SUMMARY OF SCIENTIFIC SESSIONS AND WORKSHOPS

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

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

Background

FUTURE (**F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems), the new Science Program undertaken by PICES member countries, has the broad goals of: (1) understanding the responses of marine ecosystems in the North Pacific to climate change and human activities at basin-wide and regional scales; (2) providing forecasts of what might be expected based on a current understanding of how nature works; and (3) communicating this information effectively to its members and to society in general. Past advances in understanding marine ecosystems in the North Pacific have been largely based either on the direct analysis of observations, or on the development of conceptual and numerical models that help to describe the processes underlying the observations. Though these activities will continue to play an important role in FUTURE, the provision of forecasts and estimates of their associated uncertainties necessitates moving beyond observationally based understanding, so that ecosystem responses to natural and anthropogenic changes can be anticipated and communicated effectively to society. Presentations were invited to address the goals of FUTURE and the three key research questions that it identifies:
1. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?
2. What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?
3. How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?

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

Summary of presentations

The Science Board Symposium was held on Monday, October 27, 2008 and consisted of 14 oral presentations (including 1 keynote and 6 invited talks) plus 5 posters. It focused on the new areas of FUTURE: current forecasting capability, communication of science to society, impacts of ecosystem change on human society, and human influences in coastal areas. The keynote speech by Fangli Qiao addressed the first focal point, namely how to improve forecasting capability. He noted that there are two major problems in circulation models. Firstly, mixed layer depths predicted by general circulation models were typically shallower than observations and sea surface temperature from model outputs were higher than the observations. Secondly, the cold tongue structure in the equatorial pacific was colder than the observations. It was then noted that wave-motion related vertical mixing plays an important role in the upper ocean but is not included in many current circulation models. He showed a new model of the coupling between waves on circulation could improve results when wave vertical mixing effects were included in the model. Based on this, he suggested wave-tide-circulation coupled models could improve our forecasting.

The remaining talks covered a wide range of topics including improvement of forecasting ability, North Pacific decadal variability, anthropogenic impacts in the coastal regions, and the relationship between social and natural phenomena. From a perspective not typical of PICES topics, Lawrence Hamilton addressed one of the main questions of FUTURE, which is how societies are affected by changes in the

marine ecosystems. He illustrated the interactions among ocean conditions, fisheries and effects on coastal communities through case studies from Iceland, Northwest Newfoundland, Faroe Islands, Greenland, and western Alaska. The interdisciplinary studies of linked ecological and social changes in fisheries-dependent regions revealed a number of broad patterns. Large ecological shifts, disastrous to historical fisheries, have resulted when unfavorable climatic events occur on top of overfishing. These resulted in demographic transitions in fishing societies, such as human population decline, older populations, and sex ratio changes.

Eitaro Wada introduced his approach of integrative studies involving observation, modeling and simulation. He compared the classification of marine biomes based on satellite data with that based on stable isotopes. A newly developed stable isotope method for amino acid trophic levels was suggested to validate NEMURO.FISH and ECOSIM models. He also proposed to use $\delta^{13}C$ to estimate the growth rates of phytoplankton in the ocean.

Using SeaWiFS data, Jeffrey Polovina showed that there has been an expansion of the least productive areas in the ocean's subtropical gyres over past decade. Based on fishery data and model simulations, he also anticipated the following changes in the subtropical gyre in response to climate change: (1) a continued decline in fished species with low Productivity/Biomass ratio and at high trophic levels; (2) an increase in mid-trophic level species especially those with high P/B ratios; (3) an increase in high trophic level species not caught in fisheries; and (4) due to the increase in high P/B species, the ecosystem will be more sensitive to climate forcing – making mean P/B of the catch a useful indicator.

Icarus Allen focused on developing coupler methodologies to link models using Newtonian approaches (*e.g.*, physics and phytoplankton), with those of the Darwinian world (*e.g.*, zooplankton and fish) and those of the human world (economics and policy). He illustrated the challenges using examples of MEECE (Marine Ecosystem Evolution in a Changing Environment) and GCOMS (Global-Coastal Ocean Modeling System). MEECE is a European Integrated Project, which aims to increase ecosystem modeling predictive capacities. The objective of GCOMS is to couple the shelf seas ecosystems to the global ocean.

Hiroaki Saito first summarized the predicaments of the "Anthropocene" era, and era dominated by human activities that affect the global ecosystem. He then pointed out the necessity and difficulties of forecasting the future of ecosystems. Strategies were proposed for FUTURE that include: (1) developing a general ecosystem model, such as eddy-resolving 3D-NEMURO, under IPCC or other climate scenarios to understand the change comprehensively and supply the basic scenarios of the future North Pacific ecosystems to specific models; (2) understanding the mechanisms of present ecosystem responses to perturbations, (3) understanding sensitive processes in the ecosystem (vulnerability, amplifiers, key-stone species, *etc.*) to perturbations; (4) developing specific models to forecast selected ecosystem or selected ecosystem processes whose change would have significant impacts for society.

The presentation by Emanuele Di Lorenzo explained how the first two dominant modes of ocean–atmosphere co-variability evident in sea level pressure and sea surface height can explain decadal climate and ecosystem variations in the North Pacific. These include the Aleutian Low, Pacific Decadal Oscillation (PDO), North Pacific Oscillation (NPO) and the recently identified North Pacific Gyre Oscillation (NPGO). He put forward a hypothesis on how these variability modes are linked. In addition, using a set of ten coupled climate models from the Intergovernmental Panel on Climate Change (IPCC), he assessed the degree of realism of the IPCC models to reproduce the first two decadal modes of ocean–atmosphere co-variability in the North Pacific during the twentieth century (1901–2000) and to project changes in future scenarios (2001–2100). The model results showed that GFDL 2.0 produced the best results.

Using the NEMURO.FISH model Shin-ichi Ito made future predictions of Pacific saury under global warming scenarios. To improve the model, laboratory experiments were conducted to measure several unknown parameters. The model results suggested the possibilities of size reduction, and increase of Pacific saury abundance under global warming conditions. Suggestions were also presented on how to improve the modeling.

In moving from strict modeling to the application of science in decision making, Harold Batchelder discussed how to improve decision making in Coho salmon management. The approach was to enhance the

existing "multi-indicator" approach by using Bayesian enhanced multidimensional decision support theory. Applying the method, it was found that social complexity makes it difficult to achieve consensus decisions. Formal decision support strategies (DSS) provide ways to include bias, data trustworthiness, criteria importance, and world beliefs of diverse stakeholders. While DSS may not achieve consensus, through the process, uncertainty, bias and beliefs can be qualitatively or quantitatively accounted for, and thus when applied to salmon forecasting, or other fishery species, has potential societal benefits in applying science in decision making.

George Sugihara presented a very different theoretical perspective in approaching nonlinear, non-equilibrium ecosystems that are prone to regime-like and non-stationary behavior. He first showed that lack of correlation does not necessarily mean there is no relationship between variables, by using the example of Lorenz attractors. As a positive alternative to classical correlation models and equilibrium-based fishery modeling approaches, concepts and forecasting methods from nonlinear time series analysis were introduced and applications were discussed that hold implications for a non-equilibrium ecosystem-based management of fisheries.

The remainder of the symposium was focused on environmental problems in coastal regions. Paul Harrison described the oceanographic and biological processes in the Pearl River Estuary, which is a sub-tropical estuary and the second largest in China based on discharge volume from the Pearl River. Processes in the estuary vary spatially and temporally (wet vs. dry season). Despite the huge nutrient loads from the Pearl River plus local sewage discharge, eutrophication was not as severe as one would expect due to the estuary's remarkable capacity to cope with excessive nutrients. In summer, intermittent upwelling of nitrogen-poor water sometimes relieves the eutrophication condition. Since phosphorus potentially limits the amount of algal biomass in summer, controlling phosphorus could be an efficient way of controlling eutrophication. Dr. Harrison also suggested that monitoring programs are essential to detect ecosystem response since nutrient loads are likely to change over the next several decades. Rong-Shuo Cai then discussed analyses of monthly mean sea surface temperatures (SST) and atmospheric circulation divergences (ACD) in the China Sea and its adjacent ocean using the empirical orthogonal function (EOF), polynomial function and spectrum analysis. The results show that SST anomaly and ACD anomaly fields have three major patterns: (1) interannual and inter-decadal variations, (2) warming of the regional seas particularly since 1980s, and (3) intensification of the atmospheric circulation divergences. When the long-term temporal variation of SST and ACD were compared with the frequency of red tides during 1972 to 2005, the results implied that the red tide events might be related to regional climate change. The results of the analysis of 10 year's ocean color data in the East China Sea and Yellow Sea by Joji Ishizaka showed detailed characteristics of spatial and temporal variability in satellite chlorophyll-a in the region. According to his analysis, the Changjiang River discharge might be the dominant factor of variation of summer satellite chlorophyll-a in the East China Sea. He also showed that the magnitude of spring blooms has increased during the last 10 years in the Yellow Sea, possibly a sign of eutrophication. This study demonstrated that ocean color remote sensing can be efficiently used as a monitoring tool for coastal environments. Lastly, Song Sun presented an overview of drastic changes in the Yellow Sea ecosystem. Many ecological events have happened in recent years, including giant jellyfish blooms, starfish blooms, salp blooms and green algae blooms. Some details of these events were discussed with interesting questions on their causes and processes.

List of papers

Oral presentations

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

Lawrence C. Hamilton (Invited)
Ocean, fishery and society: Interconnections among systems in change

Eitaro Wada (Invited)
Marine ecosystem studies of today and tomorrow with emphasis on the western North Pacific Ocean

Jeffrey J. Polovina, Melanie Abecassis, Evan A. Howell and Séverine Alvain
Developing an understanding of future changes in the North Pacific Subtropical Gyre marine ecosystem

J. Icarus Allen (Invited)
On the simulation of the impacts of multiple climatic and anthropogenic drivers on marine ecosystems

Hiroaki <u>Saito</u> (Invited)
A strategy for marine ecosystem studies in the first half of the 21st century

Emanuele <u>Di Lorenzo</u>, Jason Furtado and Niklas Schneider
North Pacific decadal variability in the future

Shin-ichi <u>Ito</u>, Taizo Morioka, Yasuhiro Ueno, Satoshi Suyama, Masayasu Nakagami, Akihiro Shiomoto, Fumitake Shido and Michio J. Kishi
Future projection of Pacific saury to climate change and its improvements by experimental and observational approaches

Harold (Hal) P. <u>Batchelder</u>, Michael Harte, David Ullman and William Peterson
Bayesian decision support to improve flexibility and reduce uncertainty in ecological forecasting of coho salmon marine survival

George <u>Sugihara</u> (Invited)
Causality, prediction and nonlinearity in fisheries why adaptive fitting fails

Paul J. <u>Harrison</u> and Kedong Yin (Invited)
Eutrophication impacts in Hong Kong waters are reduced by physical and chemical factors

Rong-shuo <u>Cai</u>, Qi-long Zhang and Ji-long Chen
Spatial and temporal oscillations of SST and atmospheric circulation divergence in the offshore area of China and its adjacent ocean and their associations with the red tide

Joji <u>Ishizaka</u>
Long-term change of primary production in the Yellow Sea and East China Sea

Song <u>Sun</u>, Chaolun Li, Fang Zhang and Yuanzi Huo
A changing ecosystem: The Yellow Sea

Posters

Vladimir B. Darnitskiy and Maxim A. <u>Ishchenko</u>
Some properties of oceanic waters off Japan

Lyudmila I. <u>Mezentseva</u> and Oleg V. Sokolov
Change of weather components at the seashore of the Far East as a result of the changes in general circulation of atmosphere

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

Vladimir <u>Ponomarev</u>, Elena Dmitrieva and Nina Savelieva
Changing climate and teleconnections in the Asian Pacific

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

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

Background

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

Summary of presentations

The session was partially successful in attracting papers that provided examples and technologies for FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems), the next major science integrated program of PICES. There were a total of 17 talks, of which 2 were invited. Three oral presentations were by scientists who identified themselves as "early career" scientists eligible for a best paper award. There were no cancellations for the oral presentations. In addition, there were 22 posters accepted for the session, although not all were presented in Dalian.

There were several talks on models and modeling which addressed some parts of the session objectives. Yamanaka and colleagues (Invited) informed us of the evolution of the PICES NEMURO model and the many offspring of NEMURO. They emphasized how the purpose or goals of each exercise influenced the changes to NEMURO, and how the model needed to be customized for different biogeographic zones. Ro demonstrated how an existing network of meteorological and oceanographic observational stations and an existing numerical model were used to respond to an urgent societal need, the prediction of the spread of oil from a spill off the western coast of Korea. The presentation included advice for future improvement of their operational model. Chai (Invited) presented an excellent overview of how model and data were being used in the equatorial South Pacific Ocean to forecast seasonal or monthly chlorophyll distribution for use in an ecosystem approach to the anchoveta fishery. Christian explored the ability of models to predict primary productivity and pCO_2 from satellite estimates of chlorophyll in the Pacific Ocean.

There was a single presentation on the organization of data (Objective 4) with Macklin and Megrey updating us on the PICES Metadata Federation, including new changes to language and other requirements that will hopefully make it easier for all to submit metadata. An e-poster presented later in the day by Shevchenko and colleagues demonstrated the new PICES Clearinghouse that is under development.

Several talks reviewed existing or emerging technologies to supply biomass or species/functional group relationships (Objective 2). Batten briefly reviewed the PICES North Pacific Continuous Plankton Recorder Program and demonstrated how it could be used to examine the effect of eddies on biomass and species richness. Moving to very small organisms, Zhang *et al.* presented their work using Denaturing Gradient Gel Electrophoresis (DGGE) to show how one could begin to separate the bacterial community into identifiable groups. The technique is not quantitative by itself, but could be used with other techniques (such as culturing) to obtain proportions of bacteria by group. Tang *et al.* presented preliminary results of their tests of a new omni-directional, multi-beam sonar that has the potential to improve estimates of fish abundance derived from traditional single or dual fixed-beam SONAR currently in use by fisheries scientists.

Two presentations discussed application of new or advanced methods of observation in physical oceanography. Ito *et al.* presented results from a pilot study using gliders in the Oyashio Current, demonstrating a strong link to operational ocean forecasting, while Bezotvetnykh *et al.* demonstrated the utility of using acoustic tomography in a shallow coastal area to measure currents.

The remainder of the talks were a collection of somewhat disparate topics from the status and review of euphausiid data sets along the west coast of North America to the long-term monitoring in sardine spawning areas off Japan, measurements and estimates of different parts of the carbonate system in the coastal waters of Russia, upper ocean export of carbon in the Bering Sea basin and Chukchi Sea, distribution of persistent organic substances in the coastal zone of China, distribution of trace metals in the surface sediments of the coastal waters of Russia, and improving analysis methods for optical remote sensing.

Highpoints:
- Ecosystem models such as NEMURO are advancing and show promise for FUTURE forecasting,
- PICES is developing its own metadata Clearinghouse that could streamline access and delivery of ecosystem data for FUTURE,
- There area a wide range of new sensors and platforms.

Issues and Obstacles:
- End-to-end inclusion of information from metadata to data to analyses and forecasts is yet to be demonstrated,
- Much information presented at this session is not cataloged adequately for FUTURE use,
- We still have not mastered the difficult task of fully integrating interdisciplinary data into complete, analyzable data sets. The cabled observatories NEPTUNE and VENUS are likely the best examples.

List of papers

Oral presentations

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

Francisco P. Chavez and Fei Chai (Invited)
The realities of integrated measurement and modeling systems

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

Young Jae Ro, Kwang Young Jung and Chung Ho Lee
"Hebei Spirit" oil spill fate and trajectory modeling in the western coast of Korea, Yellow Sea

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

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

Yong Tang, Koji Iida, Tohru Mukai and Yasushi Nishimori
Measurement of fish school abundances in shallow sea using omnidirectional multi-beam sonar

Zhen-dong Zhang, Shu-fen Wang and Ya-nan Zou
DGGE technique and its application in marine environmental microbial diversity study

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

James R. Christian
Photosynthesis, photoacclimation, and ocean surface pCO_2

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

Hao Ma, Mingduan Yin, Liqi Chen, Jianhua He, Wen Yu and Shi Zeng
Upper ocean export of particulate organic carbon in the Bering Sea estimated from thorium-234

Ziwei Yao, Zhongsheng Lin, Xindong Ma, Yanjie Wang and Dongmei Zhao
Distribution maps of persistent organic substances in the coastal zone of China

Mikhail V. Simokon and Lidia T. Kovekovdova
Assessment of trace metals contamination in surface sediments of Peter the Great Bay (Japan/East Sea)

Georgiy Moiseenko, Vadim Burago, Igor Shevchenko and Yury Zuenko
The application of empirical orthogonal functions in the ocean remote sensing

Sonia Batten, Bill Sydeman, Mike Henry, David Hyrenbach and Ken Morgan
Ship of opportunity observations of mesoscale eddies in the Gulf of Alaska

Vladimir V. Bezotvetnykh, Evgeny A. Voytenko, Yury N. Morgunov and Dmitry S. Strobykin
Multifunction acoustic hardware and software system for support of works execution and studies in ocean shelf zones

Posters

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

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

Igor Burago, Georgiy Moiseenko, Olga Vasik and Igor Shevchenko
From metadata federation to geospatial portal

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

Evgeniya A. Tikhomirova
Oceanographic regime of Peter the Great Bay (Sea of Japan)

Qilun Yan and Gengchen Han
National coastal ecological system monitoring program–SOA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Background

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

Summary of presentations

While gaining predictive insights to the onset and occurrence of harmful algal blooms is a central goal of HAB research, we still have very limited capabilities, largely because of our incomplete knowledge of the ecophysiology of HAB species. The underlying purpose of this session was to determine whether phytoplankton community succession prior to HAB outbreaks on both seasonal and interannual time scales may provide clues to better explain these events. The half day session opened on Tuesday morning, October 28, 2008 with Dr. William Sunda (invited speaker) detailing a new conceptual model of ecosystem disruptive algal blooms; events that severely alter or degrade ecosystem functions and serve as an extreme form of HAB events. Dr. Songhui Lu (invited speaker) spoke about the species succession occurring during a large bloom of *Karenia mikimotoi* in the East China Sea during 2005. Seven other presentations detailed long-term trends and phytoplankton successional patterns covering the entire PICES region, from Hong Kong waters through central and northern China, Korea, Russia and the United States. In many cases an increasing frequency and intensity of HAB events coincided with increasing temperature and nutrient input trends, though this may not be the case in Amurskii Bay, Russia. The poster session topics focused on a range of topics from bacterial associations with HAB species, restoration of a HAB affected artificial lagoon, studies of red tides and massive green algal blooms, to data integration efforts to facilitate research and modelling of HAB events. In attendance were scientists from: Japan (13), China (12), USA (6), Russia (5), Korea (3), Canada (2), Denmark (1).

List of papers

Oral presentations

William Sunda, D. Rance Hardison and Kyle Shertzer (Invited)
Positive feedback and the development of ecosystem disruptive algal blooms

Jinhui Wang, Yanqing Wu, Zhien Li and Lingyun Xiang
The succession of bloom caused species: A result of complexity and variability of Changjiang estuary ecosystem

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

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

Songhui Lu (Invited)
Ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005

Tatiana Yu. Orlova, Inna V. Stonik and Olga G. Shevchenko *(presented by T. Morozova)*
Long-term changes in the phytoplankton of the coastal waters off Vladivostok (Amurskii Bay, the Sea of Japan), 1992-2007

Raphael Kudela, Vera L. Trainer, Grant Pitcher, Teresa Moita, P. Figueiras, Trevor Probyn and Theodore J. Smayda
GEOHAB Core Research Project – Species succession of harmful algal blooms in upwelling systems

Renyan Liu and Yubo Liang
The review of study on shellfish poisoning toxins in China

Feng-ao Lin, Xing-wang Lu, Hao Luo and Ming-hui Ma
The historical and present situation of the red tide and its characteristics in the Bohai Sea of China

Posters

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

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

Mingyuan Zhu, Ruixiang Li and Zongling Wang
Study on growth of macro green algae *Enteromorpha prolifera*

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

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

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

Background

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

Summary of presentations

Papers presented all explored aspects of the four themes of Topic Session 4 as framed in the background paragraph above. The invited talk by Keith Criddle demonstrated how governance systems and management strategies that assume a static relationship between biological and social systems are bound to fail and illustrated how nonstationary dynamics systems differ from a stationary approach. At the international level Jake Rice identified a pending conflict in marine ecosystems between the positions of countries adhering to the Convention on Biological Diversity and the various Conventions under the auspices of the Food and Agriculture Organization. He called on regional scientific bodies like PICES to engage in the provision of scientific information in a consistent manner to member countries in order to promote institutional coherence.

While it is not possible to review each of the session talks and the accompanying posters in detail it is useful to characterize the overall content and to call attention to their contributions to development of management approaches suitable for the challenges of today's fisheries in making a transition to sustainability. Many of the papers focused on some aspect of the way climate variability contributes to fluctuations in marine resources. Clearly, the lessons learned for management institutions are that such fluctuations must be taken into account and, even better, that the changes should be predicted to the extent feasible as forecasting skills increase.

An underlying theme that developed over the course of the session was the need to consider the incentives for fishermen to respond to ecosystem changes and social system changes. Such fluctuations imply that management arrangements and institutions must be flexible and robust to change. Innovative examples of how adaptive responses have been employed and how to internalize the external diseconomies of fishing were presented for sand eels and general fisheries in Japan as well as the swordfish fishery in Hawaii.

Taking into account fluctuating resources was shown to be extremely challenging in terms of understanding the fundamental spatial and temporal variability of stocks of red king crabs in Alaska, coastal molluscan fishery resources in Australia, North Pacific salmon and on artificial oyster reefs in China. The use of nested risk indices such as the objectives risk index, species risk index, fishery risk index and, ultimately a management status index, was applied in the eastern Bering Sea trawl fishery in testing how to holistically assess and manage fisheries and their associated habitats for ecosystem-based management. A final cautionary note was sounded by study of the fisheries off California where long-term

assessment of the variability of fished and unfished stocks shows clearly that a truncated age structure in the fished populations increases the variability and sensitivity of such populations.

List of papers

Oral presentations

Keith R. Criddle (Invited)
Management of linked nonstationary dynamic bioeconomic systems

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

Takaomi Kaneko, Takashi Yamakawa and Ichiro Aoki
Fisheries management by a non-cooperative income pooling system as a remedy for the "tragedy of the commons"

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

Akihiko Yatsu (Invited)
Fisheries management and ecosystem regime shifts: Lessons learned from the Kuroshio/Oyashio current system

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

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

John K. Keesing, Fred E. Wells and Tennille R. Irvine
Long-term stability of coastal molluscan fisheries resources and biodiversity aided by effective spatial and temporal management intervention

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

Masahide Kaeriyama, Hyunju Seo and Shigehiko Urawa
Situation and perspective on production trends of Pacific salmon in the North Pacific

Hee Won Park and Chang-Ik Zhang
Ecosystem-based fisheries resource assessment and management system in Jeonnam marine ranching in Korea

Chang-Ik Zhang, Anne B. Hollowed, Jennifer Boldt, Pat Livingston and Jim Ianelli
An ecosystem-based risk assessment for the eastern Bering Sea trawl fishery

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

Posters

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

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

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

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

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

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

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

Background

PICES member countries share a common interest in the development of highly efficient, environmentally friendly and diverse aquaculture industry. The diversification of aquaculture operations through the culture of new species and the use of innovative grow out technologies is of world-wide interest to both industry investors and the agencies responsible for ecosystem protection. In many Pacific Rim countries recent developments of effective and efficient fish feed, development of animal husbandry protocols to ensure fish health and welfare, and advances in reproductive physiology using state-of-the-art molecular techniques show promise for enabling the socio-economic acceptance of aquaculture operations while preventing or mitigating environmental impacts. A variety of tools presently exist that permit the modeling of environmental risk from these developments and the subsequent incorporation of risk into an ecosystem management scheme.

Summary of presentations

The presentations covered a variety of applications of mariculture in PICES member countries, moving through themes related to mariculture for stock enhancement, understanding physiological effects of culture conditions, to measuring and modeling environmental interactions, including disease and organic loading to inclusion of climatic information into models and information to enhance the sustainability of aquaculture activities. There were a total of 9 oral presentations and 11 posters prepared for this session, which had representation from each PICES member country.

The invited speaker, Shienori Suzuki (Fisheries Research Agency, Japan) started the session by describing efforts that have been underway since 1981 in Japan to enhance the stocks of the endangered barfin flounder. This effort has been increasingly successful, particularly since the inclusion of new tools to discriminate between families, while maximizing the genetic diversity and minimizing inbreeding from the limited wild stock that has been captured. Kwang Hoon Kim (Pukyong National University, Korea) followed with a presentation comparing the growth of wild and cultured black seabream, concluding that the decrease in growth rate of cultured black seabream in year 3 was due to culture conditions, as cultured seabream are used for enhancing wild populations rather than for harvesting.

These two stock enhancement-related presentations were followed by a presentation by Nikolina Kovatcheva (Russian Federal Research Institute of Fisheries and Oceanography, Russia) focusing on health and stress related questions associated with culture conditions for king crab, using a novel monitoring approach to determine the heart rate and overall stress levels.

This was followed by three presentations focusing on environmental interactions associated with marine aquaculture activities – from salmon aquaculture and the presence of sea lice in the surrounding environment, to the organic inputs associated with scallop farming and oceanographic modeling studies used to assess environmental sustainability.

The session concluded with presentations on moving to an ecosystem science approach to aquaculture research and management, disease management challenges and the introduction of the terms of reference of the proposed working group, focusing on the environmental interactions of marine aquaculture. This was followed by a lively discussion on the direction of the proposed working group. Participants in this discussion emphasized the need for additional communication on the opportunities and challenges for scientific exchange and collaboration regarding the interactions between marine aquaculture and the environment. As well, enhancements that can be achieved through marine aquaculture (*i.e.*, habitat restoration, stock enhancement) were identified as an area that should be considered as discussions on this working group move forward. The importance of linking oceanographic data acquisition to both inform

and enhance scientific modeling of the interactions and to inform overall management approaches of marine aquaculture in the environment was also emphasized.

List of papers

Oral presentations

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

Kwang Hoon Kim and Chang-Ik Zhang
Growth of cultured and wild black seabream in the coastal water of Yeosu, Korea

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

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

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

Katsuyuki Abo, Toshinori Takashi and Hisashi Yokoyama
Environmental indicators and modeling studies for assessing sustainability of marine aquaculture

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

Ingrid Burgetz, Jay Parsons and Steve MacDonald
Ecosystem-based approaches and environmental interactions of marine aquaculture: Opportunities and priorities from a Canadian perspective

Kevin H. Amos
Interactions between marine aquaculture and marine ecosystems: Infectious aquatic pathogens and disease

Posters

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

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

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

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

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

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

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

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

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

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

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

POC Topic Session (S6)
Coastal upwelling processes and their ecological effects

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

Background

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

Summary of presentations

POC Topic Session 6 on "*Coastal upwelling processes and their ecological effects*" came to a successful end on October 29, 2008. The main topics were (1) observations, numerical modeling and mechanism analysis of upwelling and related processes, (2) evaluation of upwelling on marine ecology; and (3) changes in upwelling system as a result of climate change.

A total of 35 abstracts were submitted to this session (of which 8 were moved to other sessions). Finally, 25 submissions were accepted for presentation in this Session, including 13 as oral presentations for a ¾-day session and 12 as posters (although not all were presented due to cancellations). The session included three invited speakers from Hong Kong (China) and the United States of America.

The session covered the latest studies from almost the whole North Pacific and discussed diverse methodologies including cruise observation, satellite remote sensing, and numerical modeling. Examples of coastal upwelling systems and their dynamics were presented for different locations such as the South China Sea, the Yellow Sea, the Japan/East Sea, the Bering Strait, the Gulf of Alaska, the Caribbean Sea, and the waters off the west coast of North America.

One of the important points mentioned by several speakers was that besides the classic along-shore wind-driven upwelling mechanism, there are various other proposed important processes that are not yet well understood and need further analysis and observations; these include upwelling due to offshore processes and eddies, tides, estuarine flow, and wind stress curl. The upwelling influences on marine ecology, especially in the Eastern Boundary Ecosystem, were also investigated. In the California Current large marine ecosystem, the changes of the coastal upwelling in the past four decades were quantitatively studied from a view of phenology.

Therefore, we need to continue the interdisciplinary nature of the upwelling studies, considering the various processes and various spatial and temporal scales involved, from small-scale short-term local processes, to basin-scale long-term climate variations. We believe that by bringing together experts in those areas of research, Topic Session 6 has deepened our understandings of coastal dynamics and their ecological effects, and thus will help future collaborations and the development and management of ecosystem-based marine systems.

As the financial support from PICES is limited and can not totally meet the needs of the invited speakers, First Institute of Oceanography, China provides 1100USD to cover the accommodation and registration fees of Dr. Steven J. Bograd. We would like to thank all the speakers for the interesting and well structured presentations, and the organizers of this annual meeting for inviting us to chair this session. We also would like to thank Dr. Jianping Gan, Dr. Tal Ezer, and Dr. Bograd for their wonderful talks as invited speakers.

<u>List of papers</u>

Oral presentations

Jianping <u>Gan</u>, Anson Cheung, L. Li, L. Liang, X. Guo and D. Wang (Invited)
Alongshore variability of upwelling induced by variable shelf topography and river plume in the northeastern South China Sea

Pifu <u>Cong</u>, Dongzhi Zhao, Limei Qu and Changan Liu
Analysis of coastal upwelling and its ecological impacts in the China Sea using remote sensing

Xingang <u>Lü</u>, Fangli Qiao and Changshui Xia
Numerical simulation of the summertime surface cold patches and upwelling in the Yellow Sea

Elena A. <u>Schtraikhert</u>, Sergey P. Zakharkov and Tatyana N. Gordeychuk
Chlorophyll-*a* concentration at wind-induced upwelling regions in Peter the Great Bay in 2003-2007

Tal <u>Ezer</u>, Digna T. Rueda-Roa and Frank Muller-Karger (Invited)
Unusual mechanisms for driving coastal upwelling and near-shore currents: Examples from the Caribbean Sea and biological consequences

John A. <u>Barth</u>, F. Chan, Stephen D. Pierce, R. Kipp Shearman, Anatoli Y. Erofeev, Laura Rubiano-Gomez and Justin Brodersen
Interannual variability and modeling of upwelling-driven shelf hypoxia off the central Oregon coast

Michael G. <u>Foreman</u>, Wendy Callendar, Amy MacFadyen and Barbara Hickey
Present and future upwelling off the entrance to Juan de Fuca Strait

Albert J. <u>Hermann</u>, Sarah Hinckley, Elizabeth L. Dobbins, Dale B. Haidvogel, Nicholas A. Bond, Phyllis J. Stabeno and Calvin Mordy
Significance of curl-driven upwelling to production in the Coastal Gulf of Alaska

Zhongyong <u>Gao</u> and Liqi Chen
The different water masses of the Bering Strait throughflow and their mixing on the way to the Arctic Ocean

Steven J. <u>Bograd</u>, Isaac Schroeder, Nandita Sarkar, William J. Sydeman and Franklin B. Schwing (Invited)
The phenology of coastal upwelling in the California Current: Interannual variability and ecosystem consequences

Elena <u>Vilyanskaya</u> and Gennady Yurasov
The peculiarities of the coastal upwelling in Peter the Great Bay

Hee Dong <u>Jeong</u>, Yang Ho Choi and Chang Su Jeong
Cold water appearance in the southwestern coast of Korea in summer

Vyacheslav <u>Lobanov</u>, Vladimir Zvalinsky, Pavel Tishchenko, Anatoly Salyuk, Svetlana Y. Ladychenko and Aleksandr F. Sergeev
Coastal upwelling and its ecological effects in the northwestern Japan Sea

Posters

Huasheng Hong, Xin <u>Liu</u> and Bangqin Huang
Seasonal and interannual variations of phytoplankton in the southern Taiwan Strait

Victor <u>Kuzin</u>, Elena Golubeva and Gennady Platov
Simulation of the Bering Sea water propagation to the Arctic-North Atlantic

Fedor F. <u>Khrapchenkov</u>
The upwelling effect on the north shelf area of Sakhalin Island based on hydrological measurements and satellite imaging data (2005-2007)

Fedor F. <u>Khrapchenkov</u> and Nadezda M. Dulova
Seasonal variability of water currents and temperature in Peter the Great Bay of the Sea of Japan in 2004 - 2007

Svetlana Y. <u>Ladychenko</u>, Vyacheslav B. Lobanov and Olga O. Trusenkova
Mesoscale eddy dynamics off Peter the Great Bay, northwestern Japan Sea

Georgy <u>Shevchenko</u>, Valery Chastikov and Elena Vilyanskaya
Wind-induced autumn upwelling near western coast of Sakhalin Island

Alexander Romanov, Alexander Tsoy and Georgy <u>Shevchenko</u>
Eddies determination in the North Kuril area from satellite altimetry, SST and chlorophyll-*a* data

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

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

Background

As marine system models mature, they are increasingly used to forecast future conditions, both for understanding potential effects of climate change and for projecting system responses to management activities. In particular, the PICES FUTURE Program is focused on forecasting and understanding the responses of North Pacific marine systems to climate change and human activities. This work will reach beyond the models currently used by the PICES community to include models that provide system forecasts, assess uncertainty, and link together multiple levels of system organization. Achieving meaningful forecasts that are useful for management of marine resources will require cross-disciplinary approaches that link processes ranging from atmospheric and ocean physics, through biology to socio-economic systems.

This session focused on multidisciplinary coupled models designed to forecast marine systems in the PICES region, including both strategic (long-term) and tactical (short-term) forecasts linking across two or more disciplines (such as physical oceanography, climate, ecosystem dynamics, marine resource management, or socio-economic systems). Presentations describing approaches to assessing and communicating the reliability (or uncertainty) of coupled marine system forecasts were particularly encouraged.

Summary of presentations

The CCCC/POC Topic Session was held on Friday, October 31, 2008, and consisted of 15 oral presentations and 5 posters. These included presentations from every PICES member country, plus Norway and the Philippines. The keynote talk by Kenneth Drinkwater provided a valuable perspective on the role of models in marine ecology and climate change research. Dr. Drinkwater noted the wide diversity of biological models used in assessing climate effects and the need for more comparative model studies (across models and for contrasting ecosystems) to gain the broadest insight on ecosystem response to climate change. He emphasized the need for more and better interactions between modelers and observationalists with constructive feedback between the two (modelers indicating the need for more focused observations; observationalists providing feedback on model results). He outlined the limits on present global climate models and the need for better expression of uncertainty in results. Finally, he concluded that we need to get on with ecosystem projections even if they are highly uncertain, and that modelers should expect and embrace failure because mistakes are the basis of learning.

Remaining talks covered diverse topics. The keynote talk was followed by two talks focused on fishery problems. Caihong Fu presented a strategy for assessing effects of climate and fishing in the Strait of Georgia using the OSMOSE coupled biophysics and fishery model. Maria Rebecca Campos tied issues of ecosystem exploitation to human bioeconomics with an analysis of fishery conservation policies in the Phillipines. These talks were followed by a number of presentations related to lower trophic level (nutrients and plankton) production. Yuheng Wang showed results of 40-year simulations of the ecosystem in Jiaozhou Bay with an emphasis on phytoplankton production and community structure. Hao Wei provided an overview of ecosystem modeling studies in coastal China, covering a range of topics including nutrient and primary production dynamics, individual-based models (IBMs) of anchovy and copepods, and models for understanding coastal hypoxia. Albert Hermann examined the limits of predictability of plankton response to physical forcing in a coupled biophysical model applied to the Bering Sea and coastal Gulf of Alaska. Yury Zuenko applied an empirical model relating temperature to fecundity and survival of zooplankton to predict zooplankton abundance in the Japan/East Sea. Hiroshi Sumata presented preliminary results for a project embedding the NEMURO model into a fine-scale eddy-resolving global general circulation model. Sinjae Yoo used a 2D biophysical model of the East China Sea shelf to show that coastal wind-driven upwelling is a plausible mechanism to drive offshore plankton blooms. Three posters also addressed lower trophic production: Evgeniya Tikhomirova presented a model

of primary production, Xiuhua Yan presented a study of phytoplankton dynamics in Xiamen Bay, and Maki Noguchi Aita presented model-based studies of the effects of iron on global phytoplankton distribution. Several presentations addressed new developments in modeling ocean physics. Jia Gao discussed results of a model of tides and tidal currents in the Bohai Sea in relation to outflow from the Yellow River. Jinrui Chen applied a high resolution model of tides and tidal circulation in Jiaozhou Bay to examine the effects of construction of the Olympic sailing facility on the bay. Zhenya Song and Qi Shu presented related talks on the improvement of predictions of ocean physics by incorporating wave-induced mixing into the dynamic equations. Xunqiang Yin discussed the potential of the Ensemble Adjustment Kalman Filter (EAKF) to improve simulation results for temperature and salinity profiles compared to data from the Argo system. Two poster presentations also addressed models of ocean physics: Svetlana Shkorba presented a technique for statistical forecasting of sea ice in the Sea of Japan, and Yasumas Miyazawa presented progress toward a data-assimilation system for marginal seas to improve ocean circulation model results in the Southeast Asia and West Pacific region. The final talk by Thomas Wainwright focused on software infrastructure available for integrating cross-disciplinary models on regional and global scales. The session ended with a brief discussion of the opportunities and obstacles for developing multidisciplinary forecasting tools.

<u>List of papers</u>

Oral presentations

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

Caihong <u>Fu</u>, Ian Perry, Angelica Peña , Yunne Shin and Morgane Trevers
Towards end-to-end modeling for investigating the effects of climate and fishing in the Strait of Georgia ecosystem, Canada

Maria Rebecca A. <u>Campos</u>
Moving forward to the future: Bioeconomic modelling of fishery conservation policies in the Philippines

Yuheng <u>Wang</u> Liang Zhao, Zhenyong Wang and Hao Wei
Simulation on phytoplankton system evolution of Jiaozhou Bay for recent 40 years

Hao <u>Wei</u>, Liang Zhao, Tian Tian, Jun Han, Yuheng Wang, Jie Shi, Xiangxin Li, Luning Wang, Zhe Liu, Zhenyong Wang, and Chengyi Yuan
Ecosystem modeling studies in the coastal water of China

Jia <u>Gao</u>, Xueen Chen and Huaming Yu
Numerical simulation for tides and tidal currents in the Bohai Sea

Albert J. <u>Hermann</u> and Bernard A. Megrey
Examining the predictability limits of NPZ-fish dynamics in the Coastal Gulf of Alaska and the Bering Sea using a numerical model

Yury I. <u>Zuenko</u>, Natalia T. Dolganova and Victoria V. Nadtochy
Forecasting of climate change influence on zooplankton in the Japan/East Sea

Hiroshi <u>Sumata</u>, Taketo Hashioka, Takashi T. Sakamoto, Tatsuo Suzuki and Yasuhiro Yamanaka
Application of 3-D NEMURO to an eddy-permitting general circulation model for the global domain

Sinjae <u>Yoo</u>, Ig-Chan Pang, Sung-Jun Pang and Jisoo Park
Wind-driven coastal upwelling and offshore summer phytoplankton blooms on the East China Sea shelf

Jinrui <u>Chen</u>, Shiliang Shan, Huaming Yu and Xueen Chen
Three-dimensional high-resolution numerical study of the tide and tidal current in the Jiaozhou Bay and Olympic sailing site

Zhenya <u>Song</u> and Fangli Qiao
The improvement of the simulated sea surface temperature seasonal cycle in the equatorial eastern Pacific by surface wave-induced vertical mixing

Qi <u>Shu</u>, Fangli Qiao, Zhenya Song, Changshui Xia and Yongzeng Yang
The improvement of MOM4 by adding wave-induced mixing

Xunqiang <u>Yin</u>, Fangli Qiao, Yongzeng Yang and Changshui Xia
Ensemble adjustment Kalman filter study for Argo data

Thomas C. <u>Wainwright</u>, Jim J. Colbert and Bernard A. Megrey
Integrating ocean system models using a software framework

Posters

Evgeniya A. Tikhomirova and Vladimir I. Dulepov
Model for estimation of primary production

Svetlana P. Shkorba
Probabilistic forecast for the ice cover evolution in the Sea of Japan

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

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

Xiuhua Yan
A modeling study of phytoplankton dynamics in Xiamen Bay

MEQ Topic Session (S8)
Consequences of non-indigenous species introductions

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

Background

Non-indigenous species (NIS) are ubiquitous throughout the world's marine, coastal and estuarine waters. There is little doubt that human-mediated dispersal of NIS and subsequent establishment of NIS has altered biodiversity, species assemblages, food web dynamics, and trophic structure and interactions in marine ecosystems. These alterations have ecological, biological, evolutionary and economic consequences, especially in coastal and estuarine systems of all PICES member countries. It is ironic that mariculture and the global shipping trade have been identified as the most affected economically, given that these two activities are often identified as the primary vectors of marine NIS introductions. While there are many threats to the biota and ecosystem integrity of the North Pacific, the threat of marine NIS is arguably the least understood.

Summary of presentations

The presentations covered a variety of marine NIS topics relevant to all PICES member countries. The central themes included biogeography, potential and observed impacts, monitoring, vectors, and rapid response. There were a total of 17 oral presentations and 1 poster prepared for this session, with representation from each PICES member country.

The invited speaker, Dr. Edwin "Ted" Grosholz (Department of Environmental Science and Policy, University of California, Davis, U.S.A.) started the session by providing an overview of marine NIS consequences in coastal and nearshore systems. The consequences he described ran the gamut of spatio-temporal scales, ranging from community up through ecosystem levels. His presentation set the stage for the remaining talks as he touched on impacts (socio-economic as well as ecological), vectors, case studies, and policy/management implications.

The second presentation was an overview of biogeographic patterns of invasion in near-coastal and estuarine communities in the Northeast Pacific (NEP) based on surveys by the U.S. EPA's Environmental Monitoring and Assessment Program (EMAP) and the EPA/USGS synthesis of native and non-native species in the "Pacific Coast Ecosystem Information System" (PCEIS) database. This was followed by a series of four presentations that addressed vectors of introduction. These included: the occurrence of non-indigenous polychaetes in Russian ports; the origin, expansion, and fate of introduced populations of non-indigenous macroalgae (from East Asia including Japan, Oceania, North America, *etc.*); distribution, origin and vectors of marine NIS on the Pacific coast of Canada; and, spatio-temporal variability in the abundance and size of *Nemopilema nomurai* in Korean waters, with implications for vectors.

The next four presentations were organized around an impacts (potential and documented) theme. The presentations covered topics including: changes in the biogeography of harmful dinoflagellates and

raphidophytes along the Chinese coast, as well as strong northward shifts in the spatial distribution of *Phaeocystis globosa* and *Karenia mikimotoi* blooms; consequences of NIS that have been introduced for marine aquaculture in China, including secondary introductions such as pathogens; the range expansion and potential community level impacts of European green crab on the Pacific coast of Canada; and, impediments of native Olympia oyster recovery due to interactions with non-indigenous aquatic species along coastal Oregon.

Following these presentations, we learned about the application of autonomous underwater vehicles (AUV) for detecting invasive tunicate prevalence in deeper marine waters; rapid response plans and their utility in quickly eradicating newly discovered NIS; coupling of individual based models (IBMs) with existing 3D ocean circulation models for predicting the northward range expansion of European green crab along the west coast of North America; and, Dr. Tom Therriault presented results from a multi-year, interdisciplinary program for identifying, tracking and understanding biological and economic impacts of NIS in Canada.

Dr. Darlene Smith, Co-Chair of Working Group on *Non-indigenous Aquatic Species* (WG 21), introduced the final two presentations. These presentations showcased two of the major products from the Working Group: the Rapid Assessment Surveys in PICES member country ports and the North Pacific NIS database (supported by the Ministry of Agriculture, Forestry and Fisheries of Japan). The Rapid Assessment Surveys have been coordinated by Dr. Tom Therriault (DFO Canada) and they provide valuable information about the prevalence of marine NIS in ports around the Pacific. Dr. Deborah Reusser and Dr. Henry Lee, II have led development of the North Pacific non-indigenous species database, which is a spatially explicit database of all known NIS occurrences in all PICES member countries.

List of papers

Oral presentations

Edwin Grosholz (Invited)
A new agenda for addressing the impacts and management of coastal invasions

Henry Lee II, Deborah Reusser, Walter Nelson and Janet Lamberson
Changes in latitude, changes in attitude – Emerging biogeographic patterns of invasion in the Northeast Pacific

Vasily I. Radashevsky
Unknown vector of organism transportation with ballast water between the Northwest Pacific and Southwest Atlantic

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

Graham E. Gillespie, Thomas W. Therriault and Glen S. Jamieson
Marine non-indigenous species on the Pacific coast of Canada: Distribution, origin and vectors

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

Jinhui Wang, Yanqing Wu, Yutao Qin and Yihong Li
The threat of potential alien species in the East China Sea and a mitigation strategy

Lijun Wang
Species introduced for marine aquaculture and their impacts in China

Graham E. Gillespie and Thomas W. Therriault
Biology and ecological impacts of the European green crab, *Carcinus maenas*, on the Pacific coast of Canada

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

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

Judith Pederson, Victor Polidoro, James Morash, Justin G. Eskesen, Dylan Owens, Franz Hover and Chrys Chryssostomidis
Advancing technologies to identify marine invaders in support of fisheries management

Paul Heimowitz
Rapid response plans for aquatic invasive species

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

Darlene <u>Smith</u>
Introduction of a PICES project on marine non-indigeous species supported by the Ministry of Agriculture, Forestry and Fisheries of Japan

Thomas W. <u>Therriault</u>
Rapid Assessment Surveys: PICES WG-21's approach

Deborah <u>Reusser</u> and Henry Lee II
Evolution of biogeography in the 21st Century – Development of a North Pacific non-indigenous species database

Poster

Xuezheng <u>Lin</u> and Xiaohang Huang
Introduced marine organisms in China from Japan and their impacts

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

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

Background

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

Summary of presentations

Sum of 34 studies (25 orals and 9 posters) were presented (1 oral and 1 poster cancelled) on October 28 and 30 (1½ days). There were about 70 attendants each day.

In the first and second slot of talks, structure and dynamics in microbial and planktonic food webs were presented. Many studies focused on trophic cascading effects. Various techniques were introduced for the studies of food-web structure and dynamics such as stable isotopes, fluorescent probes, PCR, *etc*. The scheduled invited talk by Dr. A. Peña was canceled; instead, Dr. J. I. Allen gave a talk on integrated E2E modeling.

Studies presented in the first and second slots of the second day were focused on higher trophic levels such as pollock, cod, seabirds, and marine mammals. Many presentations were not limited within a single prey–predator interaction, but focused on the dynamics in several trophic levels and also on the influence of climate change on food-web dynamics. New information was presented on the feeding ecology of previously unstudied issues such as giant jellyfish, minke whales in Korean waters, *etc*.

Studies on higher trophic levels continued in the third and fourth slots on October 30. Many of them were targeted on the influences of climate change on seabirds through changes in upwelling, prey abundance and composition. These papers highlighted the interconnections of food webs from physical processes through several trophic levels to the top predators. A review paper on the impact of global warming on global marine ecosystems wound up the session.

Many studies were focused on the indirect influence of climate change on target species through changes in physical oceanographic conditions and the food-web structure as well as the direct influence (*e.g.*, temperature, weather). Presentations on the feedback from marine ecosystems to the terrestrial

ecosystem (seabird egestion in the colony) and atmosphere (DMS production by phytoplankton) showed that the change in marine food-web dynamics has an influence outside of the oceans. A study estimating habitats of oceanic whales using satellite images showed a new direction to investigate the impact of environmental change in marine ecosystems. Presentations covered many food-web processes with adequate overlaps and were quite useful in reviewing the present state of knowledge. Discussions were quite active throughout the session. We believe the presentations in this session inspired the attendees' scientific motivation for future studies.

List of papers

Oral presentations

J. Icarus Allen (Invited)
Bio-physical interactions on the NW European Shelf and thoughts on the next generation of ecosystem models

Mitsuhide Sato, Shigenobu Takeda and Ken Furuya
Temporal variation in the cellular labile iron pool of phytoplankton during an *in situ* iron enrichment experiment as measured by flow cytometry

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

Hongbin Liu, Bingzhang Chen, Mianrun Chen, Xihan Chen, Loklun Shek, Hongmei Jing and Thomas Wong
Planktonic microbial food web dynamics in Hong Kong coastal waters

JiHo Seo, Seok Hyun Youn, Jeong Kyu Yoo and Joong Ki Choi
The variation in zooplankton abundance related to sea water temperature changes in Incheon coastal waters, Gyeonggi Bay from 2000 to 2007

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

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

Jeffrey M. Napp, Christine T. Baier and Suzanne L. Strom
Mesozooplankton grazing and egg production in the coastal Gulf of Alaska

Hiroaki Saito, Keiichiro Ide, Masatoshi Moku, Hiroya Sugisaki and Kazutaka Takahashi
The end-to-end food web of the subarctic Pacific from the viewpoint of *Neocalanus* copepods

Orio Yamamura (Invited)
Inside and outside the food web: Factors affecting dynamics of walleye pollock

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

George L. Hunt, Jr., Kenneth O. Coyle and Jeffrey M. Napp
Does a warming climate aid pollock recruitment in the eastern Bering Sea? A new look at assumptions behind the Oscillating Control Hypothesis

Franz Mueter and Ken Coyle
From physics to humans: Climate effects on Bering Sea food webs and fisheries

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

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

Olga Yu. Tyurneva, Valery. I. Fadeev, Yuri M. Yakovlev and Vladimir V. Vertyankin
Changes in the movement and distribution of western gray whales between known feeding areas in 2002-2007

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

Hongsheng Bi, William T. Peterson, Jesse Lamb and Cheryl Morgan
Couplings between multi-scale physical processes and copepod communities along the Washington and Oregon coast

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

Jaime Jahncke, Meredith L. Elliott, Benjamin L. Saenz, Jennifer E. Roth and Christine L. Abraham
Planktivorous seabird responses to variability in coastal upwelling in Central California

Jarrod A. Santora, William J. Sydeman and Steve Ralston
Do seabirds at sea in the California Current reflect krill distribution, abundance and patch structure?

Jennifer E. Roth, Russell W. Bradley, Peter Warzybok, Christine L. Abraham and Jaime Jahncke
Ocean processes driving the phenology and productivity of marine birds in the California Current System

Katarzyna Zmudczyńska, Lech Stempniewicz, Adrian Zwolicki, Lech Iliszko, Bronisław Wojtuń and Jan Matuła
The influence of plankton- and fish-eating seabird colonies on the Arctic tundra ecosystem of Spitsbergen

Hiroko Sasaki, Hiroshi Kiwada, Koji Matsuoka and Sei-Ichi Saitoh
The relationship between cetacean distributions and oceanographic conditions in the western North Pacific

Kazuaki Tadokoro, Takashige Sugimoto and Michio J. Kishi
The effects of anthropogenic global warming on the marine ecosystem

Posters

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

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

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

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

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

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

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

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

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

FIS Topic Session (S11)
Effects of fisheries bycatch and discards on marine ecosystems and methods to mitigate the effects

Co-Convenors: Hui Chun An (Korea) and Patricia Livingston (U.S.A.)

Background

This was the first time PICES sponsored a topic session on bycatch. Attention to bycatch is important because it impacts marine ecosystem components; thus it is a key consideration in evaluating the success in ecosystem-based approaches to fishery management. Commercial fisheries using gears, such as bottom trawling, capture both target and non-target species. In some instances, bycatch mortality is sufficiently high to adversely affect the stock status and productivity of non-target species. To minimize unintended impacts on the environment, commercial fisheries should strive to increase their selectivity by reducing the bycatch of birds, mammals, turtles and other non-target species, as well as by reducing the catch and discard of undersized commercial species. This session examined the magnitude of bycatch of non-target species, effects of bycatch mortality on the health of non-target stocks, and recent research on methodology to reduce bycatch and discards in the PICES region. Particular emphasis was placed on studies that resulted in changes in commercial fishing practices.

Summary of presentations

The session was well-attended and began with an excellent invited talk that covered all the facets of bycatch reduction, with numerous examples. Successful reduction of bycatch involves a number of steps: (1) catch monitoring to determine bycatch levels, (2) development of techniques to reduce bycatch, (3) implementing a bycatch reduction method, and (4) communicating the results to all parties. It is essential to involve fishers at every step in this process.

Six talks and one poster provided specific examples of bycatch reduction or estimation in different PICES regions. Examples were provided from the Republic of Korea with respect to bycatch reduction in the snow crab gillnet fishery and a study of factors and gears involved in minke whale bycatch. Snow crab research was initiated upon request of the fishing industry and involved studies of mesh selectivity that have now been implemented along with the use of biodegradable gear. These changes will reduce the bycatch of female and undersized crabs. Minke whale catch occurs in several gear types in Korean fisheries. An analysis was performed to look at spatial and biological characteristics of the whale bycatch. A variety of mitigation measures are planned for study including acoustic alarms, time/area closures, and gear modifications. One Russian researcher presented information on the study of gear and fish loss and how to improve fish retention by changing the soak time of gear. Two of the U.S. talks involved looking at fishery information relative to endangered species locations. These related to loggerhead turtle bycatch in Hawaii and the short-tailed albatross potential overlap with trawl fisheries in Alaska. The turtle research involves developing a daily oceanographic product based on sea surface temperature that can inform fishermen in real-time about areas to avoid. The short-tailed albatross research is evaluating the potential for bycatch of this species in a situation where bycatch is not easily observed because the bycatch is not retained in the gear. The final U.S. talk provided an overview of a U.S. national implementation policy with respect to bycatch and provided a number of examples of research and management issues involved in bycatch reduction in Alaska groundfish fisheries. The topic session ended with a presentation on a potential workshop on bycatch proposed for PICES 18.

List of papers

Oral presentations

Steven J. Kennelly (Invited)
Reducing bycatch in the world's fisheries

Heui Chun An, Chang-Doo Park, Jong Keun Shin and Kyoung-Hoon Lee
Bycatch reduction in the snow crab gillnet fishery of Korea

Kyung-Jun Song, Zang Geun Kim, Seok Gwan Choi, Yong-Rock An and Chang-Ik Zhang
Fishing gears involved in entanglements of minke whales in the southwestern East/Japan Sea

Larisa P. Nikolenko
How big are the losses of Greenland turbot (*Reinhardtius hippoglossoides*) and crabs (*Lithodes aequispina* and *Chionoecetes angulatus*) during deep-sea bottom net and long-line fishing in the Okhotsk Sea?

Evan A. Howell, Jeffrey J. Polovina, Donald R. Kobayashi, George H. Balazs, Denise M. Parker and Peter Dutton
A new dimension to the problem of loggerhead turtle (*Caretta caretta*) bycatch in the Hawaii-based longline fishery

Stephani G. Zador, Julia K. Parrish, André E. Punt, Jennifer L. Burke and Shannon M. Fitzgerald
Determining spatial and temporal overlap of an endangered seabird with a large commercial trawl fishery

Patricia A. Livingston, Jennifer Boldt, Shannon M. Fitzgerald, William Karp and David Witherell
Assessing and reducing the amounts and impacts of fisheries bycatch in Alaska marine ecosystems

Posters

Hyoung Chul Shin, Doonam Kim and Kyu Jin Seok
To monitor and mitigate the incidental mortality and discards from fisheries; Lessons from the Southern Ocean, a test bed of ideal management

MEQ Topic Session (S12)
Connecting the human and natural dimensions of marine ecosystems and marine management in the PICES context

Co-Convenors: David L. Fluharty (U.S.A.), Mitsutaku Makino (Japan), R. Ian Perry (Canada) and Chang-Ik Zhang (Korea)

Background

A complete definition of marine ecosystems includes the human components. Consideration of ecosystem-based management, at least within the natural sciences, usually leaves out the human dimensions, or includes it only as fishing effort. For ecosystem-based management to succeed, however, humans need to be included. This session builds on the Science Board Symposium of 2003 titled "*Human dimensions of ecosystem variability*". Human relationships and how humans interact with the ocean have been changing in nature and strength over time. Natural variability in marine systems can be large, but so are socio-economic pressures and considerations relating to marine environments. Determining appropriate socio-economic indicators to complement indicators of natural climate variability, *e.g.* for ecosystem-based management, is an ongoing challenge. This session will address these interactions between natural and socio-economic issues in the context of ecosystem-based management. Specifically, it will consider: (1) What are the criteria to determine relevant socio-economic indicators of human well-being related to marine issues for PICES member countries? (2) What are appropriate indicators to monitor changes in management objectives and human well-being relevant to changing ecosystem structure and production? (3) How might decisions that are made to enhance human well-being likely to impact (positively or negatively) the nature and functions of marine ecosystems? This session theme will continue to explore the many ways that humans interact with marine ecosystems and the scientific efforts to quantify and predict human impacts on the dynamics of such systems.

Summary of presentations

Ten oral (including 1 invited) and 13 posters were presented in this session. After the introduction of this session from Mr. Fluharty (U.S.A) on behalf of the co-convenors, Dr. Makino reviewed the social and ecological conditions of fisheries with respect to management strategies. Then, Dr. Hamilton (Invited, University of New Hampshire, U.S.A.) presented the relationships between ecosystems, fisheries and social changes in western Alaska. Dr. Zhang talked about socio-economic indicators used in ecosystem-based assessments for the Eastern Bering Sea trawl fishery. After the introduction of environmental contaminants in Pacific food webs and their implications for coastal First Nations by Dr. Ross, Dr. Fluharty talked about the use of social science information in marine management processes in the U.S.A. Four more studies were then presented from Korea (by Dr. Park), China (Dr. Chen and Dr. Zhang), and Russia (Dr. Lukyanova). Dr. Pooley reported the results of a related symposium, convened by GLOBEC and co-sponsored by PICES, which was held at FAO headquarters in July 2008, and which was convened by Dr. Perry. Session 12 concluded that we should continue to explore the many ways that humans interact with marine ecosystems and the scientific efforts to quantify and predict human impacts on the dynamics of such systems.

List of papers

Oral presentations
Mitsutaku Makino and Hiroshi Horikawa
Social-ecological conditions of fisheries and management by ITQs: A global review

Lawrence C. Hamilton (Invited)
Ecosystem, fishery and social changes in western Alaska

Chang Seung and Chang-Ik Zhang
Socio-economic indicators used in ecosystem-based assessment for the eastern Bering Sea trawl fishery

Peter S. Ross, T. Child and N. Turner
Caught in the crossfire: Environmental contaminants in Pacific food webs and implications for coastal First Nations

David L. Fluharty
Developing and using social science information in marine management processes in the United States

Hee Won Park, Chang-Ik Zhang and Jae Bong Lee
A comparative study on the structure and function of Korean marine ranching ecosystems

Shang Chen, Jian Liu, Tao Xia and Qixiang Wang
Change of ecosystem services of the Yellow River Delta Wetland, China

Olga N. Lukyanova and Ludmila V. Nigmatulina
The value of ecosystem services of Peter the Great Bay (Japan/East Sea)

Samuel G. Pooley, Ian Perry and Mitsutaku Makino
Socio-economic considerations of ecosystem approaches to fisheries management

Zhifeng Zhang
Effects of dredging on internal release of phosphate from marine sediments in Dalian Bay

Posters

Jingfeng Fan, Hongxia Ming, Lijun Wu, Yubo Liang and Jiping Chen
Detection of human enteric viruses in shellfish in China

Peter M. Zhadan and Marina A. Vaschenko
Does pollution change the reproductive strategy of the sea urchin?

Natalia M. Aminina and Lidia T. Kovekovdova
Brown algae metabolism in polluted environments

Zhen Wang, Xindong Ma, Zhongsheng Lin, Guangshui Na, Qiang Wang and Ziwei Yao
Occurrence and congener specific distribution of polybrominated diphenyl ethers in sediments and mussels from the Bo Sea, China

Guangshui Na, Qiang Wang, Zhen Wang, Hongxia Li, Shilan Zhao, Tong Chen, Zhongsheng Lin and Ziwei Yao
Pharmaceuticals and Cersonal Care Products (PPCPs) in some river and sewage water of Dalian, China

Li Zheng, Xuezheng Lin, Zhisong Cui, Frank S.C. Lee and Xiaoru Wang
Phylogenetic analysis of indigenous marine bacteria with the ability to degrade oil pollutants in Bohai Bay

Liping Jiao, Liqi Chen, Yuanhui Zhang, Gene J. Zheng, Tu Binh Minh and Paul K.S. Lam
Polycyclic aromatic hydrocarbons in remote lake and coastal sediments from Svalbard, Norway: Levels, sources and fluxes

Qixiang Wang, Shang Chen and Xuexi Tang
Preliminary assessment of ecosystem services of the Yellow Sea

Petr V. Lushvin
The impact of anthropogenic activity (regime of hydroelectric power stations and technological explosions) on behaviour and reproduction of fish and crustaceans

Zhang Hongliang, Leng Yu, Xu Zijun and Li Jiye
Research on the generating and vanishing process of *Enteromorpha* bloom and the environmental controlling factors

Zhou Yan-Rong Zhang Wei Tang Wei Zhao Bei andYang Dong-Fang
Analysis of nutrients and organic pollution in Shuangdao Bay

Ji-Ye Li, Xiu-Qin Sun, Feng-Rong Zheng and Lin-Hua Hao
Screen and effect analysis of immunostimulants for sea cucumber, *Apostichopus japonicus*

Wang Xinping, Sun Peiyan, Zhou Qing, Li Mei, Cao Lixin and Zhao Yuhui
Compounds concentration analysis of oil and its application in oil spill identification

BIO Contributed Paper Session

Co-Convenors: Michael J. Dagg (U.S.A.) and Michio J. Kishi (Japan)

Background

Oral and poster presentations on biological aspects of the PICES XVII theme were welcome, as well as papers on all aspects of biological oceanography in the North Pacific and its marginal seas (except those related to the BIO-sponsored Topic Sessions S2 and S9). Early career scientists were especially encouraged to submit papers to this session.

Summary of presentations

This session received a large number of applications for oral and poster presentations and it ended up with a very full day of talks (19 total) and 16 posters. Presentations were given by members of all PICES

member countries, and 6 of the 19 oral presentations were given by early career scientists. As indicated in the Book of Abstracts, topics ranged widely and all were of interest to the PICES community of Biological Oceanographers. Both morning and afternoon sessions were well attended.

List of papers

Oral presentations

Meibing Jin, Clara Deal, Jia Wang and Peter McRoy
Response of lower trophic level productivity to long-term climate changes in the southeastern Bering Sea

Hui Liu and William T. Peterson
A phase shift in the Northern California Current (NCC) ecosystem?

Kohji Iida, Onishi Yuriko and Tohru Mukai
Regional characteristics of diel vertical migration of the sound scattering layer in the North Pacific

C. Tracy Shaw, Leah R. Feinberg, Hongsheng Bi and William T. Peterson
Upwelling conditions and cohort analysis of the euphausiid *Euphausia pacifica* off Newport, OR, USA

Zhongming Lu, Jianping Gan, Anson Cheung, Minhan Dai, Hongbin Liu and Paul J. Harrison
Biological response to wind-driven upwelling and river plume in the northeastern South China Sea

Atsushi Tsuda and Shinji Shimode
Distribution and life history of a subtropical copepod, *Neocalanus gracilis*: Implication for the northward intrusion by subarctic species

Soo-Jung Chang, Won-Duk Yoon and Suam Kim
Molecular phylogeography of *Nemopilema nomurai* (Class: Scyphozoa) in Korean waters

Jing Dong
Possible origin of *Nemopilema nomurai* in the northern part of the China Sea, and causes of population fluctuations

David L. Mackas
Scale-dependent spatial correlation of zooplankton time series: Biomass, phenology, and species composition

Sergey P. Zakharkov, Tatyana N. Gordeychuk and Elena A. Shtraikhert
Variability of satellite primary production in the Sea of Japan from 2003 to 2007

Pavel A. Salyuk, Oleg A. Bukin, Andrey N. Pavlov, Konstantin A. Shmirko and Denis A. Akmaykin
Estimation of phytoplankton community response to Asian dust forcing in the northwestern Pacific

Suguru Okamoto, Toru Hirawake and Sei-Ichi Saitoh
Interannual variability of the spring, column-integrated chlorophyll-*a* content in the Kuroshio Extension region

Qiang Hao, Xiuren Ning, Chenggang Liu and Fengfeng Le
Primary production in the northern South China Sea – Satellite and *in situ* observations

Pavel Ya. Tishchenko, Vyacheslav B. Lobanov, Alexey M. Koltunov, Anna A. Maryash, Tatyana A. Mikhailik, Galina Yu. Pavlova, Sergey G. Sagalaev, Alexander F. Sergeev, Elena M. Shkirnikova, Mariya G. Shvetsova, Petr P. Tishchenko and Vladimir I. Zvalinsky
Physical and biological mechanisms of Amurskiy Bay re-oxygenation after deep hypoxia events

Meng Zhou, Di Wu, Yiwu Zhu, Stephen D. Pierce, John A. Barth and Timothy Cowles
Zooplankton productivity, trophic dynamics and size spectra in the Oregon shelf areas

Jian Hu, Zhao-Li Xu and De-Di Zhu
Seasonal changes in the ecological characteristics of pelagic molluscs in the Changjiang Estuary

Juyun Lee, Toshiya Katano and Myung-Soo Han
Cell cycle of *Heterosigma akashiwo* with special reference to vertical migration behavior

Oleg N. Katugin, Michael A. Zuev and Gennadyi A. Shevtsov
Distribution patterns, morphology and taxonomy of the gonatid squid *Gonatus tinro* and *Gonatopsis okutanii* in the Sea of Okhotsk and northwestern Pacific Ocean

Hyunjung Kang, Yeonghye Kim, Seongyeon Kim and Dongwoo Lee
Reproductive ecology of common octopus, *Octopus vulgaris* in the South Sea, Korea

Posters

Alexander V. Zavolokin, Elena A. Zavolokina, Igor I. Glebov, Alexander M. Slabinskiy and Alexander Ya. Efimkin
Food supply of Pacific salmon (*Oncorhynchus* spp.) in the western Bering Sea in 2002-2006

Jia-Jie Chen, Zhao-Li Xu and De-di Zhu
Seasonal abundance and distribution of pelagic euphausiids in the Changjiang Estuary, China

Keiichi Fukushi and Taro Minato
The potential usefulness of recovered jellyfish as fertilizer

Shigenobu Takeda and Y. Kondo
Organic complexation of iron in the Pacific Ocean

Hiromichi Ueno, William R. Crawford and Hiroji Onishi
Impact of Alaskan Stream eddies on chlorophyll distribution in the western and central subarctic North Pacific

Toru Kobari, Ai Ueda and Yuichiro Nishibe
Development and growth of ontogenetically migrating copepods during the spring phytoplankton bloom in the Oyashio region

Wen-Tseng Lo, Meng-Chen Ke and Hao-Hsien Chang
Effects of temperature and salinity changes on asexual reproduction of *Aurelia aurita* (Cnidaria, Scyphozoan)

Chaewoo Ma, Wongyu Park and Jung Hwa Choi
Long-term variations of sea surface temperature and zooplankton biomass driven by climate changes in the Yellow Sea, western part of Korean peninsula during 1968-2007

Sonia Batten, Dave Mackas and Doug Moore
Changing size with latitude in *Neocalanus plumchrus* and *N. flemingeri*

Elena Smirnova and Natalia P. Fadeeva
Seasonal dynamics of meiofauna community and zonation patterns in (un)disturbed sandy beaches of the Sea of Japan

Natalia P. Fadeeva and Valery I. Fadeev
Indicator role of sublittoral meiofauna in monitoring the status of marine environments

Yuji Okazaki and Kazuaki Tadokoro
Spatial and seasonal variability of euphausiid distribution and community structure in the Oyashio and the Kuroshio-Oyashio transition region

Takumi Nonomura, Jun Nishikawa, Atsushi Tsuda, Ichiro Yasuda and Shuhei Nishida
Practical identification of three sympatric calanoid copepods, *Calanus sinicus*, *C. jashnovi* and *C. pacificus*, in the western North Pacific

Miju Kim, Dong-Jin Kang, Kyung-Ryul Kim, Noriko Nakayama, Toshitaka Gamo, Eun Hee Kim and Jae Seong Lee
Diurnal variation in the concentration and stable isotope composition of dissolved oxygen (O_2) in Lake Shihwa, Korea

Masaya Toyokawa and Jing Dong
Salinity tolerance of planula and polyp stages of Nomura's jellyfish, and their possible natural habitat

Jimin Zhang and Wenzhai Ma
Nutrient distribution and eutrophication assessment for the adjacent waters of the Yellow River Estuary

FIS Contributed Paper Session

Convenor: Gordon H. Kruse (U.S.A.)

Background

Fishery science is a broad field in the PICES region, owing in part to the diversity of species, water masses, and fisheries of the North Pacific Ocean. The FIS Paper Session enhances FIS activities in PICES by fostering participation by more fisheries scientists with different interests in annual meetings. The FIS Paper Session invited papers on topics in fisheries science and fisheries oceanography in the North Pacific and its marginal seas.

Summary of presentations

The FIS Paper Session included 19 oral presentations and 25 posters that covered a wide variety of fish species and topics from all PICES-member countries. Biological and ecological topics presented orally included salmon genetics, new information on the distribution of poachers and lamprey, feeding habits of myctophids and other forage fishes, and effects of long-term exposure to polycyclic aromatic hydrocarbons on the maturation of longfin goby. Studies on population dynamics and fishery oceanography included presentations on density-dependent growth of Japanese sardine, variability in fish species in the Sea of Okhotsk, long-term variability in abundance and recruitment, oceanographic mechanisms regulating recruitment of longfin squid, migration dynamics of Pacific sardine and jack mackerel, and forecasting returns of Pacific salmon based on multiple oceanographic indicators. Other oral presentations developed and applied new methods to estimate the number of fishing vessels based on satellite night-time imagery, an ecological risk assessment approach, and a length-based approach to estimate fish biomass based on a single year of assessment surveys.

Likewise, posters covered a wider variety of species and topics. Biological topics covered in posters included genetics, age, growth, maturity, spawning, abundance and distribution. Species studied included Pacific salmon, walleye pollock, sand lance, horesehead, chub mackerel, Pacific cod, sardine, squid and snailfish. Process and modelling studies included simulation of diamond squid movements, role of eelgrass on sea bass growth, fishing effects on flounders, variations in climate and fishes in the North Pacific and North Atlantic, the role of sea ice on pollock stocks, and the impacts of seismic activity on fish and fisheries. New methods were reported, including the application of self-organizing maps and k-means clustering to analyze and compare marine ecosystems. Based on the number of oral presentations and posters and the high quality of the presentations, the FIS paper session at PICES 17 was deemed very successful.

List of papers

Oral presentations

Anastasia M. Khrustaleva
Integrated method for sockeye salmon stock differentiation in the West Pacific and the Sea of Okhotsk

Moongeun Yoon, Syuiti Abe and Deuk-Hee Jin
Population genetic structure of chum salmon in the Pacific Rim inferred from mitochondrial and microsatellite DNA analyses

In Joon Hwang and Hea Ja Baek
Assessment of ovarian maturation in *Chasmichthys dolichognathus* after exposure to single polycyclic aromatic hydrocarbons, benzo[a]pyrene

Guoping Zhu, Xuefang Wang, Liuxiong Xu, Xuchang Ye and Chunlei Wang
Comparison on the biological characteristics of skipjack tuna *Katsuwonus pelamis* between the log school and free school caught by purse seine from the Western and Central Pacific Ocean

Alexei M. Orlov, Dmitry V. Pelenev, Vadim F. Savinykh, Natalia V. Klovach and Andrei V. Vinnikov
Pacific lamprey: Some ecological and biological features during their sea life and relationships with host species

Hiroshige Tanaka, Chiyuki Sassa, Seiji Ohshimo and Ichiro Aoki
Feeding habits and diel feeding patterns of two dominant myctophid fishes in the continental shelf region off western Kyushu, Japan

Lei Guo, Robert Foy, Kate Wynne and Lawrence Schaufler
Combining stomach content and fatty acid analyses to assess forage fish diets

Jung Nyun Kim, Heeyong Kim and Kwang Ho Choi
Migration and coastal recruitment of jack mackerel *Trachurus japonicus* in Korean waters

Jake Schweigert, Joanna Hirner and Sean Cox
Predicting Pacific sardine (*Sardinops sagax*) migration into Canadian waters

Jong Hee Lee, Jae Bong Lee and Chang-Ik Zhang
Long-term fluctuation of commercial fished species and their marine environment in Korean waters

Anatoliy Ya. Velikanov
Long-term variability of pelagic fish species composition near the eastern Sakhalin (Sea of Okhotsk): Distribution, fluctuations in abundance, fishery

Alexander I. Glubokov and Alexei M. Orlov
Poachers (Agonidae) of the Russian part of the Bering Sea: Spatial distribution and biology

Jung Jin Kim and Suam Kim
Recruitment mechanisms of common squid (*Todarodes Pacificus*) in the Yellow Sea

Takeshi Okunishi, Shin-ichi Ito, Naoki Yoshie, Taketo Hashioka, Hiroshi Sumata and Yasuhiro Yamanaka
The impact of density-dependent processes on growth of Japanese sardine (*Sardinops melanostictus*)

William Peterson, Edmundo Casillas, Hui Liu and Cheryl Morgan
Forecasting returns of coho and chinook salmon in the northern California Current: A role for high-frequency long-term observations

You-Jung Kwon, Doo-Hae An, Chang-Ik Zhang, Dae-Yeon Moon and Jae Bong Lee
An ecological risk assessment of the effect of the tuna longline fishery in the Western and Central Pacific Ocean

Arata Fukaya, Katsuya Saitoh and Sei-Ichi Saitoh
Estimation of number of Pacific saury fishing vessels using nighttime visible images

Hyeok Chan Kwon and Chang-Ik Zhang
Maturation and spawning of black seabream, *Acanthopagrus schlegeli* in the Jeonnam marine ranching area of Korea

Bernard A. Megrey and Chang-Ik Zhang
Estimating biomass and management parameters from length composition data: A stock assessment method for data-deficient situations

Posters

Guoping Zhu, Liuxiong Xu, Yingqi Zhou and Xiaojie Dai
Age, growth and mortality of bigeye tuna *Thunnus obesus* (Scombridae) in the eastern and central tropical Pacific Ocean

Chiyuki Sassa, Keisuke Yamamoto, Youichi Tsukamoto and Muneharu Tokimura
Distribution and biomass of *Benthosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China Sea: Mechanisms of population maintenance

Victor F. Bugaev, B.B. Vronsky, L.O. Zavarina and Zh.Kh. Zorbidi
Correlation analysis of interannual variations of length, weight and condition factor of salmon from the Kamchatka River

You-Jung Kwon, Sun-Do Hwang, Yeong-Seung Kim and Dae-Yeon Moon
Recent stock status of fishes on Emperor seamounts in the Pacific Ocean

You-Jung Kwon, Doo-Hae An, Soon-Song Kim, Dae-Yeon Moon and Seon-Jea Hwang
Determinants of bigeye and yellowfin tuna catch rates in the tuna longline fishery

Yukimasa Ishida and Akihiro Yamada
Salmon distribution in the northern Japan during the Jomon Period

Elena Dulepova and Evgeny Ovsyannikov
Productivity of walleye pollock (*Theragra chalcogramma*) in the eastern Okhotsk Sea in 2006-2008

Goh Onitsuka, Naoki Hirose, Kazutaka Miyahara, Taro Ota, Jun Hatayama, Yasushi Mitsunaga and Tsuneo Goto
Lagrangian simulation of diamond squid (*Thysanoteuthis rhombus*) in the southwestern Japan Sea from 2003 to 2005

Nobushige Shimizu, Seiji Oshimo, Ryuji Yukami and Ichiro Aoki
Growth of larvae and juvenile Japanese anchovy *Engraulis japonicus* off the coast of western Kyusyu, Japan

Anastasia M. Khrustaleva, Yury V. Fedotov and Elena N. Kuznetsova
Application of a spectral method of scale-structure analysis for salmon stock differentiation in the Pacific Rim

Andrei S. Krovnin and George P. Moury
Changes in the spatio-temporal structure of climatic variations in the North Pacific and North Atlantic during the last 20 years and their relation to fluctuations in fish stocks

Bernard A. Megrey and Jae Bong Lee
On the utility of self-organizing maps (SOM) and k-means clustering to characterize and compare marine ecosystems

Jin Koo Kim, William Watson, John R. Hyde, Nancy C.H. Lo, Jin Yeong Kim and Sung Kim
Identification of *Ammodytes larvae* using mtDNA COI with morphological descriptions

Jin Koo Kim, Kyeong Dong Park, Dae Soo Chang and Joo Il Kim
Age and growth of *Scartelaos gigas* (Gobiidae) from a mud flat in Korea

Jeong Bae Kim, Jung Hwa Ryu, Sang Yong Lee and Jin Koo Kim
Effect of eelgrass on fish species composition and growth of young sea bass

Jung Hwa Ryu, Jin Koo Kim and Jung Youn Park
Genetic relationship among six horsehead species, *Branchiostegus* (Pisces, Perciformes), and an osteological comparison

Sukgeun Jung, Dong-woo Lee, Young Shil Kang, Young-Sang Suh, Jin-yeong Kim and Yeong Gong
Regime shifts indicated in fishery catch statistics (1968-2007) from Korean coastal waters

Yasunori Sakurai, Mio Osato and Jun Yamamoto
Does the extent of ice cover affect the fate of walleye pollock?

Yeong Gong, Young-Sang Suh, In-Seong Han, Ki-Tack Seong, Woo-Jin Go and Suk-Geun Jung
Year-to-year and inter-decadal fluctuations in abundance of pelagic fish populations in relation to climate-induced oceanic conditions

Sukgeun Jung, Jae Bong Lee and Gyun Heo
Relationship between ship tonnage and catch per haul examined to improve the stock assessment of chub mackerel, *Scomber japonicus*, in Korean sea waters

Woo-Seok Gwak
Population structure of Pacific cod *Gadus macrocephalus* in Korean waters inferred from mtDNA and msDNA markers

Tai Jin Kim, Byung Ki Kim, Chung Youl Park, Byung Eon Choi, Hyung Woon Ju, Hwan Sung Ji, Sang Yong Shin, So Gwang Lee and Woo Seok Gwak
Characteristics of Pacific cod (*Gadus macrocephalus*) during spawning in Jinhae Bay, Korea

Petr V. Lushvin
The impact of seismic activity on development of populations and fishery

Jin Yeong Kim, Jae Bong Lee, Suam Kim, Young Min Choi and Ulf Dieckmann
Changes in patterns of maturation and growth of sardine in Korean waters in relation to fluctuations in abundance and temperature

Hak-Jin Hwang, Inja Yeon, Yang-Jae Im, Myoung-Ho Sohn, Mi-Young Song, Jong-Bin Kim and Heeyong Kim
Spatio-temporal distribution of snailfish, *Liparis tankae* (Gilbert and Burke) in the West Sea of Korea

POC Contributed Paper Session

Co-Convenors: Michael G. Foreman (Canada) and Ichiro Yasuda (Japan)

Background

Papers are invited on all aspects of physical oceanography and climate in the North Pacific and its marginal seas, excluding papers on coastal upwelling (Topic Session S6).

Summary of presentations

The session consisted of 21 oral presentations (Nabiullin's poster was switched to oral after Fan Wang's cancellation) and 28 posters covering a wide range of physical and biogeochemical oceanographic research. Ichiro Yasuda, Steven Bograd and Kyung-Il Chang assisted Mike Foreman in chairing sub-sessions over the 1-day presentation period. The morning portion included interesting talks related to: (1) climate change and variability in the North Pacific (Di Lorenzo, Yeh) and Far-Eastern seas (Ustinova), (2) mixing in Bussol' Strait (Yagi) and the Kuroshio/Oyashio region (Chen), (3) results of a bibliographic search of North Pacific publications (Nabiullin), (4) shifts in the mixed layer development in the Oyashio (Ono), (5) a comparison of CO_2 fluxes in the Southern and Western Arctic Oceans (Chen), (6) heat transfer in the bottom sediment of Amurskii Bay (Ponomarev), and (7) a winter thermal front in South Yellow Sea (Liu).

Apart from one presentation on the selection of climate models for ecosystem projections (Wang), the afternoon talks focused on the western Pacific. They included presentations on (1) eddy (Chang) and SSH (Kaplunenko) variability in the Japan/East Sea, (2) Kuroshio inflow in the East Taiwan Channel (Yan), (3) decadal changes in temperature and salinity around Korea (Jung), (4) seasonal changes in the East Sakhalin Current (Shevchenko), (5) a model for the Pearl River estuary (Zu), (6) nutrient distribution in Bussol' Strait (Kaneko), (7) impact of dam water release in South Korea (Jung), (8) a model for Yellow River sediment transport into the Bohai Sea (Lu), and (9) interannual variations in transport in Tsushima Strait (Andreev).

List of papers

Oral presentations

Lina Ceballos, Emanuele Di Lorenzo and Niklas Schneider
North Pacific Gyre Oscillation synchronizes climate fluctuations in the eastern and western North Pacific

Sang-Wook Yeh, Young-Gyu Park, Hong-Sik Min, Cheol-Ho Kim and Jae-Hak Lee
Changes in the Pacific Decadal Oscillation from observations

Masahiro Yagi and Ichiro Yasuda
Turbulent mixing at the Bussol' Strait in the Kuril Islands using density inversions

Xianyao Chen, Qin Wang, Xiuhong Wang and Fangli Qiao
Lagrangian hydrographic features of the Mixed Water Region in the North Pacific derived from Argo data

Elena I. Ustinova and Yury D. Sorokin
Changes in the relationships between large-scale climatic indices and regional conditions in the Far-Eastern Seas

Ahat A. Nabiullin
North Pacific oceanography: Past, present and the future. A half-century bibliometric survey

Tsuneo Ono and Akira Kusaka
Advanced timing of spring mixed layer development in recent years in the Oyashio region

Liqi Chen, Rik Wanninkhof, Wei-Jun Cai, Zhongyong Gao, Yuanhui Zhang, Suqing Xu, Kavin Sullivan and Yongchen Wang
Comparison of air-sea fluxes of CO_2 in the Southern Ocean and the Western Arctic Ocean

Vladimir I. Ponomarev, Boris A. Burov and Alexander Yu. Lazaryuk
Seasonal heat transfer in the bottom sediment–sea water column of Amurskii Bay

Chuanyu Liu and Fan Wang
An N-shape thermal front in the western South Yellow Sea in winter

Yun-Bae Kim, Kyung-Il Chang and Kuh Kim
Eddy variability from direct current measurements in the southwestern East/Japan Sea

Muyin Wang, James E. Overland and Nicholas A. Bond
Selection of climate models for regional ecosystem projections

Dmitry D. Kaplunenko, Olga O. Trusenkova and Vyacheslav B. Lobanov
SSH variability in the northern Japan/East Sea from altimetry data

Xiao-Mei Yan, L. Zhang and Che Sun
Analysis of the Kuroshio inflow at the East Taiwan Channel (POC_P-5292)

Yeojin Jung, Jong Hee Lee, Chang-Ik Zhang and Jae Bong Lee
Decadal changes in temperature and salinity in Korean waters

Georgy Shevchenko and Valery Chastikov
Seasonal changes of the East Sakhalin Current from CTD data analysis

Tingting Zu and Jianping Gan
Coupled estuarine-coastal circulation in the Pearl River Estuary: Response to the wind and tidal forcing

Hitoshi Kaneko, Ichiro Yasuda, Tohru Ikeya, Jun Nishioka, Takeshi Nakatsuka and Sachihiko Itoh
Nutrient distribution around the Bussol' Strait

Kwang Young Jung, Young Jae Ro and Chung Ho Lee
Impact of dam water release based on a numerical model of the Kangjin Bay, South Sea, Korea

Jing Lu, Fangli Qiao, Yonggang Wang, Changshui Xia and Feng Shan
A numerical study of the sediment transport process from the Yellow River to the Bohai Sea and Yellow Sea

Andrey G. Andreev
Interannual variations of the water transport through the Tsushima Strait and its impact on the chemical parameters and chlorophyll-*a* in the Japan/East Sea

Posters

Vladimir B. Darnitskiy and Maxim A. Ishchenko
Cyclic thermohaline changes in the topographical eddy system above Erimo Seamount

Antonina M. Polyakova
Atmospheric activity types over the Northern Pacific

Antonina M. Polyakova
Especially dangerous wave heights in the Northern Pacific

Antonina M. Polyakova
Extreme distribution of floating ice in the NW Pacific

Antonina M. Polyakova
Destructive tsunamis near the coast of Primorye

Vladimir V. Plotnikov
Change in seasonal cycles of ice formation in the Far East Seas of Russia in the second half of the 20th and beginning of the 21st centuries

Valentina V. Moroz and K.T. Bogdanov
The Kuril-Kamchatka and Oyashio Currents system water structure and circulation variability

Valentina V. Moroz
Oyashio and Kuroshio Currents water characteristic variability in the area of their interaction and formation zones

Anastasiya A. Abrosimova, Igor A. Zhabin, Luiza N. Propp and Vyacheslav A. Dubina
Hydrographic and hydrochemical conditions near the Amur River mouth

Larissa S. Muktepavel and Tatyana A. Shatilina
Mechanisms determining the formation of extremely low-ice winters in the Okhotsk Sea

Elena.V. Dmitrieva and Vladimir. I. Ponomarev
Sea surface temperature aggregation from different sources to study multiple scale variability in the Japan/East Sea

Olga I. Kursova and Ahat A. Nabiullin
Bibliometric analysis of oceanographic research: A case of Kuroshio literature, a half-century bibliographic survey

Gennady I. Yurasov
Climatic characteristics of water masses, fronts, and currents in the Japan/East Sea

Ahat A. Nabiullin
North Pacific oceanography: Past, present and the future. A half-century bibliometric survey

Talgat R. Kilmatov
Calculation of entropy flux through the World Ocean surface

Alexander N. Man'ko andVera A. Petrova
Temporal variability of heat exchange between the ocean and atmosphere in the North Pacific

Nadezda M. Dulova and Vadim V. Novotryasov
Free oscillations of the Japan/East Sea in Posyet Bay

Zheng Xian Yang
Monitoring and assessing atmospheric deposition of pollutants to the Bohai Sea

Jinwen Zhang, Wenjing <u>Fan</u>, Jinkun Yang, Ruguang Yin, Wenxi Xiang, Yongshou Cheng, Dongsheng Zhang, Jingxin Luo and Guanghao Wei
Harmonic analysis of and predictive methods for some marine hydrometeorological elements

Natalia <u>Rudykh</u> and Vladimir Ponomarev
Cluster analyses of temperature and salinity in the Japan/East Sea pycnocline

Masatoshi <u>Sato</u> and Tokihiro Kono
The 1000 km-scale variability of the dynamic height revealed by Argo CTD data at 40°N in the North Pacific

Oleg A. Bukin, Andrey N. Pavlov, Konstantin A. <u>Shmirko</u>, Pavel A. Salyuk and Sergey Yu. Stolyarchuk
Aerosols and ozone dynamics in the atmosphere over Peter the Great Bay

Alexander Yu. Lazaryuk and Vladimir <u>Ponomarev</u>
Matching of Mark-IIIC CTD data

Petr V. <u>Lushvin</u>
Spectral characteristics seismogenic clouds

Emi <u>Shiraishi</u>, Risako Sakai, Tokihiro Kono and Sachiko Oguma
Density inversion in the Soya Current on the Hokkaido coast in the Okhotsk Sea

Tomowo <u>Watanabe</u>, Makoto Okazaki and Hideki Akiyama
Long-term changes of the wintertime coastal water temperature around Japan in the 20th century

Nobuo <u>Tsurushima</u>, Masahiro Suzumura, Namiha Yamada and Koh Harada
Dissolution rate change of calcite in seawater due to acidification by CO_2

Xing <u>Wang</u>, Maochong Shi, Zhenhui Gao and Lunyu Wu
The oceanic general circulation and transport in the Bohai Sea

MEQ Workshop and laboratory demonstration (W1)
Review of selected harmful algae in the PICES region: IV. Karenia and Prorocentrum

Co-Convenors: Vera L. Trainer (U.S.A.) and Ming-Yuan Zhu (China)

Background

This workshop was the fourth of an annual series in which harmful algal bloom (HAB) species that impact all or most countries in the North Pacific were discussed in detail. In 2008, the focus was on two fish-killing species *Karenia* and *Prorocentrum. Karenia mikimotoi* is known to kill both wild and cultured fish in China, Korea and Japan. Although this species was absent, to date, in the eastern Pacific, other species from the genus *Karenia* are known to kill fish in the southeastern U.S. *Prorocentrum* is a "red tide" species that forms dense, colored blooms in China, Korea and Japan, resulting in economic loss to fisheries due to reduced consumer confidence. *Prorocentrum* blooms are relatively rare in the eastern Pacific, but have been documented occasionally in areas of the U.S. and Canada. The integration of information from each country has advanced our understanding of these organisms.

Topics for the workshop included modes of toxicity, distribution, impact (differences between toxic and nontoxic strains), as well as physiology and ecology in each of the member countries. In particular, we wanted to identify additional studies needed specifically to understand the difference in occurrence and toxicity of these organisms in the eastern and western Pacific. The workshop produced a list of recommendations to help guide collaborative HAB research priorities in PICES member countries over the next 5 years. The workshop was preceded by a ½-day laboratory demonstration on *Karenia* and *Prorocentrum* identification and detection methods.

Summary of presentations

For the laboratory demonstration, Dr. Jacob Larsen gave an overview of the features used to distinguish *Prorocentrum* and *Karenia* species by light microscope. He discussed recent taxonomic changes. An emphasis was placed on the need to look at unarmored *Gymnodiniales* live. He suggested using flash photography and focusing into the cell, taking several pictures to be able to distinguish morphological features later from photographs. Lab demo participants had a chance to view the distinguishing characteristics of several species that Dr. Larsen has collected from scientists around the world.

For the workshop, summary of taxonomy helped to clarify some recent changes in nomeclature among *Prorocentrum* and *Karenia* species and will assist with identification of some morphologically similar species. Dr. Charles Trick gave a presentation about "getting there, being there and staying there". Getting there focuses on the correct physiological condition available for a HAB species in the area. For example, is the temperature right for survival. Being there includes the presence of the right physical conditions to allow a HAB to remain at a given location. Staying there is represented by effective competition for nutrients and resistance to grazers, among other factors. An interesting finding of this workshop was the presence of *Trichodesmium* blooms prior to *Karenia* spp. HABs in both the Gulf of Mexico (Florida, U.S.A.) and in the East China Sea (noted in Songhui Lu's presentation given by Mingyuan Zhu). It is thought that atmospheric iron is effectively able to provide nitrogen to *Karenia* blooms via nitrogen fixation, a process that requires iron. Because *Trichodesmium* forms surface blooms, it is a cell that can efficiently assimilate iron from atmospheric sources. In the East China Sea, *Karenia mikimotoi* blooms are followed by *Noctiluca* blooms, not typical to the Florida *K. brevis* blooms. This showed the value of continuous monitoring, allowing the characterization of phytoplankton assemblages prior to, during and following HAB events. *Karenia* species are problematic primarily in the western Pacific. *K. brevis* and *K. mikimotoi* are known to be present in Russian waters although no toxin monitoring is done. *K. mikimotoi* and

K. brevis have caused fish kills in Japan, Korea, and China. Shiguru Itakura (Japan) described the ability of *K. mikimotoi* to grow well in low light, suggesting that this species does well during the rainy season in both eurythermal and euryhaline environments. Ruixiang Li (China) described *K. mikimotoi* blooms in the Bohai Sea, S. China Sea, Yangtze River estuary, East China Sea and the coastal waters of Tianjin City. Other *Karenia* species have been identified around the world, but these are the two major problem species in PICES member countries.

Prorocentrum spp. HABs were described primarily for the western Pacific where they pose the greatest problem. Tatiana Morozova described over 9 planktonic species of *Prorocentrum* on the coastline of eastern Russia, with 10 additional benthic speceis known from Peter the Great Bay. Douding Lu described *Prorocentrum* spp. blooms in the E. China Sea as a major species causing red tides in Asian waters. He noted that species identification was important as there are many mistaken species descriptions in the literature. Weol Ae Lim showed that *Prorocentrum* blooms are spreading in geographical area since the 1970s, primarily to areas of increased anthropogenic nutrients. Mingyuan Zhu described situations where *Karenia* and *Prorocentrum* can co-occur in Chinese coatal waters.

List of papers

Oral presentations
Laboratory demonstrations on detection techniques for algal toxins
Jacob <u>Larsen</u>
Microscopic Observations and detailed analysis of *Karenia* and *Prorocentrun* taxonomy

Workshop
Jacob <u>Larsen</u> (Invited)
Karenia and *Prorocentrum:* Review

Yutao <u>Qin</u>, Jinhui Wang, Yanqing Wu, MingYuan Zhu and Lingyun Xiang
Blooms of *Karenia mikimotoi* and *Prorocentrum* sp. in the East China Sea

Charles G. <u>Trick</u>
A historical overview of *Karenia* and *Prorocentrum* occurrences in North American coastal waters

Tatiana V. <u>Morozova</u>, Tatiana Yu. Orlova, Marina S. Selina and Inna V. Stonik
Species of the genera *Karenia* and *Prorocentrum* from the east coast of Russia

Douding <u>Lu</u>
The species complex *Prorocetrum donghaiense* (*"dentatum"*) in East Asian waters

Mineo Yamaguchi, Shigeru <u>Itakura</u> and Ichiro Imai
Ecophysiological characteristics of the harmful dinoflagellate *Karenia mikimotoi* in Japanese coastal waters

Yang-Soon Kang, Youngtae Park, Kyung Suk Seo and Yoon <u>Lee</u>
Karenia spp. and *Prorocentrum* spp. blooms in Korean coastal waters

Ruixiang <u>Li</u>, Mingyuan Zhu and Jianqiang Yang
The formation of *Karenia mikimotoi* blooms in the Bohai Sea, China

Songhui Lu
An ecological study of a *Karenia mikimotoi* bloom in the East China Sea in 2005

Mingyuan Zhu, Ruixiang Li and Zongling Wang
Study on growth of macro green algae *Enteromorpha prolifera*

David G. Foley
Data integration to help identify and monitor harmful algal blooms along the West Coast of North America

Takafumi Yoshida and Hidemasa Yamamoto
HAB-related Activities of NOWPAP CEARAC in the NOWPAP Region

Posters

Yasuhiro Yamasaki, Masayuki Tameishi, Sou Nagasoe, Yohei Shimasaki, Yuji Oshima, Kenichi Yamaguchi, Tatsuya Oda and Tsuneo Honjo
Allelopathic effects of the dinophyte *Prorocentrum minimum* on the growth of the bacillariophyte *Skeletonema costatum*

Jong-Gyu Park, Weol Ae Lim, Yang-Soon Kang, Kyung Suk Seo and Yoon Lee
Pseudo-nitzschia in Korean coastal waters

Tae-Gyu Park, Yang-Soon Kang, Youngtae Park, Heon Meen Bae and Yoon Lee
Fish killing dinoflagellate *Cochlodinium polykrikoides* (Dinophyceae) blooms in Korea in 2007

BIO Workshop (W2)
Oceanic ecodynamics comparison in the subarctic Pacific

Co-Convenors: Charles B. Miller (U.S.A.) and Atsushi Yamaguchi (Japan)

Background

OECOS (**O**ceanic **E**codynamics **CO**mparison in the **S**ubarctic Pacific) is a PICES project, originally aiming to advance our understanding of the dynamics of lower trophic levels in the pelagic systems of the subarctic Pacific through a comparison of the east–west regions at a new level of detail. The first OECOS workshop was held in May 2005, at Oregon State University (U.S.A.), and participants from Japan (western Pacific region) and the U.S. and Canada (eastern Pacific region) discussed gaps in our knowledge about ecosystem dynamics of both eastern and western sectors of the subarctic Pacific, and new coordinated approaches for future research activities (PICES Scientific Report No. 32, 2006). In March–April 2007, the western group (OECOS WEST) conducted two cruises to the Oyashio region before and during massive spring phytoplankton blooms. In both cruises, high-frequency samplings were made of various biological components (bacteria, phytoplankton, micro-, meso- and macrozooplankton, and micronekton) and nutrients (including iron). To aid analysis of the origin and history of water masses at the study sites, frequent CTD casts and satellite monitoring of SST and water color were made. Drifting sediment traps were tracked to collect setting particles from the upper layers. At this workshop, recent achievements of OECOS WEST were presented and discussed along with new OECOS West and East research prospects.

Summary of presentations

All registered participants were able to attend the workshop, which proceeded exactly to the schedule on page 241 of the 17th Annual Meeting program.

1) Dr. Atsushi Yamaguchi reviewed the history of the successful Japanese expeditions to the Oyashio from March 8–15, 2007 (T/S *Oshoro Maru*) and from April 5–May 1, 2007 (R/V *Hakuho Maru*). He reported that the Japanese team of 'OECOS-West' has held two conferences after the expeditions to discuss the results.

2) Dr. Tokihiro Kono described the hydrographic circumstances during the cruises. Stations occupied were along the A-line extending southeast from Hokkaido's east coast, with much of the station work concentrated at station A4. Frequent CTD casts during both cruises showed strongly shifting proportions of offshore Oyashio Water (OYW) – a northern influence, coastal Oyashio water (COW) from over the Hokkaido shelf, and modified Kuroshio water (MKW) that appeared in satellite images as a Kuroshio loop or boundary eddy. MKW was most prevalent at station A5, but mixtures of all

three types were present throughout the April work. Greatest chlorophyll concentrations were associated with greater proportions of COW. The importance of advective variation was evident in all variables (T, S, chlorophyll and other biology).

3) Dr. Kenshi Kuma reported measures of dissolved and total (including particulate) iron concentration. Dissolved iron values were remarkably similar between prebloom and bloom periods, 0.3–0.5 nM and 0.4–0.6 nM, respectively. However, total iron shifted sharply upward from the March values of 3–5 nM during strong, deep vertical mixing to 10–25 nM during the intrusions with highest chlorophyll (10–23 μg/l) in April. At stations along the A-line, iron supply appeared to vary with the sources of advection.

4) Mr. Tomonori Isada detailed the ambitious set of phytoplankton observations completed during the cruises. Flora in the bloom period was strongly dominated by diatoms, shifting from *Thalassiosira* species initially to *Chaetoceros* species. There were several species of each in the two bloom phases. Nano- and picophytoplankton became progressively more important toward the end of the cruise. There were signs in the physiology of diatoms (F_v/F_m and flavodoxin/ferrodoxin ratio) that iron stress was significant despite high total iron and abundant macronutrients.

5) Results of dilution experiments to measure phytoplankton growth and microzooplankton grazing rates were presented by Dr. Takashi Ota. Grazing rates were very low mostly 5–15% of initial chlorophyll stock per day, or 10–30% of primary production. Phytoplankton growth rates were high during the events with highest chlorophyll stocks, up to $0.52 \, d^{-1}$.

6) Dr. Yamaguchi described the time-series sampling for mesozooplankton with three different net systems. Most of the *Neocalanus* stock was in the upper water column with no discernible vertical migration, while *Metridia pacifica* migrated in early April but stopped (except for C6-females) toward the end of the cruise, staying during night at the daytime depth. The reason was not clear. Developmental progression was clear for *Neocalanus flemingeri* (C1–C4) and for *N. cristatus* (C2–C4). Only part of the *Eucalanus bungii* population migrated into surface layers at night, with females producing eggs near the surface. Spawning rates were determined for that species only.

7) Dr. Toru Kobari reported that gut content chlorophyll of *N. cristatus* and *E. bungii* varied with water column chlorophyll levels, with extreme amounts in the diets associated with the highest bloom levels. The overall copepod community feeding rate was estimated as $0.1–1.2 \, gC \, m^{-2} \, d^{-1}$. This was a significant fraction of the primary production, reported by Mr. Isada as $0.5–3.5 \, gC \, m^{-2} \, d^{-1}$. Obviously, copepod grazing was not sufficient to prevent further development of the bloom at any point, but phytoplankton must have been the major constituent of the copepod diet, unlike the situation in continuously oligotrophic areas farther seaward. Establishing this point was a major goal of OECOS.

8) Doctoral candidate, Hye Seon Kim, reported on the metabolism and growth of two species of euphausiid abundant in the Oyashio: *Euphausia pacifica* and *Thsanoessa inspinata.* Euphausiid abundance varied with the chlorophyll concentration, suggesting that supply to the A-line stations was affected by the varying water sources. Length distributions of both species suggested only slight growth during the April cruise. It was noted that all *T. inspinata* less than the modal size were male, all those larger were female. This suggests protandrous hermaphroditism, a unique finding for euphausiids but occurring in some decapod crustacean. Metabolic rates did not vary much with the temperature or food availability during the two-cruise series, even though chlorophyll levels were ery different between March and April.

9) Midwater trawl and acoustic estimates of mesopelagic fish were reported by Mr. Tadanori Fujino. Scattering layers at 200 m appeared to stay in that vicinity day and night. Dominant species captured with a $16 \, m^2$ trawl were *Diaphus theta* and *Stenobrachius leucopsaurus.* Mr. Fujino characterized the estimated abundance of the two species, $6.9 \, g \, m^{-2}$, as less than typical for the region.

10) Three papers were presented by participants in the failed attempt to obtain funding for a parallel study in the Gulf of Alaska. Drs. Michael Dagg and Suzanne Strom reported results from the GLOBEC Northeast Pacific program work on the Alaskan shelf. In apparently iron-limited waters at the shelf edge, Dr. Dagg found that grazing by *Neocalanus* spp. could be (1) keeping large phytoplankton from blooming – balancing their slow growth rate with grazing, and (2) releasing nano- and picophytoplankton from predation by microherbivores. Dr. Strom reported on the lower trophic level community composition shelf-edge waters, showing the parallel to definitively iron-limited communities farther seaward. Events are observed in which iron limitationis relieved at and beyond the shelf edge by both riverine discharges laden with sediment and by wind-borne dust plumes. Dr. Charles Miller reviewed the original OECOS-East plan to investigate the likely causal correlates of

subseasonal variation in phytoplankton stock abundance at Station P. He stressed that detailed evaluation of relations at the lowest trophic levels in *without* supplementing the iron availability is a key to understanding the function of HNLC ecosystems. The key is to determine the phase relations of physics, nutrients, floristics, microherbivores and macrozooplankton to the subseasonal variation of chlorophyll (and likely to more explicit measure of phytoplankton biomass).

It as clear from the reports that OECOS-West produced excellent results and valuable insights about ecosystem function during the Oyashio spring bloom. Another attempt at such a time series should consider moving farther away from Hokkaido and from the Kuroshio–Oyashio frontal region. Such a project might well be undertaken under Russian auspices someplace well offshore from Sakalin or southern Kamchatka.

<u>List of papers</u>

Oral presentations

Atsushi <u>Yamaguchi</u> and Charles B. Miller
OECOS Workshop, PICES XVII, Dalian, China: Physical, chemical and biological dynamics of the Oyashio spring bloom

Tokihiro <u>Kono</u> and Masatoshi Sato (Invited)
Effect of water mass structure on the spring bloom in the Oyashio region revealed by sequential observations

Kenshi <u>Kuma</u>, Koji Sugie, Satoshi Fujita and Yuta Nakayama
Temporal variability and bioavailability of iron and nutrient during spring phytoplankton bloom in the Oyashio region

Tomonori <u>Isada</u>, Ai Hattori, Koji Suzuki, Mitsuhide Sato and Ken Furuya
Community structure, productivity and photosynthetic physiology of phytoplankton in the Oyashio region of the NW subarctic Pacific during spring 2007

Takashi <u>Ota</u>, Toru Kobari, Mutsuo Ishinomiya, Yasushi Gomi and Yasumasa Oikawa
Grazing activity of microzooplankton during a diatom bloom in the Oyasio region

Atsushi <u>Yamaguchi</u>, Yuka Onishi, Aya Omata, Mariko Kaneda, Momoka Kawai and Tsutomu Ikeda
Vertical distribution and population structure of large grazing copepods during spring phytoplankton bloom in the Oyashio region

Toru <u>Kobari</u>, Yumi Inoue, Yosuke Nakamura, Hidemi Okamura, Takashi Ota, Yuichiro Nishibe and Mutsuo Ichinomiya
Feeding impacts of ontogenetically migrating copepods on the spring phytoplankton bloom in the Oyashio region

Hye Seon <u>Kim</u>, Atsushi Yamaguchi and Tsutomu Ikeda
Abundance, metabolic rate and body composition of the euphausiid *Euphausia pacifica* and *Thysanoessa inspinata* during spring phytoplankton bloom in the Oyashio region

Tadanori <u>Fujino</u>, Yusuke Ito, Hiroki Yasuma and Kazushi Miyashita
Abundance and distribution of micronektonic, mesopelagic fish at the 2007 OECOS observation site (Northwest Pacific)

Michael <u>Dagg</u>, S. Strom and H. Liu
Phytoplankton community structure in the HNLC subarctic Pacific Ocean is determined by *Neocalanus flemingeri* and *N. plumchrus*

Suzanne L. <u>Strom</u>, K.A. Fredrickson, F. Perez, M.B. Olson and E.L. Macri
Lower trophic level responses to gradients in iron availability in the eastern subarctic Pacific

Charles B. <u>Miller</u>
OECOS Workshop: Open issues in production ecology of the oceanic Gulf of Alaska

MONITOR/ESSAS Workshop (W3)
Status of marine ecosystems in the sub-Arctic and Arctic seas – Preliminary results of IPY field monitoring in 2007 and 2008

Co-Convenors: Ken Drinkwater (Norway), George Hunt, Jr. (U.S.A.), Sei-Ichi Saitoh (Japan), and Jin Ping Zhao (China)

<u>Background</u>

The sub-Arctic and Arctic seas have distinct marine ecosystems that are affected by seasonal sea ice. During the summer, the water column is stratified by melt water from retreating sea ice, and phytoplankton are found near

the sea surface where the incoming sunlight is sufficient for photosynthesis. These summer conditions result in the highest primary production in the world's oceans and support high levels of fishery resources. Algae that live on the bottom of sea ice also play an important role in maintaining fishery resources by falling and decomposing on the sea floor in summer. Recently, global climate change has become a cause for concern. The greenhouse effect, produced by increasing anthropogenic CO_2 emissions, has induced increases in atmospheric and seawater temperatures. The effect of such increases on the cryosphere of the Arctic is already visible, and understanding its direct and indirect effects on the physical and chemical environments and the responses of marine ecosystems is critical. However, the knowledge of most aspects and responses of marine ecosystems to global climate change is still inadequate. PICES member countries conducted several field programs in these regions during the International Polar Year (IPY) 2007–2008. This workshop discussed the features and mechanisms of the responses of marine ecosystems to global climate change in the Arctic and sub-Arctic seas, based on results from the IPY cruises in 2007 and 2008.

Summary of presentations

A total of 17 presentations and 4 posters were given as part of this IPY workshop. The primary objective was to provide updates on what data have been collected and some initial results. The workshop began with the invited talk by Dr. Bob Dickson from Lowestoft in the UK who discussed the integrated Arctic Ocean Observing System (IAOOS). He provided a synthesis of the physical oceanographic data collected around the Arctic and subarctic within IPY and how they fit with earlier data. He stressed that the concentrated efforts of the various nations under IPY are allowing us to view the Arctic ocean–atmosphere–cryosphere system as a complete unit for the first time. Of particular importance was the close connection and interaction between the Arctic and the sub-Arctic.

ESSAS is coordinating the international consortium, Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) that includes 11 projects lead by 8 different nations and one internationally funded project. An overview of the work being carried out within ESSAR was presented. All but a few of the presentations and posters during the workshop represented results from the ESSAR consortium. This included studies undertaken by China, Japan, the U.S. and Norway as well as the international project, Trans North Atlantic Sightings Survey (T-NASS), which focuses on cetaceans. The survey during IPY is being compared with earlier surveys begun in the late 1980s and conducted approximately every 5 years. IPY has resulted in the first coordinated North Atlantic-wide survey with coverage in the Northwest Atlantic supplementing the surveys carried out in the central and Northeast Atlantic.

China reported on retrospective analyses related to its IPY work as well as some recent data collected on their 2008 cruise across the Bering Sea reaching into the Arctic to over 80°N. They showed the importance of this work was the flow of Bering Sea water in modifying the water mass conditions and structure in the Arctic, including the double halocline structure and the sub-surface warm water in the Canada Basin. Also, this flow supplies significant quantities of heat that appears to have played a role in the rapid melting of Arctic ice in recent years. Data also suggested an important nutrient flux into the Arctic by the Bering Strait inflow. Seasonal variability and trends in sea level elevations using historical data indicate wind forcing dominates the seasonal variability, although steric effects also contribute. Interannual sea level changes revealed a weak increasing trend of about 1 mm y^{-1} over the Arctic. Hydrographic data collected by China during 2008 in the Bering Sea indicated a large quantity of cold water below 40 m on the northern Bering Shelf between the 40–100 m isobaths that extended south to the continental shelf. It was speculated that this cold water formed in Anadyr Bay or south of St. Lawrence Island. Dr. Kohei Mizobata, another invited speaker, presented observations taken by Japan in the Western Arctic during IPY cruises in 2008 that extended north to 71°N. He discussed the role of the circulation, and especially eddies, in transporting shelf water into the deep basin in the Arctic. The role of heat fluxes through the Bering Strait on the ice retreat in the Arctic was also presented and was consistent with the Chinese observations. Other speakers showed evidence of increased primary production in the open waters of the Arctic that were previously ice covered. The biodiversity of fish species in the northern Bering and Arctic was also investigated, with evidence that Arctic cod might have decreased in abundance and moved farther north in 2007 compared to data collected in the early 1990s. Another Japanese study found that the continental shelf waters in the Sea of Okhotsk are an important source of iron to the western subarctic Pacific. In Norway, their IPY ecosystem program is focusing upon the fronts between the cold Arctic waters and warm Atlantic waters. Results from both the Barents and the Norwegian seas were presented

and show that the hydrography of the front seems to structure the biology, including the fish and its feeding patterns. Dr. Lee Cooper of the U.S. was the third invited speaker and he discussed the approaches in the two IPY programs, the Bering Sea Ecosystem Study (BEST) and the Bering Sea Integrated Ecosystem Research Program (BSIERP). He highlighted the large changes in the benthic biomass and community structure in the Bering since 1970 and discussed changes in the primary production and biomass under different oceanographic conditions.

A short discussion at the end of the workshop focused on the need for scientists to meet to compare and contrast their data and should not only be between NESSAR projects but with other IPY programs as well. This is especially important as the data analysis progresses beyond its present preliminary stage. ESSAS is looking forward to further promoting comparative studies within the PICES community and between ICES and PICES.

<u>List of papers</u>

Oral presentations

Robert R. Dickson (Invited)
The integrated Arctic Ocean Observing System (iAOOS)

Ling Du, Jia Wang and Juncheng Zuo
Sea level variation and its contributing factors in the Arctic Ocean and sub-Arctic region

Yong Cao and Jinping Zhao
A study of the subsurface warm water and its formation mechanism in the Canada Basin

Jie Su, Dong Xu, Shujiang Li and Jinping Zhao
Interannual variations of sea ice in the Pacific side of the Arctic and its relation with the Pacific Inflow

Kohei Mizobata, Koji Shimada, Sei-ichi Saitoh, Toru Hirawake and Masahiro Hori (Invited)
Japanese IPY activities in the western Arctic Ocean and the Bering Sea

Jinping Zhao and Jiuxin Shi
Study of the extension of Pacific warm water under sea ice of the Chukchi Sea

Liqi Chen and Zhongyong Gao
Differences of water masses in Bering Strait throughflow and mixing on their way to the Arctic Ocean

Sei-Ichi Saitoh and Toru Hirawake
Preliminarily results from the Oshoro-Maru IPY cruises in summer 2007 and 2008

Jiuxin Shi, Jinping Zhao and Shujiang Li
The double haloclines in the Canada Basin under the warming climate

Lee W. Cooper and Jacqueline M. Grebmeier (Invited)
Results from BEST, BSIERP and other IPY-relevant research in the northern Bering Sea

Nikolay S. Vanin
The summer hydrography of the west Chukchi Sea shelf during opposite patterns of atmospheric circulation in 2007 and 2003

Sei-Ichi Saitoh, I Nyoman Radiarta, Toru Hirawake, Yasunori Sakurai, Mamoru Yabe, Yoshihiko Kamei and Shogo Takagi
Change in the biodiversity of the demersal fish community in the northern Bering and Chukchi Seas

Kenneth F. Drinkwater
A frontal attack – Norwegian IPY studies of the Arctic Front in the Norwegian and Barents Seas

Jun Nishioka, Takeshi Nakatsuka, Kenshi Kuma, Yutaka W. Watanabe, Tsuneo Ono and Kay I. Ohshima
The importance of sea-ice formation in the Sea of Okhotsk for supplying iron to the western subarctic Pacific

Kenneth F. Drinkwater
The Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) Consortium

Geneviève Desportes, Daniel Pike, Mario Acquarone, Igor Golyak, Jean François Gosselin, Thorvaldur Gunnlaugsson, Sverrir D. Halldórsson, Mads Peter Heide-Jørgensen, Jack Lawson, Christina Lockyer, Bjarni Mikkelsen, Droplaug Ólafsdóttir and Malene Simon
From the Barents Sea to the St. Lawrence: A Trans North Atlantic Sightings Survey (T-NASS)

George L. Hunt, Jr.
Hotspots in cold seas

Posters

Wen Yu, Liqi Chen, Jianping Cheng, Jianhua He, Zhongyong Gao and Heng Sun
Western Arctic Ocean POC flux derived by the small volume 234Th method

Eduard A. Spivak, Nina I. Savelieva and Anatoliy N. Salyuk

Winter oceanographic conditions in the coastal waters of the Laptev Sea (Buor-Khaya Bay) – Results of IPY field monitoring in 2007
Shinya Nagashima, Hideaki Kudo and Masahide <u>Kaeriyama</u>
Spatial comparison of the feeding ecology of Pacific salmon in the North Pacific Ocean during summer of 2007 IPY (Preliminary results)
Hongli <u>Fu</u>, Jinping Zhao and Jie Su
Study of polynya processes in the Bering Sea using a high resolution dynamic-thermodynamic sea ice model

CCCC/POC/FIS Workshop (W4)
Climate scenarios for ecosystem modeling (II)

Co-Convenors: Michael G. Foreman (Canada), Anne B. Hollowed (U.S.A.), Suam Kim (Korea) and Gordon McFarlane (Canada)

<u>Background</u>

Members of the Climate Forcing and Marine Ecosystem Task Team (CFAME), the Working Group on Evaluations of Climate Change Projections (WG 20), and the FIS Committee presented the results of their research on developing and applying the output of regional and global climate scenarios to ecosystem and fish stock forecasts. These groups have been developing conceptual and empirical models of the mechanisms that link climate variation to the dynamics of marine ecosystems and their commercially important species. Their work has focused on comparisons among a diversity of North Pacific ecosystems with differing dominant physical processes. WG 20 is developing higher resolution regional coupled atmosphere–ocean models forced by IPCC global or regional models to provide forecasts of regional parameters (such as SST, sea ice cover, and river discharge) that are relevant to ecosystem processes. This workshop provided an opportunity to discuss the results, present them to the PICES community, and describe their potential for the FUTURE Program.

<u>List of papers</u>

Oral presentations

Thomas A. <u>Okey</u>, Anne B. Hollowed, Michael J. Schirripa and Richard J. Beamish (Invited)
The 2035 modelling challenge for forecasting climate impacts on marine biota and fisheries: A collaboration emerging from an international workshop

James E. <u>Overland</u>, Muyin Wang and Nicholas A. Bond
Utility of climate models for regional ecosystem projections

Young Shil <u>Kang</u> and Sukgeun Jung
Regional differences in responses of meso-zooplankton to long-term oceanographic changes in Korean sea waters

Yasuhiro <u>Yamanaka</u> *et al.*
(WG 20 update): Recent results connecting climate change to fish resources using the high resolution model, COCO-NEMURO

Emanuele <u>Di Lorenzo,</u> N. Schneider, K.M. Cobb, K. Chhak, P.J.S. Franks, A.J. Miller, J.C. McWilliams, S.J. Bograd, W.J. Arango, H. Sydeman, E. Curchister, T.M. Powell and P. Rivere
(WG 20 update): North Pacific Decadal Variability in the FUTURE

James <u>Christian</u>
(WG 20 update): Canadian Earth System Model scenarios for the North Pacific

Qigeng <u>Zhao</u>, Qingquan Li, Jianglong Li and Fanghua Wu
A simulation of acidification in the Pacific Ocean

Enrique <u>Curchitser</u>, William Large, Jon Wolfe and Kate Hedstrom
(WG 20 update): Downscaling climate scenarios with a fully coupled global-to-regional model

Michael G. <u>Foreman</u>, William J. Merryfield, Badal Pal and Eric Salathé
An update of regional climate modelling along the British Columbia Shelf

Vadim <u>Navrotsky</u>
(WG20 update): On the role of ocean and land living matter in Global Climate Change

Anne B. <u>Hollowed</u>, Teresa A'mar, Richard J. Beamish, Nicholas A. Bond, James E. Overland, Michael Schirripa and Tom Wilderbuer
Fish population response to future climate drivers: A next step forward

Gordon H. Kruse, Jie Zheng and James E. Overland
A scenario approach to forecast potential impacts of climate change on red king crabs in the Eastern Bering Sea

Sukyung Kang, Jae Bong Lee, Anne B. Hollowed, Nicholas A. Bond and Suam Kim
Techniques for forecasting climate-induced variation in the distribution and abundance of mackerels in the northwestern Pacific

Michio J. Kishi, Yasunori Sakurai and Masahide Kaeriyama
What affects on the growth and stock of chum salmon, walleye pollack, and common squid in the Northern Pacific

Richard J. Beamish
A tail of two sockeyes

Richard J. Beamish
Evidence that the carrying capacity of local marine ecosystems can regulate the productivity of chinook salmon

Poster

Leonid Klyashtorin and Alexey Lyubushin
Cyclic climate changes and salmon production in the North Pacific

CCCC/ESSSAS Workshop (W5)
Marine ecosystem model inter-comparisons

Co-Convenors: Masahiko Fujii (Japan), Shin-ichi Ito (Japan) and Bernard A. Megrey (U.S.A.)

Background

Comparative analysis is a valuable scientific activity because the size and complexity of marine ecosystems precludes conducting controlled *in situ* experiments. It is also a powerful technique for understanding the important similarities and differences between and among ecosystems. Modelling is a central approach to comparative analyses of ecosystem structure, function and responses. It is important to understand whether inter-relationships among physical, chemical and biological variables vary geographically, and the extent to which any particular conclusions depend on the model used to derive them. The model inter-comparison project will use different models to develop forecasts of different ecosystems and will use different models to compare forecasts of the same location/species. The intention of the project is to develop ensemble model forecasts to compare predicted and observed responses of marine ecosystem types to global changes–similar to the widely-accepted approach used by the IPCC to evaluate alternative climate models. The project will implement the same model evaluation process with marine ecosystem models rather than climate prediction models.

A major goal of the workshop was to begin planning the work of the project. Workshop activities included: (1) nomination and discussion of potential models (and their data needs) to compare (the EurOceans Model Shopping Tool, http://www.eur-oceans.eu/WP3.1/shopping_tool/about.php, which provides a large array of documented models from which to choose); (2) nominating location(s) for comparisons; (3) identifying comparison protocols to compare model performance, given data needs against location data availability and compatibility; (4) identifying the most appropriate indicator species on which to base comparisons, such as krill, as the "metric" for correct model behavior; and (5) planning "pseudo-controlled" experiments. Workshop participants were advised have at least one of the following characteristics: (a) be familiar with ecosystem models from beyond the PICES region; (b) be knowledgeable about running models; (c) be an expert on the life histories of selected organisms and data associated with them; and (d) have a broad perspective on marine ecosystems.

Summary of presentations

The PICES working group on Marine Ecosystem Model Inter-Comparison met for the first time in Dalian China. The session opened with a brief introduction. Then, the audience (40–55 people) listened to several stimulating presentations. These included the benefit of performing model inter-comparisons, methods of assessing model skill assessment, and three presentations on krill and copepod biology and ecology. A lengthy discussion took place on five main questions which were intended to frame the preparation of a work plan: (1) identifying the objective of the models used for inter-comparison, (2) which models to

compare, (3) identifying location(s) for comparison, (4) identifying comparison protocols (model skill assessment), and (5) identifying indicator species.

Plans were being developed to solicit active participation and contribution of models. The objective of the inter-comparison was to apply several models to one location in order to identify important mechanisms that control secondary production abundance and variability as well as bounding the levels of uncertainty in model predictions by calculating ensemble statistics. This approach could be applied to several places simultaneously as an extension. However, it was necessary discuss the selection of locations where the model was to be applied.

A schedule of activities was proposed and accepted. This meeting report was presented at the Science Board meeting in Dalian. Participants were be contacted via email to get confirmation of their willingness to participate and be active (November–December 2008), a work plan was to be prepared (November 2008–April 2009), and the work plan was to be presented at inter-sessional Science Board meeting (April 2009) along with a proposal to hold a modeling workshop at PICES-2009 to compile observational data and begin model construction, parameterization (October 2009).

List of papers

Oral presentations

Fei Chai, Masahiko Fujii and Marjorie Friedrichs (Keynote)
A regional ecosystem modeling intercomparison project

J. Icarus Allen (Invited)
Some thoughts on assessing the skill of marine ecosystem models

William T. Peterson, Tracy Shaw, Jennifer Menkel and Leah Feinberg (Invited)
An overview of the ecology and population dynamics of euphausiids around the Pacific Rim

Harold (Hal) P. Batchelder (Invited)
Copepods as indicator species for comparing pelagic marine ecosystem models

Toru Kobari, Tsutomu Ikeda, Michael Dagg and Atsushi Yamaguchi (Invited)
Neocalanus copepods are useful for inter-comparison of marine ecosystem models in the PICES region

Best Presentations for Committee/Program-sponsored Topic Sessions or Workshops at PICES XVII

Science Board Best Oral Presenation

Emanuele Di Lorenzo (School of Earth and Atmospheric Sciences, Georgia Institute of Technology, U.S.A.) on "*North Pacific decadal variability in the future*" co-authored with Jason Furtado and Niklas Schneider

Best Oral Presentation by an early career scientist for the BIO-sponsored Workshop on "Oceanic ecodynamics comparison in the subarctic Pacific" (W2)

Tomonori Isada (Graduate School of Environmental Science and Faculty of Environmental Earth Science, Hokkaido University, Japan) on "Community structure, productivity and photosynthetic physiology of phytoplankton in the Oyashio region of the NW subarctic Pacific during spring 2007" co-authored with Ai Hattori, Koji Suzuki, Mitsuhide Sato and Ken Furuya

Best Poster for the BIO-sponsored Topic Session on"End-to-end food webs: Impacts of a changing ocean"(S9)

Russell W. Bradley (PRBO Conservation Science, U.S.A.) on "How effective are Cassin's auklets as environmental monitors in Central California?" co-authored with Peter Warzybok, Meredith L. Elliot, Benjamin L. Saenz, Nina J. Karnovsky and Jaime Jahncke

Best Oral Presentation by an early career scientist for the FIS-sponsored Contributed Paper Session

Anastasia M. Khrustaleva (Russian Federal Research Institute of Fisheries and Oceanography, VNIRO, Russia) on "Integrated method for sockeye salmon stock differentiation in the West Pacific and the Sea of Okhotsk"

Best Poster for the FIS-sponsored Contributed Paper Session

Chiyuki Sassa (Seikai National Fisheries Research Institute, Fisheries Research Agency, Japan) on "Distribution and biomass of *Benthosema pterotum* (Pisces: Myctophidae) in the shelf region of the East China Sea: Mechanisms of population maintenance" co-authored with Keisuke Yamamoto, Youichi Tsukamoto and Munecharu Tokimura

Best Oral Presentation by an early career scientist for the <u>MEQ-sponsored</u> Topic Session on "Connecting the human and natural dimensions of marine ecosystems and marine management in the PICES context"(S12)

Shang Chen (Research Center for Marine Ecology, First Institute of Oceanography, SOA, China) on "Change of ecosystem services of the Yellow River Delta Wetland, China" co-authored with Jian Liu, Tao Xia and Qixiang Wang

Best Poster for the <u>MEQ-sponsored</u> Topic Session on "Mariculture technology and husbandry for alternate and developing culture species"(S5)

Yubo Liang (National Marine Environmental Monitoring Center, China) on "Spatial distribution of *Perkinsus olseni* in the Manila clam *Ruditapes philippinarum* along Chinese coast" co-authored with Dongmei Li, Sa Liu, Xingbo Wang, Tao Song, Xing Miao, Guanhua Chen and Guize Liu

Best Oral Presentation by an early career scientist for the <u>POC-sponsored</u> Contributed Paper Session

Chuanyu Liu (Institute of Oceanology, Chinese Academy of Sciences, China) on "An N-shape thermal front in the western South Yellow Sea in winter" co-authored with Fan Wang

Best Poster for the <u>POC-sponsored</u> Contributed Paper Session

Masatoshi Sato (Unified Graduate School of Earth and Environmental Science, Tokai University, Japan) on "The 1000 km-scale variability of the dynamic height revealed by Argo CTD data at 40ºN in the North Pacific" co-authored with Tokihiro Kono

Best Oral Presentation by an early career scientist for the <u>MONITOR-sponsored</u> Workshop on "Status of marine ecosystems in the sub-Arctic and Arctic seas – Preliminary results of IPY field monitoring in 2007 and 2008 (W3)

Kohei Mizobata (Department of Ocean Sciences, Tokyo University of Marine Science and Technology, Japan) on "Japanese IPY activities in the western Arctic Ocean and the Bering Sea" co-authored with Koji Shimada, Sei-ichi Saitoh, Toru Hirawake and Masahiro Hori

Best Poster for the <u>MONITOR -sponsored Workshop</u> on "Status of marine ecosystems in the sub-Arctic and Arctic seas – Preliminary results of IPY field monitoring in 2007 and 2008 (W3)

Hongli Fu (Key Laboratory of Polar Oceanography and Global Ocean Change, Ocean University of China, China) on "Study of polynya processes in the Bearing Sea using a high resolution dynamic-thermodynamic sea ice model" co-authored with Jinping Zhao and Jie Su

Best Oral Presentation by an early career scientist for the <u>TCODE-sponsored</u> Topic Session on "Linking biology, chemistry, and physics in our observational systems – present status and FUTURE needs"(S2)

Hao Ma (Key Laboratory of Global Change and Marine-Atmospheric Chemistry, Third Institute of Oceanography, SOA, China) on "Upper ocean export of particulate organic carbon in the Bering Sea estimated from thorium-234" co-authored with Mingduan Yin, Liqi Chen, Jianhua He, Wen Yu and Shi Zeng

Best Poster for the <u>TCODE-sponsored</u> Topic Session on "Linking biology, chemistry, and physics in our observational systems – present status and FUTURE needs" (S2)

In-Seong Han (National Fisheries Research and Development Institute, Korea) on "Behavior of a low salinity water mass during summer in the South Sea of Korea using *in-situ* observations" co-authored with Takeshi Matsuno, Tomoharu Senjyu, Young-Sang Suh and Ki-Tack Seong

Best Oral Presentation by an early career scientist for the <u>CCCC Program-sponsored</u> Topic Session on "Marine system forecast models: Moving forward to the FUTURE"(S7)

Xunqiang Yin (First Institute of Oceanography, China) on "Ensemble adjustment Kalman filter study for Argo data" co-authored with Fangli Qiao, Yongzeng Yang and Chagshui Xia

Best Poster for the <u>CCCC Program-sponsored</u> Topic Session on "Marine system forecast models: Moving forward to the FUTURE"(S7)

Yasumasa Miyazawa (Frontier Research Center for Global Change, JAMSTEC, Japan) on "Toward a data-assimilation system for marginal seas in the SEA-WP region" co-authored with Yoshikazu Sasai and Kazuo Nadoaka