity of stratification and upwelling favorable winds. Satellite ocean color can potentially provide an excellent tool for tracking these changes since a nearly 15-year record is available. However, intense blooms can create issues with standard processing of the imagery leading to a potential bias (underestimate) in coastal biomass and productivity. Here we explore both the technical challenges of extracting ocean color information from coastal time series and use these data in conjunction with long term records from shore and mooring platforms to link changes in bloom dynamics to the underlying physical processes dominating the California Current System.

October 15, 9:45 (W2-7632)

Study of diatom succession in the Sea of Japan based on satellite and ship data

Sergey P. **Zakharkov**, Tatyana N. Gordeychuk, Elena A. Shtraikhert and Julianna V. Shambarova

VI. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, Primorsky Krai, 690041, Russia

E-mail: zakharkov@poi.dvo.ru

We studied the spatial distribution and succession of diatoms in surface water layers in geographically separate areas of Sea of Japan in relationship to the chlorophyll *a* index. This chlorophyll *a* index was calculated as the relationship of the chlorophyll *a* concentration (Chl-*a*) to biomass. Biomass was determined using estimates of Total Suspended Material_{Clark}(tsm_{clark}; Ocean Color Product, <http://ocean.color.gsfc.nasa.gov>) with corrections for the Inorganic Suspended Materials (this correction value was estimated from ship data). Chl-*a* and tsm_{clark} data were obtained from the Center for Satellite Monitoring of IACP FEB RAS. To process these data, Glance software was used. Chlorophyll-*a*, total suspended material, biomass and phytoplankton species composition data were obtained during cruises conducted by POI FEB RAS in the Sea of Japan in 2000-2005. We determined that the tsm_{clark} product can be used for the estimation of total suspended material in the Sea of Japan. A relatively high correlation between the chlorophyll *a* index and the diatom content of the phytoplankton community was observed. These findings have allowed us to observe the distributions of diatom species using satellite data.

October 15, 10:05 (W2-7802)

The application of HJ-1A/1B CCD data to *Enteromorpha Prolifera* monitoring over the Yellow Sea and East Sea

Lijian **Shi**¹, Bin Zou¹, Yingni Shi² and Maohua Guo¹

¹ National Satellite Ocean Application Service, 8 Dahuisi Rd., Haidian, Beijing, 100081, PR China. E-mail: shilj@mail.nsoas.gov.cn

² Unit 61741 of PLA, Beijing, 100089, PR China

Based on the spectral characteristics and NDVI (Normalized Difference Vegetation Index), *Enteromorpha prolifera* was monitored over the Yellow Sea and the East Sea by the images of HJ-1A/1B satellite's CCD sensor. The result shows that the CCD data of HJ-1A/1B can be used to acquire information on *Enteromorpha prolifera* such as the distribution range, coverage, and drift trend. These satellite data provide more detailed information than ground-based monitoring because of the high spatial resolution.

October 15, 10:50 (W2-7637), Invited

Status and perspective remote sensing data use to reduce the damage caused by red tides (Harmful Algal Bloom) in Japan

Joji **Ishizaka**¹, Kazuyoshi Miyamura², Ken Furuya³ and Shigeru Itakura⁴

¹ Hydrospheric Atmospheric Research Center, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Aichi, 464-8601, Japan
E-mail: jishizak@hyarc.nagoya.ac.jp

² Oita Prefectural Agriculture, Forestry and Fisheries Research Center, Tsuiura, Kamiura, Saeki, Oita, 879-2602, Japan

³ Graduate School of Agricultural and Life Science, University of Tokyo, Yayoi, Bunkyo, Tokyo, 113-8657, Japan

⁴ National Research Institute of Fisheries and Environment of Inland Sea, Maruichi, Hatsukaichi, Hiroshima, 739-0452, Japan

Harmful algal blooms (HABs) cause huge economic damage to coastal fisheries activities, in particular aquaculture enterprises in Japan. Ocean color satellite may be a useful tool for monitoring red tide. However, satellite remote sensing is not often used operationally; however, there are some examples of success in using satellite data for the early warning of HABs if the transport route is clearly identified. We are now conducting a practical exercise targeted off the Oita prefecture where occurrence of *Karenia mikimotoi* during summer months causes the most problems. We set up a web site for red tide distributions in this area (<http://redtide.hyarc.nagoya-u.ac.jp/>) based on simple spectral characterization methods from 2010. There was no serious *K. mikimotoi* bloom occurring in this area during 2010; however, a diatom bloom, confirmed by a ship survey, was detected in near real time by satellite. Improvement of the red tide algorithm, which currently is not sensitive to turbid water and high colored dissolved organic matter but which discriminates *K. mikimotoi* and diatoms, is ongoing. We conducted a survey at local fisheries experimental stations regarding their opinion and experience in the use of satellite data for red tide detection. The survey indicated that many scientists in fisheries experimental stations who have strong contacts with local fisherman are interested in using satellite data; however, they do not have much information and knowledge about the data. Thus, training courses may be important for the transfer of this knowledge from research to application. It is also important to understand that remote sensing data is just one of the integrated information system is required for HAB detection.

October 15, 11:30 (W2-7813)

A preliminary study on the application of the wave degree of polarization in marine oil spill monitoring

Chao **Liang**

National Satellite Ocean Application Service, 8 Dahuisi Rd., Beijing, 100081, PR China. E-mail: zyr@mail.nsoas.gov.cn

Oil spills cause serious harm to the marine environment making operational monitoring work increasingly urgent. Synthetic aperture radar (SAR) is an important means of oil spill monitoring due to its round-the-clock, all-weather operational capability. Essential to the principle of SAR oil spill monitoring, is the ability to distinguish between oil spills and other surface slicks (named “look-alikes”). The degree of polarization (DoP) is given by the ratio of the power in the polarized part of an electromagnetic wave to the total power in the electromagnetic wave. Based on the polarimetric SIR-C data, this paper has studied the usefulness of the DoP in oil spill detection and identification. The results shows that the oil spill makes the scattering properties of the film-covered surface change significantly due to its strong damping effect to the short gravity capillary wave. The oil spill’s depolarization effect is stronger than any biogenic slick or the sea surface, therefore the oil spills have a relatively smaller value of DoP. Therefore, there is a capability to visually distinguish the oil spill film and other natural slicks using the DoP imagery.

W3

MEQ Workshop

Pollutants in a changing ocean: Refining indicator approaches in support of coastal management

Co-Sponsored by GESAMP, ICES and IOC

Co-Convenors: *Kris Cooreman (ICES/Belgium), Peter Kershaw (GESAMP/UK), Olga Lukyanova (PICES/Russia) and Peter Ross (PICES/Canada)*

Invited Speakers:

Joel Baker (University Washington Tacoma, U.S.A.)

Chris Cooreman (Institute for Agricultural and Fisheries Research, Belgium)

Peter Kershaw (Centre for Environment, Fisheries and Aquaculture Science, UK)

Annamalai Subramanian (Ehime University, Japan)

Many anthropogenic pollutants impact marine environmental quality, with coastal zones being particularly vulnerable. Persistent organic pollutants (POPs) are a concern because they magnify in food webs and present health risks to humans and wildlife. Other chemicals are less persistent, but may nonetheless impact the health of biota. While some pollution indicators are ensconced into monitoring and management regimes in different nations over space and time, new pollutant concerns may not yet be captured by existing protocols. These include “micro-plastics”, the breakdown products of debris and other forms of structural pollutants, which can clog the gills of invertebrates and fish, and asphyxiate seabirds and marine mammals. In addition, these micro-plastics may adsorb some of the other chemical contaminants and transfer them to marine organisms. This workshop will review ways in which chemical and structural pollutants enter the marine environment, are transported through ocean currents and/or biological transport, and impact marine biota. The workshop will critically review several examples of pollution indicators used by different nations, as a basis for improving and/or expanding indicator approaches in the North Pacific Ocean. These examples will also critically evaluate the extent to which changing baselines (*e.g.*, climate variability) may impact on source/transport/fate processes and effects on biota, and recommend means of improving the utility and reliability of current indicator / monitoring approaches in a changing world. The objectives of this workshop are to:

- (1) Critically review 3-5 examples of currently used indicators of marine contamination in different PICES member nations (*e.g.*, shellfish monitoring of PAHs, metals, persistent organic pollutants, fecal bacteria; POPs in seabird eggs and marine mammals); List advantages and disadvantages for each, and describe management/policy linkages; Consider the influence of changing climate on indicator performance and ways to address this.
- (2) Review emergent pollutant concerns and in particular, examine the topic of plastics and micro-plastics as structural pollutants and as mechanisms for the transfer of contaminants to marine biota; Examine existing and/or new opportunities to establish indicator approaches to plastic pollution, and review sampling and analytical methods.
- (3) From these applied examples/case studies, identify opportunities for future PICES activities on the topic of marine pollution:
 - a). evaluate feasibility of establishing Study Group on Marine Contaminants, including terms of reference, membership, and deliverables;
 - b). description of the scope of PICES/FUTURE activities that focus on contaminants in the North Pacific marine environment;
 - c). update and revise MEQ Action Plan elements on marine contaminants;
 - d). identify potential interactions with IOC/ICES/GESAMP/NOWPAP/NOAA programs that focus on contaminants in the marine environment.

Friday, October 14 (9:00-18:00)

- 9:00 ***Introduction by Convenors***
- 9:15 **Peter J. Kershaw**
Pollution indicators in the marine environment – A GESAMP perspective (W3-7908), Invited
- 9:45 **Kris Cooreman, Roel Smolders, Yves Verhaegen, Koen Parmentier, Patrick Roose and Guy Smaghe**
Building expert knowledge to reach integrated scientific advice for marine management (W3-7926), Invited
- 10:15 ***Coffee/Tea Break***
- 10:35 6 ‘power talks’ and poster presentations
- 11:15 **Annamalai Subramanian and Shinsuke Tanabe**
Contamination by persistent organic pollutants in the Asia-Pacific region (W3-7884), Invited
- 11:45 **Joel E. Baker, Julie Masura, Gregory Foster and Courtney Arthur**
Abundance, distribution, sources and potential implication of microplastic particles in coastal waters of the North Pacific region (W3-7863), Invited
- 12:15 ***Lunch***
- 13:45 Emerging opportunities for pollution research and monitoring in the North Pacific Ocean (projects, national programs, international collaborations, knowledge gaps): Draft summary statement
- 15:30 ***Coffee/Tea Break***
- 15:50 PICES opportunities: hot topics, activities, collaborations, and linkages to other groups or programmes (MEQ Committee, BIO Committee, Advisory Panel on Marine Birds and Mammals, FUTURE Advisory Panel Anthropogenic Impacts on Coastal Ecosystems)
- 17:00 Draft statement/proposal for activity/plan to PICES
- 18:00 Workshop ends

Workshop 3 Posters

- W3-7660 **Natalia Pichugina and Vladimir Goryachev**
The radioactive pollution of hydrobionts at the place of nuclear accident in the Chazhma Bay, the Japan Sea
- W3-7677 **Vasiliy Yu. Tsygankov, Margarita D. Boyarova, Peter A. Tyupeleev and Olga N. Lukyanova**
Persistent organic pollutants (POPs) and mercury (Hg) in organs of the grey whale (*Eschrichtius robustus*) from the Bering Sea
- W3-7729 **Mikhail V. Simokon and Lidiya T. Kovekovdova**
Mercury in the bottom sediments of Peter the Great Bay (Japan/East Sea)
- W3-7730 **Mikhail V. Simokon**
Environmental pollution monitoring of Far Eastern Seas
- W3-7796 **Zou Ya-Rong, Zou Bin and Liang Chao**
Multiple index marine oil spill information extraction research
- W3-7797 **Zou Ya-Rong, Zou Bin and Liang Chao**
Using the SAR to analyze marine oil spill polarization characteristics

W3 Workshop Oral Presentations

October 14, 9:15 (W3-7908), Invited

Pollution indicators in the marine environment – A GESAMP perspective

Peter J. **Kershaw**

Centre for Environment, Fisheries and Aquaculture Science (Cefas), Pakefield Rd., Lowestoft, NR33 0HT, UK
E-mail: peter.kershaw@cefas.co.uk

The Joint Group of Experts on Scientific Aspects of Marine Protection (GESAMP) is an inter-agency body of the United Nations, with a remit to provide independent scientific advice to the eight sponsoring UN Agencies which have particular interest in the marine environment. GESAMP has a global interest, with currently one Member from the PICES 'family' (Peoples' Republic of China). GESAMP is involved in several initiatives of relevance to PICES MEQ activities. For example, it has been involved with IOC in a multi-agency initiative to define pollution indicators for coastal waters and the open ocean, in the context of the UNEP/GEF Transboundary Waters Assessment Programme (e.g. mercury, cadmium & lead, plastics, POPs in plastic resin beads, POPs in marine mammals, shipping density, dissolved oxygen, nutrients). During the same period significant progress has been made within the European Union to define indicators and targets to achieve 'good environmental status' for eleven 'descriptors' in European Seas by 2020. In both cases there may be approaches that are applicable to the PICES region. However, key questions remain about defining levels of 'harm', and GESAMP is engaged in several initiatives to address these: a global review of mercury inputs to the ocean (re UNEP Hg Convention); a correspondence group on bio-magnification of contaminants (including human impacts); a correspondence group on hypoxia and fish health; and, a new Working Group to conduct a global assessment of micro-plastics and associated contaminants. Examples from these activities will be presented to support the aims of the Workshop and subsequent activities.

October 14, 9:45 (W3-7926), Invited

Building expert knowledge to reach integrated scientific advice for marine management

Kris **Cooreman**¹, Roel Smolders², Yves Verhaegen^{1,4}, Koen Parmentier¹, Patrick Roose³ and Guy Smagghe⁴

¹ Institute for Agricultural and Fisheries Research, Animal Sciences Unit, Fisheries, Ankerstraat 1, 8400 Oostende, Belgium
E-mail: kris.cooreman@ilvo.vlaanderen.be

² 2 Flemish Institute for Technological Research, Environment and health, Boeretang 200, 2400 Mol, Belgium

³ Management Unit of the North Sea Mathematical Models, Royal Belgian Institute of Natural Sciences, 3de en 23ste Linierregimentsplein, 8400 Oostende, Belgium

⁴ Laboratory of Agrozoology, Faculty of Bioscience Engineering, Ghent University, Gent, Belgium

As more information on the impact of human activities on the marine environment and especially on the interactions between those impacts is growing, awareness has shifted towards the need for better tools to reach integrated scientific advice for marine/maritime management. The single-purpose scientific advice to management as practiced today is too narrow and has often shown to be inadequate or even ineffective in its attempts to preserve the health of the marine environment. Expert knowledge should represent an ecosystems view which is able to maintain biodiversity and long-term sustainability of the marine resources. This requires generalist expertise of particularly the human interchanges with the marine ecosystems.

Three case studies are presented here that, amongst other, could be useful to achieve such a broader knowledge platform.

Case one reports on effects of tributyltin on growth and development in the brown shrimp (*Crangon crangon*). The results show that there are strong tributyltin-driven indications of suppression of growth and development of the shrimp stocks and the remediation of the stocks after the ban on tributyltin.

Case two reports on the seasonal influences on accumulation and redistribution of persistent organic chemicals in the flatfish dab (*Limanda limanda*) from the southern North Sea. This system could be helpful in better understanding the biological activities of persistent contaminants.

Case three reports on Cellular Energy Allocation which is a general indicator of health of organisms. This technique was deployed successfully in river systems as well as in coastal areas and open sea.

October 14, 11:15 (W3-7884), Invited

Contamination by persistent organic pollutants in the Asia-Pacific region

Annamalai **Subramanian** and Shinsuke Tanabe

Center for Marine Environmental Studies, Ehime University, 2-5 Bunkyo-cho, Matsuyama, Ehime Prefecture, 790 8577, Japan
E-mail: subra@agr.ehime-u.ac.jp

Persistent organic pollutants (POPs) used in developing and developed nations evaporate at different rates, are carried away by long-range atmospheric transport, and are eventually deposited mostly in the open seas of the colder regions. To evaluate this phenomenon, we have used the long-archived specimens of mussels, fish, birds, marine mammals, *etc.* in our environmental specimen bank (*es*-BANK) of Ehime University, and studied their transport, distribution and bioaccumulation in the Asia-Pacific region. Results indicate that the recent contamination by organochlorines in inland areas have decreased in comparison with their severely polluted status in the 1970s. However, their declining trends have been very slow in remote oceans in recent decades due to the fact that the oceans are vast reservoirs and represent final sinks of such pollutants. We found the presence of dioxins and the new chemicals such as PBDEs in these samples. Collectively, we can conclude that the significant pollution and probable risk of POPs will continue in the marine ecosystems in future. Our results also show that the pollution sources of these contaminants and their final sinks are also different. If so, the toxic impacts of POPs may affect not only the regional ecosystems near to the emission sources, but also remote areas such as the Arctic and Antarctic. The significant pollution and probable risk of POPs will continue in marine ecosystems in the future and hence long-term monitoring is necessary in the remote regions (*e.g.* the marine environment), as has been done for ozone depletion and global warming.

October 14, 11:45 (W3-7863), Invited

Abundance, distribution, sources and potential implication of microplastic particles in coastal waters of the North Pacific region

Joel E. **Baker**¹, Julie Masura¹, Gregory Foster² and Courtney Arthur³

¹ Center for Urban Waters, University of Washington Tacoma, Tacoma, WA, 98421, USA. E-mail: jebaker@uw.edu

² Department of Chemistry and Biochemistry, George Mason University, Fairfax, VA, 22030, USA

³ NOAA Marine Debris Program, Silver Spring, MD, 20910, USA

Microplastic particles, solid materials between 0.33 and 5 mm comprised mostly of synthetic polymers, enter the ocean both from disintegration of larger plastic objects and from release of pre-production resin pellets and plastic-based abrasives. We have developed methods to systematically sample and quantify marine microplastics in surface waters and in sediments, and have used these methods to measure the abundance and spatial distribution of microplastics in the Puget Sound and elsewhere. A modified Manta net is used to collect particles greater than 0.33 mm from surface waters. Non-plastic particles with densities greater than 1.6 g/cm³ are removed by settling in salt solution, and the remaining low-density particles undergo aggressive chemical oxidation with iron-enhanced hydrogen peroxide to remove naturally occurring labile carbon. The isolated particles are examined under a microscope, any remaining non-plastic particles are removed, and the purified microplastic sample is weighed. Microplastic concentrations in Puget Sound are highly variable, ranging from 5 to 225 mg/g-dry weight in samples analyzed to date. Highest concentrations found during wet and cold conditions during February in urbanized embayments may result from increased stormwater loadings. We find very few microplastic particles in surface waters during algal blooms, suggesting that microplastics may be removed from surface waters as plankton grows, is grazed, and settles. A limited number of samples from remote regions of Puget Sound indicates a regional background concentration of microplastics in the range of 10's of mg plastic/g-dry weight.

W3 Workshop Posters

W3-7660

The radioactive pollution of hydrobionts at the place of nuclear accident in the Chazhma Bay, the Japan Sea

Natalia **Pichugina** and Vladimir Goryachev

Laboratory of Nuclear Oceanology, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, 43 Baltiyskaya St., Vladivostok, 690041, Russia
E-mail: pichugina@poi.dvo.ru

In 1985 in the Chazhma Bay (The Japan Sea), a nuclear accident occurred on the atomic submarine. As a result, the source of long-lived radioactive contamination was formed, basically for the account ^{60}Co and partially ^{137}Cs . The analysis of radioactive contamination revealed that radionuclides have been deposited into bottom sediments, where it may affect benthic organisms negatively. The POI FEB RAS have been conducting radio-ecological researches in this region with 1996. To measure the amount of Cs-137, and Co-60 gamma-emitters in sea water we apply the method of their concentration on selective sorbent. We carefully separated suspended matter on special filters. Being dried properly, sorbent, filters, and hydrobionts are burnt under the temperature of 400°C ; and after that we define their gamma-activity and amount of radioisotope on the gamma-spectrometer. In the area of research we have obtained the ^{60}Co concentrations in different tissues of scallop (*Mizuhopecten yessoensis*) and ascidia, and defined the concentration factor. The highest indexes of ^{60}Co concentration were found in the branchia (11.2 Bq/kg) and digestive glands of the scallop (27.2 Bq/kg). The reason is detritus—the element of scallop's nutrition, that is a good absorbent for radioactive elements. The concentration factor is defined as relation of Co-60 concentrations in the subject of research to its concentration in environment, which we found to be: Muscle–44-222; Gonads–102-510; Mantle–178-892; Branchia–224-1118; Digestive Gland–544-2720. ^{60}Co concentration in the waters of experiment is equal to 0.01-0.05 Bq/kg.

W3-7677

Persistent organic pollutants (POPs) and mercury (Hg) in organs of the grey whale (*Eschrichtius robustus*) from the Bering Sea

Vasilii Yu. **Tsygankov**¹, Margarita D. Boyarova¹, Peter A. Tyupelev² and Olga N. Lukyanova²

¹ Far Eastern Federal University, 27 Oktyabrskaya St., Vladivostok, 690091, Russia. E-mail: tsig_90@mail.ru

² Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690950, Russia

Persistent organochlorine pesticides (OCPs) (α -, β -, γ -HCH and DDT and its metabolites) were determined in muscle and liver samples of seven (four male and three female) grey whales (*Eschrichtius robustus*) from the Bering Sea in coastal zone of Chukotka (Russia) in the summer of 2010. The International Whaling Commission (IWC) has allowed exclusive harvesting rights for these grey whales to the indigenous peoples of Chukotka and Alaska as a means of supporting their traditional lifestyles. The total concentrations OCPs in organs of whales varied from 11.5 to 285.7 ng/g dry weight. The maximal content of HCHs, DDT and its metabolites were revealed in a liver. The total concentrations of HCHs exceeded the total concentrations of DDTs and products of its degradation. Coefficients α/γ -HCH and DDT/DDE show “old” input of pesticides in mammals. Hg has been found only in liver of an adult male (length 11.3 m) and a female (length 9.6 m). Concentrations of Hg in the male were 0.12 mg/kg, and in the female – 0.007 mg/kg. Pesticides and Hg levels did not exceed the health standards of the Russian Federation for the intake of these compounds by humans. There are no known local sources of pesticide pollution in the Bering Sea, and the possible causes of accumulation xenobiotics and Hg in organs of the grey whale are global transport in atmosphere and ocean currents.

W3-7729**Mercury in the bottom sediments of Peter the Great Bay (Japan/East Sea)**Mikhail V. **Simokon** and Lidiya T. KovekovdovaPacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: simokon@tinro.ru

Mercury is a metal of predominant concern due to its ability in its organic form to bioconcentrate and biomagnify in marine food webs. Mercury is a toxic element of first class hazard for human consumption, and source and emissions control are important to prevent the contamination of in environmental compartments and living resources. The determination of inorganic mercury was carried out in the surface bottom sediments of Peter the Great Bay, as a part of ecological monitoring of coastal waters of east-western part of Japan/East Sea over the last decade. Spatial distribution of mercury varied with hydrological conditions and point sources of pollution. Highest concentrations (hotspots) of mercury (up to 1.56 mg/kg dry wt) were observed in the vicinity of Vladivostok city near municipal waste water discharges, port facilities and solid domestic waste sites. The open portion of Peter the Great Bay appears relatively free of significant contamination, with background level of mercury concentrations in bottom sediments. The geoaccumulation index (I_{geo}) was calculated to classify bottom sediments from uncontaminated to highly contaminated by mercury. A comparison with Interim Sediment Quality Guidelines (ISQGs) made evident the possibility of negative biological effects related with mercury on benthic organisms in the areas under anthropogenic influence.

W3-7730**Environmental pollution monitoring of Far Eastern Seas**Mikhail V. **Simokon**Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), 4 Shevchenko Alley, Vladivostok, 690091, Russia
E-mail: simokon@tinro.ru

In the recent past, due to the initiative of Russian Federation Fisheries Agency, ecological monitoring of bioresources safety and environmental quality of Far Eastern Seas is developing in TINRO-Center. The main purpose of these researches is to protect and preserve commercial fish stocks in condition of oil and gas drilling, processing, transport and other human activities development in the region, in other words to provide sustainable development of Far Eastern fishery industrial complex in future. During this year screening researches and organizational efforts are carried out to provide the determination of aliphatic hydrocarbons, microelements, chlorinated pesticides, PAHs, PCBs and radionuclides in sea water, bottom sediments, commercial fish, invertebrates and seaweed species from fishing areas of Far Eastern Seas. The next step necessary to do is to produce the regional Monitoring Program based on preliminary environmental issues. This Program have to include sampling strategy, unified methods of target substances determination, methods of data acquiring, handling and quality control. Including in Program the methods of pollution effect researches are also important. Afterwards monitoring results will be the powerful tool for Ecological Risk Assessments (ERA) of anthropogenic activities in the region, that allows to solve successfully the contradiction of economical development and sustainable fishery.

W3-7796**Multiple index marine oil spill information extraction research**Zou **Ya-Rong**, Zou Bin and Liang Chao

National Satellite Ocean Application Service, No 8. Dahuisi Rd., Beijing, 100081, PR China. E-mail: zyr@mail.nsoas.gov.cn

Oil spills can cause tremendous damage to the marine environment, sometimes taking decades to recover. Using remote sensing for marine oil spill detection has become a major new direction. In this paper, we analyze marine oil spills using a new remote sensing detection method based on a multivariate index of oil spill information extraction with SAR data. First, images are segmented, and then shape parameters are established, the texture feature indexes, and the physical indexes of the spots. The indexes weights were generated based on the hierarchical analysis method. For each category index, on the image processing with the on-site validation information, choice shape parameters, *e.g.* the perimeter-to-area ratio, complexity, to establish oil spill shape interpretive level. Choose the texture characteristics parameters from the gray level co-occurrence matrix, *e.g.* relevance, entropy, change, to establish the oil spill texture feature judgment level. Choose the physical characteristics, *e.g.* the standard deviation, RMS, contrast, to establish the oil spill physical parameters judgment level. Finally, by calculating the remote sensing information extraction index of the segmentations image dark spots, we can evaluate the credibility of the oil spill remote sensing information extraction, even get a significant basis for the oil spill identification.

W3-7797**Using the SAR to analyze marine oil spill polarization characteristics**Zou **Ya-Rong**, Zou Bin and Liang Chao

National Satellite Ocean Application Service, 8 Dahuisi Rd., Beijing, 100081, PR China. E-mail: zyr@mail.nsoas.gov.cn

Oil spills represent one of the most common forms of water pollution. Based on reflection, scattering and transmission properties in the process of electromagnetic radiation, they will show their own polarization properties. Using the SAR to oil spill the polarization characteristics of research can reveal the oil spill in the SAR of performance characteristics for the oil spill, the recognition to lay the foundation. This paper selects the sir-c, data, building up the oil spill Stockes matrix, effectively extract oil spill, and carry out the scattering properties Pauli decomposition, using polarization scattering matrix reveal the physical mechanism of oil spill, promote the polarization of the information to make full use of, can provide important for polarization remote sensing of the parameters of the precise identification of oil spill and inversion have important practical significance.

W4

POC/MONITOR/TCODE Workshop

Recent advances in monitoring and understanding of Asian marginal seas: 5 years of CREAMS/PICES EAST-I Program

Co-Convenors: Kyung-Il Chang (Korea), Toshitaka Gamo (Japan), Young-Shil Kang (Korea), Kyung-Ryul Kim (Korea), Vyacheslav Lobanov (Russia), Toru Suzuki (Japan) and Yury Zuenko (Russia)

Invited Speakers:

Sukgeun Jung (Jeju National University, Korea)

Tomoharu Senjyu (Kyushu University, Japan)

Under the auspices of the EAST-I program initiated and supervised by the CREAMS/PICES Advisory Panel, scientists from Japan, Korea and Russia have carried out many successful cruises in the East Asian marginal seas over the last 5 years. With the active discussion and promotion by CREAMS/PICES of a new EAST-II program focusing on the Yellow and East China Seas, it is timely to have a forum summarizing some important results obtained by the international cooperative efforts of EAST-I. This workshop welcomes studies on hydrography, circulation, biogeochemistry, and ecology and their variability in East Asian marginal seas in the PICES area and on effects of climate and long-term changes in the abiotic and biotic environments of this region.

Friday, October 14 (9:00-18:00)

- 9:00 ***Introduction by Convenors***
- 9:05 **Toshitaka Gamo, Joji Ishizaka, Changkeun Kang, Kuh Kim, Vyacheslav Lobanov and Yury Zuenko**
Progress report of CREAMS-AP *ad hoc* committee to complete 2010 North Pacific Ecosystem Status Report (W4-7770)
- 9:25 **Kyung-Ryul Kim, Kyung-Il Chang, Tongsup Lee, Changkeun Kang and Dong-Jin Kang**
A report on Korea EAST-I (East Asian Seas Time-series I) program (W4-7777)
- 9:45 **Dong-Jin Kang, Hee-Mang Park, Cho-Rong Moon, Kyung-Il Chang and Kyung-Ryul Kim**
Preliminary results of E-RAP (EAST-I Real-time Automatic Profiler) in the Ulleung Basin, the East/Japan Sea (W4-7773)
- 10:05 **Tomoharu Senjyu**
The East Asian Marginal Seas System; Connectivity between the Japan Sea and the East China Sea (W4-7769), Invited
- 10:30 ***Coffee/Tea Break***
- 10:50 **Vyacheslav Lobanov, Pavel Tishchenko, Alexander Sergeev, Dmitry D. Kaplunenko, Vladimir Ponomarev and Svetlana Ladychenko**
Overview of POI activities under the CREAMS/PICES program (W4-7841)
- 11:10 **Taekeun Rho, Tongsup Lee, Hyunduck Jeon, Dong-Jin Kang and Kyung-Ryul Kim**
Vertical and spatial distribution patterns of transparent exopolymer particles (TEP) in the East Sea during summer 2009 (W4-7759)
- 11:30 **Dmitry D. Kaplunenko, Vyacheslav Lobanov, Pavel Tishchenko and Mariya Shvetsova**
Vertical *in situ* profiles of nitrate and oxygen in the northern Japan Sea (W4-7714)
- 11:50 **Olga Trusenкова, Dmitry D. Kaplunenko, Svetlana Ladychenko and Vyacheslav Lobanov**
Non-linear patterns of eddy kinetic energy in the Japan/East Sea (W4-7587)

- 12:10 **Junheon Jang, Kyung-II Chang, Seungtae Yoon and Hanna Na**
 Long-term variation of subsurface temperature in the Ulleung Basin of the East/Japan Sea (W4-7785)
- 12:30 **Lunch**
- 14:00 **Junghyun Kwak, Yunsook Kim, Daesung Lee, Jeomshik Hwang, Kyung-Ryul Kim and Changkeun Kang**
 Summer primary productivity and phytoplankton community structure in the East/Japan Sea (W4-7854)
- 14:20 **Andrey G. Andreev**
 Year-to-year changes of pre-winter environmental conditions and chlorophyll *a* concentration in the central and southern Japan Sea (W4-7725)
- 14:40 **Sukgeun Jung and Iisu Choi**
 Alternations of dominant fisheries species in the southwestern Japan/East Sea since 1968 in relation to climate change (W4-7798), Invited
- 15:05 **Yury Zuenko, Yongjun Tian, Sukgeun Jung and Rabea Diekmann**
 Recent climatic changes in the Japan/East Sea ecosystem on the tri-national data set (W4-7726)
- 15:25 Discussion
- 15:30 **Coffee/Tea Break**
- 15:50 CREAMS/PICES AP meeting
- 18:00 Workshop ends

Workshop 4 Posters

- W4-7635 **Dmitry V. Stepanov and Nikolay A. Diansky**
 Study of the low-frequency variability of the Japan/East Sea circulation by numerical simulations
- W4-7754 **Pavel Semkin, Pavel Tishchenko, Vyacheslav Lobanov, Alexander Sergeev, Ruslan Chichkin, Galina Pavlova, Sergey Sagalaev, Elena Shkirnikova, Mariya Shvetsova, Petr Tishchenko, Tatyana Volkova and Vladimir Zvalinsky**
 Seasonal and spatial variability of hydrochemical parameters in the Ussuriyskiy Bay (Japan Sea)
- W4-7764 **Keiko Yamada, Sangwoo Kim and Joji Ishizaka**
 Spring phytoplankton blooms detected in the Japan/East Sea since 1998 by the ocean color sensor, SeaWiFS
- W4-7786 **Jaehyung Park and Kyung-II Chang**
 Characteristics of anomalous summertime coastal upwelling events off the east coast of Korea during 2003-2009
- W4-7819 **Georgiy Moiseenko, Igor Shevchenko, Vadim Burago and Sergey Levashov**
 On the possible estimation of the Okhotsk Sea water upper layer properties using remote-sensing reflectances
- W4-7865 **Lian Zhong-Lian, Zheng Ai-Rong, Fang Hong-Da and Qian Hong-Lin**
 Preliminary study on biological nitrogen fixation of Tokin Gulf in winter
- W4-7911 **Gennady Kantakoy, Victor Tambovsky, Alexey Bobkov and Evgeny Lunev**
 Recent surface currents observations in the Okhotsk Sea by Argos drifters

W4 Workshop Oral Presentations

October 14, 9:05 (W4-7770)

Progress report of CREAMS-AP *ad hoc* committee to complete 2010 North Pacific Ecosystem Status Report

Toshitaka Gamo¹, Joji Ishizaka², Changkeun Kang³, Kuh **Kim**³, Vyacheslav Lobanov⁴ and Yury Zuenko⁵

¹ Atmosphere and Ocean Research Institute, University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba, 277-8564, Japan

² Hydrospheric Atmospheric Research Center, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Aichi, 464-8601, Japan

³ POSTECH Ocean Science and Technology Institute, Pohang University of Science and Technology, Pohang, 790-784, R Korea
E-mail: kuhkim@postech.ac.kr

⁴ V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia

⁵ Pacific Fisheries Research Center (TINRO), 4 Shevchenko Alley, Vladivostok, 690600, Russia

The Science Board at PICES-2010 charged the CREAMS-AP with the task to complete the chapter not included in the 2010 North Pacific Ecosystem Status Report by the 2011 PICES Annual Meeting in Khabarovsk. The CREAMS-AP then formed an *ad hoc* committee to carry out this task and 6 members of the committee met at Novotel Hotel in Busan on June 17, 2011 and agreed to prepare the first draft by August 15 and the final draft by early October to present its progress report at the CREAMS-AP Workshop at the PICES-2011 to be reviewed and finalized. The product of the Workshop could be published in the PICES Scientific Report Series.

October 14, 9:25 (W4-7777)

A report on Korea EAST-I (East Asian Seas Time-series I) program

Kyung-Ryul **Kim**¹, Kyung-Il Chang¹, Tongsup Lee², Changkeun Kang³ and Dong-Jin Kang⁴

¹ School of Earth and Environmental Sciences/Research Institute of Oceanography, Seoul National University, Seoul, 151-742, R Korea
E-mail: krkim@snu.ac.kr

² Department of Oceanography, Pusan National University, Busan, 609-735, R Korea

³ Ocean Science and Technology Institute, Pohang University of Science and Technology, Pohang, 790-784, R Korea

⁴ Ocean Measurement and Instrument Calibration Service Center, KORDI, 1270 Sa2-dong, Ansan, 426-744, R Korea

There is widely approved that the East/Japan Sea may serve as a miniature test ocean for global changes, since she has many oceanic features including her own conveyor belt system. In this regards, PICES approved a CREAMS/PICES program, named EAST-I (East Asian Sea Time-series-I), promoting international cooperation over East/Japan Sea, especially among Japan, Korea and Russia. Since 2006, Ministry of Land, Transport and Maritime Affairs of Korea has supported the Korea EAST-I program to identify, quantify and model the dynamic processes governing the climate variability and their linkage to changes in marine ecosystem. Through the Korea EAST-I program, integrated time-series monitoring (*e.g.* E-RAP, UBIM) was successfully performed on various spatiotemporal scales in the East/Japan Sea. Furthermore, Korea EAST-I program has promoted successfully international cooperation on joint cruises and international workshops. We believe that the just started second-phase Korean EAST-I program would continue to serve as an important forum for active international cooperation in this area for the next five years. Some important results obtained during the past 5 years of Korea EAST-I program are presented.

October 14, 9:45 (W4-7773)

Preliminary results of E-RAP (EAST-I Real-time Automatic Profiler) in the Ulleung Basin, the East/Japan Sea

Dong-Jin **Kang**¹, Hee-Mang Park², Cho-Rong Moon¹, Kyung-Il Chang² and Kyung-Ryul Kim²

¹ Ocean Measurement and Instrument Calibration Service Center, KORDI, 1270 Sa2-dong, Ansan, 426-744, R Korea
E-mail: djocean@kordi.re.kr

² School of Earth and Environmental Studies/Research Institute of Oceanography, Seoul National University, Seoul, 151-742, R Korea

E-RAP (EAST-I Real-time Automatic Profiler), which was newly developed by the CREAMS/PICES EAST-1 (East Asian Seas Time-series I) program, had been deployed at the Super-Station of EAST-1 (37°00' N, 131°00' E) located at the center of the Ulleung Basin of the East/Japan Sea since May 2010 until September 2010. Vertical profiles of temperature, salinity, dissolved oxygen, and fluorescence from the near surface (around 20 m) to the depth of 350 m had been collected once a day (May, 17 - June, 10) or twice a day (June, 10 - September, 1). The profiles were sent to the surface buoy in real-time by inductive modem through the deployment wire, then the buoy sent the data to the main shore workstation by a wireless telecommunication system (CDMA). The E-RAP data demonstrate clearly the Ulleung Warm Eddy movement. The E-RAP time-series are compared with nearby data obtained by other methods.

October 14, 10:05 (W4-7769), Invited

The East Asian Marginal Seas System; Connectivity between the Japan Sea and the East China Sea

Tomoharu **Senjyu**

Research Institute for Applied Mechanics, Kyushu University, 6-1 Kasuga-koen, Kasuga, Fukuoka, 816-8580, Japan
E-mail: senjyu@riam.kyushu-u.ac.jp

There is a linkage system among the East Asian marginal seas and atmosphere over the seas. We call it as the East Asian Marginal Seas System. Two examples of connectivity between the Japan and East China Seas are introduced. The first example is the interdecadal variation in the Japan Sea Proper Water. Temperature and dissolved oxygen in the Japan Sea Proper Water show a bidecadal periodicity. The bidecadal variation is synchronized with activity of cold-air outbreaks, which are induced by atmospheric disturbances, and the atmospheric disturbances develop over the East China Sea more actively in winters with weak monsoon because of positive SST anomalies (Isobe and Beardsley, 2007). Thus, the formation of the Japan Sea Proper Water is modulated by SST variation in the East China Sea through atmosphere. The second example is the interannual salinity variation in the western channel of the Tsushima Strait. Salinity in this area is highly correlated with that in the Jeju Strait. On the other hand, the salinity variation in the Jeju Strait is determined by the cold bottom water penetration in the strait from the Yellow Sea in summer. Since the Yellow Sea cold water is formed in winter by air-sea interaction and its southern extension depends on summer monsoon, the influx of freshwater to the Japan Sea is controlled by atmospheric and oceanographic conditions in the Yellow and East China Seas.

October 14, 10:50 (W4-7841)

Overview of POI activities under the CREAMS/PICES program

Vyacheslav **Lobanov**, Pavel Tishchenko, Alexander Sergeev, Dmitry D. Kaplunenko, Vladimir Ponomarev and Svetlana Ladychenko

V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok 690041, Russia. E-mail: lobanov@poi.dvo.ru

Having a goal to initiate and oversee research programs for monitoring and investigation of the status and variability of the East Asian marginal seas and to facilitate observations and data exchange in this region, the CREAMS/PICES advisory panel supports close international collaboration in the Japan/East Sea researches over the whole five years of its activity. Under this program V.I. Il'ichev Pacific Oceanological Institute (POI) has continued joint efforts with Seoul National University and other universities of Korea. Two collaborative cruises on R/V *Akademik M.A. Lavrentyev* were conducted in May 2007 and July 2009 to monitor the state of meridional over-turning circulation and biogeochemical processes in the sea. The data obtained in these cruises with addition of other observations taken in 2010-2011 confirmed clearly a trend of bottom waters warming, that is continuing since the last ventilation event of 2001, and further weakening of convective mixing which corresponds to climate warming. Another subject of these surveys was an area of dissolved oxygen depletion in the northwestern part of the sea. Low oxygen content along the continental slope northward from 45° N was confirmed and geochemical processes on the boundary between the bottom sediments and sea water were examined. Shelf-slope interaction and ventilation of Peter the Great Bay were observed as a national contribution to the studies. Strong hypoxia was found in the bottom layer of its inner part caused by increasing eutrophication. In this case, intrusions from the deep sea to the shelf during upwelling events play an important role for restoring the oxygen regime in the coastal zone. Physical and biogeochemical processes in winter associated with convection, ice formation and cascading of dense brain water down the continental slope were also studied. Mesoscale water dynamics associated with anticyclonic eddies along northwestern shelf of the sea were considered on the base of shipboard and satellite observations and defined as an important mechanism of cross-shelf exchange and ventilation of coastal waters. These and some other scientific results obtained by POI under the CREAMS/PICES program are presented and discussed.

October 14, 11:10 (W4-7759)

Vertical and spatial distribution patterns of transparent exopolymer particles (TEP) in the East Sea during summer 2009

Taekeun **Rho**¹, Tongsup Lee¹, Hyunduck Jeon¹, Dong-Jin Kang² and Kyung-Ryul Kim³

¹ Department of Oceanography, Pusan National University, San 30 Jangjeon-dong, Geumjeong-gu, Busan, 609-735, R Korea
E-mail: tkrho@hotmail.com

² Korea Ocean Research and Development Institute (KORDI), 787 Haean-ro, Ansan, 426-744, R Korea

³ Research Institute of Oceanography, Seoul National University, San 56-1 Shillim-dong, Kwanaka-ku, Seoul, 151-742, R Korea

Phytoplankton converts carbon dioxide to organic material through photosynthesis and exports the organics to the deep ocean that results in oceanic absorption of atmospheric carbon dioxide. For better understanding the biological pump, distribution of transparent exopolymer particles (TEP) was examined. These gel-like particles suspended in the water play essential role for aggregation of large particles. Other parameters as total alkalinity, pH, concentration of nutrients and total and size-fractionated chlorophyll *a* were measured, as well. Total carbon dioxide, chlorophyll *a*, and surface TEP concentrations had distinctively different horizontal distribution patterns in the surface layer where TEP concentration was very high and chlorophyll *a* concentration was low with dominance of large-sized phytoplankton. However, there was strong positive relationship between TEP and chlorophyll *a* concentrations in the chlorophyll maximum layer, that indicated that TEP were related to phytoplankton.

October 14, 11:30 (W4-7714)

Vertical *in situ* profiles of nitrate and oxygen in the northern Japan Sea

Dmitry D. **Kaplunenko**, Vyacheslav Lobanov, Pavel Tishchenko and Mariya Shvetsova

V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: dimkap@poi.dvo.ru

Results of nitrate concentration measurements using the In Situ Ultraviolet Spectrophotometer (ISUS) designed by Monterey Bay Aquarium Research Institute (MBARI) and manufactured by Satlantic are presented obtained in four cruises of RV *Akademik M.A. Lavrentyev* in the Japan Sea in 2009 and 2010. The ISUS was attached to CTD SBE 9 profiler to make simultaneous observations of nitrate, temperature, salinity, fluorescence and dissolved oxygen content. These *in situ* data were verified and calibrated by the data from bottle water samples treated by standard chemical analysis during the surveys. Quite good correspondence was found between ISUS and bottle samples data for the layers deeper than 250 m, but large deviations were observed in the upper layer. On the background of general NO₃ concentration increasing and oxygen content decreasing with depth, a step-like structure of both parameters was found at some stations with typical vertical scale of the steps from few meters to few tens meters. The layer of the maximum NO₃ concentration lied just under the layer of the maximum density gradient, within the upper 50 m layer. Variations of nitrate and dissolved oxygen matched each other and in some cases were associated with vertical structure of chlorophyll *a*. Extremely high chlorophyll *a* concentrations were found at several stations at the depths about 100 meters which were also associated with extreme values of nitrate and oxygen. The step-like structure of the profiles is caused by coupling of dynamic and biogeochemical processes which are discussed.

October 14, 11:50 (W4-7587)

Non-linear patterns of eddy kinetic energy in the Japan/East Sea

Olga **Trusenkova**, Dmitry D. Kaplunenko, Svetlana Ladychenko and Vyacheslav Lobanov

V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: trolia@poi.dvo.ru

Energetics of mesoscale oceanic motions is studied using satellite altimetry data for almost two decades. Mesoscale dynamics is very intense in the Japan/East Sea, in particular in its subarctic sector where the eddy kinetic energy (EKE) computed from altimetry data is lower, whereas it is higher in the subtropical part of the Sea. Seasonal cycle of EKE is distinguished by lowering in spring and heightening in autumn (Son *et al.*, 2010). To consider this variability in detail, EKE was computed under geostrophic approximation from AVISO 1/4°-gridded weekly sea level anomalies (SLA) for the period from October 1992 to October 2009. Then the EKE time-series were low-pass filtered, with the 20-week cut-off period, and decomposed to correlation-based Empirical Orthogonal Functions (EOF) for better resolution of low-amplitude signals in the subarctic sector and for detection of interacting modes by subsequent decomposition with removing a contribution from leading modes before each next step. Several successive EKE modes covering more than 50% of the total variance have the same changes as the SLA meridional gradient (describing general circulation strength), with seasonal extremes in October and March. Dynamic instability and interaction with bathymetry are considered as physical mechanisms of EKE generation. EKE variations in the area off Primorye coast are interpreted taking into account mesoscale structures (meanders, eddies, filaments) in thermal contrasts on AVHRR satellite images. Patterns of wind stress and curl derived from data of satellite scatterometry are discussed as additional EKE forcing. Strong quasi-biennial and interannual variability is determined for EKE, but a long-term trend has not been detected.

October 14, 12:10 (W4-7785)

Long-term variation of subsurface temperature in the Ulleung Basin of the East/Japan Sea

Junheon Jang, Kyung-Il **Chang**, Seungtae Yoon and Hanna Na

School of Earth and Environmental Sciences, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, 425-600, R Korea
E-mail: kichang@snu.ac.kr

Water temperature variation in the Ulleung Basin (southwestern East Sea) is analyzed on the data of spatially dense surveys conducted by National Fisheries Research and Development Institute and temporally high-resolution time series on temperature and velocity acquired at the continental slope in 2006-2010. Annual mean temperature of the East Sea Intermediate Water at the continental slope had a decreasing trend estimated as $-0.063^{\circ}\text{C}/\text{yr}$ for the period between 1990 and 2009, while the southward flow had a tendency of velocity decreasing in 0.12 cm/s per year. The cooling in the layer 75-500 m was observed offshore, too, with the maximum rate $-0.090^{\circ}\text{C}/\text{yr}$ for the period 1976-2010 at the depth 200~250 m. These results suggest that the intermediate waters reaching the Ulleung Basin become colder. Possible reasons of the changes and their implications for the ecosystem are discussed.

October 14, 14:00 (W4-7854)

Summer primary productivity and phytoplankton community structure in the East/Japan Sea

Junghyun **Kwak**¹, Yunsook Kim¹, Daesung Lee¹, Jeomshik Hwang¹, Kyung-Ryul Kim² and Changkeun Kang¹

¹ POSTECH Ocean Science and Technology Institute, Pohang University of Science and Technology, Pohang, 790-784, R Korea
E-mail: ckkang@postech.ac.kr

² School of Earth and Environmental Sciences/Research Institute of Oceanography, Seoul National University, Seoul, 151-747, Korea

Summer primary (PP), new, and regenerated productivity were investigated in the East/Japan Sea (EJS) in 2008-2010 and compared with those in the Western Subtropical North Pacific Ocean (WST), and Western Subarctic Pacific Ocean (WSA). In order to examine the phenomenon of high PP in the Ulleung Basin, seasonal variation of PP was determined for this area in the period from August 2009 to June 2011. In summer, the integrated PP in the EJS was higher ($0.41\text{-}0.83\text{ g C m}^{-2}\text{ d}^{-1}$) than in the WST ($0.17\text{-}0.28\text{ g C m}^{-2}\text{ d}^{-1}$) and WSA ($0.26\text{-}0.36\text{ g C m}^{-2}\text{ d}^{-1}$) possibly because of strong water column stability, shallow surface mixed layer, and high new production (also f -ratio). Despite of strong stratification, nutrient limitation for phytoplankton growth was not evident in the EJS. In the Ulleung Basin, PP decreased gradually from spring to winter and then increased again to spring. Such seasonal variation corresponded to nutrients dynamics with the lowest concentration in November. Picophytoplankton was the main size fraction of phytoplankton that produced the largest portion of PP both in the EJS and WSA, but micro- and nanophytoplankton contributed over 60% of integrated PP in the Ulleung Basin in summer. Spatial variation of PP was closely associated with water column structure and vertical distributions of physicochemical parameters.

October 14, 14:20 (W4-7725)

Year-to-year changes of pre-winter environmental conditions and chlorophyll *a* concentration in the central and southern Japan Sea

Andrey G. **Andreev**

VI. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: andreev@poi.dvo.ru

Changes of physical and chemical parameters (water temperature, salinity, dissolved oxygen and nutrients content) and chlorophyll *a* concentration (Chl-*a*) in the central and southern Japan/East Sea (JES) are considered in relation to the ocean climate variability. The water transport from the East China Sea through the Tsushima/Korean Strait is defined as an important factor of year-to-year variability of temperature, salinity, chemical parameters, and Chl-*a* in the JES surface layer in fall season. Enhanced water volume transport through the Strait leads to dissolved oxygen depletion and increases stratification in the surface layer in pre-winter season that is one of the main reasons of dissolved oxygen reducing and temperature rising in the intermediate and deep layers. Tendencies to Chl-*a* decreasing at the horizon 50 m and Chl-*a* increasing in the 0-30 m layer were observed between 1978 and 2008. These tendencies in Chl-*a* vertical distribution, as well as the rising of N:P ratio in the upper layer of JES, are possibly caused by strengthening of the coastal waters inflow into the JES from the East China Sea.

October 14, 14:40 (W4-7798), Invited

Alternations of dominant fisheries species in the southwestern Japan/East Sea since 1968 in relation to climate change

Sukgeun **Jung**¹ and Ilsu Choi²

¹ School of Marine Biomedical Sciences, Jeju National University, 1 Ara 1-dong, 102 Jejudaehakno, Jeju, 690-756, R Korea
E-mail: sukgeun.jung@gmail.com

² Department of Applied Mathematics, Chonnam National University, Yeosu, 550-749, R Korea

Two clupeid species (sardine *Sardinops melanostictus* and herring *Clupea pallasii*), two gadoid species (pacific cod *Gadus macrocephalus* and walleye pollock *Theragra chalcogramma*), and one squid species (*Todarodes pacificus*), being traditionally important for commercial fishery in Korea, have either contrasting or synchronized responses to climate change. The catches of herring, cod and squid started to increase in the 1990s, whereas the catches of pollock and sardine decreased suddenly in the late 1980s – early 1990s. Water temperature changes corresponded to these fluctuations in the Korea Strait rather than in the Japan/East Sea: annual water temperature in the 0-100 m layer in the Korea Strait increased suddenly in 1987-1988 and then decreased in 1999-2000, whereas the temperature in the 75-100 m layer in the Japan/East Sea decreased in 1995. The shifts in catches of pollock, sardine, and squid seemed to be related with the basin-wide regime shift in 1988. On the other hand, the catch increases of cod and herring in the late 1990s seemed to be related with cooling of their spawning grounds in the coastal waters at southeastern Korea, as well as with prey-predator interaction between them and bottom-up control indicated by dramatic increase of zooplankton biomass. In overall, environmental conditions in the Korea Strait depended on episodic intrusions of cold water from the Japan/East Sea are important for hatching and recruitment of some commercial fish species in the southwestern Japan/East Sea, especially cod and herring.

October 14, 15:05 (W4-7726)

Recent climatic changes in the Japan/East Sea ecosystem on the tri-national data set

Yury **Zuenko**¹, Yongjun Tian², Sukgeun Jung³ and Rabea Diekmann⁴

¹ Pacific Fisheries Research Center (TINRO), 4 Shevchenko Alley, Vladivostok 690091, Russia. E-mail: zuenko_yury@hotmail.com

² Japan Sea National Fisheries Research Institute, Fisheries Research Agency, 1-5939-22 Suido-cho, Chuo-ku, Niigata, 951-8121, Japan

³ Jeju University, 1 Ara 1-dong, 102 Jejudaehakno, Jeju, 690-756, R Korea

⁴ University of Hamburg, 133 Grosse Elbstrasse, Hamburg, D-22767, Germany

The combined data set includes 45 long-term (1978-2004) data series for all main components of the Japan/East Sea ecosystem representing the EEZs of Russia, Japan, and Rep. Korea. The following time series are analyzed: 11 series of abiotic parameters (air and water temperature, salinity, ice cover), 6 series on primary producers (phytoplankton biomass and annual catches of commercial algae), 10 series on zooplankton and zoobenthos (total zooplankton biomass, abundance of its taxonomic groups, annual catches of commercial invertebrates), 10 series on plankton and benthos eaters (catch or year-class strength of the main fish and squid species), 7 series on fish predators (catches of the main species), and 1 time series on mammals (total catch of whales). The abiotic and biotic parts of the data set are processed by Principal Component Analysis: 57-58 % of both subsets variability are explained by the sum of PC-1 and PC-2. The scores of PC-1 for abiotic and biotic variables have similar changes in the investigated period, the same as the scores of PC-2. The PC-1 for the abiotic variables is related with winter conditions, therefore those biotic variables, which are closely correlated with PC-1, are supposedly dependent on winter processes; they are: all primary producers, pink shrimp, red snow crab, sea urchins, sardine, pollock, herring, saffron cod, chub mackerel, pacific cod, sharks (negatively) and copepods, horse mackerel and yellowtail (positively). Other biotic variables show significant correlations with PC-2: total zooplankton, pollock, round herring (negative) and copepods, sea cucumber, tanner crab, sandfish, spanish mackerel, bluefin tuna (positive); physical nature of PC-2 is uncertain. Some biotic variables don't reveal significant relations to both PCs, possibly because of time lags in their variability. The PC-1 shows a tendency to increase, with a well-known regime shift in the late 1980s. These changes depend on winter monsoon intensity that could be described by the Siberian High Index. So far as the Siberian High strength is inter-correlated with Arctic Oscillation, winter conditions in the Japan/East Sea and the state of its ecosystem have teleconnections with other subarctic regions. The PC-2 decreased until the mid 1990s then had a shift to higher scores. These changes are possibly related to processes in the Pacific, more important for summer season in the Japan/East Sea. The results on the ecosystem changes from the combined data set that represents the whole Japan/East Sea are similar to the results on the area of the Tsushima Current obtained earlier (Tian *et al.*, 2008; 2011).

W4 Workshop Posters

W4-7635

Study of the low-frequency variability of the Japan/East Sea circulation by numerical simulations

Dmitry V. **Stepanov**¹ and Nikolay A. Diansky²

¹ V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: step-nov@poi.dvo.ru

² Institute of Numerical Mathematics, 8 Gubkin St., Moscow, 119333, Russia

Low-frequency variability of the circulation in the central part of the Japan/East Sea is investigated based on numerical simulations. The large-scale three-dimensional circulation of the Japan/East Sea is reconstructed by using the Institute of Numerical Mathematics Ocean Model (INMOM). The INMOM is a three-dimensional, σ -coordinate, nonlinear, finite difference model. The hydrostatic and Boussinesq approximations are used in the model. The $1/10^\circ$ and $1/20^\circ$ meshes with 15 sigma levels from surface to bottom are used to reproduce the large-scale circulation of the Japan/East Sea. A version of the ETOPO2 is used to represent the coastline geometry and bottom topography. Initial fields of temperature and salinity are adopted from Levitus data and atmosphere forcing – from CORE data. The INMOM is spun up for 4 years and then the Japan/East Sea circulation is reconstructed for 1958-1990. The model reproduces adequately the main features of large-scale three-dimensional circulation and its seasonal variability. To study its low-frequency variability, relative vorticity is calculated and analyzed for the layer 200-800 m and the depths of 200 m, 500 m, and 800 m. Interannual variability of the circulation is considered for the central part of the Sea from 1958 to 1990. Harmonics with the periods 4 and 8 years dominated in its variability.

W4-7754

Seasonal and spatial variability of hydrochemical parameters in the Ussuriyskiy Bay (Japan Sea)

Pavel **Semkin**, Pavel Tishchenko, Vyacheslav Lobanov, Alexander Sergeev, Ruslan Chichkin, Galina Pavlova, Sergey Sagalae, Elena Shkirknikova, Mariya Shvetsova, Petr Tishchenko, Tatyana Volkova and Vladimir Zvalinsky

V.I. Il'ichev Pacific Oceanological Institute (POI), 43 Baltiyskaya St., Vladivostok, 690041, Russia. E-mail: Pahno@list.ru

Main features of spatial and seasonal variability of chemical parameters in the Ussuriyskiy Bay are considered on the data obtained in 2008-2011. Abnormally low oxygen content (< 2 ml/l) formed under certain conditions in the bottom layer in summer. At the same time, the low-oxygen waters had low pH (7.59) and high values of CO_2 partial pressure (1600 matm), normalized dissolved inorganic carbon content (2.34 mmol/kg), and silicate concentration (80.3 mM). Upwelling was developed under summer monsoon at the beginning of autumn and sharply changed the chemical and physical parameters of the bottom layer in the Bay. The maximum oxygen concentration (> 10 ml/l), the lowest CO_2 partial pressures (about 200 matm) and low nutrients concentration in the whole water column of the Bay were observed in late winter (February – beginning of March). In spring, water temperature increased, dissolved oxygen content decreased, nutrients concentration and CO_2 partial pressure increased at the sea bottom.

W4-7764

Spring phytoplankton blooms detected in the Japan/East Sea since 1998 by the ocean color sensor, SeaWiFS

Keiko **Yamada**¹, Sangwoo Kim² and Joji Ishizaka³

¹ Department of Global Environment, College of Environment, Keimyung University, 2800 Dalgubeoldae-ro, Dalseo-gu, Daegu, 704-701, R Korea. E-mail: qeiko77@hotmail.com

² East Sea Fisheries Research Institute, 30-6 Dongdeok-ri, Yeongok-dong, Gangneung, Gangwon-do, 210-861, R Korea

³ Hydrospheric Atmospheric Research Center, Nagoya University, F3-1 (200) Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan

The interannual variability of spring blooms of phytoplankton in the Japan/East Sea (JES) were studied in relationship to the wind speed using data of ocean color satellite, Sea-viewing Wide Field-of-view Sensor (SeaWiFS) operated by NASA. Even though the SeaWiFS mission ended in December 2010, the data were available for 13 spring seasons from 1998 to 2010. The start and peak timing of the spring phytoplankton bloom in the southern part of JES (36.5-38°N, 134-136°E) corresponded well to the weakening of springtime winds in the area. The bloom start time was positively correlated with the averaged wind speed in February and March ($r^2 = 0.69$, $p < 0.01$). The peak timing had a positive correlation with the averaged wind speed in April and May ($r^2 = 0.69$, $p < 0.01$). The peak bloom concentration had a negative correlation with averaged wind speed in March and April ($r^2 = 0.59$, $P < 0.05$). Furthermore, spring wind speed in the JES corresponded well with the West Pacific (WP) pattern from 1998 to 2002 and the Arctic Oscillation (AO) index from 2003 to 2009. Thus, it is possible to say that the timing of spring bloom in the JES is controlled by multiple climate patterns. Furthermore, the dominating climate pattern changed from oscillation of the meridional dipole in sea level pressure over the western Pacific (WP) to a large scale polar vortex that reached to the stratosphere (AO) between 2002 and 2003.

W4-7786

Characteristics of anomalous summertime coastal upwelling events off the east coast of Korea during 2003-2009

Jaehyung Park and Kyung-Il **Chang**

School of Earth and Environmental Sciences, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, 425-600, R Korea

E-mail: kichang@snu.ac.kr

East coast of Korea is characterized by seasonally changing monsoon winds, the East Korean Warm Current at the sea surface flowing northward, and the subsurface North Korean Cold Current flowing southward. High productivity in the southwestern East Sea has often been attributed to wind-induced coastal upwelling and offshore movement of the upwelled cold and nutrient-rich water in the flow of the East Korean Warm Current. Ocean buoy observations in 2003-2009 identified 19 events of the sea surface temperature drops greater than 5°C: 5 events in 2003, 6 events in 2004, no data for 2005, no events in 2006, 3 events in 2007, 2 events in 2008, and 3 events in 2009. Among these 19 events, the temperature drops exceeded 10°C for three times: in 2003 (12°C drop), 2004 (11°C drop), and 2007 (17°C drop). These 3 anomalous events are considered in detail focusing on understanding the affecting factors, *i.e.*, winds, background currents, and stratification. The temperature drops are thought as concerned to coastal upwelling driven by southerly winds. However, observed wind-stress impulses were lower than required values for most of the 19 events including 3 anomalous ones. Besides, a thick layer of cold water carried by the North Korean Cold Current was found prior to 2 upwelling events (in 2003 and 2004). The strongest upwelling in summer 2007 was caused by thermocline inclination at the coast on periphery of the East Korean Warm Current combined with persistent action of southerly winds.

W4-7819

On the possible estimation of the Okhotsk Sea water upper layer properties using remote-sensing reflectancesGeorgiy **Moiseenko**¹, Igor Shevchenko², Vadim Burago² and Sergey Levashov¹¹ Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), 17 V.-Krasnoselskaya St., Moscow, 107140, Russia

E-mail: georgem@vniro.ru

² Pacific Fisheries Research Center (TINRO), 4 Shevchenko Alley, Vladivostok, 690950, Russia

Standard algorithms and their modifications for MODIS data processing are widely used in scientific community but they have low accuracy for coastal areas and marginal seas. That's why their results could differ too much from *in situ* measurements. For example, the chlorophyll *a* concentration estimated from satellite data is often higher than its shipboard measured values. Many scientific groups, including international projects and individual investigators, try to create their own algorithms for MODIS data processing using some additional information or analytical models. One of possible approaches is to use regression equations which connect the estimated parameters with coefficients of serial expansion for remote-sensing reflectances on the basis of empirical orthogonal functions. The most significant eigenvectors for the remote-sensing reflectances covariance matrix are used. The covariance matrix is calculated for the annual array of pixels to include all variances of the remote-sensing spectra for MODIS Aqua L1b (11 channels in the visible spectral range). Annual variance of the empirical orthogonal functions for the Okhotsk Sea is considered and possible applications of the method are discussed.

W4-7865

Preliminary study on biological nitrogen fixation of Tokin Gulf in winterLian Zhong-Lian¹, Zheng **Ai-Rong**², Fang Hong-Da¹ and Qian Hong-Lin¹¹ South China Sea Branch, State Oceanic Administration, 155 Xingangxi Rd., Haizhu District, Guangzhou, Guangdong, 510300, PR China² Department of Oceanography, College of Oceanography and Environmental Science, Xiamen University, Xiamen, 361005, PR China
E-mail: lianzhonglian@yahoo.com.cn

The biological nitrogen fixation of Tokin Gulf in winter was investigated. The nitrogen fixation rate decreased as extension of culture time, the optimal culture time was 2 h. In different water depths the nitrogen fixation rate possessed diurnal variation, the highest nitrogen fixation rate was got at 8:20-10:20 time period, diazotrophs still had nitrogen fixation activity in the dark period at the depths of 10 m and 30 m. Rates of nitrogen fixation ranged from 447.46 pmolN L⁻¹ h⁻¹ to 1447.24 pmolN L⁻¹ h⁻¹ for Tokin Gulf in winter, which showed a longitudinally increasing trend, the integral nitrogen fixation rate in B06 was 319.48 μmolN m⁻² d⁻¹. Iron enrichment experiment at B06 station indicated that, adding concentration of iron at 100 nmol L⁻¹ significantly promoted biological nitrogen fixation, therefore, the biological nitrogen fixation at B06 may be limited by iron.

W4-7911

Recent surface currents observations in the Okhotsk Sea by Argos drifters

Gennady **Kantakov**¹, Victor Tambovsky², Alexey Bobkov² and Evgeny Lunev³

¹ Far-Eastern Ecological Center, Office 404, 426 Mira Ave., Yuzhno-Sakhalinsk, 693004, Russia. E-mail: deco@sakhalin.ru

² Ecological Company of Sakhalin, 63 Rozhdestvenskaya St., Yuzhno-Sakhalinsk, 693007, Russia

³ Marlin-Yug Ltd, 2 Kapitanskaya St., Sevastopol, 99011, Ukraine

Three experiments on surface currents observations were conducted with Argos drifters deployed in the Okhotsk Sea at West Kamchatka and East Sakhalin in 2009-2011. The surface Argos drifters of new design fitted for the Okhotsk Sea conditions were used, which differed from standard WOCE drifters. These new Argos drifters are able to survive in the pack ice and among drifting ice fields and are equipped with small underwater sail to diminish the drag at sea surface. The first experiment was the measurements of the West-Kamchatka and East-Sakhalin Currents at the seas surface in summer-fall season. The second one was the *in situ* tracking of water masses and ice removal from the Amur estuary and the Sakhalin Bay during the ice melting period from May to July. The buoys removed from the Sakhalin Bay covered the area at Shantar Islands with very rare oceanographic observations. The third experiment concerned the problem of the East-Sakhalin Current intensification in fall season that provided the surface water transport from north-eastern Sakhalin to Kuril Islands and adjacent areas of the Pacific Ocean. Results of all three experiments are presented and discussed. The newly-designed Argos drifters proved their ability to provide reliable observational base for scientific and industrial activity in severe conditions of the Okhotsk Sea, including regional oceanography, weather forecasting, transportation, fishery, oil and gas production, and rescue service.

Registrants (as of August 24)

Australia

Mary-Anne Lea

Institute for Marine and Antarctic Studies, University of Tasmania
cnr Alexander/Grosvenor Sts
Sandy Bay, TAS 7005
Australia
ma_lea@utas.edu.au

Belgium

Kris Cooreman

Animal Sciences - Fisheries
Institute for Agricultural and Fisheries Research
1 Ankerstraat
Oostende, 8400
Belgium
kris.cooreman@ilvo.vlaanderen.be

Canada

Sonia D. Batten*

Sir Alister Hardy Foundation for Ocean Science
4737 Vista View Cres.
Nanaimo, BC V9V 1N8
Canada
soba@sahfos.ac.uk
*representing SAHFOS

Jennifer L. Boldt

Pacific Biological Station,
Fisheries and Oceans Canada
3190 Hammond Bay Rd.
Nanaimo, BC V9T 6N7
Canada
Jennifer.Boldt@dfo-mpo.gc.ca

Lucas Brotz

Fisheries Centre, Sea Around Us Project
University of British Columbia
AERL Bldg., 2202 Main Mall
Vancouver, BC V6T 1Z4
Canada
lucasbrotz@gmail.com

Robin Brown

Institute of Ocean Sciences,
Fisheries and Oceans Canada
P.O. Box 6000
Sidney, BC V8L 1J6
Canada
robin.brown@dfo-mpo.gc.ca

Ingrid Burgetz

Fisheries and Oceans Canada
200 Kent St., Station 12S013
Ottawa, ON K1A 0E6
Canada
ingrid.burgetz@dfo-mpo.gc.ca

James Christian

Canadian Centre for Climate Modelling and Analysis,
Fisheries and Oceans Canada
c/o University of Victoria
P.O. Box 3065
Victoria, BC V8W 3V6
Canada
jim.christian@ec.gc.ca

Michael G. Foreman

Institute of Ocean Sciences,
Fisheries and Oceans Canada
9860 W. Saanich Rd.
P.O. Box 6000
Sidney, BC V8L 4B2
Canada
mike.foreman@dfo-mpo.gc.ca

Sophie Foster

Fisheries and Oceans Canada
200 Kent St., Station 12S013
Ottawa, ON K1A 0E6
Canada
sophie.foster@dfo-mpo.gc.ca

Howard J. Freeland*

Institute of Ocean Sciences,
Fisheries and Oceans Canada
9860 W. Saanich Rd.
P.O. Box 6000
Sidney, BC V8L 4B2
Canada
Howard.Freeland@dfo-mpo.gc.ca
*representing Argo

Graham E. Gillespie

Pacific Biological Station,
Fisheries and Oceans Canada
3190 Hammond Bay Rd.
Nanaimo, BC V9T 6N7
Canada
Graham.Gillespie@dfo-mpo.gc.ca

Lu Guan

Biology Department
University of Victoria
39403-2375 Lam Circle
Victoria, BC V8N 6K8
Canada
lguan@uvic.ca

Tabitha Cheng Yee Hui

Marine Mammal Research Unit
University of British Columbia
Fisheries Centre, 2202 Main Mall
Vancouver, BC V6T 1Z4
Canada
t.hui@fisheries.ubc.ca

Stewart Johnson

Pacific Biological Station,
Fisheries and Oceans Canada
3190 Hammond Bay Rd.
Nanaimo, BC V9T 6N7
Canada
Stewart.Johnson@dfo-mpo.gc.ca

Jacquelyne R. King
Pacific Biological Station,
Fisheries and Oceans Canada
3190 Hammond Bay Rd.
Nanaimo, BC V9T 6N7
Canada
Jackie.King@dfo-mpo.gc.ca

Maurice Levasseur
Biologie (Québec-Océan)
Université Laval
Pavillon Alexandre-Vachon
Québec, QC G1K 7P4
Canada
Maurice.levasseur@bio.ulaval.ca

Angelica Peña
Institute of Ocean Sciences,
Fisheries and Oceans Canada
9860 W. Saanich Rd.
P.O. Box 6000
Sidney, BC V8L 4B2
Canada
angelica.pena@dfo-mpo.gc.ca

Peter S. Ross
Institute of Ocean Sciences,
Fisheries and Oceans Canada
9860 W. Saanich Rd.
P.O. Box 6000
Sidney, BC V8L 4B2
Canada
peter.s.ross@dfo-mpo.gc.ca

Darlene Loretta Smith
Fisheries and Oceans Canada,
Federal Government of Canada
200 Kent St., Station 8W133
Ottawa, ON K1A 0E6
Canada
darlene.smith@dfo-mpo.gc.ca

Thomas W. Therriault
Pacific Biological Station,
Fisheries and Oceans Canada
3190 Hammond Bay Rd.
Nanaimo, BC V9T 6N7
Canada
Thomas.Therriault@dfo-mpo.gc.ca

Charles Trick
Schulich School of Medicine
University of Western Ontario
N. Campus Bldg.
1151 Richmond St. N.
London, ON N6A 5B7
Canada
trick@uwo.ca

China, PR

Tao Bai
State Oceanic Administration (SOA)
22 Fushun Rd.
Qingdao, Shandong 266033
China, PR
baitao@nmfc.gov.cn

Rongshuo Cai
Key Laboratory of Global Change and
Marine-Atmospheric Chemistry
Third Institute of Oceanography, SOA
178 Daxue Rd.
Xiamen, Fujian 361005
China, PR
rscai@163.com

Yajing Cao
State Oceanic Administration (SOA)
22 Fushun Rd.
Qingdao, Shandong 266033
China, PR
caoyajing@nmfc.gov.cn

Bingzhang Chen
Xiamen University
Room B407, Zeng Cheng Kui Bldg.
182 Daxue Rd.
Xiamen, 361005
China, PR
bingzhang.chen@gmail.com

Hong Chen
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
hchen@nmemc.gov.cn

Siqing Chen
Yellow Sea Fisheries Research
Institute, CAFS
106 Nanjing Rd.
Qingdao, Shandong 266071
China, PR
chensq@ysfri.ac.cn

Jiahua Cheng
East China Sea Fisheries Research
Institute, CAFS
300 Jungong Rd., Yangpu District
Shanghai, 200090
China, PR
ziyuan@sh163.net

Minhan Dai*
State Key Laboratory of Marine
Environmental Science
Xiamen University
182 Daxue Rd., Siming District
Xiamen, Fujian 361005
China, PR
mdai@xmu.edu.cn
*representing GEOTRACERS and
SOLAS

Zeng Dingyong
State Key Laboratory of Satellite
Ocean Environment Dynamics
Second Institute of Oceanography,
State Oceanic Administration
36 Bao-Chu-Bei Rd.
Hangzhou, Zhejiang 310012
China, PR
zengdy017@163.com

Shuanglin Dong
Fisheries College, Administration
Office of the University
Ocean University of China
238 Songling Rd., Laoshan District
Qingdao, Shandong 266100
China, PR
dongsl@ouc.edu.cn

Jianguo Du
Laboratory of Marine Biology and
Ecology
Third Institute of Oceanography, SOA
184 Daxue Rd.,
Xiamen, Fujian 361005
China, PR
dujianguo999@gmail.com

Xiuning Du

Environmental Science and
Engineering
Ocean University of China
238 Songling Rd., Laoshan District
Qingdao, 266100
China, PR
xiuningdu@gmail.com

Jingfeng Fan

Department of Marine
Environmental Ecology
National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
fanjingfeng@163.com

Song Gao

State Oceanic Administration (SOA)
22 Fushun Rd.
Qingdao, Shandong 266033
China, PR
gaosong@nmfc.gov.cn

Zhongyong Gao

Key Laboratory of Global Change and
Marine-Atmospheric Chemistry
Third Institute of Oceanography, SOA
178 Daxue Rd.
Xiamen, Fujian 361005
China, PR
zgao@263.net

Chunjiang Guan

National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
cjguan@189.cn

Hao Guo

National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
hguo@nmemc.gov.cn

Daji Huang

State Key Laboratory of Satellite
Ocean Environment Dynamics
Second Institute of Oceanography, SOA
36 Bao-Chu-Bei-Lu
Hangzhou, Zhejiang 310012
China, PR
djuang@sio.org.cn

Sui Jun

National Center of Ocean
Standards and Metrology
219 Jieyuan West Rd.
NanKai District
Tianjin, 300112
China, PR
jianghebe@tom.com

Chaolun Li

Institute of Oceanology, Chinese
Academy of Sciences (IOCAS)
7 Nanhai Rd.
Qingdao, Shandong 266071
China, PR
lcl@qdio.ac.cn

Qiufen Li

Yellow Sea Fisheries Research
Institute, CAFS
106 Nanjing Rd.
Qingdao, Shandong 266071
China, PR
liqf@ysfri.ac.cn

Yingren Li

Division of Academic Exchange
and Cooperation
Chinese Academy of Fishery Sciences
150 Qingtacun, South Yongding Rd.
Beijing, 100141
China, PR
liyr@cafs.ac.cn

Zhenlin Liang

Marine College
Shandong University at Weihai
180 Wenhua Xi Rd.
Weihai, Shandong 264209
China, PR
liang@ouc.edu.cn

Fengao Lin

Department of Marine
Environmental Ecology
National Environmental
Monitoring Center
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
falin@nmemc.gov.cn

Xiaopei Lin

Ocean University of China
238 Songling Rd., Laoshan District
Qingdao, 266100
China, PR
linxiaop@ouc.edu.cn

Guimei Liu

National Marine Environmental
Forecasting Center
State Oceanic Administration (SOA)
8 Dahuisi Rd., Haidian District
Beijing, 100081
China, PR
liugm@nmefc.gov.cn

Min-bo Luo

Environment Division
East China Sea Fisheries Research
Institute, CAFS
300 Jungong Rd., Yangpu District
Shanghai, Shanghai 200090
China, PR
minbl@163.com

Xinming Pu

Marine Ecology Research Center
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
xmpu@fio.org.cn

Fangli Qiao

First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
qiaofl@fio.org.cn

Wang Rong

State Oceanic Administration (SOA)
353 XingangZhong Rd.
Guangzhou, Guangdong 510310
China, PR
www.rwrrr@163.com

Lijian Shi

National Satellite Ocean
Application Service
8 Dahuisi Rd., Haidian District
Beijing, 100081
China, PR
shilj@mail.nsoas.gov.cn

Baonan Sun

1 Fuxingmenwai Ave.
Beijing, 100860
China, PR
sunbn@fio.org.cn

Peng Sun

College of Fisheries
Ocean University of China
Room 213, 5 Rd.
Qingdao, Shandong 266003
China, PR
sunbird1103@sina.com

Song Sun

Key Laboratory of Marine Ecology
and Environmental Science
Institute of Oceanology, Chinese
Academy of Sciences (IOCAS)
7 Nanhai Rd.
Qingdao, Shandong 266071
China, PR
sunsong@ms.qdio.ac.cn

Gongke Tan

Office of the General Affairs
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
gongke_tan@fio.org.cn

Qiulu Wang

National Marine Data and
Information Service
93 Liuwei Rd., Hedong District
Tianjin, 300171
China, PR
shelleyqing@hotmail.com

Xiangnan Wang

National Ocean Technology Center
219 Jieyuanxi Rd., Nankai District
Tianjin, Tianjin 300112
China, PR
machanglei@sina.com

Xiaomeng Wang

National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
xmwang@nmemc.gov.cn

Yuan Wang

International Cooperation
State Oceanic Administration (SOA)
1 Fuxingmenwai Ave.
Beijing, 100860
China, PR
aiwowo0149@163.com

Zhen Wang

National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
z_wang@163.com

Zheng Wei

First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
zhengwei@fio.org.cn

Changshui Xia

Physical Oceanography Division
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
xiacs@fio.org.cn

Dongfeng Xu

Second Institute of Oceanography, SOA
36 Baochubei Rd.
Hangzhou, Zhejiang 310012
China, PR
xudongfengyhcn@yahoo.com.cn

Zijun Xu

North China Sea Environmental
Monitoring Center
North China Sea Branch of SOA
22 Fushun Rd.
Qingdao, Shandong 266000
China, PR
zjxu77@gmail.com

Zongjun Xu

Research Center of Marine Ecology
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
xzj@fio.org.cn

Jinkun Yang

National Marine Data and
Information Service
93 Liuwei Rd., Hedong District
Tianjin, 300171
China, PR
yjk@mail.nmdis.gov.cn

Ningsheng Yang

Research Center of Information
and Economy
Chinese Academy of Fishery
Sciences
150 Qingta Cun, Yongding Rd.
Beijing, 100141
China, PR
nsyang@cafs.ac.cn

Wang Yongzhi

First Institute of Oceanography, SOA
6 Songling Rd.
Qingdao, Shandong 266061
China, PR
wangyongzhi@fio.org.cn

Xiutang Yuan

Department of Marine
Environmental Ecology
National Marine Environmental
Monitoring Center, SOA
42 Linghe St., Shahekou District
Dalian, Liaoning 116023
China, PR
xtyuan@nmemc.gov.cn

Jing Zhang

State Key Laboratory of Estuarine
and Coastal Research
East China Normal University
3663 Zhongshan Rd. North
Putuo, Shanghai 200062
China, PR
jzhang@sklec.ecnu.edu.cn

Xuele Zhang

Center for Marine Ecology
Research
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
zhangxl@fio.org.cn

Zhuoying Zhao

National Center of Ocean
Standards and Metrology
219 Jieyuanxi Rd., NanKai District
Tianjin, 300112
China, PR
zzy_sky@163.com

Lian Zhonglian

South China Sea Branch
State Oceanic Administration (SOA)
Room 209, 155 Xingangxi Rd.,
Haizhu District
Guangzhou, Guangdong 510300
China, PR
lianzhonglian@yahoo.com.cn

Feng Zhou

Laboratory of Satellite Ocean
Environment Dynamics
Second Institute of Oceanography, SOA
36 Bao-Chu-Bei-Ru.
Hangzhou, Zhejiang 310012
China, PR
zhoufeng@sio.org.cn

YanXia Zhou

National Marine Data and
Information Center
93 Liuwei Rd., Hedong District
Tianjin, 300171
China, PR
tj_zyx@163.com

Mingyuan Zhu

Key Laboratory for Marine Ecology
First Institute of Oceanography, SOA
6 Xian-Xia Ling Rd.
LaoShan District
Qingdao, Shandong 266061
China, PR
zhumingyuan@fio.org.cn

Ping Zhuang

East China Sea Fisheries Research
Institute, CAFS
300 Jungong Rd., Yangpu District
Shanghai, 200090
China, PR
pzhuang@online.sh.cn

Zhimeng Zhuang

Yellow Sea Fisheries Research
Institute, CAFS
106 Nanjing Rd.
Qingdao, Shandong 266071
China, PR
zhuangzm@ysfri.ac.cn

Yarong Zou

8 Dahuisi Rd., Haidian District
Beijing, 100081
China, PR
zyr@mail.nsoas.gov.cn

Chinese-Taipei

Chih-hao Hsieh

Institute of Oceanography
National Taiwan University
1-Sec. 4 Roosevelt Rd.
Taipei, Taiwan 10617
ROC
chsieh@ntu.edu.tw

Chi-Lu Sun*

Institute of Oceanography
National Taiwan University
1-Sec. 4 Roosevelt Rd.
Taipei, Taiwan 10617
ROC
chilu@ntu.edu.tw
*representing ISC

Yu-Heng Tseng

Department of Atmospheric
Sciences
National Taiwan University
1-Sec. 4 Roosevelt Rd.
Taipei, Taiwan 10617
ROC
yhtseng@as.ntu.edu.tw

Denmark

Adolf K. Kellermann*

Head Science Programme
International Council for the
Exploration of the Sea (ICES)
44-46 H.C. Andersens Blvd.
Copenhagen, DK-1553
Denmark
adi@ices.dk
*representing ICES

Germany

Juergen Alheit*

Biological Oceanography
Department
Leibniz Institute for Baltic Sea
Research, IOW
Seestr. 15
Warnemuende, 18119
Germany
juergen.alheit@io-warnemuende.de
*representing ICES

Japan

Katsuyuki Abo

Fisheries Research Agency
2-17-5 Maruishi
Hatsukaichi, Hiroshima 739-0452
Japan
abo@fra.affrc.go.jp

Hideki Akiyama

East China Sea Fisheries
Oceanography Division
Seikai National Fisheries Research
Institute, FRA
1551-8 Taira-machi
Nagasaki, Nagasaki 851-2213
Japan
hakiyama@fra.affrc.go.jp

Kaoru Aoki

Graduate school of Environmental
Sciences
Yokohama National University
79-1 Tokiwadai, Hodogaya-ku
Kanagawa, Kanagawa 240-8501
Japan
d09ta001@ynu.ac.jp

Sanae Chiba

Research Institute for Global Change
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
chibas@jamstec.go.jp

Masayuki Chimura

Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
chimchim@fra.affrc.go.jp

Sangdeok Chung

Graduate school of Science and
Technology
1-14 Bunkyo-machi
Nagasaki, 852-8521
Japan
eeyoresd@hotmail.com

Erika Fujii

Environment and Information
Sciences
Yokohama National University
No. 3 Bldg., Faculty of Education
and Human Science, 79
Yokohama, 2408501
Japan
fujii-erika-wj@ynu.ac.jp

Natsuki Hasegawa

Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
hasena@fra.affrc.go.jp

Kaoru Hattori

Fisheries Resources Division
Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
khattori@fra.affrc.go.jp

Masahito Hirota

Marketing and Distribution System
Section
National Research Institute of
Fisheries Science, FRA
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
mmhirot@affrc.go.jp

Toyomitsu Horii

Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
thorii@affrc.go.jp

Taro Ichii

Resources Enhancement Promotion
Department
Fisheries Agency
1-2-1 Kasumigaseki, Chiyoda-ku
Tokyo, 100-8907
Japan
ichii@affrc.go.jp

Hiromichi Igarashi

Data Management and Engineering
Data Research Center for Marine-
Earth Sciences/ JAMSTEC
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
higarashi@jamstec.go.jp

Ichiro Imai

Graduate School of Fisheries
Sciences
Hokkaido University
3-1-1 Minatomachi
Hakodate, Hokkaido 041-8611
Japan
imai1ro@fish.hokudai.ac.jp

Yoichiro Ishibashi

Environmental Risk Assessment Unit
Japan NUS Co., Ltd.
5F Nishi-Shinjuku Kimuraya Bldg.
7-5-25 Nishi-Shinkuku
Tokyo, 160-0023
Japan
ishibashi@janus.co.jp

Yukimasa Ishida

Japan Sea National Fisheries
Research Institute, FRA
1-5935-22 Suido-cho, Chuo-ku
Niigata, Niigata 951-8121
Japan
ishiday@fra.affrc.go.jp

Haruto Ishii

Faculty of Marine Science
Tokyo University of Marine
Science and Technology
4-5-7 Konan, Minato-ku
Tokyo, 108-8477
Japan
ishii@kaiyodai.ac.jp

Akira Ishikawa

Graduate School of Bioresources
Mie University
1577 Kurimamachiya
Tsu-city, Mie 514-8507
Japan
ishikawa@bio.mie-u.ac.jp

Yoichi Ishikawa

Graduate School of Science
Kyoto University
Oiwakecho, Kitashirakawa, Sakyo
Kyoto, Kyoto 606-8502
Japan
ishikawa@kugi.kyoto-u.ac.jp

Joji Ishizaka

Hydrospheric Atmospheric
Research Center
Nagoya University
Furo-cho, Chikusa-ku
Nagoya, Aichi 464-8601
Japan
jishizak@hyarc.nagoya-u.ac.jp

Shigeru Itakura

National Research Institute of
Fisheries and Environment of
Inland Sea, FRA
2-17-5 Maruishi
Hatsukaichi, Hiroshima 739-0452
Japan
itakura@affrc.go.jp

Shin-ichi Ito

Tohoku National Fisheries
Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi 985-0001
Japan
goito@affrc.go.jp

Sachihiko Itoh

Atmosphere and Ocean Research
Institute
University of Tokyo
5-1-5 Kashiwanoha
Kashiwa, Chiba 277-8564
Japan
itohsach@aori.u-tokyo.ac.jp

Masahide Kaeriyama

Faculty and Graduate School of
Fisheries Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
salmon@fish.hokudai.ac.jp

Hidehiro Kato

Laboratory of Cetacean Biology,
Faculty of Marine Science
Tokyo University of Marine
Science and Technology
4-5-7 Konan, Minato-ku
Tokyo, 108-8477
Japan
katohide@kaiyodai.ac.jp

Yoshiki Kato

National Research Institute
Far Seas Fisheries
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
kyoshiki@affrc.go.jp

Takao Kawasaki

Atmosphere and Ocean Research
Institute, University of Tokyo
5-1-5 Kashiwanoha
Kashiwa, Chiba 277-8568
Japan
kawasaki@aori.u-tokyo.ac.jp

Hideaki Kidokoro

Japan Sea National Fisheries
Research Institute, FRA
1-5939-22 Suido-cho, Chuo-ku
Niigata, Niigata 951-8121
Japan
kidokoro@fra.affrc.go.jp

Tomohiko Kikuchi

Natural Environment and
Information Research
Graduate School of Environment
and Information Science,
Yokohama National University
No. 3 Bldg., Faculty of Education
and Human Science, 79
Yokohama, Kanagawa 240-8501
Japan
t-kiku@ynu.ac.jp

Kunio Kohata

Water and Soil Environment Division
National Institute for
Environmental Studies (NIES)
16-2 Onogawa
Tsukuba, Ibaraki 305-8506
Japan
kohata@nies.go.jp

Yousuke Koshino

Fisheries Department
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
y-koshino516@mopera.net

Takeo Kurihara

Ariake Yatsuchiro Center
Seikai National Fisheries Research
Institute, FRA
1551-8 Taira-machi
Nagasaki, Nagasaki 851-2213
Japan
takeo@affrc.go.jp

Mitsutaku Makino

Fisheries Research Agency
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
mmakino@affrc.go.jp

Kohei Matsuno

Fisheries Science
Hokkaido University
3-1-1 Minatomachi
Hakodate, Hokkaido 041-8611
Japan
k.matsuno@fish.hokudai.ac.jp

Shoshiro Minobe

Natural History Sciences
Graduate School of Sciences
Hokkaido University
N10W8 Rigaku-8-goukan 3F
Sapporo, Hokkaido 060-0810
Japan
minobe@mail.sci.hokudai.ac.jp

Yasumasa Miyazawa

Research Institute for Global Change
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
miyazawa@jamstec.go.jp

Takashi Mochizuki

Research Institute for Global Change
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
motizuki@jamstec.go.jp

Akihiko Murata

RIGC
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
2-15 Natsushima
Yokosuka, Kanagawa 237-0061
Japan
akihiko.murata@jamstec.go.jp

Satoshi Nagai

National Research Institute of
Fisheries and Environment of
Inland Sea, FRA
2-17-5 Maruishi
Hatsukaichi, Hiroshima 739-0452
Japan
snagai@affrc.go.jp

Satoshi Nakada

Department of Geophysics
Division of Earth and Planetary
Sciences
Graduate School of Science
Kyoto University
Kitashirakawa-Oiwake Cho,
Sakyo-ku
Kyoto, Kyoto 606-8502
Japan
snakada@kugi.kyoto-u.ac.jp

Haruka Nishikawa

Data Research Center for Marine-
Earth Sciences
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
harukan@jamstec.go.jp

Yuji Okazaki

Fisheries Management and
Oceanography Division
Tohoku National Fisheries
Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi 985-0001
Japan
okazakiy@affrc.go.jp

Akira Okuno

Fisheries Oceanography Division
Japan Sea National Fisheries
Research Institute, FRA
1-5939-22 Suido-cho, Chuo-ku
Niigata, Niigata 951-8121
Japan
okuaki@affrc.go.jp

Toshihiro Onitsuka

Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
onitsuka@affrc.go.jp

Tsuneo Ono

Subarctic Fisheries Oceanography
Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro, Hokkaido 085-0802
Japan
tono@fra.affrc.go.jp

Hiroaki Saito

Ecosystem Dynamics Group
Tohoku National Fisheries
Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi 985-0001
Japan
hsaito@affrc.go.jp

Rui Saito

Graduate School of Fisheries
Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
ruis@fish.hokudai.ac.jp

Sei-Ichi Saitoh

Graduate School of Fisheries
Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
ssaitoh@salmon.fish.hokudai.ac.jp

Mitsuo Sakai

Oceanic Squid Section
National Research Institute of Far
Seas Fisheries
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
sakaimit@affrc.go.jp

Tomoko Sakami

Stock Enhancement and
Aquaculture Division
Tohoku National Fisheries
Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi 985-0001
Japan
sakami@affrc.go.jp

Yasunori Sakurai

Graduate School of Fisheries
Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
sakurai@fish.hokudai.ac.jp

Chiyyuki Sassa

Seikai National Fisheries Research
Institute, FRA
1551-8 Taira-machi
Nagasaki, Nagasaki 851-2213
Japan
csassa@fra.affrc.go.jp

Tomoharu Senjyu

Research Institute for Applied
Mechanics
Kyushu University
6-1 Kasuga-kohen
Kasuga, Fukuoka 816-8580
Japan
senjyu@riam.kyushu-u.ac.jp

Takayuki Shiraiwa

Institute of Low Temperature
Science
Hokkaido University
Kita 19, Nishi 8, Kitaku
Sapporo, Hokkaido 060-0819
Japan
shiraiwa@lowtem.hokudai.ac.jp

Sayaka Sogawa

Graduate School of Environmental
Sciences
Yokohama National University
79-1 Tokiwadai, Hodogaya-ku
Yokohama, Kanagawa 240-8501
Japan
say_clear@hotmail.com

Hyejin Song

Marine Ecology Department
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
insanesong@hotmail.com

Annamalai Subramanian

Center for Marine Environmental
Studies
Ehime University
2-5 Bunkyo-cho
Matsuyama
Ehime Prefecture 790 8577
Japan
subra@agr.ehime-u.ac.jp

Hiroya Sugisaki

National Research Institute of
Fisheries Science, FRA
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
sugisaki@affrc.go.jp

Toru Suzuki

Marine Information Research
Center
Japan Hydrographic Association
1-6-6-6F Hanedakuko, Ota-ku
Tokyo, 144-0041
Japan
suzuki@mirc.jha.jp

Kazuaki Tadokoro

Stock Productivity Section
Tohoku National Fisheries
Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi 985-0001
Japan
den@affrc.go.jp

Bunmei Taguchi

Earth Simulator Center
Japan Agency for Marine-Earth
Science and Technology
(JAMSTEC)
3173-25 Showa-machi
Kanazawa-ku
Yokohama, Kanagawa 236-0001
Japan
bunmei@jamstec.go.jp

Motomitsu Takahashi

Fisheries Resources and
Oceanography Division
Seikai National Fisheries Research
Institute, FRA
1551-8 Taira-machi
Nagasaki, Nagasaki 851-2213
Japan
takahamt@fra.affrc.go.jp

Osamu Tamaru

National Research Institute of
Fisheries Engineering
Fisheries Research Agency
7620-7 Hasaki
Kamisu, Ibaraki 314-0408
Japan
otamaru@fra.affrc.go.jp

Takahiro Tanaka

Atmosphere and Ocean Research
Institute, University of Tokyo
5-1-5 Kashiwanoha
Kashiwa, Chiba 277-8564
Japan
tanaka-t@aori.u-tokyo.ac.jp

Yongjun Tian

Japan Sea Fisheries Resources
Japan Sea National Fisheries
Research Institute, FRA
1-5939-22 Suido-cho, Chuo-ku
Niigata, Niigata 951-8121
Japan
yjtian@fra.affrc.go.jp

Atsushi Tsuda

Atmosphere and Ocean Research
Institute
University of Tokyo
5-1-5 Kashiwanoha
Kashiwa, Chiba 277-8564
Japan
tsuda@aori.u-tokyo.ac.jp

Mitsuo Uematsu

Center for International
Collaboration, Atmosphere and
Ocean Research Insti
University of Tokyo
5-1-5 Kashiwanoha
Kashiwa, Chiba 277-8564
Japan
uematsu@aori.u-tokyo.ac.jp

Shin-ichi Uye

Graduate School of Biosphere
Science
Hiroshima University
4-4 Kagamiyama 1 Chome
Higashi, Hiroshima 739-8528
Japan
suye@hiroshima-u.ac.jp

Toshie Wakabayashi

National Research Institute of Far
Seas Fisheries
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanagawa 236-8648
Japan
toshiew@fra.affrc.go.jp

Yasunori Watanabe

Hokkaido National Fisheries
Research Institute, FRA
116 Katsurakoi
Kushiro-shi, Hokkaido 085-0802
Japan
ywat@affrc.go.jp

Yutaka Watanuki

Graduate School of Fisheries
Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 040-8611
Japan
ywata@fish.hokudai.ac.jp

Atsushi Yamaguchi

Marine Biology Laboratory
(Plankton)
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
a-yama@fish.hokudai.ac.jp

Takashi Yamamoto

Polar Science
The Graduate University for
Advanced Studies
10-3 Midori-cho
Tachikawa, Tokyo 190-8518
Japan
taka.y@nipr.ac.jp

Akihiko Yatsu

Hokkaido National Fisheries
Research Institute, FRA
2-4-1 Nakanoshima 2jyou
Sapporo, Toyohira-ku 062-0922
Japan
yatsua@fra.affrc.go.jp

Hisashi Yokoyama

National Research Institute of
Aquaculture, FRA
422-1 Nakatsuhama-ura Minami-Ise
Watarai-gun Mie, 516-0193
Japan
hyoko@fra.affrc.go.jp

Xu YongJiu

Graduate School of Environmental
Studies
Nagoya University
F3-1 (200) Furo-cho, Chikusa-ku
Nagoya, Aichi 464-8601
Japan
xyj-20012318@hotmail.com

Takafumi Yoshida

Special Monitoring and Coastal
Environmental Assessment
Regional Activity Centre
5-5 Ushijima Shin-machi
Toyama, 930-0856
Japan
yoshida@npec.or.jp

Naoki Yoshie

Center for Marine Environmental
Studies
Ehime University
2-5 Bunkyo-cho
Matsuyama, 790-8577
Japan
yoshie.naoki.mm@ehime-u.ac.jp

Tomoko M. Yoshiki

National Fisheries Research
Institute
Fisheries Research Agency
2-12-4 Fukuura, Kanazawa-ku
Yokohama, Kanazawa 236-8648
Japan
tyoshiki@affrc.go.jp

Kenya

Robinson M. Mugo

Laboratory of Marine Environment
and Resource Sensing
Graduate School of Fisheries Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Hokkaido 041-8611
Japan
Kenya Marine and Fisheries
Research Institute
P.O. Box 81651, Mombasa
Kenya
robin_mugo@salmon.fish.hokudai.ac.jp

Korea, R

Soon-Il An

Department of Atmospheric Sciences
Yonsei University
50 Yonsei-ro, Seodaemun-gu
Seoul, 120-749
Korea, R
sian@yonsei.ac.kr

Jinho Bae

Department of Marine Biology
Pukyong National University
599-1 Daeyeon3-dong, Nam-gu
Busan, 608-737
Korea, R
jhbae2007@gmail.com

Kyung-Il Chang

School of Earth and Environmental
Sciences
Seoul National University
Gwanak-599 Gwanak-ro, Gwanak-gu
Seoul, 151-742
Korea, R
kichang@snu.ac.kr

Keyseok Choe

Center for International
Cooperative Programs
Korea Ocean Research and
Development Institute (KORDI)
787 Hae-an-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
kschoe@kordi.re.kr

Joong Ki Choi

Department of Oceanography
Inha University
253 Yonghyun-dong, Nam-gu
Incheon, 402-751
Korea, R
jkchoi@inha.ac.kr

Seokgwan Choi

Cetacean Research Institute
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
139-29 Maeam-dong, Nam-gu
Ulsan, 680-050
Korea, R
sgchoi@nfrdi.go.kr

Ik Kyo Chung

Earth Environmental System
Pusan National University
San 30 Jangjeon-dong,
Geumjeong-gu
Busan, 609-735
Korea, R
ikchung@pusan.ac.kr

Changhoon Han

National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
152-1 Haeon-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
chhan@nfrdi.go.kr

Chan Joo Jang

Climate Change and Coastal
Disaster Research Department
Korea Ocean Research and
Development Institute (KORDI)
787 Haeon-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
cjjang@kordi.re.kr

Pungguk Jang

Department of Southern Coastal
Environment Research
Korea Ocean Research and
Development Institute (KORDI)
391 Jangmok-ri, Jangmok-myeon
Geoje, Gyeongsangnam-do 656-830
Korea, R
pgjang@kordi.re.kr

Yujin Jeon

Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
yuzu701@naver.com

Kwangyoung Jeong

Oceanography
Chungnam National University
220 Gung-dong, Yuseong-gu
Daejeon, 305-764
Korea, R
kyjung@cnu.ac.kr

Se-Jong Ju

Deep-Sea and Marine
Georesources Research
Korea Ocean Research and
Development Institute (KORDI)
787 Haeon-ro, Sangrok-gu
Ansan, Gyeonggi-do 425-600
Korea, R
sjuu@kordi.re.kr

Sungeun Ju

Inha University
253 Yonghyun-dong, Nam-gu
Incheon, 402-751
Korea, R
comsa26@hanmail.net

Sukgeun Jung

School of Marine Biomedical
Sciences
Jeju National University
1 Ara 1-dong, 102 Jejudaehakno
Jeju, 690-756
Korea, R
sukgeun.jung@gmail.com

Changkeun Kang

Pohang University of Science and
Technology
San 31 Hyoja-dong, Nam-gu
Pohang, Gyeongsangbuk-do 790-784
Korea, R
ckkang@postech.ac.kr

Dong-Jin Kang

Korea Ocean Research and
Development Institute (KORDI)
787 Haeon-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
djocean@kordi.re.kr

Hyounwoo Kang

Climate Change and Coastal
Disaster Research Department
Korea Ocean Research and
Development Institute (KORDI)
787 Haeon-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
hwkang@kordi.re.kr

Jung-Hoon Kang

South Sea Environment Research
Korea Ocean Research and
Development Institute (KORDI)
391 Jangmok-ri, Jangmok-myeon
Geoje, Gyeongsangnam-do 656-830
Korea, R
jhkang@kordi.re.kr

Sukyung Kang

Fisheries Resources Research
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
152-1 Haeon-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
kangsk@nfrdi.go.kr

Ji Yeon Kim

Marine Biotechnology Department
Soonchunhyang University
646 Eupnae-ri, Shinchang-myeon
Ansan, Chungcheongnam-do 336-745
Korea, R
kgy8122@naver.com

Jinyeong Kim*

Southwest Fisheries Institute
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
22 Dangmeori-gil, Hwayang-myeon
Yeosu, Cheollanam-do 556-823
Korea, R
jiykim@nfrdi.go.kr
*representing NPAFC

Jung Nyun Kim

Fisheries Research Division
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
152-1 Haeon-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
crangonk@nfrdi.go.kr

Kuh Kim

Ocean Science and Technology
Institute
Pohang University of Science and
Technology
San 31 Hyoja-dong, Nam-gu
Pohang
Gyeongsangbuk-do 790-784
Korea, R
kuhkim@gmail.com

Kwangbae Kim

Marine Biotechnology Department
Soonchunhyang University
646 Eupnae-ri, Shinchang-myeon
Ansan
Chungcheongnam-do 336-745
Korea, R
kkb9043@naver.com

Kyung-Ryul Kim

School of Earth and Environmental
Sciences
Seoul National University
San 56-1 Shillim-dong
Kwanaka-ku
Seoul, 151-747
Korea, R
krkim@snu.ac.kr

Kyungsu Kim

Department of Marine Biology
Pukyong National University
45 Yongso-ro, Daeyeon-dong,
Nam-gu
Busan, 608-737
Korea, R
ks-kim@pknu.ac.kr

Sangwoo Kim

Fisheries Environment
East Sea Fisheries Institute,
NFRDI
482 Sacheonhaean-ro
Yeongok-myeon
Gangneung, Gangwon-do 210-861
Korea, R
swkim@nfrdi.go.kr

Suam Kim

Department of Marine Biology
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
suamkim@pknu.ac.kr

Yeon-Kye Kim

Food and Safety Division
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
408-1 Sirang-ri, Gijang-gun
Busan, 619-705
Korea, R
yeonkyekim@korea.kr

Changkyu Lee

Southeast Sea Fisheries Institute
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
361 Yeongun-ri, Sanyang-eup,
Tongyeong, 650-943
Korea, R
changkl@nfrdi.go.kr

Jaebong Lee

Fisheries Resources Management
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
152-1 Haeon-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
leejb@nfrdi.go.kr

Jin Hwan Lee

Department of Green Life Science
Department of Green Life Science
Departm
Sangmyung University
7 Hongji-dong, Jongno-gu
Seoul, 110-743
Korea, R
jhlee@smu.ac.kr

Jun Mo Lee

Department of Green Life Science
Sangmyung University
7 Hongji-dong, Jongno-gu
Seoul, 110-743
Korea, R
junmagician@yahoo.co.kr

Sang Deuk Lee

Department of Green Life Science
Sangmyung University
7 Hongji-dong, Jongno-gu
Seoul, 110-743
Korea, R
deukiiii@gmail.com

Sangjin Lee*

Regional Coordinating Unit
Northwest Pacific Action Plan
(NOWPAP) of UNEP
152-1 Haeon-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
sangjin.lee@nowpap.org
*representing NOWPAP

Soojeong Lee

Division of Marine Production
System Management
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
sjlee83@pknu.ac.kr

Hyun-Taek Lim

88 Gwanmun-ro
Gwacheon-city, 427-712
Korea, R
pado21@korea.kr

Hanna Na

School of Earth and Environmental
Sciences
Seoul National University
599 Gwanak-ro, Gwanak-gu
Seoul, 151-742
Korea, R
hanna.ocean@gmail.com

Chulwoong Oh

Department of Marine Biology
Pukyong national University
559-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
ohcw@pknu.ac.kr

Changuk Park

Marine Biology Department
Pukyong National University
45 Yongso-ro, Daeyeon-dong,
Nam-gu
Busan, 608-737
Korea, R
c.u@daum.net

Chul Park

Department Oceanography
Chungnam National University
79 Daehangro, Yuseong-gu
Daejeon, 305-764
Korea, R
chulpark@cnu.ac.kr

Heewon Park

Division of Marine Production
System Management
Pukyong National University
559-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
hwpark@pknu.ac.kr

Hyemin Park

Department of Marine Biology
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
shrimppark@gmail.com

Jaehun Park

Korea Ocean Research and
Development Institute (KORDI)
1270 Sa-dong, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
jhpark@kordi.re.kr

Jueun Park

Pukyong National University
Daeyon-3dong, Nam-Gu
Busan, 608-737
Korea, R
pinkje2000@nate.com

Taewook Park

Korea Ocean Research and
Development Institute (KORDI)
787 Haean-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
twpark.kr@gmail.com

Wongyu Park

Department of Marine Biology
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
wpark@pknu.ac.kr

Taekeun Rho

Marine Research Institute
Pusan National University
San 30 Jangjeon-dong,
Geumjeong-gu
Busan, 609-735
Korea, R
tkrho@hotmail.com

Young Jae Ro

College of Natural Sciences
Chungnam National University
220 Gung-dong, Yuseong-gu
Daejeon, 305-764
Korea, R
royoungj@cnu.ac.kr

Youngil Seo

Fisheries Resources Environment
Division
South Sea Fisheries Research
Institute, NFRDI, MIFAFF
347 Anpo-ri, Hwayang-myeon
Yeosu, Cheollanam-do 556-823
Korea, R
seoyi@nfrdi.go.kr

Kyoungsoon Shin

South Sea Environment Research
Korea Ocean Research and
Development Institute (KORDI)
391 Jangmok-ri, Jangmok-myeon
Geoje
Gyeongsangnam-do 656-830
Korea, R
ksshin@kordi.re.kr

Min Kyung Shin

Department of Marine Biology
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
hello_marine@naver.com

Alexander V. Tkalin*

Regional Coordinating Unit
Northwest Pacific Action Plan
(NOWPAP) of UNEP
152-1 Haean-ro, Gijang-eup, Gijang-gun
Busan, 619-705
Korea, R
Alexander.Tkalin@nowpap.org
*representing NOWPAP

Keiko Yamada

Department of Global Environment
College of Environment
Keimyung University
2800 Dalgubeoldae-ro, Dalseo-gu
Daegu, 704-701
Korea, R
qeiko77@hotmail.com

Sangwook Yeh

Environmental Marine Science
Hanyang University
1271 Sa3-dong, Sangrok-gu
Ansan, 426-791
Korea, R
swyeh@hanyang.ac.kr

Gi-dong Yeo

88 Gwanmun-ro
Gwacheon-city, 427-712
Korea, R
ygd1215@korea.kr

Joeeun Yoon

Phytoplankton Ecology
Korea Ocean Research and
Development Institute (KORDI)
787 Haeon-ro, Sangrok-gu
Ansan, Gyeonggi-do 426-744
Korea, R
eliterem@kordi.re.kr

Changik Zhang

Division of Marine Production
System Management
Pukyong National University
599-1 Daeyeon-3dong, Nam-gu
Busan, 608-737
Korea, R
cizhang@pknu.ac.kr

Ming Ming Zhang

Department of Marine Biology
Pukyong National University
45 Yongso-ro, Daeyeon-dong,
Nam-gu
Busan, 608-737
Korea, R
zhangmingm44ok@163.com

Malaysia

Mohamed Rawidean Mohd Kassim

Malaysian Institute of
Microelectronic Systems
(MIMOS)
Technology Park Malaysia
Bukit Jalil
Kuala Lumpur, 57000
Malaysia
dean@mimos.my

México

Oleg Zaitsev

Oceanology
Interdisciplinary Center on Marine
Sciences
National Polytechnic Institute
Avenida Instituto Politecnico
Nacional, s/n, Playa Palo
La Paz, Baja California Sur 23096
México
ozaytsev@hotmail.com

Norway

Kjell Rong Utne

Ecosystem Processes
Institute of Marine Research
33 Nordnesgt
Bergen, 5004
Norway
kjell.rong.utne@imr.no

Russia

Anastasiya A. Abrosimova

General Oceanology
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
amber84@bk.ru

Natalia M. Aminina

Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690950
Russia
aminina@tinro.ru

Andrey G. Andreev

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
andreev@poi.dvo.ru

Antonina V. Artemova

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, 690041
Russia
artemova@poi.dvo.ru

Nadezhda L. Aseeva

Fisheries Resources of the Far
Eastern Seas
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
aseeva_n@hotmail.com

Tatyana A. Belan

Oceanography and Marine Ecology
Far Eastern Regional
Hyrdrometeorological Research
Institute (FERHRI)
24 Fontannaya St.
Vladivostok, Primorsky Kray
690091
Russia
Tbelan@ferhri.ru

Svetlana A. Belaya
General Ecology
Far Eastern Federal University
(FEFU)
27 Oktyabrskaya St.
Vladivostok, Primorsky Krai
690091
Russia
belaya41@mail.ru

Tatyana V. Belonenko
Department of Oceanology,
Faculty of Geography and
Geology
Saint Petersburg State University
33/35 10th Line
Saint Petersburg, 199178
Russia
btvlisab@yandex.ru

Victor Bugaev
Kamchatka Research Institute of
Fisheries and Oceanography
(KamchatNIRO)
18 Naberezhnaya St.
Petropavlovsk-Kamchatsky,
Kamchatka 683600
Russia
bugaevv@kamniro.ru

Oleg A. Bulatov
Fishery Biology
Russian Federal Research Institute
of Fisheries and Oceanography
(VNIRO)
17 V. Krasnoselskaya St.
Moscow, 107140
Russia
obulatov@vniro.ru

Andrey P. Chernyaev
Laboratory of Applied Ecology and
Ecotoxicology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
blizzard_01@mail.ru

Tatiana Chizhova
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Krai
690041
Russia
chizhova@poi.dvo.ru

Anna V. Dakus
Laboratory for Pelagic Resources
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690091
Russia
anna.dakus@gmail.com

Nikolay Diansky
Russian Academy of Sciences
Institute of Numerical Mathematics
8 Gubkina
Moscow, 119333
Russia
nikolay.diansky@gmail.com

Anastasia S. Dolganova
Laboratory of Hydrobiology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
acdolganova@yandex.ru

Natalia T. Dolganova
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
dolganova@tinro.ru

Polina A. Dulenina
Khabarovsk Branch of TINRO-
Center
13-A Amursky Blvd.
Khabarovsk, 680028
Russia
dulenin@mail.ru

Elena P. Dulepova
Laboratory of Applied Bioecology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
dep@tinro.ru

Nadezda M. Dulova
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Krai
690041
Russia
nadydul@poi.dvo.ru

Pavel Fayman
Department of Engineering
Oceanology and Ecological
Designing
Far Eastern Regional
Hydrometeorological Research
Institute (FERHRI)
24 Fontannaya St.
Vladivostok, 690600
Russia
pavel.fayman@gmail.com

Galina S. Gavrilova
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
gavrilova@tinro.ru

Larissa A. Gayko

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Krai
690041
Russia
gayko@yandex.ru

Gennady A. Kantakov

Far-Eastern Ecological Center Ltd.
Office 404, 426 Mira Ave.
Yuzhno-Sakhalinsk, Sakhalin
693004
Russia
deco@sakhalin.ru

Dmitry D. Kaplunenko

Department of Satellite Oceanology
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Krai
690041
Russia
dimkap@poi.dvo.ru

Oleg N. Katugin

Fisheries Resources of the Far
Eastern Seas
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690090
Russia
katugin@tinro.ru

Alexey A. Khoruzhiy

Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
100 Let Vladivostok 33, 16
Vladivostok, 4232
Russia
alex.khoruzhiy@gmail.com

Nadezda K. Khristoforova

Ecology Department
Far Eastern Federal University
(FEFU)
27 Oktyabrskaya St.
Vladivostok, Primorsky Krai
690091
Russia
marineecology@rambler.ru

Denis Kiku

Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690091
Russia
kiku@tinro.ru

Talgat R. Kilmатов

Far Eastern Federal University
(FEFU)
19 Ocean Prospect
Vladivostok, Primorsky Krai
690950
Russia
talgat_k@mail.ru

Kirill Kivva

Climatic Bases of Biological
Productivity Laboratory
Russian Federal Research Institute
of Fisheries and Oceanography
(VNIRO)
17 V. Krasnoselskaya St.
Moscow, 107140
Russia
kirill.kivva@gmail.com

Alexandra Kondakova

Institute of Chemistry and Applied
Ecology
Far Eastern Federal University (FEFU)
27 Oktyabrskaya St.
Vladivostok, Primorsky Krai
690950
Russia
petrovasasha@yandex.ru

Olga Koval

Kamchatka Research Institute of
Fisheries and Oceanography
(KamchatNIRO)
18 Naberezhnaya St.
Petropavlovsk-Kamchatsky,
683000
Russia
koval.o.o@kamniro.ru

Andrey S. Krovnin

Laboratory of Climatic Bases of
Bioproductivity
Russian Federal Research Institute
of Fisheries and Oceanography
(VNIRO)
17 V. Krasnoselskaya St.
Moscow, 107140
Russia
akrovnin@vniro.ru

Tatyana N. Krupnova

Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690950
Russia
krupnova@tinro.ru

Sergey E. Kulbachnyi

Khabarovsk Branch of TINRO-
Center
13-A Amursky Blvd.
Khabarovsk, 680028
Russia
khlopova82@mail.ru

Vladimir V. Kulik

Laboratory of Applied Bioceanology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Krai
690091
Russia
vladicon82@gmail.com

Vyacheslav S. Labay

Hydrobiology
Sakhalin Research Institute of
Fisheries and Oceanography
(SakhNIRO)
196 Komsomolskaya St.
Yuzhno-Sakhalinsk, Sakhalin
693023
Russia
Labay@sakhniro.ru

Alexander Yu. Lazaryuk

Physical Oceanography
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorskiy Kray
690041
Russia
lazaryuk@poi.dvo.ru

Ekaterina V. Lepskaya

Kamchatka Research Institute of
Fisheries and Oceanography
(KamchatNIRO)
18 Naberezhnaya St.
Petropavlovsk-Kamchatsky,
683000
Russia
lepskaya@list.ru

Irina R. Levenets

Far East Branch of Russian
Academy of Sciences
A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorye 690041
Russia
iralevenetz@rambler.ru

Vyacheslav B. Lobanov

Deputy Director
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorskiy Kray
690041
Russia
lobanov@poi.dvo.ru

Polina V. Lobanova

Department of Oceanology,
Faculty of Geography and
Geology
Saint Petersburg State University
33/35 10th Line
Saint Petersburg, 199178
Russia
pl19@mail.ru

Olga N. Lukyanova

Laboratory of Applied Ecology and
Ecotoxicology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorskiy Kray
690950
Russia
onlukyanova@tinro.ru

Artur Maiss

Kamchatka Lige Independent Experts
N/Tereshkovo 1
Petropavlovsk-Kamchatsky,
683038
Russia
koryak@yandex.ru

Irina Mashkina

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, 690041
Russia
i-val-mash@poi.dvo.ru

Vasilii F. Mishukov

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorskiy Kray
690041
Russia
vmishukov@poi.dvo.ru

Georgiy S. Moiseenko

Satellite Monitoring Systems
Laboratory
Russian Federal Research Institute
of Fisheries and Oceanography
(VNIRO)
17 V. Krasnoselskaya St.
Moscow, 107140
Russia
georgem@vniro.ru

Valentina V. Moroz

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorskiy Kray
690041
Russia
moroz@poi.dvo.ru

Tatiana V. Morozova

A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorskiy Kray
690041
Russia
tatiana_morozova@mail.ru

Alexander V. Moshchenko

Institute of Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, 690041
Russia
avmoshchenko@mail.ru

Chingiz Nigmatullin

Atlantic Research Institute of
Fisheries and Oceanography
5 Donskoy St.
Kaliningrad, 236022
Russia
chingiznigmatullin@rambler.ru

Vadim V. Novotryasov

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorskiy Kray
690041
Russia
vadimnov@poi.dvo.ru

Alexei M. Orlov

International Fisheries Cooperation
Russian Federal Research Institute
of Fisheries and Oceanography
(VNIRO)
17 V. Krasnoselskaya St.
Moscow, 107140
Russia
orlov@vniro.ru

Tatiana Yu. Orlova

Department of Hydrobiology
A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorsky Kray
690041
Russia
torlova06@mail.ru

Vladimir I. Ostrovsky

Khabarovsk Branch of TINRO-
Center
13-A Amursky Blvd.
Khabarovsk, 680028
Russia
ostrovkhv@mail.ru

Galina Yu. Pavlova

Geochemistry
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
pavlova@poi.dvo.ru

Tatyana Pavlova

Voeikov Main Geophysical
Observatory
7 Karbyshev St.
Saint Petersburg, 194021
Russia
t-v-pavlova@mail.ru

Natalia Pichugina

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
pichugina@poi.dvo.ru

Viktoriya A. Platonova

Meteorology
Far Eastern Federal University (FEFU)
8 Sukhanova St.
Vladivostok, Primorsky Kray
690600
Russia
platonova@meteo.dvgu.ru

Sergey D. Ponomarev

Okhotsk Laboratory
Khabarovsk Branch of TINRO-
Center
13-A Amursky Blvd.
Khabarovsk, 680028
Russia
katy_k07@mail.ru

Vladimir I. Ponomarev

Physical Oceanography
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
pvi711@yandex.ru

Konstantin A. Rogachev

Ocean Physics Department
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
rogachev@poi.dvo.ru

Natalia I. Rudykh

Laboratory of Ocean Information
and Ocean Monitoring
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
rudykh@poi.dvo.ru

Pavel Salyuk

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
pavel.salyuk@gmail.com

Pavel Saveliev

Laboratory of Ichthyology
A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorsky Kray
690041
Russia
tomthumb@mail.ru

Olga N. Selivanova

Hydrobiology
Kamchatka Branch of Pacific
Institute of Geography
6 Partizanskaya St.
Petropavlovsk-Kamchatsky,
Kamchatskii Krai 683000
Russia
oselivanova@mail.ru

Tatiana Semenova

International Collaboration
Department
FSUE "TINRO-Centre"
4 Shevchenko Alley
Vladivostok, 690091
Russia
tanushik@bk.ru

Pavel Yu. Semkin

Hydrochemistry
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Territory
690041
Russia
Pahno@list.ru

Tatyana A. Shatilina

Fisheries Oceanography
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
Shatilina@tinro.ru

Igor I. Shevchenko

Information Technology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690950
Russia
igor@tinro.ru

Olga Shevchenko

Biology Department
A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorsky Kray
690041
Russia
713553@mail.ru

Svetlana P. Shkorba

Ice Research Laboratory
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
sshkorba@yandex.ru

Elena A. Shtraikhert

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
straj@poi.dvo.ru

Vladimir M. Shulkin

Pacific Geographical Institute,
FEB RAS
7 Radio St.
Vladivostok, Primorsky Kray
690041
Russia
shulkin@tig.dvo.ru

Mikhail Simokon

Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
simokon@tinro.ru

Eduard Spivak

Laboratory of Arctic Research
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
stilo@poi.dvo.ru

Dmitry Stepanov

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
step-nov@poi.dvo.ru

Inna V. Stonik

Hydrobiology
A.V. Zhirmunsky Institute of
Marine Biology, FEB RAS
17 Palchevskogo St.
Vladivostok, Primorsky Kray
690041
Russia
innast@imb.dvo.ru

Dmitrii S. Strobykin

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
doom46@yandex.ru

Svetlana Taranova

V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
taranova@poi.dvo.ru

Olga S. Temnykh

Laboratory of Applied Bioecology
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690950
Russia
temnykh@tinro.ru

Evgeniya A. Tikhomirova

Department of General
Oceanology, Laboratory of
Hydrological Processes and
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
tikhomirova@poi.dvo.ru

Pavel Ya. Tishchenko

Head, Hydrochemistry Laboratory
V.I. Il'ichev Pacific Oceanological
Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
tpavel@poi.dvo.ru

Tatyana I. Tolstyak

Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO)
18 Naberezhnaya St.
Petropavlovsk-Kamchatsky,
683000
Russia
nikolayeva.a.a@kamniro.ru

Olga O. Trusenкова

Laboratory of Physical Oceanography
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
troliia@poi.dvo.ru

Vasiliy Yu. Tsygankov

General Ecology
Far Eastern Federal University (FEFU)
27 Oktyabrskaya St.
Vladivostok, 690950
Russia
tsig_90@mail.ru

Elena I. Ustinova

Laboratory of Fisheries Oceanography
Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690950
Russia
eustinova@mail.ru

Nadezda M. Vakulskaya

Ice Research Laboratory
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
vakulskaya@poi.dvo.ru

Vera N. Valova

Laboratory of Fish Reproduction
Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
valova@tinro.ru

Anna Vazhova

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
free_flyer@mail.ru

Anatoliy Velikanov

Sakhalin Research Institute of Fisheries and Oceanography (SakhNIRO)
196 Komsomolskaya St.
Yuzhno-Sakhalinsk, Sakhalin
693023
Russia
velikanov@sakhniro.ru

Igor V. Volvenko

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690950
Russia
volvenko@tinro.ru

Elena I. Yaroshchuk

Education and Science Department
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
101-128 Kirova St.
Vladivostok, Primorsky Kray
690022
Russia
e.yaroshchuk@poi.dvo.ru

Marina I. Yurieva

Laboratory of Biochemistry of Water Organisms
Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky kray
690091
Russia
yureva@tinro.ru

Sergey P. Zakharkov

General Oceanology
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
zakharkov@poi.dvo.ru

Alexander V. Zavolokin

Pacific Research Institute of Fisheries and Oceanography (TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
zavolokin@tinro.ru

Igor A. Zhabin

Oceanology
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
690041
Russia
zhabin@poi.dvo.ru

Sergey F. Zolotukhin

Khabarovsk Branch of TINRO-Center
13-A Amursky Blvd.
Khabarovsk, 680028
Russia
sergchum2009@yandex.ru

Yury I. Zuenko
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690091
Russia
zuenko_yury@hotmail.com

Mikhail Zuev
Pacific Research Institute of
Fisheries and Oceanography
(TINRO-Center)
4 Shevchenko Alley
Vladivostok, Primorsky Kray
690090
Russia
maiklzusqd@mail.ru

Thailand

Suchana A. Chavanich*
Department of Marine Science,
Faculty of Science
Chulalongkorn University
Payathai Rd.
Bangkok, Bangkok 10330
Thailand
suchana.c@chula.ac.th
*representing WESTPAC

Simon James Funge-Smith*
Regional Office for Asia and the
Pacific
Food and Agriculture Organization
of the United Nations
39 Pra Athit Rd.
Bangkok, 10200
Thailand
simon.fungesmith@fao.org
*representing APFIC and FAO

U.S.A.

Joel Baker
Center for Urban Waters
University of Washington
326 East D St.
Tacoma, WA 98421
U.S.A.
jebaker@uw.edu

Neil S. Banas
Applied Physics Laboratory
University of Washington
Campus Box 355640
Seattle, WA 98195
U.S.A.
neil@apl.washington.edu

Jack A. Barth*
College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, OR 97331-5503
U.S.A.
barth@coas.oregonstate.edu
*representing NANOOS

Harold (Hal) P. Batchelder
College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, OR 97331-5503
U.S.A.
hbatchelder@coas.oregonstate.edu

Igor Belkin
Graduate School of Oceanography
University of Rhode Island
215 South Ferry Rd.
Narragansett, RI 02882
U.S.A.
igormbelkin@gmail.com

George W. Boehlert
Hatfield Marine Science Center
Oregon State University
2030 SE Marine Science Dr.
Newport, OR 97365-5296
U.S.A.
george.boehlert@oregonstate.edu

Steven J. Bograd
Environmental Research Division
Southwest Fisheries Science
Center (SWFSC), NMFS, NOAA
1352 Lighthouse Ave.
Pacific Grove, CA 93950
U.S.A.
steven.bograd@noaa.gov

Richard D. Brodeur
Fish Ecology, HMSC
National Marine Fisheries Service,
NOAA
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
Rick.Brodeur@noaa.gov

David M. Checkley*
Scripps Institution of Oceanography
University of California, San Diego
9500 Gilman Dr.
La Jolla, CA 92093-0218
U.S.A.
dcheckley@ucsd.edu
*representing GOOS

Kristin Cieciel
Auke Bay Laboratories
Alaska Fisheries Science Center,
NMFS, NOAA
17109 Point Lena Loop Rd.
Juneau, AK 99801
U.S.A.
kristin.cieciel@noaa.gov

Keith R. Criddle
Fisheries Academic Program
University of Alaska, Fairbanks
17101 Point Lena Loop Rd.
Juneau, AK 99801
U.S.A.
kcriddle@sfos.uaf.edu

Enrique N. Curchitser*
Institute of Marine and Coastal
Sciences
Rutgers University
71 Dudley Rd.
New Brunswick, NJ 08901
U.S.A.
enrique@marine.rutgers.edu
*representing CLIVAR

Michael J. Dagg

Louisiana Universities Marine
Consortium
8124 Hwy. 56
Chauvin, LA 70344
U.S.A.
mdagg@lumcon.edu

Jerome Fiechter

Institute of Marine Sciences
University of California Santa Cruz
1156 High St.
Santa Cruz, CA 95064
U.S.A.
fiechter@ucsc.edu

Anne B. Hollowed

Alaska Fisheries Science Center,
NMFS, NOAA
7600 Sand Point Way NE
Seattle, WA 98115-6349
U.S.A.
Anne.Hollowed@noaa.gov

Emanuele Di Lorenzo

School of Earth and Atmospheric
Sciences
Georgia Institute of Technology
311 Ferst Dr.
Atlanta, GA 30332
U.S.A.
edl@gatech.edu

John C. Field

Fisheries Ecology
Southwest Fisheries Science
Center (SWFSC), NMFS, NOAA
110 Shaffer Rd.
Santa Cruz, CA 95060
U.S.A.
John.Field@noaa.gov

Mary Hunsicker

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 Ocean Administration Bldg.
Corvallis, OR 97331
U.S.A.
mhunsicker@coas.oregonstate.edu

Brett Dumbauld

Agriculture, Agricultural Research
Service (USDA/ARS)
Forage Seed and Cereal Research
Unit
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
brett.dumbauld@ars.usda.gov

David Gareth Foley

Joint Institute for Marine and
Atmospheric Research
University of Hawaii at Manoa
1352 Lighthouse Ave.
Pacific Grove, CA 93950
U.S.A.
dave.foley@noaa.gov

George L. Hunt, Jr.*

School of Aquatic and Fishery
Sciences
University of Washington
P.O. Box 355020
Seattle, WA 98195
U.S.A.
geohunt2@u.washington.edu
*representing ESSAS

Anatoli Erofeev

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, OR 97331
U.S.A.
aerofeev@coas.oregonstate.edu

Feixue Fu

Department of Biology
University of Southern California
3616 Trousdale Pkwy.
Los Angeles, CA 90089
U.S.A.
ffu@usc.edu

Takamitsu Ito

Georgia Institute of Technology
School of Earth and Atmospheric
Sciences
Atlanta, GA 30332
U.S.A.
taka.ito.work@gmail.com

Maggie Esch

4429 Lakeway Dr.
Bellingham, WA 98229
U.S.A.
maggiesch@charter.net

Burke Hales

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 Ocean Administration Bldg.
Corvallis, OR 97331
U.S.A.
bhales@coas.oregonstate.edu

J. Anthony (Tony) Koslow*

California Cooperative Oceanic
Fisheries Investigations
Scripps Institution of
Oceanography, UCSD
9500 Gilman Dr.
La Jolla, CA 92093-0218
U.S.A.
tkoslow@ucsd.edu
*representing SCCOOS

Blake E. Feist

Conservation Biology Division
Northwest Fisheries Science Center
(NWFS), NMFS, NOAA
2725 Montlake Blvd. East
Seattle, WA 98112
U.S.A.
Blake.Feist@noaa.gov

Elliott Lee Hazen

Environmental Research Division
Southwest Fisheries Science
Center (SWFSC), NMFS, NOAA
1352 Lighthouse Ave.
Pacific Grove, CA 93950
U.S.A.
elliott.hazen@noaa.gov

Alexander Kozyr

Carbon Dioxide Information
Analysis Center (CDIAC)
Environment Science Division,
Oak Ridge National Laboratory,
U.S. Departmen
Bldg. 2040, MS 6290
Oak Ridge, TN 37831-6290
U.S.A.
kozyra@ornl.gov

Gordon H. Kruse*

School of Fisheries and Ocean
Sciences
University of Alaska, Fairbanks
17101 Point Lena Loop Rd.
Juneau, AK 99801
U.S.A.
Gordon.Kruse@alaska.edu
*representing BEST/BSIERP

Raphael Kudela*

Ocean Sciences
University of California Santa Cruz
Ocean Sciences Department
1156 High St.
Santa Cruz, CA 95064
U.S.A.
kudela@ucsc.edu
*representing GEOHAB

Alexander Kurapov*

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, 97331-5503
U.S.A.
kurapov@coas.oregonstate.edu
*representing NANOOS

Henry Lee II

Pacific Coastal Ecology Branch
U.S. Environmental Protection
Agency (EPA)
2111 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
lee.henry@epa.gov

Elizabeth A. Logerwell

Resource Ecology and Fishery
Management
Alaska Fisheries Science Center,
NMFS, NOAA
P.O. Box 15700 F/AKC2
Seattle, WA 98115
U.S.A.
Libby.Logerwell@noaa.gov

Phillip R. Mundy*

Auke Bay Laboratories
Alaska Fisheries Science Center,
NMFS, NOAA
Ted Stevens Marine Research
Institute, 17109 Pt. Lena L
Juneau, AK 99801
U.S.A.
Phil.mundy@noaa.gov
*representing AOOS

William T. Peterson

Northwest Fisheries Science Center
(NWFSC), NMFS, NOAA
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
Bill.Peterson@noaa.gov

Jennifer E. Purcell

Shannon Point Marine Center
Western Washington University
1900 Shannon Point Rd.
Anacortes, WA 98221
U.S.A.
purcelj3@wwu.edu

Rolf R. Ream

National Marine Mammal Laboratory
Alaska Fisheries Science Center,
NMFS, NOAA
7600 Sand Point Way NE
Seattle, WA 98115
U.S.A.
rolf.ream@noaa.gov

Deborah Ann Reusser

Western Fisheries Research Center
U.S. Geological Survey
2111 SE Marine Science Dr.
Newport, OR 97376
U.S.A.
dreusser@usgs.gov

Kenneth A. Rose

Oceanography and Coastal
Sciences
Louisiana State University
3125 Energy, Coast, and
Environment Bldg.
Baton Rouge, LA 70803
U.S.A.
karose@lsu.edu

Thomas C. Royer

Ocean, Earth and Atmospheric
Sciences, Center for Coastal
Physical Oceanogr
Old Dominion University
Apt. 412, 100 Hauoli St.
Wailuku, HI 96793
U.S.A.
royer@ccpo.odu.edu

Steven S. Rumrill*

Biology Department
University of Oregon
63466 Boat Basin Rd.
Charleston, OR 97420
U.S.A.
Steve.Rumrill@state.or.us
*representing CERF

Rosa Melida Runcie*

PaCOOS (Pacific Coast Ocean
Observing System) and HMS
(Highly Migratory Species)
National Oceanic and Atmospheric
Administration
3333 North Torrey Pines Court
La Jolla, CA 92037
U.S.A.
Rosa.Runcie@noaa.gov
*representing PaCOOS

Ryan R. Rykaczewski

Hatfield Marine Science Center
Oregon State University
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
ryan.rykaczewski@noaa.gov

Jameal F. Samhouri

Northwest Fisheries Science Center
NOAA Fisheries
2725 Montlake Blvd. East
Seattle, WA 98112
U.S.A.
jameal.samhouri@noaa.gov

Robert Suryan

Hatfield Fisheries and Wildlife
Oregon State University
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
rob.suryan@oregonstate.edu

C. Tracy Shaw

Cooperative Institute for Marine
Resources Studies, HMSC
Oregon State University
2030 SE Marine Science Dr.
Newport, OR 97365
U.S.A.
tracy.shaw@noaa.gov

William J. Sydeman

Farallon Institute for Advanced
Ecosystem Research
101 H St., Suite Q
Petaluma, CA 94952
U.S.A.
wsydeman@comcast.net

George L. Shillinger

Marine Biology
Center for Ocean Solutions,
Stanford University
Heritage Harbor Complex, 99
Pacific St., Suite 155A
Monterey, CA 93940
U.S.A.
georges@stanford.edu

Vera L. Trainer

Northeast Fisheries Science Center
(NEFSC), NMFS, NOAA
2725 Montlake Blvd. East
Seattle, WA 98112
U.S.A.
Vera.L.Trainer@noaa.gov

Yvette H. Spitz

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, OR 97331
U.S.A.
yvette@coas.oregonstate.edu

Mark L. Wells

School of Marine Sciences
University of Maine
5741 Libby Hall
Orono, ME 04469
U.S.A.
mlwells@maine.edu

John E. Stein

Northwest Fisheries Science Center
(NWFSC), NMFS, NOAA
2725 Montlake Blvd. East
Seattle, WA 98112-2097
U.S.A.
John.E.Stein@noaa.gov

Francis Karl Wiese*

North Pacific Research Board
(NPRB)
1007 West 3rd Ave., Suite 100
Anchorage, AK 99501
U.S.A.
francis.wiese@nprb.org
*representing NPRB

Cynthia Suchman*

1007 West 3rd Ave., Suite 100
Anchorage, AK 99501
U.S.A.
cynthia.suchman@nprb.org
*representing NPRB

Peter Kershaw*

GESAMP
Cefas, Pakefield Rd.
Lowestoft, NR33 0HT
United Kingdom
peter.kershaw@cefas.co.uk
*representing GESAMP

United Kingdom

Observers from Organizations/Programs

AOOS

Phillip Mundy
Auke Bay Laboratories
Alaska Fisheries Science Center,
NMFS, NOAA
Ted Stevens Marine Research
Institute, 17109 Pt. Lena L
Juneau, AK 99801
U.S.A.
Phil.mundy@noaa.gov

APFIC/FAO

Simon Funge-Smith
Asia-Pacific Fishery Commission
(APFIC)
FAO Regional Office for Asia and
the Pacific
39 Pra Athit Rd., Bangkok, 10900
Thailand
Simon.FungeSmith@fao.org

Argo

Howard J. Freeland
Fisheries and Oceans Canada
Institute of Ocean Sciences
9860 W. Saanich Rd., P.O. Box 6000
Sidney, BC V8L 4B2
Canada
Howard.Freeland@dfo-mpo.gc.ca

BEST/BSIERP

Gordon H. Kruse
School of Fisheries and Ocean Sciences
University of Alaska, Fairbanks
17101 Point Lena Loop Rd.
Juneau, AK 99801
U.S.A.
Gordon.Kruse@alaska.edu

CERF

Steven Rumrill
Biology Department
University of Oregon
63466 Boat Basin Rd.
Charleston, OR 97420
U.S.A.
Steve.Rumrill@state.or.us

CLIVAR

Enrique N. Curchitser
Institute of Marine and Coastal
Sciences
Rutgers University
71 Dudley Rd.
New Brunswick, NJ 08901
U.S.A.
enrique@marine.rutgers.edu

ESSAS

George L. Hunt, Jr.
School of Aquatic and Fishery
Sciences
University of Washington
P.O. Box 355020
Seattle, WA 98195
U.S.A.
geohunt2@u.washington.edu

GESAMP

Peter Kershaw
GESAMP
Cefas, Pakefield Rd.
Lowestoft, NR33 0HT
United Kingdom
peter.kershaw@cefass.co.uk

GEOHAB

Raphael Kudela
Ocean Sciences
University of California Santa Cruz
Ocean Sciences Department
1156 High St.
Santa Cruz, CA 95064
U.S.A.
kudela@ucsc.edu

GEOTRACERS/SOLAS

Minhan Dai
State Key Laboratory of Marine
Environmental Science
Xiamen University
182 Daxue Rd., Siming Distirct
Xiamen, Fujian 361005
China, PR
mdai@xmu.edu.cn

GOOS

David M. Checkley
Scripps Institution of Oceanography
University of California, San Diego
9500 Gilman Dr.
La Jolla, CA 92093-0218
U.S.A.
dcheckley@ucsd.edu

ICES

Adolf K. Kellermann
Head Science Programme
International Council for the
Exploration of the Sea (ICES)
44-46 H.C. Andersens Blvd.
Copenhagen, DK-1553
Denmark
adi@ices.dk

Jürgen Alheit
Biological Oceanography
Department
Leibniz Institute for Baltic Sea
Research, IOW
Seestr. 15
Warnemuende, 18119
Germany
juergen.alheit@io-warnemuende.de

Myron A. Peck
Center for Marine and Climate
Research
University of Hamburg
Olbersweg 24
Hamburg, 22767
Germany
myron.peck@uni-hamburg.de

IMBER/YSLME

Sinjaee Yoo
Marine Living Resources
Korea Ocean R&D Institute (KORDI)
1270 Sa-dong
Ansan, Gyeonggi-do 426-170
Korea, R
sjyoo@kordi.re.kr

IOC

Henrik Enevoldsen

IOC Science and Communication
Centre on Harmful Algae,
University of Copenhagen
University of Copenhagen,
Department of Biology
Øster Farimagsgade 2D
DK-1353 Copenhagen K
Denmark
h.enevoldsen@unesco.org

ISC

Chi-Lu Sun

Institute of Oceanography
National Taiwan University
1-Sec. 4 Roosevelt Rd.
Taipei, Taiwan 10617
Chinese-Taipei
chilu@ntu.edu.tw

NANOOS

Jack A. Barth

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, OR 97331-5503
U.S.A.
barth@coas.oregonstate.edu

Alexander Kurapov

College of Oceanic and
Atmospheric Sciences (COAS)
Oregon State University
104 COAS Administration Bldg.
Corvallis, 97331-5503
U.S.A.
kurapov@coas.oregonstate.edu

NEAR-GOOS

Hee-Dong Jeong

Fisheries Resources & Environment
East Sea Fisheries Research
Institute, NFRDI, MIFAFF
482, Sacheonhaean-ro
Yeongok-Myeon
Gangneung, Gangwon-do 210-861
Korea, R
hdjeong@nfrdi.go.kr

NOWPAP

Sangjin Lee

Regional Coordinating Unit
Northwest Pacific Action Plan
(NOWPAP) of UNEP
152-1 Haean-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
sangjin.lee@nowpap.org

Alexander V. Tkalin

Regional Coordinating Unit
Northwest Pacific Action Plan
(NOWPAP) of UNEP
152-1 Haean-ro, Gijang-eup,
Gijang-gun
Busan, 619-705
Korea, R
Alexander.Tkalin@nowpap.org

NPAFC

Jin Yeong Kim

Southwest Fisheries Institute
National Fisheries Research and
Development Institute (NFRDI),
MIFAFF
22 Dangmeori-gil, Hwayang-myeon
Yeosu, Cheollanam-do 556-823
Korea, R
jykim@nfrdi.go.kr

NPFMC

Patricia Livingston

Finance and Administration
Committee Chairman
Alaska Fisheries Science Center,
NMFS, NOAA
7600 Sand Point Way NE
Seattle, WA 98115-6349
U.S.A.
Pat.Livingston@noaa.gov

NPRB

Cynthia Suchman

1007 West 3rd Ave., Suite 100
Anchorage, AK 99501
U.S.A.
cynthia.suchman@nprb.org

Francis Karl Wiese

North Pacific Research Board
(NPRB)
1007 West 3rd Ave., Suite 100
Anchorage, AK 99501
U.S.A.
francis.wiese@nprb.org

PaCOOS

Rosa Melida Runcie

PaCOOS (Pacific Coast Ocean
Observing System) and HMS
(Highly Migratory Species)
National Oceanic and Atmospheric
Administration
3333 North Torrey Pines Court
La Jolla, CA 92037
U.S.A.
Rosa.Runcie@noaa.gov

SAHFOS

Sonia D. Batten

Sir Alister Hardy Foundation for
Ocean Science
4737 Vista View Cres.
Nanaimo, BC V9V 1N8
Canada
soba@sahfos.ac.uk

SCCOOS

J. Anthony (Tony) Koslow

California Cooperative Oceanic
Fisheries Investigations
Scripps Institution of
Oceanography, UCSD
9500 Gilman Dr.
La Jolla, CA 92093-0218
U.S.A.
tkoslow@ucsd.edu

WESTPAC

Suchana A. Chavanich

Department of Marine Science,
Faculty of Science
Chulalongkorn University
Payathai Rd.
Bangkok, Bangkok 10330
Thailand
suchana.c@chula.ac.th

PICES

Lev N. Bocharov
 PICES Chairman
 Pacific Research Institute of
 Fisheries and Oceanography
 (TINRO-Center)
 4 Shevchenko Alley
 Vladivostok, Primorsky Kray
 690050 Russia
 bocharov@tinro.ru

Tokio Wada
 Past-Chairman
 Fisheries Research Agency
 Queen's Tower B 15F
 2-3-3 Minato Mirai, Nishi-ku
 Yokohama 220-6115
 Japan
 wadat@affrc.go.jp

Laura Richards
 PICES Vice-Chairman
 Fisheries and Oceans Canada
 Pacific Biological Station
 3190 Hammond Bay Rd.
 Nanaimo, BC V9T 6N7
 Canada
 Laura.Richards@dfm-mpo.gc.ca

Patricia Livingston*
 Finance and Administration
 Committee Chairman
 Alaska Fisheries Science Center,
 NMFS, NOAA
 7600 Sand Point Way NE
 Seattle, WA 98115-6349
 U.S.A.
 Pat.Livingston@noaa.gov
 *representing NPFMC

Sinjaee Yoo*
 Science Board Chairman
 Marine Living Resources
 Korea Ocean R&D Institute
 (KORDI)
 1270 Sa-dong
 Ansan, Gyeonggi-do 426-170
 Korea, R
 sjyoo@kordi.re.kr
 *representing IMBER and YSLME

Alexander Bychkov
 Executive Secretary
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 bychkov@pices.int

Christina Chiu
 Deputy Executive Secretary on
 Administration
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 christina@pices.int

Stewart (Skip) M. McKinnell
 Deputy Executive Secretary
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 mckinnell@pices.int

Jeongim Mok
 PICES Intern
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 tatiana@pices.int

Rosalie Rutka
 PICES Administrative Assistant
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 rrutka@pices.int

Julia Yazvenko
 Database and Web Administrator
 PICES Secretariat
 P.O. Box 6000
 Sidney, BC V8L 4B2
 Canada
 secretariat@pices.int

Author Index

A

Abbott, Cathryn L. 53
 Abe, Hiroya 199
 Abo, Katsuyuki 72
 Abrosimova, Anastasiya 174
 Ahn, Jisuk 56
 Aiping, Feng 95
 Ai-Rong, Zheng 236
 Alexander, Mike 179
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 An, Soonil 45
 An, Yongrock 141
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 Aoki, Kaoru 140
 Arkhipkin, Alexander 156
 Artemova, Antonina 57
 Arthur, Courtney 220
 Aseeva, Nadezhda L. 54, 153
 Awaji, Toshiyuki 36, 89, 114, 155

B

Back, Jaemin 149, 163
 Badaev, Oleg Z. 157
 Bae, Jinho 166
 Baek, Seungho 135
 Bailey, Helen 28
 Bailey, Kevin M. 152
 Baker, Joel E. 220
 Baker, Mary Campbell 155
 Baker, Matt 50
 Banas, Neil S. 82
 Barth, John A. 108, 195
 Batchelder, Harold P. 133, 195
 Batten, Sonia 13, 46
 Bechtol, William R. 153
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 Belan, Tatyana 93, 136
 Belaya, Svetlana 81
 Belkin, Igor M. 23, 29, 174
 Belonenko, Tatyana 126, 178
 Belova, T.P. 94
 Bernal, Miguel 99
 Bezotvetnykh, Vladimir V. 183
 Bezrukov, R.G. 134
 Bin, Zou 223
 Black, Bryan A. 11
 Block, Barbara A. 28, 168
 Bobkov, Alexey 237
 Bograd, Steven J. 11, 25, 28

Boldt, Jennifer L. 151
 Bondarenko, Mikhail V. 52
 Bond, Nicholas A. 26
 Borisenko, Galina S. 93
 Borisov, Boris 136
 Bowlin, N. 53
 Boyarova, Margarita D. 221
 Brown, Jeremiah 111
 Bugaev, Victor F. 157
 Bulatov, Oleg A. 150
 Burago, Vadim 236
 Burov, Boris 173

C

Cai, Rong-shuo 180, 183
 Callendar, Wendy 179
 Campbell, Matthew 99
 Castelton, Michael R. 28
 Cha, Hyunki 167
 Chae, Jinho 130
 Chai, Fei 210
 Chang, Chih-Wei 55
 Chang, Kyung-Il 127, 227, 228, 231, 235
 Chao, Liang 223
 Checkley, David M. 15
 Chen, Bijuan 67
 Chen, Bin 48, 87
 Chen, Hong 96
 Chen, Liqi 200
 Chen, Mingru 48
 Chernushova, Larisa S. 189
 Chernyaev, Andrey P. 91, 92
 Chiba, Sanae 13, 46
 Chichkin, Ruslan 234
 Chikamoto, Yoshimitsu 113
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 Chimura, Masayuki 148
 Chiu, Tai-Sheng 100
 Chizhova, Tatiana L. 86
 Choi, Ilsu 13, 232
 Choi, Joongki 138, 139
 Choi, Junghwa 161, 162
 Choi, Kwangho 56, 160, 162
 Choi, Seokgwon 141
 Choi, Youngmin 34
 Christian, James R. 113
 Chung, Ik Kyo 127
 Chung, Sangdeok 52
 Ciannelli, Lorenzo 152
 Ciecziel, Kristin 137
 Cooreman, Kris 219
 Costa, Daniel P. 25
 Creekmore, Sean 99

Criddle, Keith R. 154
 Cueto, Jean Linero 176
 Curchitser, Enrique N. 99, 179

D

Dai, DeJun 180
 Dakus, Anna V. 159
 Davison, P. 53
 Deans, Nora L. 205
 Deguchi, Tomohiro 22, 29
 DeMarzo, Adam 83
 Demchenko, Natalia L. 66
 Deminoy, Andrew N. 164
 Denisenko, Evgeny 159
 Deutsch, Curtis 112
 Dewar, Heidi 168
 Di Lorenzo, Emanuele 45, 55
 Diansky, Nikolay A. 107, 234
 DiBacco, Claudio 83
 Didenko, Vasily D. 40
 Diekmann, Rabea 233
 Dmitrieva, Elena 190, 201
 Doi, Toshimasa 36, 114
 Dolganova, Anastasia S. 134
 Dolganova, Natalia T. 130
 Dong, Shuanglin 71
 Dorman, Jeffrey G. 11
 Dower, John 47
 Drake, Patrick T. 108
 Du, Jianguo 48, 87
 Du, Xiuning 125
 Duan, L.Y. 62
 Dubina, Vyacheslav 174, 194
 Dudkov, Sergey 193
 Dulenin, Alexander 35
 Dulenina, Polina 35
 Dulepova, Elena 141
 Dulova, Nadezda M. 186
 Dumbauld, Brett R. 72
 Dunne, John 10

E

Edwards, Christopher A. 108, 209
 Eisner, Lisa 137
 Erofeev, Anatoli 195
 Essington, Timothy E. 34

F

Fan, Jingfeng 126
 Fan, Yang 182
 Fayman, Pavel A. 108, 174, 194
 Feinberg, Leah R. 46
 Fiechter, Jerome 99, 111, 209
 Field, John C. 11, 40, 156
 Figurkin, Alexandr 189
 Filonov, Anatoliy E. 187
 Finney, Jessica 167

Fisher, Jennifer 133
 Fitzgerald, Shannon 22
 Foley, David G. 22, 25, 213
 Foreman, Michael 73, 115, 179
 Foster, Gregory 220
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 Freeland, Howard J. 179, 202
 Fu, Feixue 61
 Fujii, Naoki 118
 Fujii, Yosuke 36, 114
 Fujimori, Yasuzumi 37
 Fukuda, Jumpei 131
 Furutani, Hiroshi 9
 Furuya, Ken 23, 214

G

Galbraith, Moira 47
 Gamo, Toshitaka 227
 Gao, C.L. 62
 Gao, Zhongyong 200
 Garver, Kyle 73, 115
 Geier, Hans 153
 Gelatt, Tom 26
 Gillespie, Graham E. 167
 Gilly, William F. 40
 Gilmore, Scott R. 53
 Glebova, Svetlana Yu. 173
 Goebel, Nicole 209
 Golovashchenko, Ekaterina V. 157, 158
 Gorbatenko, Konstantin 129
 Gordeychuk, Tatyana N. 125, 132, 213
 Goryachev, Vladimir 221
 Goryainov, A.A. 163
 Goto, Atsushi 119
 Greenberg, Joshua 153
 Guan, Chunjiang 75
 Guan, Lu 47
 Guo, Hao 67, 126
 Guo, Maohua 214
 Guo, Ming 115
 Guo, Xinyu 118

H

Haak, Helmuth 194
 Hamaji, Nobuhide 33
 Hamasaki, Koji 23
 Han, Changhoon 132
 Han, Gengchen 115
 Han, Jianbo 96, 182
 Han, Lei 201
 Han, Yu-San 55
 Hanawa, Kimio 51
 Harada, Kazuhiro 61
 Harada, Tomoko 29
 Hargreaves, Brent 73
 Hasegawa, Natsuki 199
 Hashioka, Taketo 117

Hasumi, Hiroyasu 177
 Hattori, Kaoru 26
 Hay, Douglas E. 151
 Hayakawa, Kazuichi 86
 Haynie, Alan 99
 Hazen, Elliott L. 25
 Hedstrom, Kate 99, 179
 Heeyong 160
 Hefeng, Wang 182
 Helms, Alicia 83
 Herbei, Radu 111
 Hickey, Barbara M. 82
 Hidaka, Kiyotaka 23
 Hilborn, Ray 50
 Hiraoka, Yoshiobu 33
 Hirawake, Toru 74
 Hiyoshi, Yoshihisa 36, 114
 Hollowed, Anne 50
 Honda, Naoto 131
 Honda, Satoshi 148
 Hong-Da, Fang 236
 Hong-Lin, Qian 236
 Hooten, Mevin 111
 Hori, Yutaka 61, 86
 Horii, Toyomitsu 199
 Hosoya, Utaka 112
 Hsieh, Chih-Hao 55, 100
 Hsu, Chih-Chieh 55
 Huang, Daji 181
 Huang, Hao 87
 Huang, Haosheng 99
 Huang, Rong-hui 180
 Hunsicker, Mary E. 34, 152
 Huo, Chuanlin 96, 115
 Huse, Geir 101
 Hwang, Jaedong 56
 Hwang, Jeomshik 231
 Hwang, Kangseok 162
 Hwang, Okmyung 191
 Hyen, Bongkil 191
 Hyun, Bonggil 135

I

Ichii, Taro 33
 Ichikawa, Tadafumi 23
 Ichinomiya, Mutsuo 23
 Igarashi, Hiromichi 36, 114, 155
 Iida, Takahiro 24
 Im, Seulhee 45
 Imai, Ichiro 61, 86, 128, 129, 131
 Imaizumi, Hitoshi 33
 Imamura, Shintaro 33
 Inagake, Denzo 33
 Ireykina, Svetlana A. 91, 94
 Ishida, Ken-Ichi 33
 Ishii, Masayoshi 113
 Ishikawa, Akira 63
 Ishikawa, Yoichi 36, 89, 114, 155

Ishizaka, Joji 135, 214, 227, 235
 Isono, Takeomi 26
 Itakura, Shigeru 214
 Ito, Shin-ichi 21, 100, 102, 117
 Ito, Takamitsu 112
 Itoh, Sachihiko 27, 165

J

Jan, Sen 55
 Jang, Chan Joo 11, 16, 17, 175, 181, 194
 Jang, Junheon 231
 Jang, Minchel 191
 Jang, Minchul 135
 Jang, Pungguk 135, 191
 Jeffries, Steven 84
 Jeon, Dongchll 191
 Jeon, Hyunduck 229
 Jeon, Yujin 161
 Jiang, Hong 67
 Johnson, Stewart 73
 Jones, Simon R.M. 53, 73
 Ju, Se-Jong 130
 Ju, Sungeun 139
 Jung, Kwangyoung 110, 192
 Jung, Kyungtae 175
 Jung, Sukgeun 13, 48, 232, 233
 Jungclaus, Johann H. 194
 Justic, Dubravko 99

K

Kadnikova, Irina A. 203
 Kaeriyama, Masahide 82
 Kahru, Mati 213
 Kakehi, Shigeho 21, 23, 117
 Kalinchuk, V.V. 116
 Kamachi, Masafumi 36, 114, 155
 Kameda, Takahiko 102
 Kang, Changkeun 227, 231
 Kang, Dong-Jin 227, 228, 229
 Kang, Donhyug 130
 Kang, Jung-Hoon 137, 140
 Kang, Sukyung 56
 Kantakov, Gennady 237
 Kaplunenko, Dmitry D. 229, 230
 Kappes, Michelle A. 25
 Karyakin, Konstantin A. 38, 39
 Kasai, Hiromi 117
 Kashchenko, Helen V. 159
 Kato, Yoshiki 33, 36, 39, 114, 155
 Katsumata, Nobuhiro 24
 Katugin, Oleg N. 36, 38, 39, 40
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