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The state of PICES science - 2000

The PICES Ninth Annual Meeting, held October 18-29, 2000 in Japan, was extremely successful with over 500 people registered to attend the 253 oral presentations and many posters that were given at the meeting. The main part of the meeting was held at the newly opened Future University in Hakodate. It was truly a futuristic building with many open areas, high-tech rooms, and beautiful grounds. The keynote lecture on "Recent advances and key questions on the Kuroshio-Oyashio ecosystem" given by Prof. Takashige Sugimoto provided a comprehensive overview of the research efforts, results, and questions of this important region. The Science Board Symposium topic "*Subarctic gyre processes and their interaction with coastal and transition zones: physical and biological relationships and ecosystem impacts*" followed. Presentations in this session provided many interesting insights, ranging from physical connections between the Subarctic gyres to the biological responses of upper trophic level species to interannual variations in the transition zone chlorophyll front. Similar importance of the frontal regions in the Oyashio/Kuroshio region was also noted.

Topic sessions were very well attended and ranged from purely physical ones such as "*Large-scale circulation in the North Pacific*", to those dealing with environmental quality such as "*Science and technology for environmentally sustainable mariculture in coastal areas*". The topic session on "*Short life-span squid and fish as keystone species in the North Pacific marine ecosystems*" was quite appropriate for our meeting in Hakodate, as we nightly observed the lights of the squid fishing boats and daily saw the beautiful artwork of a local artist who uses squid ink to produce his pictures. Other topic sessions encompassed the full range of the ecosystem from continuing our investigations into the carbon cycle, advancing progress in zooplankton ecology, higher trophic level predators, and continuing the ecosystem synthesis of GLOBEC research. The topic session on "*Recent Findings and comparisons of GLOBEC and GLOBEC-like programs in the North Pacific*" was co-sponsored by the Global Ocean Ecosystem Dynamics Project of IGBP. Another IGBP Core Project, Joint Global Ocean Flux Study (JGOFS) participated in planning and co-sponsored the topic session on "*North Pacific carbon cycling and ecosystem dynamics*".

Interdisciplinary workshops and sessions on understanding climate variability and its effects on ecosystems began even before the main scientific meeting with two events that were held in Tsukuba: a symposium/workshop on "*North Pacific CO_2 data synthesis*" and a planning workshop on "*Designing the iron fertilization experiment in the Subarctic Pacific*". The Marine Bird and Mammal Advisory Panel met for the first time and held a technical workshop. The Task Teams of the PICES GLOBEC Climate Change and Carrying Capacity Program (CCCC) signaled they were entering the final phase of the program with the workshops and Task Team meetings emphasizing coordination between these groups and the development of linked biophysical models.

Congratulations are in order for winners of the Best Presentation Awards at the PICES Ninth Annual Meeting. These awards are given to scientists, nominated by each PICES Scientific Committee and the Science Board, who gave the best presentation in a topic or paper session sponsored by the committee or board. Here are the 2000 winners: the BIO Award to Dr. Christine T. Baier for her paper on "*Effects of chaetognath predation on copepod communities on the southeast Bering Shelf*"; the FIS Award to Dr. Bambang Semedi for the paper on "*An approach of DMSP/OLS satellite imagery and GIS technology to study the dynamics of Pacific saury migration*"; the MEQ Award to Dr. Kazufumi Takayanagi for the paper on "*Water quality criteria to manage sustainable aquaculture in Japan*"; the POC Award to Dr. Anatoly Salyuk for the paper on "*Exchange of deep and bottom waters in the Kurile Basin, Sea of Okhotsk, with the Pacific*"; the CCCC Award to Dr. Shoko Hotta for her paper on "*Factors affecting the growth of chum salmon in the western North Pacific revisited*"; and the Science Board Award to Dr. Shingo Kimura for his paper on "*Biological production process associated with frontal disturbances of the Kuroshio and the Kuroshio Extension*". Science Board awarded a Best Poster Award for the first time this year, and the recipient was Dr. Tetsuya Takatsu for the poster on "*Dominant year-classes in brown sole Pleuronectes herzensteini*".

The year 2000 saw continued progress in the area of international collaborative field and laboratory work by the PICES scientific community. A PICES-sponsored interdisciplinary cruise aboard a research vessel "*Professor Gagarinsky*" was organized by the Pacific Oceanological Institute (Vladivostok, Russia) to study ecosystem structure and dynamics of the northern Japan/East Sea (*for details see Vyacheslav Lobanov's article in this issue, pp. 31-34*). Integration of the results from the 1999 international Vancouver Harbour practical workshop by scientists of our Marine Environmental Quality Committee's Working Group 8 on *Practical Assessment Methodology* took place in one of the topic sessions this year. All collected data will be compiled and published as a PICES Scientific Report in 2001. Similarly, the Physical Oceanography and Climate Committee's Working Group 13 on *Carbon Dioxide in the North Pacific* continued to make significant progress in improving measurement quality for the carbonate parameters by carrying out a series of between laboratory comparisons of measurement technique. This year's inter-comparison, followed up by a technical workshop in Tsukuba, was focused on the measurement of total alkalinity in seawater (*for details see Andrew Dickson's article in this issue, pp. 15-16*). Finally, the PICES-GLOBEC Climate Change and Carrying Capacity Program (CCCC) continued its two-year study to initiate continuous plankton recorder (CPR) monitoring in the North Pacific and showed interesting results with regard to a latitudinal gradient in maturation timing for winter-spring dominant copepods. PICES continues to discuss how to maintain this monitoring as a long-term PICES effort.

International collaborations of PICES are expanding. PICES scientists participated in a joint ICES/PICES mini symposium at a meeting of the ICES Zooplankton Ecology Working Group in spring 2000. Plans for a jointly sponsored large symposium on zooplankton ecology by ICES, PICES and GLOBEC are now underway. The North Pacific Anadromous Fish Commission (NPAFC) and PICES jointly sponsored an international workshop on "*Factors affecting production of juvenile salmon*" in Tokyo just after the PICES Annual Meeting in Hakodate. The Census of Marine Life and the International Pacific Research Center will co-sponsor with PICES an international workshop on "*Impact of Climate Variability on Observation and Prediction of Ecosystem and Biodiversity Changes in the North Pacific*". This workshop will help us make significant advances in producing a PICES Ecosystem Status Report and to begin collaborations to advance a North Pacific monitoring and prediction system that will match the goals of the Census of Marine Life program and the International Oceanographic Commission's Global Ocean Observing System (GOOS).

In the spring of 2000, PICES and several international organizations sponsored the "Beyond El Niño" Conference (*for details see report by Dr. Paul LeBlond in PICES Press vol. 8(2)*). This highly successful scientific conference provided substantial evidence for North Pacific ecosystem variability at interannual and decadal time scales and insights on the implications of these variations for fishery management. Selected papers from the conference will be published in a special volume of *Progress in Oceanography* scheduled to come out later in 2001. The proceedings from the 1999 Science Board Symposium was published this year as a special issue on "*North Pacific Climate Regime Shifts*" in that same journal, Vol. 47 (2-4).

Many other PICES scientific efforts were documented in 2000 by the publication of results in the PICES Scientific Report series: Volume 13 represents Bibliography on Oceanography of the Japan/East Sea, Volume 14 summarizes results of Working Group 11 on *Predation by Marine Birds and Mammals in the Subarctic North Pacific Ocean*, and Volume 15 has the proceedings of the 1999 PICES-GLOBEC CCCC Program REX and MONITOR Workshops and the 2000 MODEL Workshop.

Two Working Groups disbanded in 2000 and will be making final preparation for publication of results in 2001. The Fishery Science Committee Working Group 12 on Crab and Shrimp and Marine Environmental Quality Committee Working Group 8 on Practical Assessment Methodology will publish final results in the PICES Scientific Report Series in 2001.

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The state of the western North Pacific in the first half of 2000

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Mr. Satoshi Sugimoto is Scientific Officer of the Oceanographical Division of the Climate and Marine Department at the Japan Meteorological Agency (JMA). He is working as a member of a group in charge of monitoring and forecasting sea surface temperature and sea surface current in the western North Pacific. Based on in situ *and satellite data, this group provides various oceanographical products. One of the main products is the "Monthly Ocean Report", which is published and distributed by JMA every month. Mr. Sugimoto is now involved in developing a new analysis system for sea surface and subsurface temperature to improve sea surface temperature forecasts in the western North Pacific.*

Sea Surface Temperature

Figure 1 shows monthly mean sea surface temperature (SST) anomalies in the western North Pacific from January to June 2000, computed with respect to JMA's 1961-90 climatology. Satellite-derived SSTs (NOAA/AVHRR) and *in situ* observations are used for the area between 20°N and 50°N from 120°E to 160°E, and only *in situ* observations are used in the other region.

Positive SST anomalies prevailed zonally between 30°N and 40°N in January 2000, which continued from the second half of 1999. From February to May, the area of negative anomalies increased in the seas adjacent to Japan. In June, the area of negative anomalies decreased and that of positive anomalies prevailed again around Japan (Fig. 1). The positive anomalies around Japan after June were comparable to those of 1999 for regions 1-4 (Fig. 2).

South of 20°N, positive anomalies predominated around the Philippines and negative anomalies prevailed near the date line throughout the period. This happened in three consecutive years.

Kuroshio

The Kuroshio meandered throughout the period, shifting its path south of Japan to and fro. The southernmost position of the meander was 31.5ºN, 138.5ºE in the last 10-day of March. Since May, the Kuroshio flowed southeastward from 135ºE to 140ºE and than turned northward, shifting the turning position eastward gradually (Fig. 3).

Sea ice in the Sea of Okhotsk

The first and last dates of drift ice in sight at the meteorological stations along the coast of Hokkaido are shown in Table 1, with the location of the stations in Figure 4. The first dates of drift ice on shore and the first dates of shore lead appearance are also included. The drift ice around Hokkaido was generally characterized by normal date arrival and normal date retreat this season.

The sea ice extent was above normal (20-year averaged values from 1971 to 1990) in early February and from late February to early April. It came to a maximum on March 20th with a value of 133.76×10^4 km^2. It has been 12 years since the sea ice extent in the Sea of Okhotsk was over 130×10^4 km^2 (Fig. 5).

Drift ice flowed out into the Pacific from early February to mid-April, and was observed at Kushiro in late February. Some drift ice flowed out into the Japan Sea through the Soya Straits on the Sakhalin side from late January to early March, but was not observed at Wakkanai. Drift ice flowed out into the Japan Sea again from the end of April to the beginning of May, which was the latest observation since JMA started to analyze sea ice in the Sea of Okhotsk using satellite data.

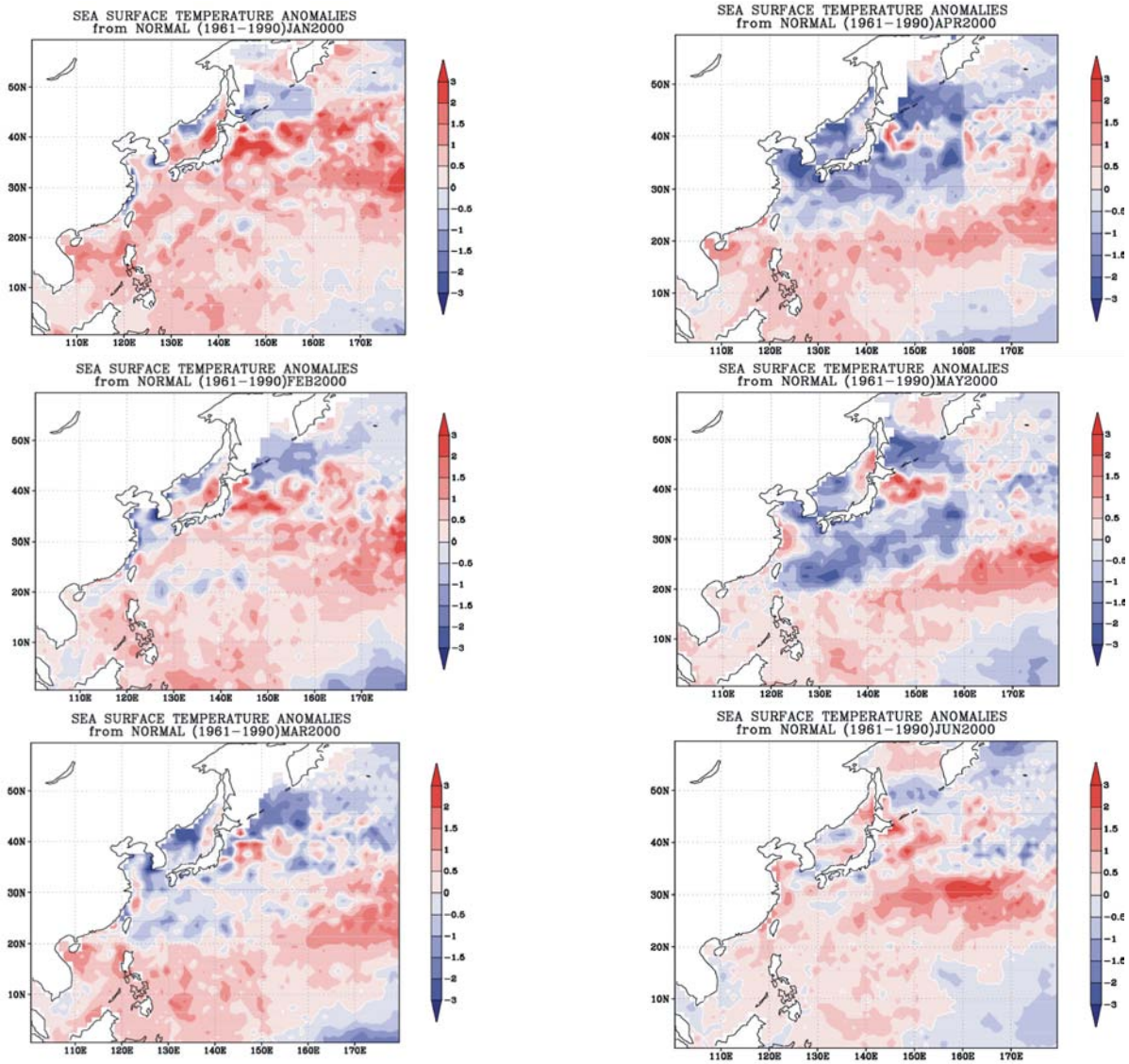
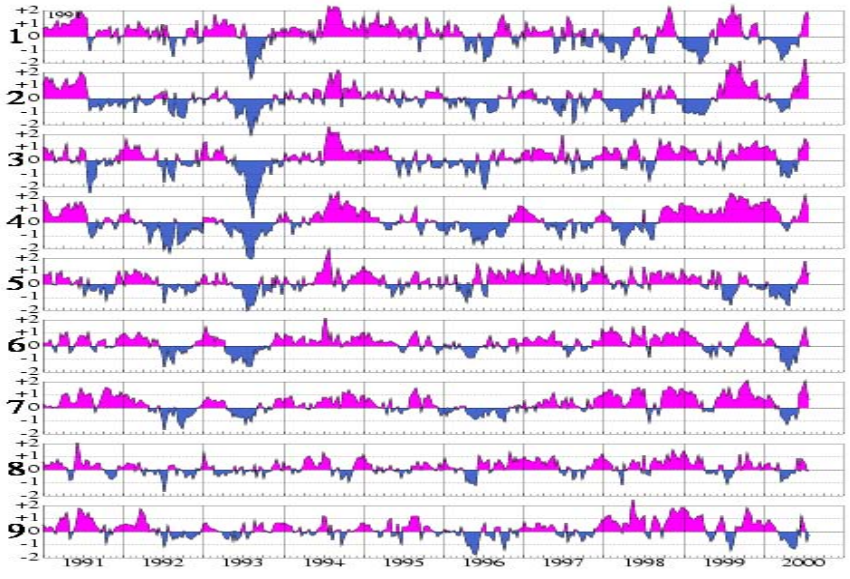


Fig. 1 Monthly mean sea surface temperature anomalies (°C). Anomalies are departures from JMA's 1961-1990 climatology.



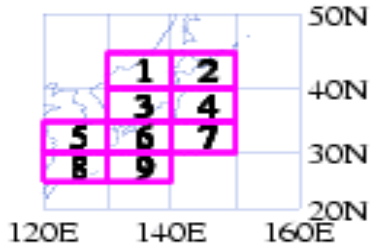


Fig. 2 Time series of the ten-day mean sea surface temperature anomalies (°C), computed from JMA's 1961-1990 climatology.

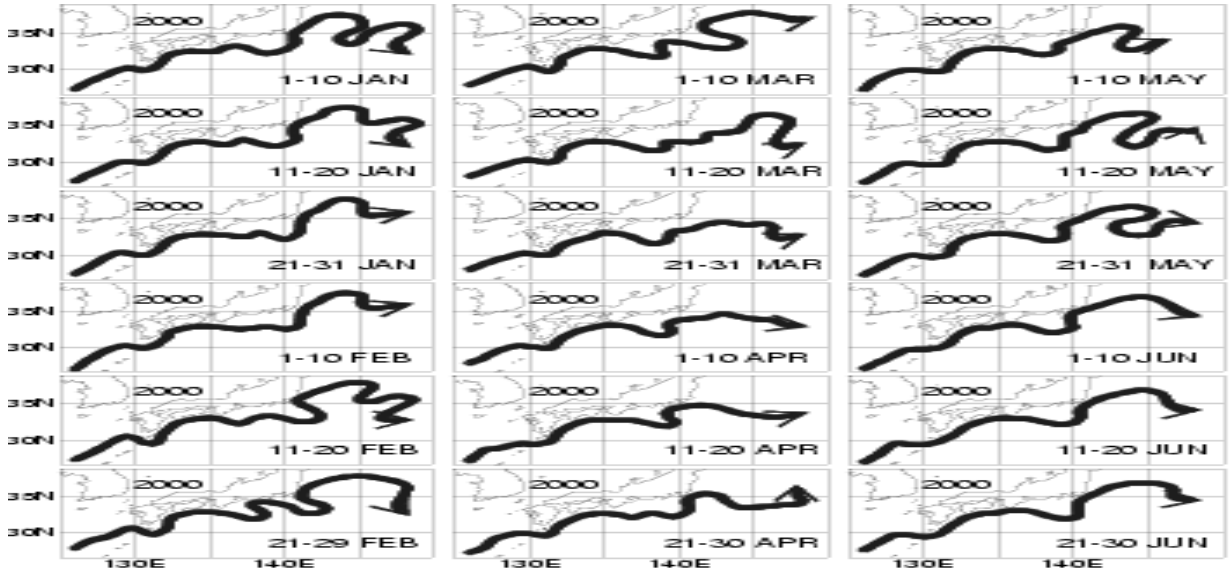


Fig. 3 Location of the Kuroshio axis from January to June 2000.

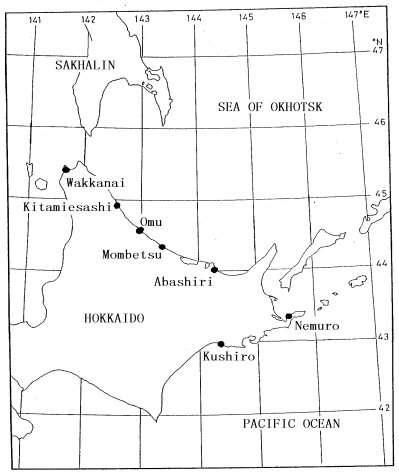


Fig. 4 Location of the sea ice stations along the coast of Hokkaido, Japan.

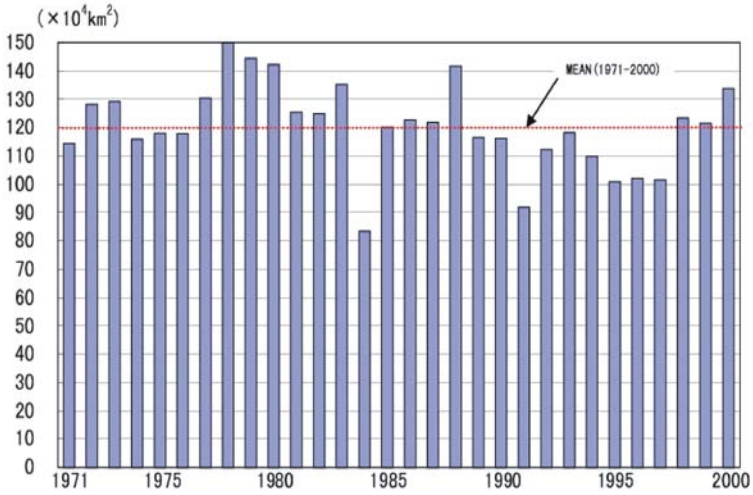


Fig. 5 The maximum area of sea ice extent area in the Sea of Okhotsk.

Table 1. The first and last dates of drift ice observed at coastal stations in the winter of 1999/2000.

Station	Drift ice				First date of drift ice on shore	First date of shore lead appearance
	First date	Last date	Period	Days		
WAKKANAI	#	#	#	#	#	*
KITAMIESASHI	1.19(-1)	4.2(+2)	75(+4)	57(+5)	1.19(-8)	3.23(+10)
OMU	1.21(+2)	4.3(-3)	74(-4)	64(+3)	1.21(-7)	3.21(+7)
MOMBETSU	1.22(+4)	4.1(-6)	71(-9)	63(-1)	1.25(-5)	3.23(+6)
ABASHIRI	1.18(+1)	4.4(-14)	78(-14)	69(-14)	1.31(0)	3.24(0)
NEMURO	2.10(+1)	4.3(+1)	54(+1)	42(+8)	2.11(-3)	*
KUSHIRO	2.26(-2)	2.26(-20)	1(-17)	1(*)	#	*

( ): *deviation from normal for the period from 1961 through 1990;*
+: *earlier or more than normal;*
-: *later or less than normal;*
*: *no observation or statistical value is not produced,*
#: *phenomenon was not observed.*

The status of the Bering Sea: January – August 2000

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Dr. Phyllis J. Stabeno, a physical oceanographer at the Pacific Marine Environmental Laboratory (PMEL) of NOAA, conducts research focused on understanding the dynamics of circulation of the North Pacific, Bering Sea and their adjoining shelves. She is the PMEL Director of NOAA Fishery Oceanography Coordinated Investigations (FOCI), and by applying her knowledge of physical processes to fisheries oceanography, she plays a vital role in its success. FOCI research focuses on building sustainable fishery resources in the Gulf of Alaska and Bering Sea while maintaining a healthy ecosystem. Phyllis is also a Principal Investigator on several research elements for other programs, including: Southeast Bering Sea Carrying Capacity (Coastal Ocean Program), the Bering Sea Green Belt: processes and ecosystem production (Arctic Research Initiative) and Prolonged Production and Trophic Transfer to Predators: processes at the inner front of the southeast Bering Sea (National Science Foundation). This research seeks to improve our understanding of ecosystems through the integration of physical and biological phenomena.

During January – August 2000, the Bering Sea was characterized by an early and extensive build-up of sea ice and an early retreat, a May phytoplankton bloom and a reoccurrence of the coccolithophorid bloom. While some of the salmon returns were typical, others were well below expected. The present status of the Bering Sea is a continuation of long-term influences that have resulted in significant changes in the ecosystem in recent years. These include fluctuation in the number of returning salmon, recurring coccolithophorid bloom, increasing numbers of jelly fish and continuing decreases in the Steller sea lion and fur seal populations. Many of the changes in this ecosystem can be attributed to shifts in decadal patterns of climate.

Great year-to-year variability is evident in the climate of the Bering Sea, but it is also sensitive to changes on decadal and longer time scales. For example, the Bering Sea responds to two dominant decadal oscillations of the North Pacific, the Pacific Decadal Oscillation (PDO) and the Arctic Oscillation (AO). The PDO is the first mode of decadal variability in the sea surface temperature of the North Pacific and is strongly coupled to the sea level pressure pattern and thus to changes in near-surface winds. Its impact on the Bering Sea is largely limited to the southern portion. The AO is a mode of variability of atmospheric pressure and is associated with the spin up of the polar vortex. When in its negative state, higher-than-normal pressure occurs over the Arctic and weaker-than-normal pressure over the mid-latitudes. When in its positive mode, there is an increase in the poleward transport of heat. The AO not only impacts the Arctic and the Bering Sea, but is also a source of variability for the Northern Hemisphere.

It is generally recognized that a regime shift occurred in 1977 when both the AO and PDO changed sign. Historically, a negative PDO has been associated with more extensive and persistent ice cover over the Bring Sea shelf. In the decade previous to the shift there was a series of cold years, with maximum ice extent over the eastern Bering Sea shelf. From 1977-1989, ice was less common over the southeastern shelf than was typical during the previous regime. In 1989, the AO changed sign and while conditions did not return to the cold years of the early 70s, the patterns of ice coverage changed. After the shift in the AO, ice persisted longer in the spring south of 61^{o}N and west of 168^{o}W, while to the north earlier ice retreats occurred. Coinciding with the early ice retreat is a warming of 3-4^{o}C at 850mb in April over the Arctic during the last decade. Much of the warming is centered over North America, stretching from the Bering to Greenland. This warming is associated with anomalously stronger winds from the south. In essence, these observations, together with others such as earlier snow melt over parts of Alaska, indicate an earlier transition from winter to ecosystem.

In 1997, the PDO changed sign (from positive to negative). It is not known whether a regime shift has occurred or if this represents shorter-term variability that is characteristic of the Bering Sea. The PDO has remained negative through July 2000, although its magnitude has decreased in spring and summer 2000. One expected impact of a change in the PDO would be in the extent and duration of ice cover. In December 1999, strong, cold northerly winds created ice in polynyas and advected it southward over the shelf. By January 2000, the eastern Bering Sea shelf (Fig. 1) was largely covered with ice. This early ice cover was more extensive than what occurred in January during the cold decade before 1977. In early February, the winds reversed and blew the ice northward, resulting in a largely ice-free southern shelf. Surprisingly, these conditions persisted for the rest of the winter and early spring.

For the last six years, a series of biophysical moorings have been deployed at 56.9°N, 164°W over the Bering Sea shelf. This mooring site is located near the center (70m isobath) of the middle shelf. Instruments measuring temperature, salinity, fluorescence, nitrate and currents are deployed year around. Shown in Figure 2 are temperature data from spring and summer of the last six years. The pattern of sea surface temperature (SST) is fairly consistent. Coldest temperatures occur after the retreat of the ice. In 1999, that occurred in early May, but more typically it occurs in February or March. From April (if the shelf is ice-free) through August, solar insolation begins to heat the system. During April and May 2000, SST was similar to what had been observed in 1995-1997. Later in the summer conditions were cooler than average, but not as cold as was observed in 1999. The depth-averaged temperature also fell between the extremes of 1999 (cold) and 1998 (warm), although warming continued longer (through August) than previously observed. If ice had persisted over the shelf through March, the initial temperatures would have been cooler, resulting in cooler summer temperatures. The timing of retreat of ice is critical to the set up of the temperature on the shelf. Just as the persistence of ice into May of 1999 contributed to the cold depth-averaged temperatures throughout the remainder of the year over the shelf, the early retreat of ice in 2000, resulted in average initial conditions that persisted through the year.

For the fourth year in a row there was a coccolithophore bloom over the eastern Bering Sea shelf. Coccolithophores are small, photosynthetic cells covered by calcareous plates (liths), from which light reflects giving the water its distinctive milky white color. While in the previous three years (1997, 1998, and 1999) the bloom appeared in early July, in 2000 it was delayed until late July. Cruises in early July found no evidence of the bloom over the southeastern shelf. By August, the milky water once again covered a significant portion of the eastern Bering Sea shelf. The cause of the late arrival of the bloom is unclear. It is likely not a result of colder temperature, since 1999 was cooler than 2000.

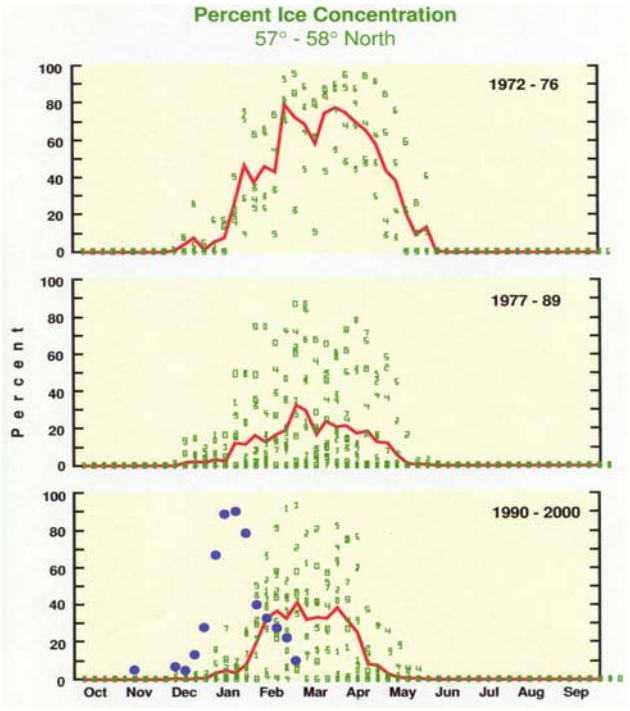

Fig. 1 Percent ice concentration during three regimes: a) 1972-1976, b) 1977-1989 and c) 1990-1999, in the one degree band (57°-58°N) across the Bering Sea shelf. The blue dots in the third panel are for 2000.

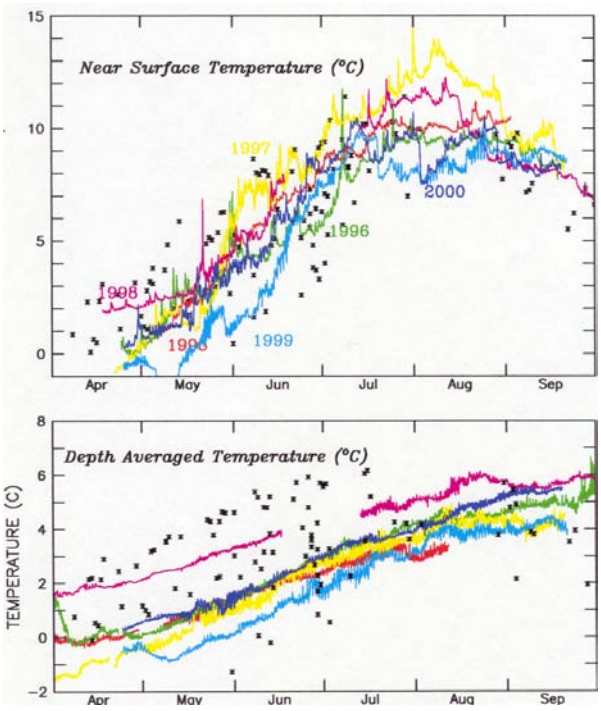

Fig. 2 a) Sea surface temperature at Site 2 on the southeastern Bering Sea shelf (56.9°N, 164°W) for the six years that a biophysical mooring has been deployed at this site. b) The depth-averaged temperature at Site 2 for the same years in a). The x's are historical data near the mooring site.

The state of the eastern North Pacific since spring 2000

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Dr. Howard Freeland is a research scientist in the Ocean Science and Productivity Division at the Institute of Ocean Sciences (Fisheries and Oceans Canada). His research interests include the climatic state of the ocean and low frequency variability. Presently he has interests in the maintenance of Line P, a line of CTD stations that has been monitored for over 45 years between the mouth of the Juan de Fuca Strait and Ocean Station Papa at 50°N and 145°W. Howard is also on the international science team for project Argo which aims to deploy a global array of profiling ALACE floats to monitor the evolving state of the ocean. He is involved in various PICES activities as a member of the Physical Oceanography and Climate Committee and Chairman of the Publications Committee.

In the previous issue it was reported that the southern oscillation index seemed a little unstable. This has continued. For a while during mid-2000 it appeared that, at least according to the southern oscillation index, that we might even be heading into persistently negative values, but late in the year we have seen a strong return to positive (La Niña-like) values (Fig. 1). Of course, the atmospheric pressure difference along the equator is only part of the issue, though a rather easy one to monitor. Of more interest is surface and sub-surface temperatures along the equator, and these have indeed returned to entirely normal distributions, as seen, for example, by the TAO array. The Climate Prediction Center (NOAA) has ceased issuing El Niño/Southern Oscillation Diagnostic Advisories, and their web page states that they will resume updates when conditions warrant advisories.

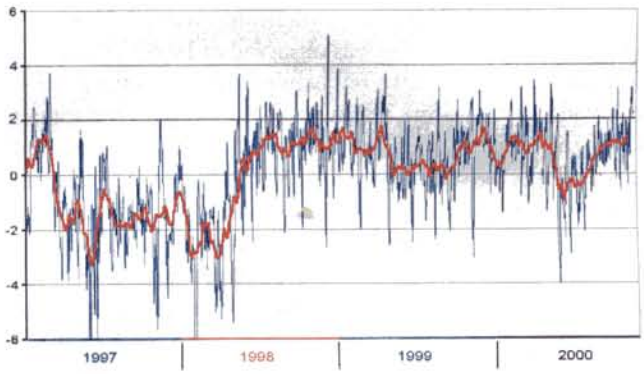

Fig. 1 Daily values of the Southern Oscillation Index (blue) and 31-day running mean (red) from Jan. 1st 1997 to Nov. 2000.

Within the Gulf of Alaska we have seen a steady decline in the influence of the surface cold water that has dominated conditions since the start of the La Niña in 1998 (Fig. 2). The only significant feature has been a mid-Pacific warm anomaly that has been migrating steadily across the North Pacific Ocean and is now approaching the coasts of N. America. This may have some influence during the upcoming winter, but as of late November, there is no sign of any significant warm anomalies appearing at the coast of British Columbia.

Project Argo is moving rapidly towards the deployment phase, and as of writing some floats have been deployed in support of Argo. It will be several years yet before the ocean is instrumented globally, but by the end of 2001, the North Atlantic should be effectively instrumented, and a large part of the Pacific Ocean will be populated with Argo drifters. The diagram shown in Figure 3 was adapted from a diagram assembled in mid-year by the Chairman of the International Argo Science Team, Dr. Dean Roemmich (SIO) and represents the best information available at that time. Since then the number of countries contributing to Argo has changed several times and this figure may now under-estimate the commitment

during 2001 to Argo deployments. All countries contributing to Argo have agreed there will be no protection of data, and that all information will be made available in near-real-time on the WWW and on the GTS (Global Telecommunications System). The implication is that should any PICES scientist be planning an experiment that could benefit from knowledge in real time of the background temperature and salinity fields, and the background geostrophic velocity fields, then by the end of 2001 you can assume that this will be available to you. I hope that one year from now when I write a report on the state of the Gulf of Alaska I will make extensive use of the fields observed by Argo drifters.

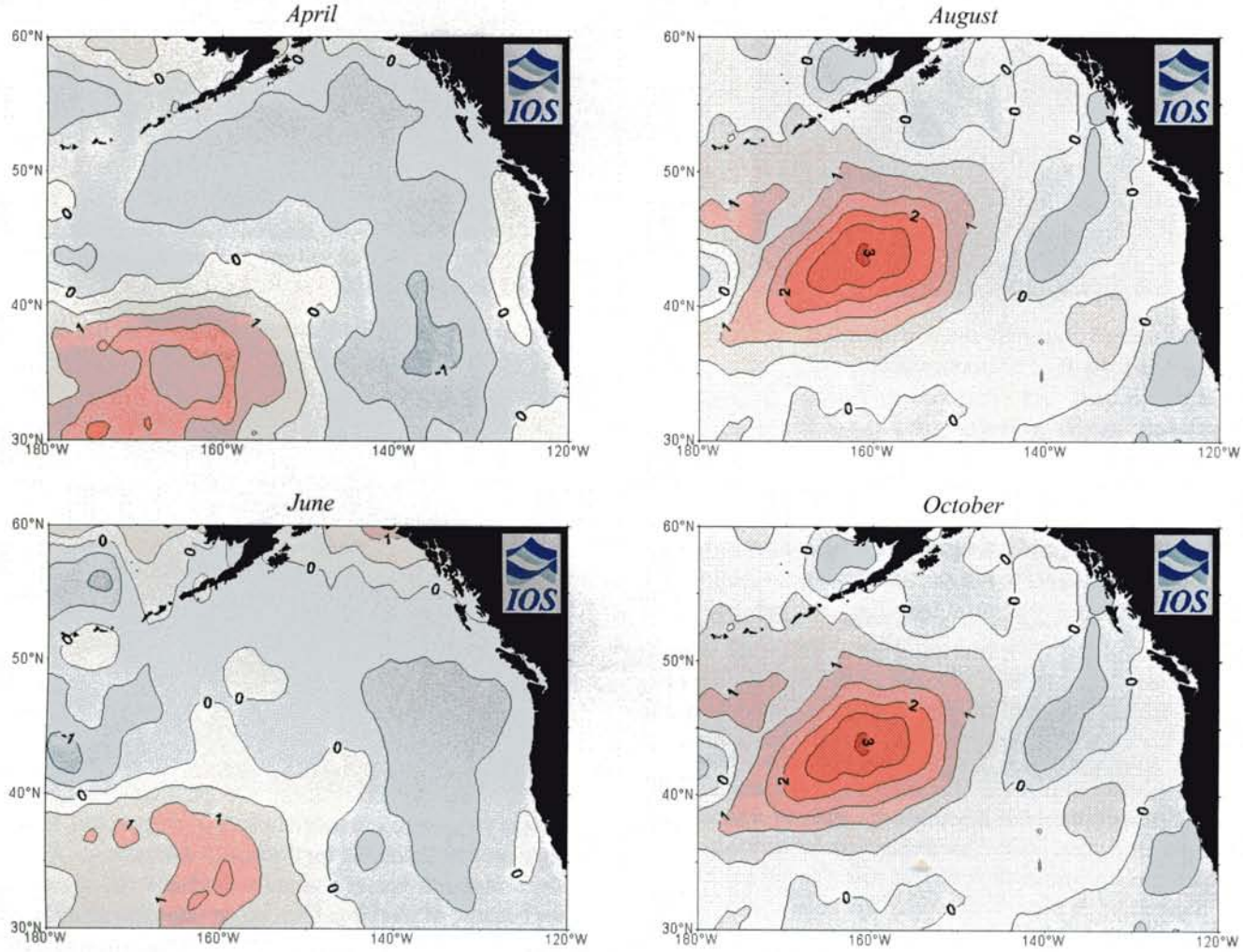

Fig. 2 Sea surface temperature anomalies in the Gulf of Alaska from spring to fall 2000.

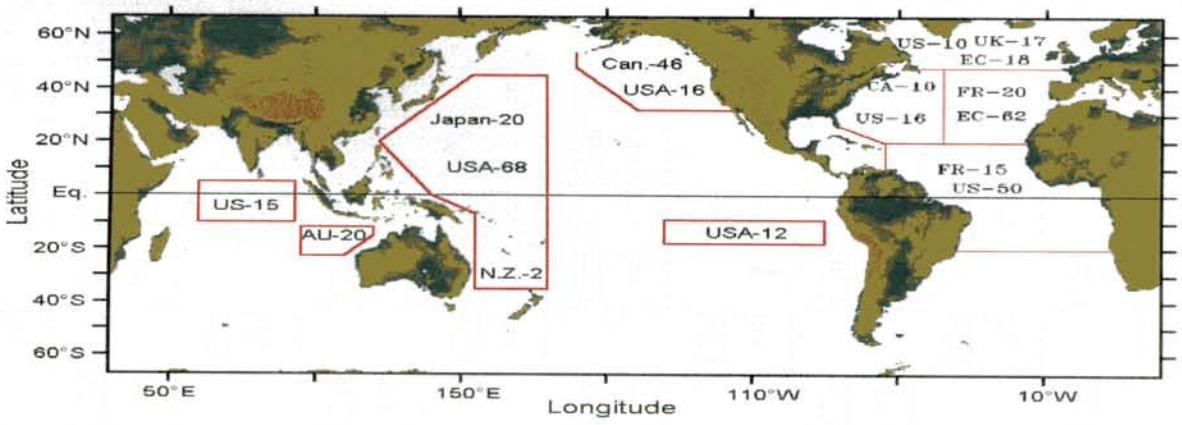

Fig. 3 Funded Argo floats will be deployed by various countries during 2001, in the regions indicated.

Makoto Kashiwai

"Makoto is always going ahead according to his belief, even if he is on his own. He never notices whether anybody is coming after him. He is surely a great scientific designer but never as smart as his form when riding on his horse." This is a good introduction to Makoto's character. It was surely hard to follow him even for his friends. But, everybody knows his sincerity for science, and his foresights were almost right in the long run.

Dr. Makoto Kashiwai was born in Tokyo as the second son of a Protestant minister. Under the influence of the dream of his father's young days, he was brought up to have a mind of devotion, logical thinking, interest in natural science and a quest for the truth. The religious part of his father's desire was taken up by his elder brother.

Makoto first saw the blue sea from the train to a town in Wakayama prefecture where his father was invited to serve in a church, as his former mission was destroyed in a B29 air raid. Swimming in these waters was frequently prohibited by the arrival of hospital ships full of repatriating defeated soldiers returning from the South Pacific islands. But the colorful small fishes in the clear blue water and the bubbles from a helmeted diver repairing the wharf were enough to enchant the heart of the boy-yet a stranger to the blue sea.

The early part of his student days at the Faculty of Fisheries, Kyoto University, was the time of an active student movement against the Japan-U.S. Security Treaty. Those days gave him an attitude of thoughtfulness in confronting history. His spare time and energy were then put into establishing the Kyoto University Cruising Club at Maizuru and the building of an ~8m open-deck ketch, *Puffinus II*, converted from a lifeboat. She had to be pulled by oars when the winds were calm and she was the best teacher about the wind and the sea, teamwork and leadership, and the importance of foresight. Every summer, Makoto and the members of the Cruising Club (including Dr. Tadashi Inada who recently became reacquainted with Makoto after a 25 year hiatus) cruised to a small island about 10 miles offshore where they dived for turbos and cooked them in their shells on board. One summer, Makoto and his colleagues planned to cruise across Wakasa Bay, a distance of almost 40 miles. The cruise was very dangerous because of the need to sail at night. The morning after her departure, *Puffinus II* was surrounded by a dense fog and she could not find her position. The members had to row toward the presumed direction at only half a mile per hour. After several hours chained to the oars, with a good fortune they finally arrived at their destination. Even in these challenging situations, his colleagues could always find Makoto sitting at the captain's place, smelling the wind and listening to the waves. Makoto and his colleagues still dream of cruising around the world in *Puffinus III*.

Then came the years of the University Revolution and cruises of the *Puffinus II* could not continue. He traded the joy of sailing for the joy of finding answers to questions of what science should be. While Makoto was a doctoral student, he led the reformation of the educational ideas of the Faculty of Fisheries in the movements of the University Revolution. In the tearoom or pubs almost every night during that hot season, he pursued arguments with his colleagues to their logical conclusion on the way to reforming it. He and his colleagues held a special summer course of lectures in cooperation with the authorities to seek what fishery science at the University should be. This is Makoto's way of doing things.

He got married and found a permanent job, first at Ehime University and then at the Kyoto University. As a university assistant he supervised many graduate students, including those left from the selection of Professors and Assistant Professors (e.g. quarterbacks, kickers or blue-band freaks having poor attendance at the Professor's lectures). As the Faculty's research vessel was only available for short day cruises because of working rules, he introduced a small boat, *Shiranami-maru*, which was classified as equipment instead of a facility, and took students and graduate students on overnight cruises while serving as acting-owner/skipper. As the number of his sea-going graduate students increased, he had to lead his research fleet, composed of *Shiranami-maru* and a collection of boats with inboard and/or outboard motors, using hand signals. In order to make it possible to identify himself as the commander of the fleet from a distance, he made it a rule to wear a red cap, and that still rests on his head now.

His scientific interest has always been in the dramatic and dynamic aspects of nature. He was engaged in studies tidal exchange using field, modeling and theoretical

Fig. 1 Makoto at two years of age sitting on his mother's lap. They are a pious Christian family.

Fig. 2 Makoto (right, back row) at 20 years of age, with his mother and brothers in the yard of the Muromachi Church in Kyoto.

Fig. 3 Makoto sitting at the captain's place in the stern side of Piffinus II. The helmsman on the right is Dr. Tadashi Inada.

Fig. 4 Beautiful hand-make ketch, Puffins II at the Bay of Maizuru (1968

approaches. In his doctoral thesis, the mechanism of tidal exchange was elucidated theoretically, but he also but he also proposed a technique for controlling tidal exchange and tidal residual circulation. When he felt that time had come to leave his cadets to a younger leader and to engage in full-scale marine science, he left university. In 1983, when Makoto moved to the Hokkaido National Fisheries Research Institute (HNFRI) in Kushiro, a new research project awaited him. The project aimed at analyzing the biological production process of Oyashio Current region from both physical and biological aspects. He led the project team, consisting of scientists from various fisheries institutes and universities, with his enthusiasm and insight for science, which laid the foundation for his PICES activities in later years. And for him, this project was a chance to change from a physical oceanographer on coastal fluid dynamics to an interdisciplinary fisheries oceanographer considering the interrelationship between ocean and living resources.

In this project, he mainly focused on the linkage between the dynamics of the Oyashio, as a part of the Western Subarctic Gyre of North Pacific, and primary and secondary production in this region. For evaluating this linkage, he and his colleagues began seasonal monitoring of ocean conditions including nutrient supply and plankton production on a line from Akkeshi, near Kushiro, across the Oyashio Current. This monitoring has been conducted by HNFRI and bore fruit in the works on the life history of copepods and spring bloom by Drs. Atsushi Tsuda and Hiroaki Saito. Now, the time series of data collected on this observation line is essential in comparing the west and east of the North Pacific. As a practical

implementation of the project, he tried to explain the population fluctuation of Japanese sardine by the food productivity in the Oyashio region. In those days, the sardine population was at a historical high level, and large number of sardines migrated into the Oyashio region for feeding in every summer. He and Dr. Tokio Wada, a fisheries biologist at HNFRI, hypothesized that an expansion of the feeding ground in the Oyashio region, i.e. an expansion of carrying capacity in the feeding ground, was essential for sustaining the high population abundance.

In February 1989, Makoto organized a special session at the international symposium on Okhotsk Sea and Sea Ice in Monbetsu, to present the results of the Oyashio project. It was his first opportunity to appear on the international stage. At the symposium, he met Prof. Yutaka Nagata of the University of Tokyo and Dr. Dan Ware of the Pacific Biological Station (PBS), Canada, and those meetings led him to ecosystem modeling work in the Oyashio region and to PICES. In the summer of 1990, Makoto and Dr. Wada visited PBS to begin collaborative work on developing a trophodynamicmodel in the Oyashio region with Dr. Ware and his colleagues. They also aimed at comparing the fish production systems between the western boundary current region and the upwelling region of the North Pacific. This collaborative work progressed well by funding from the Science and Technology Agency of Japan, and a prototype model for the Oyashio region was developed in 1993. After Dr. Wada moved to another institute, Dr. Orio Yamamura joined the team. The main topic of the collaboration was extended to the analyses and comparison of the changes in carrying capacity and biological production processes with climate variability.

In addition to his active research work, Makoto enjoyed nature around Hokkaido. During the first winter in Kushiro he started cross-country skiing. According to his colleagues, his style and skill are not very refined, in fact, rather tough, like his style in research. Then he got a horse that had retired from local drag horse racing and began horseback riding. In Japan, horseback riding is generally considered a hobby of high society, much like cruising. His riding style, however, with a thin body and a red cap on a sturdy old drag horse was a little far from the traditional image of horseback riding. Nevertheless, he was very satisfied to get a horse in the place of the cruiser of his student days.

When PICES was established by an international convention in 1992, Makoto became deeply involved in PICES' activities with Prof. Nagata and Dr. Ware. At the first PICES Annual Meeting in Victoria, Canada, Dr. Ware was elected as the Chairman of the Science Board. He began to develop a PICES-GLOBEC Plan, the first interdisciplinary scientific activity for PICES, later named "Carrying Capacity and Climate Change in the North Pacific". The research collaboration between HNFRI and PBS provided a background for this plan. In 1993, Makoto was heavily involved in the planning and organization of a PICES-STA joint workshop on Subarctic Gyres in the North Pacific in Nemuro, Hokkaido.

The Japanese Government offered to host the Third Annual Meeting of PICES in Nemuro in 1994. Makoto was appointed as the local contact point for the meeting, and as a result of a "unique circumstances", he became a legend and obtained the great trust of all PICES scientists. A week before the Annual Meeting, a major earthquake

Fig. 5 Makoto riding his lovely drag horse near Kushiro.

Fig. 6 Makoto (the Japanese mafia figure in the foreground) testing his shooting skills (Nanaimo, Canada) as Dr. Dan Ware looks on at the back.

Fig. 7 Makoto bungy jumping for the first time (Nanaimo, Canada). He was awarded a souvenir T-shirt for the successful feat.

Fig. 8 Makoto with Drs. Dan Ware and Tokio Wada at a fish market in Kushiro in the early 1990's.

Fig. 9 Makoto working at the PICES MODEL LTL Workshop.

Fig. 10 Makoto addressing participants at the Welcome Reception of the PICES MODEL Workshop (Nemuro, February, 2000).

attacked Nemuro, and the intended venue for the meeting was heavy damaged. He immediately went to Nemuro to encourage the members of the local supporting committee who were, by that time, at their wit's end, not to give up. He took the lead to find an alternate facility and to re-prepare everything for the meeting. Just as they finished removing the last stack of books from the city library and setting up the tables and chairs, the opening day arrived. Although after-shocks continued intermittently, the meeting progressed on schedule. Rooms were tight and facilities were old, but the local supporting committee and citizens of Nemuro were very hospitable. So, the Third Annual Meeting became an unforgettable experience for all participants.

At PICES III, Makoto convened the PICES-GLOBEC Workshop co-sponsored by the Japanese Fisheries Agency and was appointed a Co-Chairman of PICES-GLOBEC Plan. Then he was elected as the Chairman of the Science Board, replacing Dr. Ware. Throughout the terms of these chairmanships, he devoted himself to establishing CCCC Task Teams and holding workshops for implementing the PICES-GLOBEC Plan. Recently, in the winter of 2000, he organized a workshop in Nemuro on lower trophic level modeling with the MODEL Task Team members. During the workshop, he also led the discussion on how to link the lower trophic model to higher trophic models considered by REX and BASS for initiating the synthesis phase of the PICES-GLOBEC Plan.

The Japanese Government highly regarded his activities in PICES and appointed him as Delegate to PICES in 1998. He made his first remarks as a Delegate at the Opening Session of PICES VIII in Vladivostok. In these remarks, he emphasized the PICES role to promote marine science and international cooperation in the North Pacific and appealed to young scientists to participate in PICES activities. His speech was filled with sincere expectations based on activities by himself and was very impressive.

For Makoto, it is not too much to say that his research life at HNFRI has been with PICES. Due to age limitation, he must retire from HNFRI at the end of March 2001. He will also step down from the position of Japanese Delegate according to the government rules. As the Ninth Annual Meeting in Hakodate was the last meeting for him as the Japanese Delegate, he expected to summarize the comparative works on ecosystem modeling and to address the need to synthesize the PICES-GLOBEC activities. It was such regret, not only for him but also for us, that cancer was detected in his esophagus just before the Annual Meeting so he could not attend because of medical treated in Tokyo. Throughout the meeting, however, we witnessed many discussions about cooperation among

Task Teams and how to link the lower and higher trophic modules in the ecosystem model. His intention at the Nemuro workshop surely bore fruit in Hakodate. In the beginning phase of PICES, we were very lucky to have Dr. Makoto Kashiwai on board.

In April 1999, Makoto and Dr. Tadashi Inada were reunited when Dr. Inada arrived at HNFRI as Director. Makoto told him earnestly that PICES activities are very important for the scientific work of institutes concerned with the North Pacific including foreign organizations. On September 18, 2000, Makoto told Dr. Inada about his cancer and the need for an operation. The Japanese Government immediately contacted the PICES Secretariat, and within a few days, a beautiful flower basket arrived at Makoto's bed from the staff of the Secretariat with sincere wishes and encouragement. At PICES IX in Hakodate, Dr. Inada acted as the Japanese Delegate on behalf of Makoto and spoke at the Opening Ceremony just as Makoto had intended. Immediately after PICES IX, a T-shirt signed with heartfelt messages to Makoto by many PICES scientists for a speedy recovery was delivered to Makoto by Dr. Wada. Fortunately, the cancer was in an early stage and was removed successfully in the operation. Now he is on the road to a smooth recovery and we can expect to meet his red cap again at PICES X.

This article was written by Dr.. Tadashi Inada (left) and Dr. Tokio Wada (right), in appreciation and recognition of Dr. Makoto Kashiwai's outstanding service to the marine ecosystem science in Japan and PICES over many years.

Dr. Tadashi Inada (tinada@hnf.affrc.go.jp) is the Director-General of the Hokkaido National Fisheries Research Institute (HNFRI). When he met Makoto in Maizuru in 1965 as a student of Kyoto University, they enjoyed yachting and discussing about the student movements. They went separate ways in 1972 and reunited at HNFRI in Kushiro in 1999.

Dr. Tokio Wada (wada@s.affrc.go.jp) is a research coordinator of the Fisheries Agency of Japan. Since he met Makoto in 1984, they have worked together on the climatic influence on fish population dynamics, and they also have been involved in numerous PICES activities. Tokio is presently the Co-Chairman of WG16 (Implications of Climate Change to Fisheries Management).

(cont. from page 2)

The PICES-GLOBEC CCCC Program continues its work on integrating and stimulating national GLOBEC research efforts in the North Pacific. The Regional Experiments (REX) Task Team is presently focusing on comparative work on herring in the North Pacific. They just completed a workshop on "*Trends in Herring Populations and Trophodynamics*" and are planning an expansion of their work to consider trends in size-at-age for a number of fish species in 2001. REX and Basin Scale Studies (BASS) Task Teams are collaborating with MODEL Task Team to begin integrating their work into coupled biophysical models. MODEL has been very successful in beginning the development of a standardized lower trophic level model that can be applied to a variety of regions for intercomparison and coupling with upper trophic level models. The work on validating their NEMURO lower trophic level model will continue in the coming years.

No new Working Groups were formed this year because many new groups were started last year and these are just now beginning their work. Four Working Groups, CO_2 in the North Pacific, Micronekton, Ecology of Harmful Algal Blooms, and Climate and Fisheries are continuing their analyses. Three Advisory Panels (Continuous Plankton Recorder, Marine Mammal and Bird, and Iron Fertilization Experiment) are playing important roles in advising the PICES scientific community about research design and improvement in particular areas.

The PICES Science Board has approved many exciting topic sessions for our next Annual Meeting, to be held October 2001, in Victoria, British Columbia, Canada. This upcoming meeting will be an anniversary celebration of the first decade of science in PICES. A special Science Board Symposium will celebrate the anniversary with a review of the scientific accomplishments of PICES' first ten years, followed by thought-provoking talks on future scientific directions of PICES.

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Alkalinity measurement quality improves for PICES nations

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As one of its terms of reference, the PICES Working Group 13 on CO_2 in the North Pacific is working to improve measurement quality. To achieve this, the Working Group planned to carry out a series of between laboratory comparisons of measurement techniques for the parameters: total dissolved inorganic carbon, total alkalinity, and the $^{13}C/^{12}C$ ratio of the inorganic carbon in seawater. The first of these PICES-sponsored exercises took place in early 1999, and was organized collaboratively by the National Institute for Environmental Studies (NIES, Tsukuba, Japan) and the National Institute for Resources and Environment (NIRE, Tsukuba, Japan) and the Scripps Institution of Oceanography (SIO, La Jolla, U.S.A.). Samples were distributed to 13 participating laboratories from 5 countries, and this was followed up by a technical workshop in Tsukuba in April 1999 (for details see PICES Press Vol 7, No. 2).

A principal focus of the workshop was a detailed discussion of the results obtained for the inter-laboratory comparison. The measurements of total dissolved inorganic carbon were very encouraging. Once the data had been adjusted using the measurement on CRM (Certified Reference Material) Batch 45 so as to allow for calibration problems, all the results from the various laboratories involved were consistent with each other and within ±5 µmol/kg of the certified value. However, for the measurement of alkalinity, though a calibration adjustment improved the degree of agreement, there were still significant discrepancies of up to ±25 µmol/kg from the certified value. It was thus agreed that the next inter-comparison study would focus on the measurement of total alkalinity in seawater.

Discussion at the second PICES CO_2 Technical Workshop held October 20, 2000, at the EPOCHAL International Congress Center, Tsukuba, Japan.

Dr. Andrew G. Dickson (indicated by arrow) is an Associate Professor-in-Residence at the Scripps Institution of Oceanography of the University of California, San Diego, and a member of PICES Working Group 13 on CO_2 in the North Pacific. His research interests include the study of the oceanic carbon dioxide system as well as other aspects of ocean biogeochemistry. He plays a major role in organizing inter-calibration and quality control for CO_2 measurements in seawater.

This PICES sponsored study – again a collaborative effort between SIO and NIES/NIRE – was carried out this year, and followed up with a technical workshop held October 20, 2000, in Tuskuba, Japan. Again, four samples were distributed for analysis by the participating laboratories (1 from Canada, 7 from Japan, 1 from Korea, 1 from Russia, and 3 from the U.S.A.). Twenty four scientists, members of the participating laboratories together with some observers, attended this workshop. Similar results were obtained for total dissolved inorganic carbon as in 1999 (again after adjusting for small calibration problems). For alkalinity, the results were significantly better than they had been in 1999. With the exception of two participating laboratories, the alkalinity results (when normalized to a common reference material) were in good agreement with each other and almost all data were within ±7 µmol/kg of the assigned value. This data quality is typical for laboratories with experience in this measurement, and indicates the increased experience the various participating laboratories have acquired over the past year.

Nevertheless, it is essential to maintain an awareness of potential inter-laboratory calibration problems, and the sources of these were discussed at length during the technical workshop. A full report, detailing both the 1999 and 2000 exercises is in preparation and should be completed in early 2001. The various workshop participants expressed an interest in continuing further such exercises on about a 2-year interval. We plan to explore ways of doing this in the future. In addition, Working Group 13 is planning an interlaboratory method comparison of the measurement of the $^{13}C/^{12}C$ ratio of the inorganic carbon in seawater for the coming year. This will involve the distribution of both a CO_2 gas samples, as well as a seawater samples. If you are interested in participating, please contact either Paul Quay (pdquay@u.washington.edu) or Andrew Dickson.

Participants of the second PICES CO_2 Technical Workshop in Tsukuba, Japan (October 20, 2000)

Country	**Affiliation**	**Name**
Canada	Institute of Ocean Sciences	Johnson, W. Keith
Japan	Frontier Research System, Japan	Ono, Tsuneo
	Hokkaido University	Nakano, Yoshiyuki
	Hokkaido University	Wakita, Masahide
	Hokkaido University	Watanabe, Shuichi
	Japan Marine Science and Technology Center	Murata, Akihiko
	Kansai Environmental Engineering Center Co. Ltd.	Ishida, Kazunori
	Kansai Environmental Engineering Center Co. Ltd.	Ota, Hidekazu
	Kansai Environmental Engineering Center Co. Ltd.	Tsubota, Hiroyuki
	Marine Works Japan Ltd.	Kitada, Makio
	Marine Works Japan Ltd.	Komai, Nobuharu
	Marine Works Japan Ltd.	Shibata, Fuyuki
	Meteorological Research Institute	Ishii, Masao
	National Institute for Resources and Environment	Harada, Koh
	National Institute for Resources and Environment	Tsurushima, Nobuo
	National Institute for Resources and Environment	Watanabe, Yutaka
	University of the Ryukyus	Fujimura, Hiroyuki
	Research Institute of Oceanochemistry, Osaka/Kimoto electric Co. Ltd.	Kimoto, Takashi
Korea	Seoul National University	Kang, Dong-Jin
Russia	Pacific Oceanological Institute, Vladivostok, Russia	Pavlova, Galina
USA	Atlantic Oceanographic and Meteorological Laboratory/NOAA	Lee, Kitack
	Scripps Institution of Oceanography	Afghan, Justine
	Scripps Institution of Oceanography	Dickson, Andrew
	University of Hawaii	Dore, John

Dr. Timothy R. Parsons awarded 2001 Japan Prize

In April Dr. Tim Parsons will travel to Tokyo to receive the 2001 Japan Prize for his contribution to the development of fisheries oceanography and the conservation of fisheries resources and the marine environment. It is awarded by the Science and Technology Foundation to people whose original and outstanding achievements in science and technology are recognized as having advanced the frontiers of knowledge and served the cause of peace and prosperity for mankind. Each laureate receives a certificate of merit, a commemorative medal and a cash award of 50 million yen. The Presentation Ceremony is held in the presence of Their Majesties, the Emperor and Empress, and is also attended by the Prime Minister, the Speaker of the House of Representatives, the President of the House of Councillors, the Chief Justice of the Supreme Court, foreign ambassadors and over 1000 other guests, including eminent academics, researchers and representatives of political, business and press circles.

After receiving a Ph.D. from McGill University in 1958, Dr. Parsons started his scientific career with the Pacific Oceanographic Group of the Fisheries Research Board of Canada at the Pacific Biological Station, Nanaimo, B.C. This phase of his scientific life included a term at the Office of Oceanography for the United Nations Educational, Scientific and Cultural Organization (UNESCO) in Paris from 1962-1964. From 1972 until his retirement in 1992 he was at the Department of Oceanography at the University of British Columbia in Vancouver, B.C., where he is a professor emeritus. Dr. Parsons is currently an emeritus scientist located at the Institute of Ocean Sciences, B.C.

Together with his friend and colleague, the late Dr. John Strickland, he wrote the book on analytical methods for oceanographers. Their publication is still on the benches of virtually every oceanographic laboratory. Dr. Parsons also authored *Biological Oceanographic Processes*, the classic textbook for students of biological oceanography. Dr. Parsons pioneered the "ecosystem" approach to conservation-based fisheries management and pollution studies. Through "controlled ecosystem pollution experiments" he and colleagues from the United States, Germany and Japan were able to analyze how low levels of pollutants affect the food-web from plankton to fish. Dr. Parsons' research broke new ground and encouraged others to understand how human activity impacts our environment.

Dr. Parsons was a member of the PICES BIO Committee from 1992 to 1996 and in 1996, he gave the Keynote Lecture at the PICES Fifth Annual Meeting in Nanaimo, Canada. Throughout his career, his students and staff (including the authors) have greatly benefited from his mentoring and guidance. There are many people at many institutes that Tim has encouraged, mentored, taught and/ or hired. He asked us to do things better at the same time that we did things differently. Congratulations from PICES and a couple of admirers.

Submitted by Robin Brown (Fisheries & Oceans Canada) and Skip McKinnell (PICES) who are former employees and students of Dr. Parsons.

Dr. Parsons at PICES III in Nemuro, Japan (left), at PICES V in Nanaimo, Canada (center) and working in his lab (right).

Governing Council meeting: front row from left – J.Y. Kim, V. Alexander, H.T. Huh, L. Richards, P. Livingston; back row from left – I.I. Shevchenko, A. Kurmazov, L.N. Bocharov, A. Bychkov, R.J. Marasco, W.T. Cocke, W.G. Doubleday, T. Inada, K. Harunari, Q.F. Liu, T. Wada, Z.L. Wei, S.M. McKinnell

Opening Session – (from left) Chairman Dr. H.T. Huh giving his opening address, Mayor Hiroshi Inoue, Y. Amano (Japan), W.G. Doubleday (Canada), Q.F. Liu (China), L.H. Hong (Korea), L.N. Bocharov (Russia), V. Alexander (U.S.A.) and T. Inada (Japan)

More than full attendance at the CCCC Workshop

Poster Session

Dr. Douglas E. Hay leading discussion at the FIS Committee meeting

Science Board meeting: front row from left – T. Ikeda, S.M. McKinnell; back row from left – V.B. Lobanov, D.E. Hay, J.E. Stein, P. Livingston, R.M. Brown

The PICES Chairman, Science Board Chairman, Secretariat, Local Organizing Committee members and Russian friends on board R/V Professor Gagarinskiy

Ninth Annual Meeting

Dr. Vera Alexander (PICES Vice-Chairman), Prof. Yoshio Ezura (Dean of the Faculty of Fisheries, Hokkaido University), Dr. Hyung-Tack Huh (PICES Chairman) with a hostess at the Extravaganza Dinner

Dr. Tadashi Inada, Japanese Alternate Delegate, toasting the hard work of the Hakodate City Hall staff at the Chairman's Reception

Prof. Yutaka Nagata (fifth from right) joins the Russian scientists in an improvised performance of Russian folk songs at the Banquet hosted by Hakodate City

Drs. Sergrio V. Hernandez, Tsuyoshi Kawasaki, Ms. Christina Chiu, Dr. Tadashi Inada and Mr. Gong-Ke Tan (PICES Intern) enjoying a good time at the Extravaganza Dinner

Drs. A.V. Tkalin, R.I. Perry, T. Orlova, V.B. Lobanov, W.T. Peterson and A. Bychkov posing in front of the beautiful night scene of Hakodate

The PICES Secretariat enjoying delicious traditional Japanese cuisine in the warm company of Drs. Akihiko Yatsu (front), Tadashi Inada (center), (back from left) Yukimasa Ishida, Hidehiro Kato, Mamoru Kato, Tokio Wada and Takashi Minami

Tangible outline of the whole elephant

(Results of ecosystem studies of biological resources in the far-eastern seas in 1990s)

Dr. Vladimir I. Radchenko
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Dr. Vladimir Radchenko is the Deputy Director of TINRO-Center (Pacific Scientific Research Fisheries Center, Vladivostok, Russia). His interests include fish community dynamics in the northwest Pacific Ocean, carrying capacity and climate change issues, and the ecology of Pacific salmon during their sea life. In 1994, Vladimir received a Ph.D in Marine Biology for his thesis entitled "Composition, structure and dynamics of nekton communities of the Bering Sea epipelagic layer". He also works on problems of rational exploitation of living resources, fisheries management, and conservation in far-eastern seas. Vladimir is involved in various PICES activities as a REX Task Team co-chairman, member of the Biological Oceanography Committee and the Executive Committee for the CCCC Implementation Panel, and was formerly a member of WG5 on the Bering Sea and the Fishery Science Committee.

The major result of large marine ecosystem studies conducted by TINRO-Center in the Russian Far East has been the development of "the big picture" of long-term dynamics of the main components of the ecosystem. Tracing the path of these developments inspired the title of this article about several blind people describing an elephant's appearance. In our case, the general outline of the structure and function are beginning to show through the darkness of uncertainty. The individual elements of the whole picture were revealed through key research directions that included:

- studies of long term variability in the ecosystems;
- quantitative abundance estimation of biological resources, calculations of fish productivity and total biological productivity levels, clarification of trends of their dynamics;
- structure of pelagic and bottom communities, dynamics of biodiversity parameters;
- carrying capacity of far-eastern seas (Shuntov, 1999).

Thirty-four expeditions were conducted during the 1990s (Fig. 1), and about 50 over the last 20 years. By adopting some of the practices developed during expeditions of the Russian Academy of Science, methodological improvements were made, but significantly supplemented by our studies of higher trophic levels, especially the ecology of commercial fishes and invertebrate species. New methods were developed to rapidly process oceanographic data, especially for plankton ecology and the feeding habits of nektonic fish and invertebrates. This allowed primary conclusions to be reached before the end of an expedition. Therefore, the results were immediately available to develop recommendations for the management and conservation of fisheries resources.

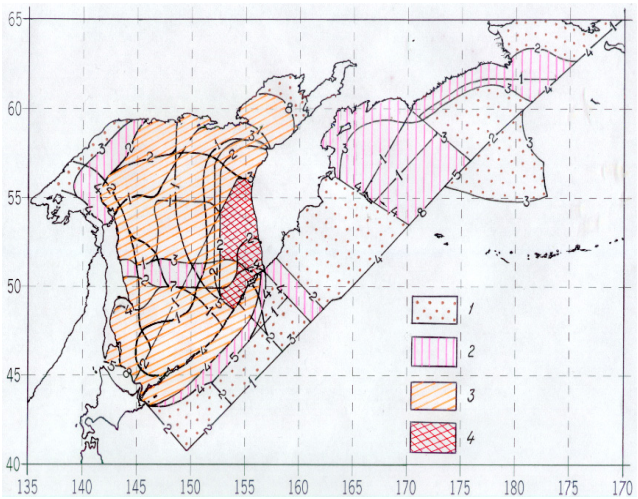

Fig. 1 Survey area for TINRO-Center biological resources ecosystem studies, 1990 - 2000. 1 – by 1-5 cruises; 2 – 6-10 cruises; 3 – 11-20 cruises; 4 – more than 20 cruises. Isolines indicate the survey borders and number of surveys conducted in these borders.

The ecosystem approach assumes synchronous collection, processing and analysis of material on all species inhabiting a study area. Conclusions about stock conditions of harvested species are made based not only on their abundance, which can be inexact due to imperfection and inconstancy of methods, but also on processes occurring in the fish and planktonic communities, in

Table 1. Dynamics of some parameters indicating a decrease of water exchange between the far-eastern seas and Pacific Ocean in 1990s.

	1989	1990	1991	1992	1993	1994	1995	1996	1998	1999
Kamchatka Current outflow (0-1000m) through Kamchatka Strait	7.0	-	3.7	4.7	3.6	-	-	3.3	1.0	3.9
Average velocity of the W. Kamchatka Current at the sea surface layer (cm/s)	-	-	8.0	5.0	-	2.7	3.6	4.6	-	-

populations of ecologically related species, and environmental conditions. As had been forecast 10 years earlier by the Applied Biocenology Laboratory, two strong year-classes of herring appeared in the Okhotsk Sea in the mid-1990s (Shuntov, 1986). The prediction was based on an understanding of periodic fluctuations of pelagic fish stocks and was further supported by an hypothesis of expected cooling in far-eastern seas after the relatively warm 1980s. Marine surveys, analyses of collected data, and discussion in the scientific literature convinced the State Committee on Fisheries of Russia to increase the total allowable catch (TAC) of the Okhotsk herring threefold in 1995 (Fig. 2).

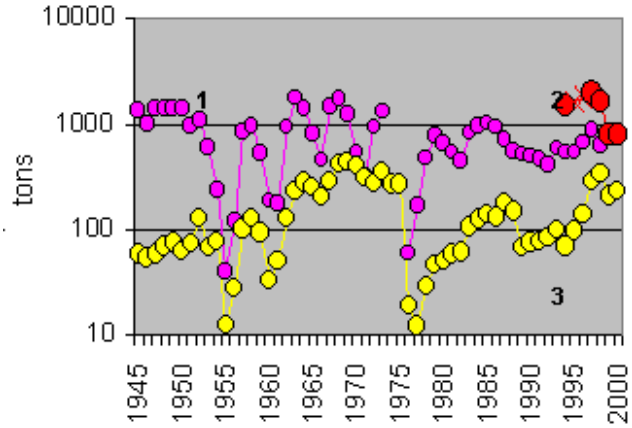

Fig. 2 Spawning stock fluctuations and catch dynamics of the Okhotsk herring population, 1945-2000. 1 - spawning stock estimations from the TINRO-Center, Magadan Division; 2 - corrections made by the TINRO-Center based on pelagic trawl survey data (crosses present an assumed level for years between autumnal integrated surveys); 3 - total annual catch.

The principles of planning and conducting integrated marine expeditions became customary after 1998 and these expeditions are now conducted in close cooperation with specialists of regional research institutes and laboratories of resource and ecological divisions. Resource studies, particularly at KamchatNIRO and SakhNIRO, have become imbued with an ecosystem focus. Research efforts of the TINRO-Center and other regional research institutes have been joined by programs of integrated studies of biological resources in the Bering, Okhotsk, and Japan Seas for 1998-2002.

Exchanging ideas with scientists conducting similar studies in different regions of the World Ocean (mostly through scientific publications) is the driving force of the far-eastern seas ecosystem studies. Some fragments of information and ideas were found in papers by many foreign authors, dealing with adjacent ocean areas. These pieces were assembled with our own new findings as parts of a giant mosaic. For example, Okada's (1986) discovery of the walleye pollock migration route in the Aleutian Basin of the central Bering Sea allowed us to conduct a more directed search for the continuation of the route in the Commander Basin within the limits of the Russian EEZ (in those times, Soviet EEZ). Hollowed and Wooster (1992) provided an explanation of the cause of decreasing water exchange between the Bering Sea and the Pacific Ocean, and the inter-annual variability of ocean current patterns and water structure observed since the early 1990s.

Hypotheses on long-term variability in the physical components of the far-eastern seas ecosystem have become organized in an harmonious scheme by combining all processes and phenomena occurring in different regions of the North Pacific. The long-term dynamics of atmospheric activity centers over the ocean lead to large-scale changes in the pressure field structure, with interdecadal periodicity. A decreasing advection of oceanic waters into the far-eastern seas (Table 1) is the consequence of an increase in water circulation intensity in the Subtropical Gyre (with the strengthening of the California Current), and a decrease in the Subarctic Gyre (with the weakening of the Alaska Stream along the North America coast). This phenomenon was accompanied by a northward shift of the main fronts and currents in the northern hemisphere.

The temperature of waters circulating in the Subarctic Gyre decreases as these waters receive less solar radiation after their northward shift. Cooling of shelf waters is more intensive in the far-eastern seas due to atmospheric variability. Beginning in the late 1990s, the seasonal development of atmospheric processes over the northwestern North Pacific is similar to that of the "cold decades" of 1960s – 1970s. The number of days with a zonal mode of atmospheric circulation pattern decreased. It is known that cold Arctic air masses shift into the Bering and northern Okhotsk Seas during periods of low atmospheric circulation zonal index. It leads to a drop of air temperature and subsequent surface water cooling.

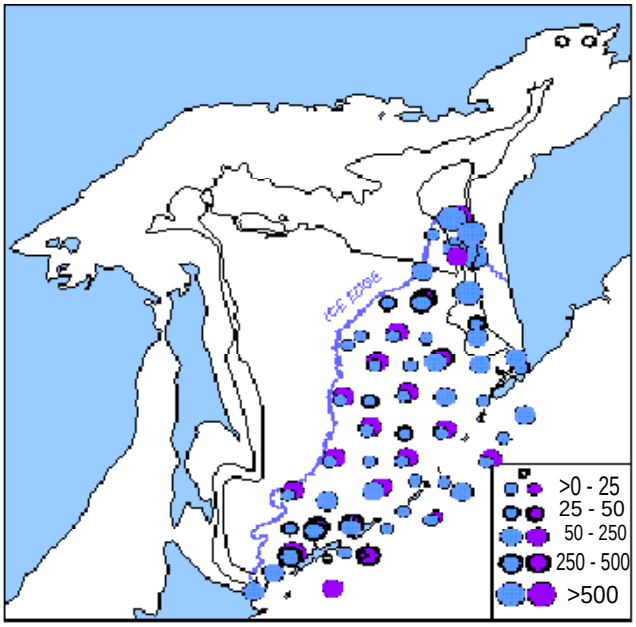

Fig. 3 Example of mesopelagic fishes catch distribution (kg per hour of trawling) in the middle (200-500 m. blue circles) and lower (500-1000 m, violet circles) pelagic layers in the Sea of Okhotsk, March – April of 1990.

Increasing temperature and salinity gradients in the border layers separate water masses, both vertically and horizontally. Continuing frontogenesis makes preconditions for water transport acceleration along fronts, and for water mass interaction through frontal zones. Therefore, some preconditions for the next climate-oceanological regime shift are beginning to appear in the far-eastern sea ecosystems.

Considerable clarification was made concerning current and potential levels of biological and fish production of the far-eastern seas. Firstly, a theoretical consideration was made because there was insufficient data on biomass (or production) at all trophic levels through most regions of the far-eastern marine basin prior to the ecosystem studies. The calculations showed that the abundance of commercial species was potentially substantially higher in the Russian far-eastern seas than previously thought.

This was the preamble of the practical findings that followed in the marine expeditions. Estimates of walleye pollock biomass showed that >45 million t of walleye pollock inhabited far-eastern seas and adjacent Pacific waters at the highest level of abundance. Thereafter, re-estimations of stock conditions and recommendations to expand fishery exploitation ensued for the Okhotsk and Korf-Karaginsky herring populations, cod, saffron cod, and the schoolmaster squid. Data summarizing the ecology, assessment of biomass and role of mesopelagic fishes in pelagic ecosystems became a special and important part of ecosystem studies. It was found that these fishes are relatively uniformly distributed in mesopelagic layers (Fig. 3), and are practically inexhaustible (Table 2) with current fisheries techniques. They undoubtedly represent significant reserve of protein for future food and technical products.

After 1990, the numbers of relatively thermophilic species, walleye pollock or Japanese sardine, noticeably decreased. In contrast, the fish species that increased preferred a relatively lower water temperature. Three major stocks of Pacific herring (the Okhotsk, the Gizhigino-Kamchatsky, and the Korf-Karaginsky populations) increased in biomass from the late 1980s to the early 1990s. From the south, the Japanese anchovy expanded their range northwards, up to the Ayano-Shantarsky region of the Okhotsk Sea (Fig. 4). Studies conducted during the late 1980s showed an interesting feature: walleye pollock declined in abundance when herring stocks increased, and vice versa. The 1980s was a "pollock epoch", and a "herring epoch" was forecast for the 1990s. What actually happened in the 1990s was a trend of declining pollock abundance and the growth of herring stocks in the northern Okhotsk Sea. The herring proportion in the pelagic fish community increased noticeably (Table 3). If we consider the dominance of the 40–60 year cycle in the variability of biological structure and physical surrounding of pelagic ecosystems, and disengage ourselves from variability of lower frequency, we can conclude that pollock stocks will reach a minimal level not earlier than the second decade of the 21st century.

Table 2. Mesopelagic fish biomasses (thousand metric tons) estimated for the middle (200-500 m) and lower (500-1000 m) pelagic layer basing from trawl survey data, March – June of 1990.

	Bering Sea		Okhotsk Sea	
	200 – 500 m	500 – 1000 m	200 – 500 m	500 – 1000 m
Light-rayed lampfish	2737.6	3752.3	57.6	42.9
Dark-rayed lampfish	14.0	1382.7	38.6	1025.0
Other myctophids	55.0	52.2	9.4	77.5
Northern smoothtongue	42.4	237.4	1477.7	2167.7
Eared blacksmelt	34.5	164.6	349.7	1434.4
Other bathylagids	22.3	650.1	0.3	632.4
Pacific viperfish	45.3	203.0	2.0	83.5

Table 3. Biomass (thousand metric tonnes) and ratio of species in pelagic fish community in the northern Okhotsk Sea in late summer – autumn of 1988, 1997-1999.

Species	1988		1997		1998		1999	
	Biomass	%	Biomass	%	Biomass	%	Biomass	%
Pollock	9475.2	94.2	4391.9	57.0	3636.5	51.5	1278.0	17.4
Herring	497.2	4.9	2492.9	32.3	1209.7	17.1	1877.6	25.5
Capelin	11.3	0.1	31.0	0.4	1002.7	14.2	929.3	12.6
Sandlance	7.8	0.1	30.3	0.4	21.2	0.3	1.5	+
Lumpfishes	20.8	0.2	37.1	0.5	127.1	1.8	41.2	0.6
Others	46.9	0.5	727.7	9.4	1064.0	15.1	3223.9	43.9
Total	10059.2	100%	7710.9	100%	7061.2	100%	7351.5	100%

Maintenance of the steady functioning of individual species and ecosystems is ensured by the complex mechanisms that regulate abundance and population density of marine species. These mechanisms regulate both reproduction and survival according to life history strategies. It has been found that cannibalism in walleye pollock and schoolmaster squid increases during shortages of forage zooplankton, both seasonally and inter-annually, especially in winter and in years of strong year-classes. Cannibalism in the schoolmaster squid is estimated to be 0.9 million t annually. This mechanism sustains the spawning stocks during unfavorable seasons, and regulates total abundance. Despite a declining abundance of pollock, cod, and Greenland turbot (all significant predators of squid), the squid biomass did not increase noticeably in the Bering Sea. It can be related to an increase in cannibalism among squid and the conditions of squid reproduction.

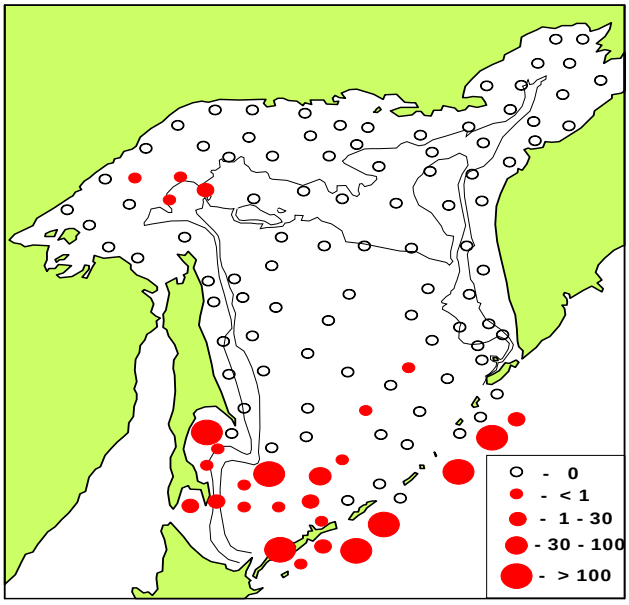

Fig. 4 Catch distribution (thousand fish per square km) of Japanese anchovy in summer-autumn of 1998.

There are consistent processes involved in the overall ecosystem functioning, like those in separate populations of sea animals. The ratio of biological productivity to total volume of consumed organic matter inside the system is also regulated by similar mechanisms. Substantial decreases in pelagic nekton biomass are considered to be one of the major features of ecosystem reconstruction in North Pacific during the climate–oceanologic regime shift of the early 1990s. Correspondingly, the predation by nekton on planktonic communities weakened and the following circumstances came about (Fig. 5). However, the last stage occurred at a lesser level than in the late 1980s in conditions of new epoch and distinctive structure of fish communities.

Despite the leaps in some fish species abundance, the structure of fish communities in the far eastern seas remains relatively stable. For the Bering Sea, although there has been a decrease of pelagic fish biomass by more than half, the planktivorous nekton (pollock, herring, schoolmaster squid) maintain a leading role in transporting biomass to the upper trophic level organisms (Fig. 6). This monthly flow is estimated at 103 thousand t (for the end of summer – beginning of autumn), whereas directly from lower trophic levels to the predator fish guilds – is estimated at 134 thousand t. In order to support this production, the planktivorous nekton consumes 2.25 million t of living substance (raw weight) monthly, including 373.5 thousand t of cannibalistic consumption by fish and squid (pollock, schoolmaster squid).

The interrelationships among ecosystem components and their integration level can be examined in the dynamics of biological diversity. Last year, the dynamics of species diversity (Shannon index), and species uniformity by abundance (Pielou evenness index) were studied in the Sea of Okhotsk nekton, macroplankton and macrobenthos. From 1985 to 1998, the variety of species in the pelagic fish community increased following an S-shaped curve up to the new quantitative level in the research area (Fig. 7). The Pielou and Shannon indices undulated to a relatively higher level. The analysis of separate ecological groups of organisms and areas showed similar attributes in both pelagic and bottom ecosystems. All changes spread from south to north. In the benthic zone, especially in deep-water areas, the process was slower than in the pelagic zone.

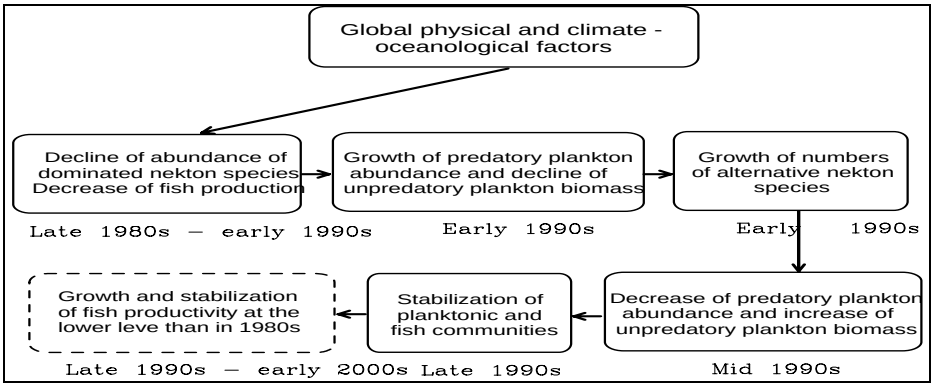

Fig. 5 Generalized ecosystem reorganization in the epipelagic layer of the far-eastern seas (after Shuntov et al., 1997).

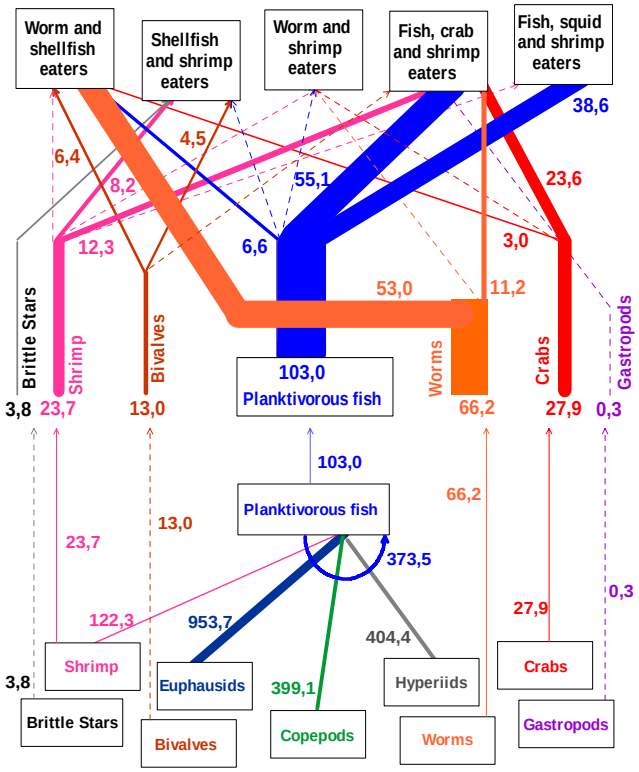

Fig. 6 Matter flows (1000 t per month) between the nekton guilds and lower trophic level organisms in the W. Bering Sea shelf and slope, 1998. Arrow' thickness reflects volume ratio of matter flows. In the upper panel, all arrows are 10 times thicker than in the lower panel. Matter flows with transport volume less than 20 (lower part of Figure) and 2 (upper part) thousand tons per month are indicated by dashed lines of equal thickness.

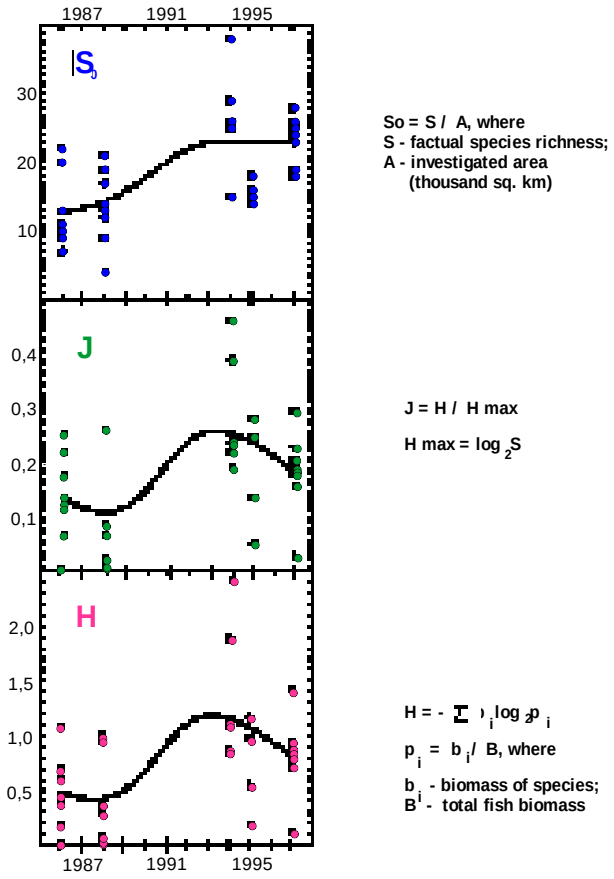

Fig. 7 Long-term trends of species richness (so), evenness (J), and diversity (H) of pelagic fish community in the northern Okhotsk Sea. Each point corresponds to one biostatistical area.

Understanding species diversity variability is needed in studies of multifaceted concepts of ecosystem "carrying capacity". The term "carrying capacity" is currently defined as the biomass of a species that can be maintained by the ecosystem resources and conditions. Obviously, the carrying capacity of a guild or a group of organisms is not equal to the sum of the component carrying capacities.

Determination of the ecosystem carrying capacity for separate guilds or ecological groups of organisms is a necessary stage for developing the management of commercial species resources within multi-species fisheries theory. Apparently, the ecosystem research of biological resources will be developed in this direction in the future.

The *Oshoro Maru*: A short history of Hokkaido University's workhorse in the North Pacific

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*Dr. John Bower began his fisheries career in 1986 as an NMFS observer aboard several South Korean trawlers in the Bering Sea. During 1987-89, he was a Peace Corps Volunteer in the Philippines, where he first became interested in cephalopods. John completed graduate degrees at the University of Hawaii (Department of Oceanography) and the Hokkaido University (Faculty of Fisheries) studying two nektonic squids (*Ommastrephes bartrami *and* Todarodes pacificus*), and became an assistant professor at the Hokkaido University in 1999. He now spends his summers aboard the Oshoro Maru studying the distribution and abundance of cephalopod paralarvae in the North Pacific*.

Setting out

LOCATION: Central Dock, Hakodate, Japan
DATE: June 3, 2000
TIME: 1000 hours

The freshly painted *Oshoro Maru IV* sits moored to the dock, where a crowd of more than one hundred has gathered to bade the ship farewell. Customs officials have finished stamping passports and assorted documents. The dean of the Faculty of Fisheries at Hokkaido University has finished his farewell speech to the ship's cadets. It is time to depart. After the last visitor disembarks, the gangplank is removed, and members of the university's cheering club dressed in black and wearing headbands begin to pound on giant drums. Crewmen and cadets gather at the ship's railing, where they wave to the crowd and hold on to colorful streamers, which flutter in the wind. As the ship eases forward, the chief officer's young daughters run alongside it to the end of the dock.

"Bye-bye, otoosan [father]! Bye-bye!"

"The next time I see them, they'll be bigger."

He waves one last time from the bridge.

So begins the 48th annual cruise of the *Oshoro Maru* to the North Pacific.

Oshoro Maru I

The first *Oshoro Maru* was built in 1909, to train students in the newly opened Department of Fisheries at the Tohoku Imperial University, a predecessor of the Hokkaido University. The 31-meter wooden topsail schooner was modeled after those used in the Gloucester cod fishery and named for a bay located 10 km west of Otaru, Hokkaido. The bay, then an important fishing ground for Pacific herring, was the ship's first home port, but maneuvering the ship in the small bay proved difficult, so her home port was soon moved to Otaru. The schooner was converted to a brigantine (Fig. 1) in 1910 and equipped with a 63-horsepower engine in 1913.

The ship's main training area was the Sea of Okhotsk, where students were taught how to fish Pacific cod, king crab and salmon. Salmon were first caught using stationary nets in inshore waters, but the Russian government soon restricted this inshore fishing, so the ship was forced to move offshore. In 1915, under the direction of Professor Kumao Kuroda, the ship began testing the use of drift gillnets to catch salmon in the western Sea of Okhotsk. The success of this new fishing method led to the birth of the Japanese salmon drift gillnet fishery.

Fig. 1 The Oshoro Maru I *as a brigantine circa 1925*.

In August 1926, the *Oshoro Maru I* finished her 26th and final cruise for the fisheries department after sailing nearly 50,000 miles and carrying more than 200 students. The

ship was then renamed the *Giyu-wani Maru* and operated by a youth group until 1938, when she was dismantled after running aground near Cape Daio on Honshu Island. Today, a gold-, diamond- and ruby-adorned model of the *Oshoro Maru I* is displayed at the Kobe Maritime Museum.

Oshoro Maru II

In 1927, the *Oshoro Maru I* was replaced by the *Oshoro Maru II*, a 42-meter steel barkentine with a 500-horsepower diesel engine and a complement of 59 (Fig. 2). Training voyages continued in the Sea of Okhotsk and expanded in 1931 to include trawl surveys in the East China Sea. These voyages continued until World War II, when the ship's sailing equipment was removed, and the ship was used by the Japanese Merchant Marine to transport coke between Hokkaido and Honshu Islands. She was strafed in an air raid by U.S. planes on Hakodate during July 14-16, 1945, but escaped with little damage.

In May 1949, the *Oshoro Maru II*'s fishing equipment was reinstalled, and training cruises resumed off Japan's Pacific coast. In 1952, she became the mothership of the submersible *Kuroshio*, which was used during Professor Naoichi Inoue's research on "marine snow". This submersible was also used in seafloor surveys conducted before the construction of the 54-km undersea Seikan Tunnel, which now connects Hokkaido and Honshu Islands. Also in 1952, the ship was lengthened to 47 meters (Fig. 3), her engine was replaced, and radar equipment was installed; these renovations broadened the ship's sampling range.

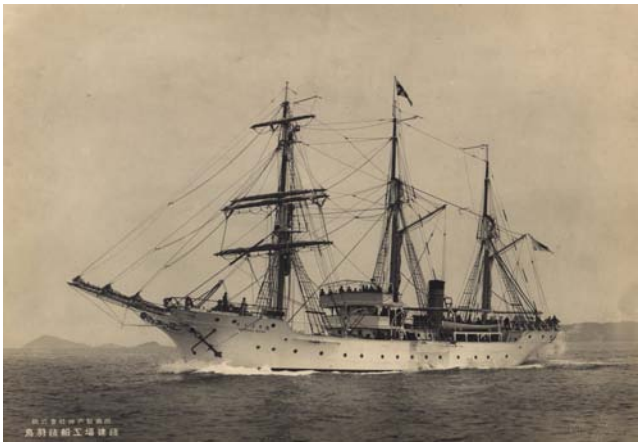

Fig. 2 The Oshoro Maru II *as a barkentine before World War II.*

North Pacific

The *Oshoro Maru II* began summer sampling in the North Pacific in 1953, as one of Japan's research ships for the International North Pacific Fisheries Commission. Salmon, plankton and hydrographic data were collected in the Northwest Pacific and southern Bering Sea, but cruise participants suffered many hardships. Meals consisted mainly of potatoes, since rice provisions were low in the postwar years, and the ship's radar broke down. The cruise ended tragically when a crewman was killed in an air-tank explosion in the ship's galley.

In 1954, the ship traveled as far as Bristol Bay, where it tied up to a Japanese crab-cannery boat for several hours to let the students observe the processing operations. The visit also allowed crewmen the rare opportunity to bathe. The *Oshoro Maru II* could carry only 126 cubic meters of freshwater, so during the 50-day cruises with no port calls, the use of freshwater was strictly controlled. Baths were forbidden, and each crewman was allowed to use only enough water to wash his face in the morning. The only chance they had to bathe was during visits to a cannery boat that had a bath.

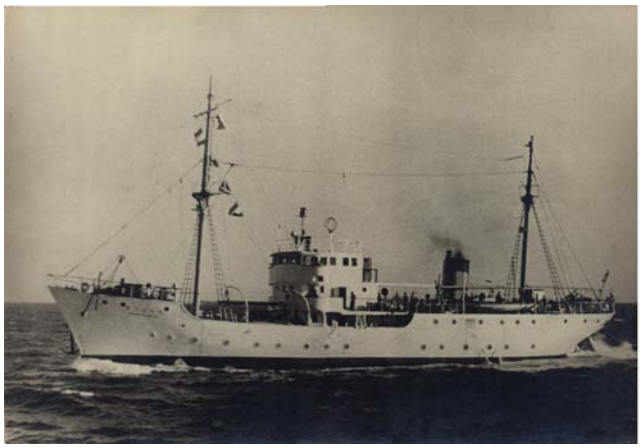

Fig. 3 The newly renovated Oshoro Maru II *in 1952*.

In 1955, the North Pacific sampling program expanded greatly under the direction of Professor Shigeru Motoda, to include meteorological observations, seawater analysis, fish-larvae net tows, dredging and sea surface temperature measurements. Also in 1955, the ship made her first foreign port call during the North Pacific cruise to Seattle (Fig. 4). This was the first visit by a Japanese government ship to the U.S. since the end of World War II. During the ship's visit, the University of Washington's president, Henry Schmitz, held a formal party at his residence for the officers and crew, and a 20-car caravan took the crewmen to climb Mt. Rainier, which they renamed "Mt. Tacoma Fuji". Since 1955, the *Oshoro Maru II*, *III* and *IV* have made 85 port calls to 16 ports during the North Pacific cruises (Table 1). These visits have become an important part of the cruises, allowing the ship to resupply its freshwater and fuel reserves, and giving the scientists and students a chance to visit local fisheries laboratories and universities. The visits also allow the ship's officers and crew to try out new golf courses.

The *Oshoro Maru II* was used for the summer North Pacific cruises through 1961. Besides these cruises, she also participated in the International Geophysical Year

(1957-58) surveys, and in observations on the 1958 solar eclipse at Suwarrow Atoll in the Cook Islands. During her final cruise in the winter of 1961 to Saigon, the weakening hull began to leak seawater. In 35 years of service, the ship traveled 303,000 miles and was used to train 1,648 students.

Fig. 4 Reception aboard the Oshoro Maru II *during the 1955 port call to Seattle. From left to right: Professor Shigeru Motoda, Captain Takeji Fujii, Yoshikazu Tsuji (a 1912 graduate of the Department of Fisheries), Assistant Professor Kenji Katoh, Chief Officer Shigeo Abe, and Chief Engineer Shoichi Tomisawa.*

Oshoro Maru III and IV

In 1962, the *Oshoro Maru II* was replaced by the *Oshoro Maru III*, a 67-m 1,180-ton stern trawler equipped with a 2,000-horsepower engine and a variable-pitch propeller (Fig. 5). The ship's complement numbered 106, including 60 students, 40 crew, and 6 scientists. Her first voyage was to the Indian Ocean to participate in the International Indian Ocean Expedition. She made her first North Pacific cruise in May 1963, and began carrying aboard foreign scientists during these cruises in 1968; a total of 86 U.S. and 5 Canadian scientists have since participated (Table 2). During her 1972 North Pacific cruise, the ship ventured into the Chukchi Sea as far north as 72°00'N, which set the record for the northernmost cruise by a Japanese ship.

During the 1953-77 North Pacific cruises, the main sampling areas were the Bering Sea and Northwest Pacific, and the core of the sampling program included hydrographic, plankton, fish-larva and salmon drift gillnet sampling. In 1978, the sampling area expanded to include the Subarctic Current and Subarctic Boundary, and the 180° transect through this region has been sampled every year since. Data have been collected on various nekton from this region, including neon flying squid, Pacific pomfret, Pacific saury, and albacore. These and other data from the North Pacific cruises have been published annually since 1957 in the Faculty of Fisheries' "*Data Record of Oceanographic Observations and Exploratory Fishing"*. The *Oshoro Maru III* completed her final cruise in 1983, after sailing nearly 530,000 nautical miles, and carrying 3263 students and 850 scientists, including 144 from foreign countries. In 1984, she was replaced by the 1,383-ton *Oshoro Maru IV*, a 73-m stern trawler equipped with a 3,200 horsepower engine (Fig. 6). This ship continues to be used today.

Fig. 5 The Oshoro Maru III.

Fig. 6 The Oshoro Maru IV.

End of the cadet training program

The Faculty of Fisheries at the Hokkaido University offers a one-year postgraduate course in ship and fishery operations. Cadets in this course receive classroom instruction in navigation, ship maneuvering and maritime law, followed by at-sea training aboard the *Oshoro Maru* during the North Pacific cruise. Since 1953, 795 cadets have participated in these cruises. Similar courses are also offered at three other universities in Japan (Tokyo University of Fisheries, Kagoshima University, and Nagasaki University), but due to declining enrollment, in 2002, these four courses will merge into one taught in

Tokyo. As a result, the cadet class graduating in March 2002 will be the Hokkaido University's last.

Funding for the *Oshoro Maru*'s North Pacific cruises comes from the Japanese Ministry of Education. It is now unclear how the closing of the cadet program will affect future funding, but since the main purpose of these cruises is to train cadets, future funding is expected to decrease. However, Hokkaido University scientists remain hopeful that these cruises and the cooperative research programs with U.S. and Canadian institutions will be able to continue.

The return home

LOCATION: Central Dock, Hakodate

DATE: 19 August 2000
TIME: 0700 hours:

The *Oshoro Maru* quietly finishes her 11-week journey by slowly approaching the dock. With her fuel and freshwater reserves low, the ship rides much higher in the water than she did in June. It is early on a Saturday morning, too early for a large welcoming party. The first to board are two customs agents, who, after an hour of checking passports and dealing with other formalities, allow the crew and cadets to disembark. The 48th annual cruise of the *Oshoro Maru* to the North Pacific has ended. The unloading of nets and frozen samples can wait until Monday. It is now time for the chief officer to see how big his daughters have grown.

Table 1. Ports visited by the Oshoro Maru *during the North Pacific cruises. Years are shown in parentheses.*

Adak	('69, '77, '78, '79, '80)	Newport, Oregon	('85)
Dutch Harbor	('73, '74 (2X), '86, '88, '89, '90 (2X), '91(2X), '92, '93, '94 (2X), '95 (2X), '96, '97, '98 (2X), '99 (2X), '00)	Nome	('72, '83)
		St. Paul Island	('74)
		Seattle	('55, '60, '70, '81, '87, '93, '98)
Honolulu	('84)	Seward	('66, '77, '79, '81, '83, '84, '86, '90, '94, '97)
Juneau	('60, '64, '68, '73, '80, '84, '92, '96, '99)		
Ketchikan	('88)	Sitka	('82)
Kodiak	('65, '67, '68, '69, '70, '71, '72, '75, '76, '78, '80, '82, '83, '85, '87, '91, '95, '97, '00)	Valdez	('96)
		Vancouver	('67, '89)
Nanaimo	('67)	Victoria	('00)

Table 2. Names and affiliations of foreign participants in the Oshoro Maru *North Pacific cruises*

David G. Ainley, PRBO	Tina Wyllie Echeverria, UA	Tsuneo Nishiyama, UA
Kerim Y. Aydin, UW	Yoji Endo, UA	Tammy C. Norgard, DFO
Christine Baier, UW	David L. Eslinger, UA	Dorinda Osterman, WHOI
Jack E. Bailey, NMFS	James A. Finn, UH	William G. Pearcy, OSU
Willard E. Barber, UA	Joanna Flanders, NMFS	Jon Peterson, NMFS
Isabelle Beaudet, DFO	Naoki Fujitani, WHOI	J.C. Quast, BCF
Evelyn D. Biggs, NMFS	Moira Galbraith, DFO	James A. Raymond, ADF&G, UA
Bruce D. Bolding, OSU	James W. Glock, NPFMC	G. M. Reid, BCF
Jennifer L. Boldt, UA	John J. Goering, UA	Robert Reid, NMFS
Christopher Bouchet, NMFS	Elizabeth Hacker, NMFS	Wendy Roberts, NMFS
Jim H. Branson, NPFMC	Raymond S. Hadley, UA	William C. Rugen, NMFS
Steve Branson	Tsutomu Haryu, UA	Raymond Sambrotto, UA
Richard D. Brodeur, NMFS, OSU	Kazuo Hirano, UA	Timothy M. Sands
Chris Bublitz, UA	Saang-Yoon Hyun, UW	John Skidmore, NMFS
Morgan Busby, NMFS	Herbert W. Janicke, NMFS	William W. Smoker, UA
Richard Carlson, BCF	Arthur Kendall, NMFS	Stella Spring, NMFS
Lie-Feng Chen, UA	Tom Kinder, UW	Matthew Stafford, ODU
Lorenzo Ciannelli, NMFS	John T. Konecki, UW	Richard Straty, BCF, NMFS
Jay B. Clark, NMFS	Joyce H. Landingham, NMFS	Hiroya Sugisaki, NMFS
Kurt Clemente, ODU	Sang-Sun Lee, UA	Kozo Takahashi, WHOI
L.K. Coachman, UW	Denby S. Lloyd, NPFMC	Sarah Thornton, UA
Lewis Consiglieri, NMFS	Ole A. Mathiesen, UA	Richard B. Tripp, UW
Glenn F. Cota, ODU	Judy McDonald, UA	Terrence Wahl, PSG, WWU
Kenneth Coyle, UA	Lawrence J. Miller, UA	Robert V. Walker, UW
Pamela S. Croom, UA	Douglas F. Moore, DFO	Mark Willette, UA
Michael L. Dahlberg, NMFS	D. Mountain, UW	Matthew T. Wilson, NMFS
Clark Darnell, UW	Josephine Munson, NMFS	David E. Withrow, NMFS
Robert H. Day, UA	Marcia May Muto, NMFS	F.F. Wright, UA
Anthony R. DeGange, USFWS	Katherine W. Myers, UW	Shinn Pyng Yeh, UA
Donald R. Deibel, MUN	Jeffrey M. Napp, NMFS	
John P. Doyle, UA	J. Nishimoto, BCF	

Note: ADF&G: Alaska Department of Fish and Game; BCF: Bureau of Commercial Fisheries; DFO: Department of Fisheries and Oceans; MUN: Memorial University of Newfoundland; NMFS: National Marine Fisheries Service; NPFMC: North Pacific Fishery Management Council; ODU: Old Dominion University; OSU: Oregon State University; PRBO: Point Reyes Bird Observatory; PSG: Pacific Seabird Group; UA: University of Alaska; UH: University of Hawaii; USFWS: U.S. Fish and Wildlife Service; UW: University of Washington; WHOI: Woods Hole Oceanographic Institution; WWU: Western Washington University.

Bering Sea and North Pacific Ocean Theme Page
(*http://www.pmel.noaa.gov/bering/*)

Providing Internet-based information to scientists, managers, and educators for six years

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Allen Macklin, director of the Bering Sea and North Pacific Ocean Theme Page, is a meteorologist with NOAA's Pacific Marine Environmental Laboratory in Seattle, Washington, U.S.A.. Presently the coordinator for Fisheries-Oceanography Coordinated Investigations (FOCI) and Southeast Bering Sea Carrying Capacity (SEBSCC), he has over 25 years experience studying Alaskan coastal meteorology and its relationship to the physical and biological oceanography of the region. Allen also co-directs the Bering Sea Ecosystem Biophysical Metadatabase, a project designed to advance understanding of the structure and function of the Bering Sea ecosystem through development of a collaborative research tool for fisheries oceanography and ecosystem investigations.

In 1995, NOAA's Pacific Marine Environmental Laboratory (PMEL) established a scientific theme page (Fig. 1) on the Worldwide Web (http://www.pmel.noaa.gov/bering/) devoted to the Bering Sea and North Pacific Ocean. The site is a clearinghouse for information pertaining to those regions and additionally serves as a resource base for the scientific investigation of the biology, oceanography, meteorology and ecology of the area. The theme page provides a forum for presenting and discussing new ideas, plans and research results.

Worldwide Web theme pages bring together data and information associated with a broad, thematic concept, allowing the viewer to do some initial investigation by reading about the broad topic, and ultimately directing the viewer toward a specific information item or data set. A theme page presents a complete, layered approach to understanding the subject area and typically includes several of the following:

- *Topic identification*
- *Data displays, forecasts, photos*
- *Background information for students and the general public*
- *In-depth information and analyses for researchers*
- *Access to analysis software*
- *Access to on-line data*
- *Perspectives, publications*
- *Live gateways to services and directories*

Elements of the theme page include geography and history of the Bering Sea and North Pacific Ocean, physical and biological sciences, monitoring and research institutions and programs, education, news, guidelines for using the resource, a site search engine, a chat room, and a news subscription service.

The physical and biological sciences element contains sections on atmospheric science, environmental chemistry, atmosphere and ocean interactions, physical oceanography, biophysical interactions, marine biology, and an environmental atlas. Components include a dynamic listing of institutions and organizations performing research in the region. This is followed by a dynamic list of research programs, active and historical. Other links provide access to information on workshops, conferences and proceedings, traditional knowledge and Native American studies, and more.

During the late 1990s, this site was designated the communication vehicle for U.S. interagency research for the Bering Sea. Agency operations schedules, science plans, proceedings of meetings, and research results are all contained in a section called Interagency Information Exchange.

Environmental data can be located through the theme page's real-time weather and ocean information links (e.g., Fig. 2), as well as on-line data and metadatabases. Prominent among holdings is the Bering Sea Ecosystem Biophysical Metadatabase with over 1500 references to data, reports, and proposals contributed by fourteen nations. The theme page's data element also includes links to the Japan Oceanographic Data Center, Comprehensive Ocean-Atmosphere Data Set (COADS), Primary Productivity of the Bering Sea (PROBES), Fisheries-

Oceanography Coordinated Investigations (FOCI), and Bering and Chukchi Sea Ecosystem databases.

Educational links span the ecosystem from physical oceanographic and meteorological forcing to the science of chemistry and nutrients and proceed up the food chain from phytoplankton to apex predators such as seabirds and marine mammals. Descriptors include fish, crustaceans, weather and ocean processes, and sea ice. WebStudy recognized the theme page in 1999 as one of the best educational sites on the Worldwide Web.

News of upcoming events such as meetings, conferences, announcements of opportunity and preprints of research results are posted to the theme page as received. Periodic messages announcing the latest news items are distributed to an electronic mailing list. To subscribe to this service, visit the theme page, or send your request with your e-mail address to *bering@pmel.noaa.gov*.

(cont. on page 34)

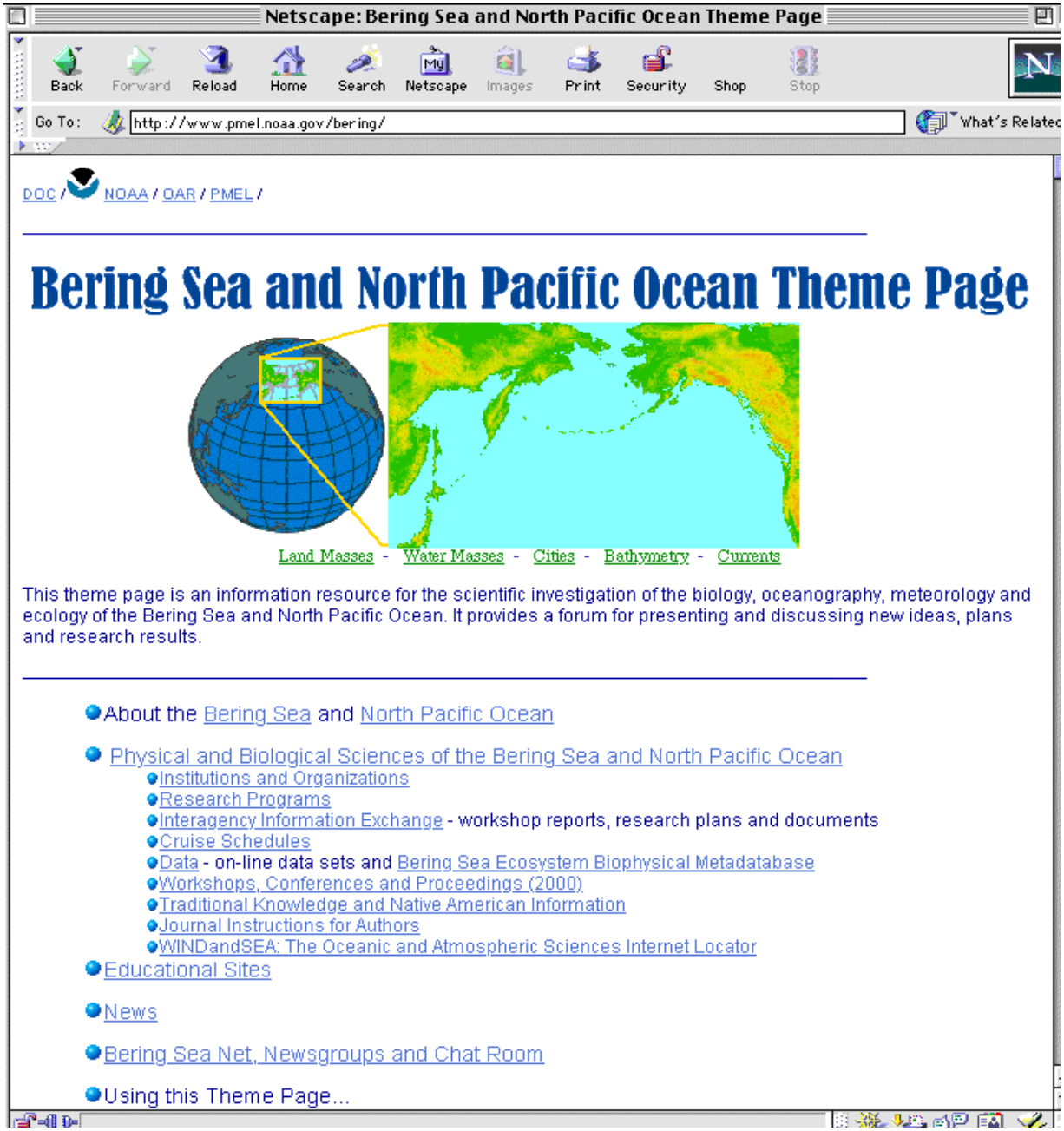

Fig. 1 The home page of the Bering Sea and North Pacific Ocean Theme Page contains links to major elements of the web site, provides basic information on geography, bathymetry and currents, gives access to regional communication, and suggests additional ways to use the theme page.

PICES IX Japan/East Sea cruise

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Dr. Vyacheslav (Slava) B. Lobanov is the Deputy Director of the V.I. Il'ichev Pacific Oceanological Institute of the Far Eastern Branch of the Russian Academy of Sciences. His scientific interest is in physical oceanography, and he is currently working on projects related with mesoscale eddies in the Japan/East Sea. Dr. Lobanov joined the PICES community in 1993 at the Nemuro workshop on Subarctic Circulation when he was involved in Working Group 1's activity. He was appointed as a member of the Physical Oceanography and Climate Committee (POC) in 1995 and elected as the POC Chairman at the PICES Seventh Annual Meeting in 1998. He also served as a Co-Chairman for the Okhotsk Sea workshops in Vladivostok (1995) and Nemuro (1998).

Hakodate City is located on the Tsugaru Strait and stands on the way from Vladivostok, Russia, to the North Pacific. When we go on scientific cruises we usually see the lights of Hakodate about one and a half days after departure. This is roughly the same time that you need to get to Hakodate from Russia by airplane, after making connecting flights across Japan. That is why when we heard that the Ninth Annual Meeting of PICES was going to be in Hakodate, our first idea was to go by ship. Even a research vessel of a small size could bring 10-15 marine scientists who might contribute to the meeting as presenters and participants. This would be a good chance to bring more Russian scientists, who usually have no funds to travel abroad, to a PICES meeting. At the same time, the V.I. Il'ychev Pacific Oceanological Institute (POI) had planned a cruise to the northern Japan Sea in the fall to conduct hydrographic and ecosystem studies under the new Russian federal program "World Ocean" and Naval International Cooperative Program (NICOP). A continuation of this cruise might have a port call at Hakodate.

The integration of these two objectives, with partial support from PICES, resulted in cruise No. 30 of R/V *Professor Gagarinskiy*. We called it the PICES Cruise because we were going to the PICES Annual Meeting, and we were planning to implement multi-disciplinary observations in the PICES area for a comprehensive study of the northern Japan/East Sea ecosystem structure and dynamics, consistent with the PICES scientific strategy.

The R/V *Professor Gagarinskiy* belongs to the Far Eastern Branch of the Russian Academy of Sciences. She is not large and economical 56 m in length and has 1100-ton tonnage. She is quite stable and allows work even in a rough sea (Fig. 1). The cruise was organized by POI with the participation of the Far Eastern Hydrometeorological Institute (FERHRI), TINRO-center, Institute of Marine Biology and Pacific Institute of Bioorganic Chemistry. Unfortunately we did not manage to have an international research team because of a lack of time for the necessary bureaucratic procedures related with EEZ.

Fig. 1 Working in the Tatar Strait (20 m/s wind): Sergey Sagalaev, Pavel Tishchenko and Olga Vereshchagina taking water samples at the last station of the leg.

The general idea of the scientific program is to study mesoscale water dynamics in the northwestern Japan/East Sea and its influence on the ecosystem. Extensive field observations implemented in the 1990s under CREAMS and ONR/JES programs revealed many findings in the circulation pattern of the basin. One of these findings is the high energy

and importance of mesoscale processes related to long-lived anticyclonic eddies over the deep central part of the sea (Japan Basin), and the strong topographic influence on water flow at the continental slope and bottom rise areas. The fall season is characterized by intense upwelling events along the Primorye coast of Russia. However the ecosystem impacts of these phenomena have never been studied in detail. The mesoscale structure of the Primorye (Liman) Current is expected to influence the composition and distribution of phytoplankton species at the shelf area, including the distribution of toxic species cysts about which we still have very poor knowledge. Our study was focused on the following major topics:

- ecosystem of isolated mesoscale eddy over the Japan Basin;
- structure of Liman Current ecosystem and its evolution during Primorye upwelling;
- biogeochemical processes at Primorye continental slope; and
- distribution and composition of the harmful algal (dinoflagellates cysts) and water quality along Russian shelf.

Observations included CTD measurements with water sampling for standard chemical parameters with nutrients, carbonate, chlorophyll and phytoplankton analyses, Jeddy net sampling for zooplankton and underway echosounder measurements. Because of limited funds, we had no sampling of higher trophic levels this time, with the exception of sampling and analyses of squid (Dr. Yuriy Zuenko). We also took samples of bottom sediments at coastal area to identify harmful algal cysts (Dr. Tatiana Orlova) and check environmental quality by biological testing (Drs. Dmitry Aminin and Irina Agafonova). To trace mesoscale structures we used NOAA satellite infrared images provided by the Inter-institute Center for Satellite Monitoring, Vladivostok (Drs. Anatoliy Aleksanin and Emil Herbeck), received just prior to the cruise and updated in Hakodate through the internet.

The cruise began just off the Vladivostok harbor on October 12, 2000, and ended at the same place on November 4 (Fig. 2). A few sections were observed repeatedly within the 2-3 week interval, which should allow us to see the ecosystem dynamics as a response to rapid changes of hydrographic structure in the fall season. A prominent upwelling event along the southern Primorye coast occurred after October 18, when we finished the first leg of the cruise (Fig.3). Rapid cooling and convective mixing of the 20-30 m surface layer also contributed to a change in the thermohaline structure. When we returned to the section off Preobrazhenie on October 31, we found that SST had declined to 3-7°C from 13-14°C on October 14 (Fig. 4). This also increased the salinity of the upper layer. Results of the upwelling are also seen at subsurface and intermediate depths. Water of the open sea, with lower temperature and higher salinity, had shifted close to the slope, replacing and displacing the offshore warm and fresh water of the Primorye Current. Slope water of 200-300 m came up to the shelf bringing higher nitrate concentration.

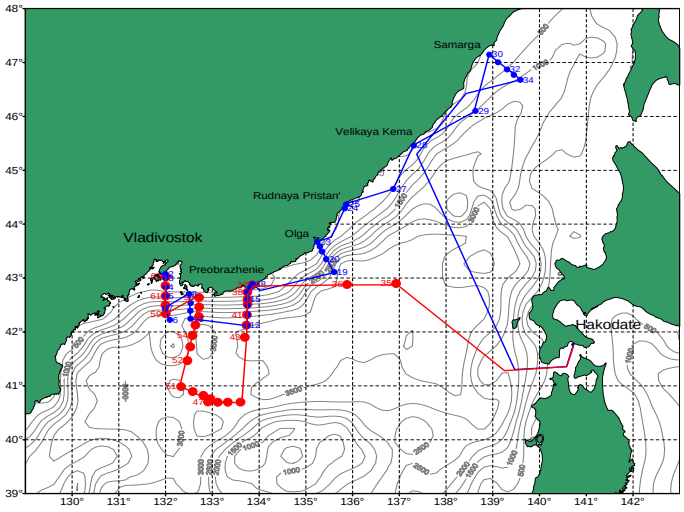


Fig. 2 Route of the cruise.

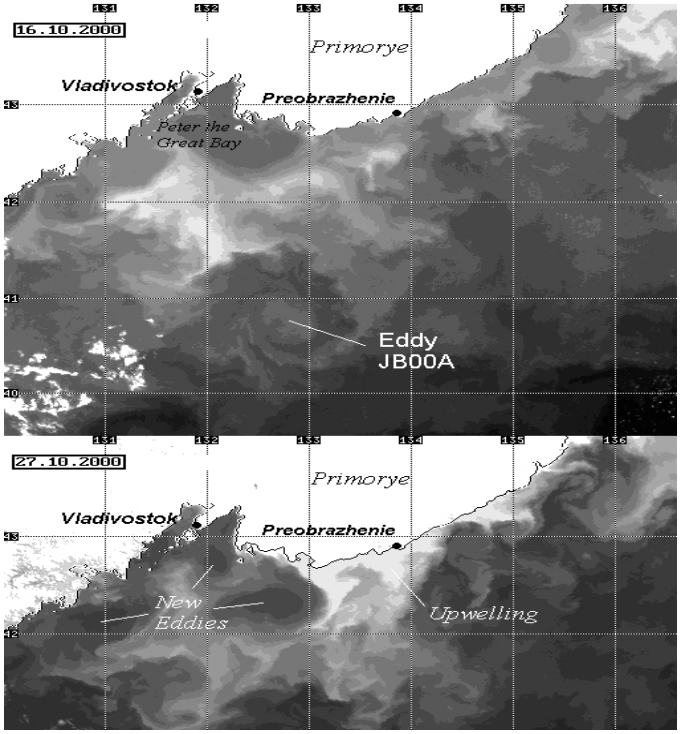


Fig. 3 Satellite images of study area showing upwelling event off Primorye coast and mesoscale anticyclonic eddies. Dark shades correspond to warm water areas, light shades are cold water, white areas are clouds.

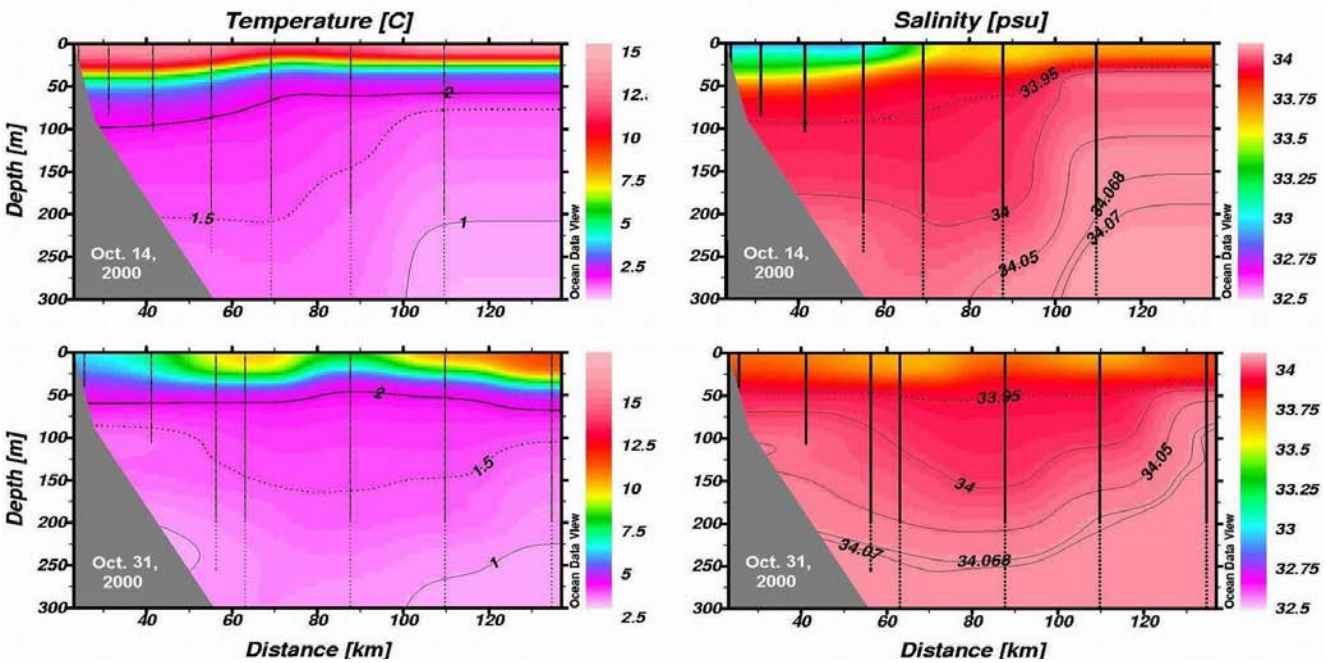


Fig. 4 Thermohaline changes at the section off Preobrazhenie during upwelling event and fall cooling.

At the same time, the horizontal structure of the Primorye Current system was noticeably changed (Fig. 3). A new anticyclonic eddy of 15-40 miles in diameter and intrusions of cold water were formed off Peter the Great Bay and along the slope off eastern Primorye.

Another objective of our cruise was to sample the anticyclonic eddy JB00A located over the southern part of the deep Japan Basin (Fig.3). The eddy was traced by satellite data from its formation in January 2000, southwest off Peter the Great Bay, and sampled on our previous cruises in March and July this year.

Recent hydrographic observations we made in cooperation with Drs. Lynne Talley (SIO), Yuri Volkov (FERHRI) and Steve Riser (UW), confirmed that these eddies travel from west to east, transporting water of lower salinity at intermediate depths and penetrating down to the bottom layer. Convergence and mixing in the upper layer as well as filamentation and streamer intrusions in the eddies should have a significant influence on the behavior of biological species. At the time of our most recent observations, the eddy had a weak signature at the surface but it was evident at depth (Fig. 5), keeping extremely cold and fresh water (0.25°C, 33.96 psu) trapped in its core at 260-380 m. A subsurface layer of high salinity was developed at the eddy center at 50-100 m providing a double-picnocline structure. These are some of the preliminary hydrographic results. After the completion of hydrochemical and biological analyses, we will understand the ecosystem response to mesoscale water processes.

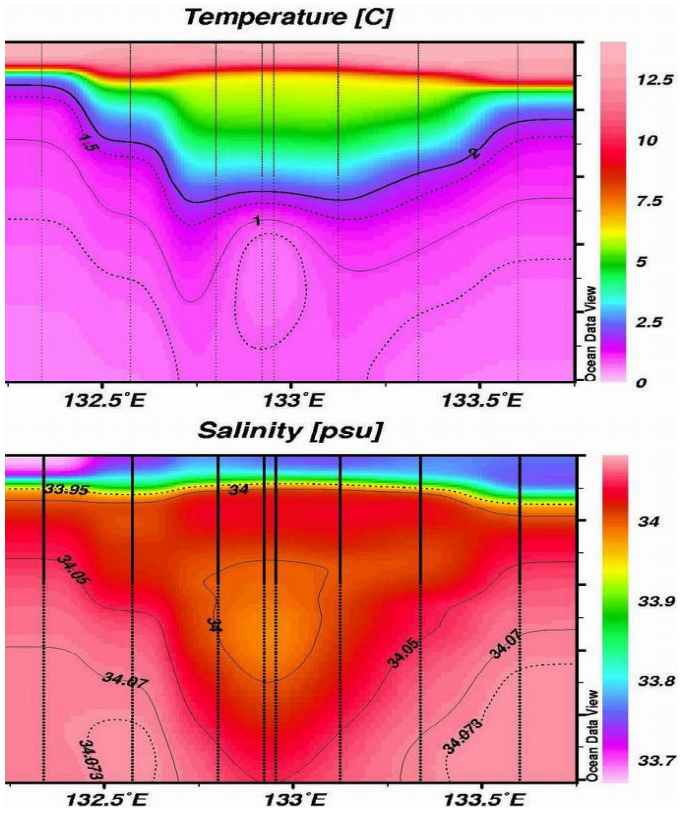


Fig. 5 Temperature and salinity section across the anticyclonic eddy over the Japan Basin (JB00A).

Coming back to the initial idea of the cruise, of bringing more and new people to the PICES meeting, we can say that it was successful. Most of the research group contributed to the PICES symposia and discussions. One of the researchers on board, Dr. Anatoliy Salyuk, received the Best Presentation Award for his talk at the topic session (Fig. 6). It was also good to relax in Hakodate in the middle of the cruise. We greatly appreciate the warm hospitality and kind arrangements of the Mayor of Hakodate City, all the staff of the Local Organizing Committee, and Dr. Yasunori Sakurai.

Thanks to Anatoliy Aleksanin for the satellite images, Sergei Sagalaev for the cruise scheme, Anatoliy Salyuk for the hydrographic sections, Pavel Tishchenko, Vladimir Ponomarev, Anatoliy Obzhirov, Yuri Zuenko, Lynne Talley, Steve Riser, Mikhail Danchenkov and Alexandr Nikitin for collaboration, inspiration and support in the organization of the cruise. Special thanks to Alexander Bychkov and Pat Livingston for support from PICES. Photos by V. Lobanov.

Fig. 6 Dr. Anatoliy Salyuk (right) reporting at the seminar on the ship after he received the PICES Best Presentation Award for the POC Committee.

(cont. from page 30)

Because PMEL's focus of research has been on the Bering Sea ecosystem during the past ten years, those portions of the theme page that deal with the Bering Sea are particularly well developed. Starting in the twenty-first century, the research focus is expected to shift to the North Pacific Ocean, and the theme page will see consequent development for that region. Presently the theme page averages about 80,000 "hits" each month. This number will increase as the larger North Pacific research community begins accessing the site.

To contribute information or to request subscription service to news postings, notify the site director at: *bering@pmel.noaa.gov*.

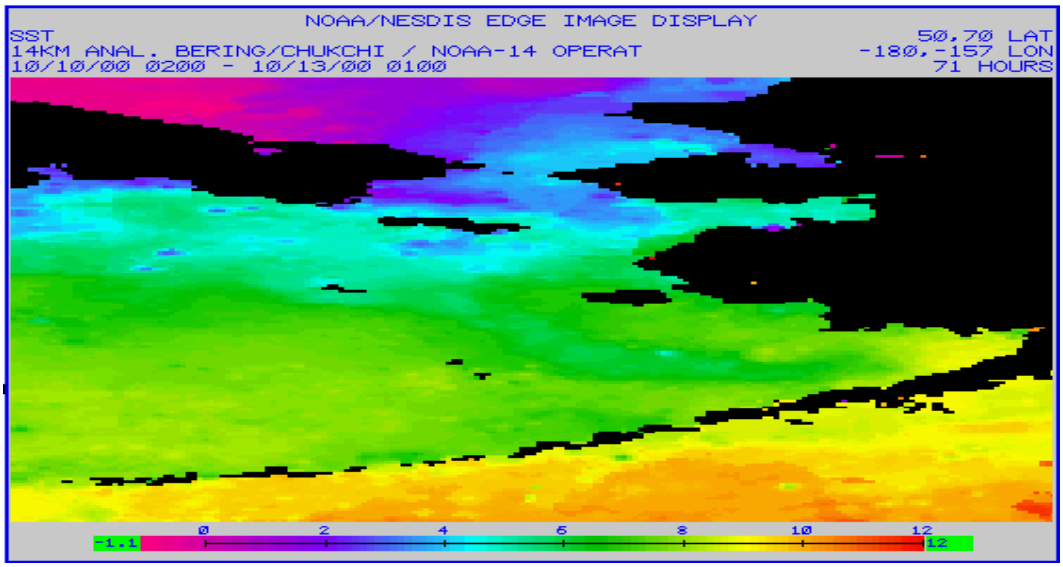


Fig. 2 Satellite-derived, sea-surface-temperature images such as this NOAA/NESDIS image from October 13 2000, are available for the Berng Sea and North Pacific Ocean from the theme page.

PICES Wooster Award

This year, PICES announces a new award, the Wooster Award, which is named in honour of Professor Warren S. Wooster, the principal founder and first Chairman of PICES and world-renowned researcher and statesman in the area of climate variability and fisheries production. This award will be given annually to an individual who has made significant scientific contributions to North Pacific marine science, such as understanding and predicting the role of human and climate interactions on marine ecosystem production.

The award consists of a commemorative plaque and travel support to attend the next PICES Annual Meeting in order to receive the award. The first award will be presented to the recipient during the Opening Session of the PICES Tenth Annual Meeting to be held October 8, 2001, in Victoria, British Columbia, Canada.

We are now soliciting nominations for the first Wooster Award. Nominations must be received no later than May 1, 2001, and should include the following information: nominee's name, institutional affiliation and title, address and biographical resume, and statement of justification for the nomination. Criteria for selection are sustained excellence in research, teaching, administration or a combination of the three in the area of North Pacific marine science. Special consideration will be given to individuals who have worked in integrating the disciplines of marine science. Individuals who are past or present PICES members are preferred but the award may be given to any suitable candidate, including those from outside PICES member countries of Canada, China, Japan, Korea, Russia, and the United States. Candidate selection will be made by the PICES Science Board in consultation with the PICES Chairman.

PICES Intern Program

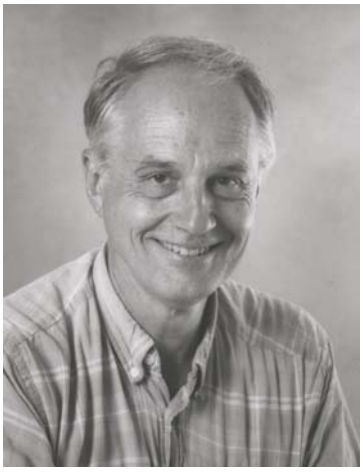
The Intern Program allows scientists from PICES member countries to experience the operations of an international, intergovernmental scientific organization by working in the PICES Secretariat for periods of up to one year. The goals of the program are: (1) professional development of marine scientists and managers from PICES member countries; (2) increasing the capacity of the PICES Secretariat to support the work of PICES; and (3) strengthening the capacity of member nations to coordinate their involvement in PICES programs.

Interns will work on projects of the Secretariat relevant to their professional interests and development needs. Interns will be given a wide variety of tasks including assisting in preparing information for and providing secretarial support to PICES bodies, organizing scientific meetings, preparing and editing various PICES publications, coordinating international cooperative programs in marine science, and coordinating PICES activities with efforts of other relevant organizations. Internships will begin in spring and extend for a period up to a maximum of 12 months.

Applicants must currently be staff of an academic or government agency of a member-countries, have an M.Sc. or Ph.D. degree, and an ability to read, write and speak English, an ability to use computers, the internet, and demonstrated personal initiative. A member country that has had an intern in any year is eligible to have an intern in the following two years only if there are no applicants from other member country. Applicants will apply to their senior PICES Delegate, describing their interests and qualifications, providing a *curriculum vitae* delineating their academic and work experience, and three professional references. The PICES delegate will review applications from his/her country and transmit national nominee(s) to the PICES Secretariat for final selection by the Chairman of PICES. Applications from Delegates must be received by the Executive Secretary by the date of the first Governing Council meeting at the PICES Annual Meeting.

Interns will be provided with a stipend of CDN $2,000 per month by the Secretariat, from which the intern must pay for his/her daily living and related expenses. Relocation costs to and from the Secretariat will be borne by the individual's home country. Travel expenses associated with the intern's work in the Secretariat will be covered by PICES. As the intern will continue to be an employee with his home institution while at the Secretariat, his/her medical insurance and all other benefits will remain the responsibility of the intern's home country.

The first PICES Intern, Mr. Gong-Ke Tan from the First Institute of Oceanography, State Oceanic Administration, People's Republic of China, has just returned home after a six-month assignment at the Secretariat. During these six months, Mr. Tan completed a number of tasks, including preparing PICES Scientific Report No. 15 and much of the current issue of PICES Press for publication and helping with the Ninth Annual Meeting in Hakodate (Japan). If you enjoyed PICES IX, some of this was because Mr. Tan was a valuable asset to the Secretariat during this meeting. He was very helpful in facilitating communication between the Secretariat and Chinese scientists and administrators. We are very grateful for his cheerful outlook and his constructive work at the Secretariat, and we wish Mr. Tan all the best in his future activities (a photo with Mr. Tan can be found on page 19).



Obituary – Prof. Michael M. Mullin

PICES regrets to announce that Prof. Michael M. Mullin passed away on December 19, 2000, in La Jolla, U.S.A., of complications following surgery. He was 63 years old. Mike had been a BIO Committee member since PICES was established in 1992, and put the Committee on firm footing while serving as its first Chairman. He was also the main organizer of the successful Beyond El Niño Conference (PICES' first large-scale collaborative activity with 5 other international organizations) held in La Jolla, in March 2000. Mike was an enthusiastic supporter of PICES and we have benefited greatly from his knowledge and insightful ideas. He will be missed immensely by all but his keen interest and attitude for marine science will not be forgotten. PICES will dedicate a topic session on *Plankton Size Classes, Functional Groups and Ecosystem Dynamics: Causes and Consequences* at the upcoming PICES Tenth Anniversary Meeting and the subsequent special issue of *Progress in Oceanography* to his memory (Mike's biography can be found in PICES Press, Vol. 8 (1), 2000).

PICES Tenth Annual Meeting

October 5-13, 2001
Victoria, British Columbia, Canada

Ten years of PICES science: Decadal-scale scientific progress and prognosis for a regime shift in scientific approach (Science Board Symposium/S1)

Plankton size classes, functional groups, and ecosystem dynamics: causes and consequences (BIO Topic Session/S2; co-sponsored by JGOFS)

Migrations of key ecological species in the North Pacific Ocean (FIS Topic Session/S3)

Coastal ocean physical processes responsible for biological productivity and biological resources distribution (POC Topic Session/S4)

Mesoscale eddies, rings, and meanders and their biological implications (POC/BIO/FIS Topic Session/S5)

Sediment contamination - the science behind remediation standards (MEQ Topic Session/S6)

Physical oceanography to societal valuation: assessing the factors affecting coastal environments (MEQ Topic Session/S7)

Emerging issues for MEQ: a 10-year perspective (MEQ Topic Session/S8)

Physical-biological interactions during harmful algal blooms (MEQ/BIO/POC Topic Session/S9)

A decade of variability in the physical and biological components of the Bering Sea ecosystem: 1991-2001 (CCCC Topic Session/S10)

Results of GLOBEC and GLOBEC-like program (with emphasis on possible 1999 regime shift) (CCCC Topic Session/S11)

Regional and National Data Centres (TCODE Electronic poster session/S12)

PICES Publications in 2000

North Pacific Climate Regime Shifts (Guest Eds. Hare, S. R., Minobe S., and Wooster, W. S.). Progress in Oceanography 47: 2-4 (selection of papers from the 1999 Science Board Symposium on The Nature and Impacts of North Pacific Climate Regime Shifts).

PICES Scientific Reports No. 13. Bibliography on Oceanography of the Japan/East Sea by Danchenkov, M. A., Aubrey, D. G., and Hong, G. H.), 99 pp.

PICES Scientific Reports No. 14. Predation by Marine Birds and Mammals in the Subarctic North Pacific Ocean (final report of WG 11), 165 pp.

PICES Scientific Report No. 15. PICES-GLOBEC International Program on Climate Change and Carrying Capacity: Report on the 1999 MONITOR and REX Workshops, and the 2000 MODEL Workshop on Lower Trophic Level Modelling, 142 pp.

Please be alerted that the PICES Home Page address (http://pices.ios.bc.ca) and the Secretariat e-mail domain (ios.bc.ca) will be changed in the near future. Check our current Home page periodically for the latest update.

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