

SUMMARY OF SCIENTIFIC SESSIONS AND WORKSHOPS

Science Board Symposium (S1)

North Pacific Ecosystems Today, and Challenges in Understanding and Forecasting Change

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Background

Climate change and increasing development of coastal areas and their watersheds are two of the most serious threats to marine ecosystems in the North Pacific. It is probable that interactions between these stressors will be complex and consequences unknown and difficult to predict. Knowledge of the sensitivity and adaptability of natural and managed ecosystems to climate change is limited and confounded by the interaction of climate change with additional stressors such as fishing, habitat loss, and pollution. While inter-annual and decadal variability are dominant sources of climate variability in the North Pacific, global warming is expected to contribute significantly to future climate change. To improve our understanding of marine ecosystems of the North Pacific, it is imperative we identify the contribution of climate change to overall ecosystem change, and to strengthen our ability to forecast how marine and coastal ecosystems will adjust or respond to ongoing stresses from climate change and other human activities.

This symposium will focus on a series of major issues that are affecting North Pacific marine ecosystems including, but not limited to: changes in cycling of carbon and other elements, increasing acidification, decreasing oxygen concentrations, eutrophication, chemical and biological pollution, changing patterns of oceanic circulation, changes in the productivity and distribution of species (including shifts in migratory routes), shifts in species interactions, increased sea-level rise, and coastal erosion. Ideally, the contribution of climate change to ecosystem characteristics can be quantified and the information made available to the 5th assessment of the Intergovernmental Panel on Climate Change scheduled for 2013–2014.

Summary of Presentations

Due to the overwhelming response to the Science Board Symposium by PICES scientists, this year it was necessary to convene an additional half-day session of the symposium. Thus, the Science Board Symposium was held on Monday, October 25, 2010 (full day) and Friday, October 29, 2010 (half day) and consisted of 25 oral presentations (including one keynote address and seven invited talks) and 12 poster presentations.

The keynote address was given by Jack Barth (Oregon State University) and his presentation set the stage for the entire symposium in that as PICES moves forward with FUTURE implementation, it is imperative that fundamental physical and biological changes in North Pacific ecosystems are characterized and understood such that forecasts can be made. In his presentation, Jack used the hypoxia zone off the Oregon/Washington coast as an example. He showed how multiple platforms have contributed to increased spatial and temporal resolution of dissolved oxygen data over the continental shelf, especially the near-bottom layers where this phenomenon appears more prevalent in recent years. The availability of this high-resolution data will be essential for developing forecasts at regional and basin-level scales. He further showed how real-time data acquisition can be used to modify sampling programs “on the fly” such that impacts due to dramatic changes in dissolved oxygen concentrations can be linked to ecosystem responses. Given that ecosystem responses to multiple stressors is likely to be very complex and potentially difficult to forecast, Jack outlined the need to increase the number and type of physiochemical and biological variables that are measured and the need to collaborate and share data within the broader scientific community. Doing this well will ensure success of the PICES FUTURE program.

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There is little doubt that human activities will change as ecosystems respond to a variety of stressors, most notably climate change. Enrique Curchister took up the challenge of including the human dimension in ecosystem responses to climate change, a primary focus of FUTURE. He presented on-going work showing how models can be used to forecast environmental/ecological changes and how by overlaying human activity models it is possible to develop scenarios whereby dynamic feedbacks between sub-components of the larger model become possible. Ultimately, it will then be possible to infer human responses (and forcing) as a result of climate variability but there remain a number of challenges to ensure predictions/forecasts are accurate and informative.

Yasuhiro Yamanaka introduced us to COCO-NEMURO, a 3-D high resolution ecosystem model. He used this model to show small pelagic fish would respond to climate change under two CO₂ scenarios (current state and double (1% per year)). For transition and subarctic regions, the double CO₂ scenario resulted in a significantly earlier spring bloom that in turn reduced the spawning and juvenile growth periods for Japanese sardine that increased mortality and potentially lowering stock productivity. Again, this presentation showed how ecosystem responses are complex and can differ at different trophic levels.

Minhan Dai's presentation outlined the current understanding and challenges in understanding how coastal ocean carbon cycles work and how this is related to modulation of CO₂ in general. Carbon cycling in coastal systems is extremely complex, varying with spatial and temporal scales and oceanic domains (*e.g.*, river plumes, upwelling, eddies) but it is complicated further by extreme changes in upland systems and the interaction between terrestrial and aquatic carbon sources. Characterizing and forecasting the interaction between climate change and anthropogenic forcing will present unique challenges to FUTURE.

Continuing on the ecosystem response to stressor theme, James Orr outlined potential impacts of ocean acidification on North Pacific ecosystems. In his presentation, James showed specific locations where ocean acidification, fuelled by anthropogenic sources of CO₂, has resulted in corrosive conditions for some marine calcifiers that depend on aragonite or calcite for shell/skeleton formation, such as shell communities off Oregon and Alaska. Pacific cold-water corral communities are at risk of corrosion and it will be important to understand how other biological communities are responding to the shallowest saturation horizons in the world.

Coupled physical-biological models, although imperfect, can be useful to explore bottom-up and/or top-down changes due to climate change. Albert Hermann showed how his group has used multivariate Empirical Orthogonal Functions to characterize emergent properties from coupled models of the North Pacific, specifically predicted effects of climate variability on pelagic *vs.* benthic food webs on the Bearing Sea shelf and their dependence on ice cover. Applying this type of analysis should result in greater predictability at the ecosystem level over univariate analyses of fixed location data.

Frank Whitney showed how declining oxygen in the subarctic Pacific has weakened ocean ventilation over the past 25–50 years and resulted in ecosystem responses to this change. For example, biological communities compress or migrate to avoid deoxygenated waters but perhaps a less studied phenomenon is reduced transport of nutrients to surface waters resulting in increased storages of these nutrients at depth. Although changes in nitrate cycling had been noted at Ocean Station Papa, it now appears this phenomenon is more widespread, with similar observations off Japan and California. It is still too early to fully understand how these chemical changes might influence biological productivity and additional research is needed.

Human activities have resulted in significant stress to coastal ecosystems, often resulting in negative impacts. Mingjiang Zhou showed how the application of fertilizers in upland systems has resulted in significant eutrophication in some coastal systems due to biogeochemical changes to nitrogen and phosphorous cycling. In some cases, this anthropogenic eutrophication has resulted in increased harmful algal bloom (HAB) events, many of which are composed of nuisance species. Further, in some cases the blooms are so prolific that trophic impacts are realized. To better understand the entire process, end-to-end studies were proposed that could result in predictive models.

The remainder of the symposium included a variety of presentations related to the theme of understanding and forecasting ecosystem responses to natural or anthropogenic stressors, primarily climate change. This included presentations on various models that could be applied to characterize how ecosystems might respond to climate change and how societies around the North Pacific might be affected by these changes (*e.g.*, changes in fisheries resources and the need for management changes). A number of presentations used a variety of methods to explore how changes in the physical environment would result in biological changes, especially commercially harvested fish populations. A universal aspect of the presentations in this symposium highlighted the need to continue to monitor key variables at a variety of spatial and temporal scales while attempting to fill identified gaps. This will ensure scientists and managers fully appreciate how stressors are affecting different ecosystems around the North Pacific and how societies are responding to these changes. Although considerable challenges and gaps were identified in this symposium, it clearly showed that much thought and effort is already underway to better understand and forecast how human activities are changing our marine ecosystems. The diversity of data already collected by PICES scientists and monitoring programs currently under way in PICES member countries will prove invaluable for advancing FUTURE.

List of Papers

Oral Presentations

John A. Barth (Keynote)

Observing change in the Northeast Pacific: Past, present and FUTURE

Enrique N. Curchitser (Invited)

Modeling the Earth System: Are we ready?

Yasuhiro Yamanaka, Takeshi Okunishi, Taketo Hashioka, Hiroshi Sumata and Shin-ichi Ito (Invited)

Predicting marine ecosystem responses to climate change by a 3-D high-resolution ecosystem model

Neil S. Banas

Limits on predictability in a diversity-resolving plankton model: A strategy for ensemble ecosystem forecasting

Evan A. Howell, Jeffrey J. Polovina and John Dunne

Modeling the central North Pacific ecosystem response to predicted climate variations and fishery management scenarios

Minhan Dai (Invited)

Coastal ocean carbon cycling – Current understanding and challenges

James C. Orr (Invited)

Chemical potential for impacts of ocean acidification on Pacific Ocean ecosystems

Jeffrey J. Polovina, John Dunne, Phoebe Woodworth and Evan A. Howell

Projected expansion of the subtropical biome and contraction of the temperate and equatorial upwelling biomes in the North Pacific under global warming

Kenneth O. Coyle, Sarah Hinckley, Wei Cheng, Georgina Gibson, Albert J. Hermann and Kate Hedstrom

Production on the Gulf of Alaska shelf: Spatial-temporal expansion of GLOBEC field measurements using an ecosystem model embedded in a circulation model

Emanuele Di Lorenzo, Julie E. Keister, Sanae Chiba, Vincent Combes, Andrew C. Thomas, P. Ted Strub, Harold Batchelder, Steven J. Bograd, Peter J.S. Franks and William T. Peterson

The Pacific Boundary Ecosystems and Climate Study (POBEX)

Albert J. Hermann, Kerim Aydin, Nicholas A. Bond, Wei Cheng, Enrique N. Curchitser, Georgina A. Gibson, Kate Hedstrom, Ivonne Ortiz, Muyin Wang and Phyllis J. Stabeno (Invited)

Modes of biophysical variability on the Bering Sea shelf

Michael A. Litzow and Franz J. Mueter

Hare and Manta updated: Four decades of climate-biology covariation in the Northeast Pacific

Muyin Wang, James E. Overland and Nicholas A. Bond

Contributions of episodic events in decadal climate variation of the Bering Sea

George L. Hunt, Jr., Kenneth O. Coyle, Lisa Eisner, Edward V. Farley, Ron Heintz, Franz J. Mueter, Jeffrey M. Napp, James E. Overland, Patrick Ressler, Sigrid Salo and Phyllis J. Stabeno

Climate impacts on eastern Bering Sea food webs: A synthesis of new data and an assessment of the Oscillating Control Hypothesis

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Hiroaki Saito, Shin-ichi Ito, Atsushi Kawabata, Mitsutaku Makino, Shoshiro Minobe, Masami Nonaka, Takeshi Okunishi, Kazutaka Takahashi and Ichiro Yasuda

Forecasting fish species alternation: Results of the SUPRFISH programme and remaining issues

Shin-ichi Ito, Takeshi Okunishi, Michio J. Kishi and Muyin Wang

Projection of Pacific saury response to future climate change

Frank Whitney, Steven Bograd and Tsuneo Ono (Invited)

How does expanding hypoxia affect the nutrient budget of the subarctic Pacific?

Tsuneo Ono

Oxygen decline in the continental slope waters off-Japan and its potential influence on groundfishes

Steven J. Bograd, Carmen G. Castro, Francisco P. Chavez, Curtis A. Collins, Vincent Combes, Emanuele Di Lorenzo, Mark Ohman, Ryan Rykaczewski and Frank Whitney

The California Undercurrent: 1949–2009 and beyond

J. Anthony Koslow, Ralf Goericke and William Watson

Climate and fish assemblages of the southern California Current, 1951–2008

William W.L. Cheung, Thomas A. Okey and Richard D. Brodeur

Projecting future changes in distributions of pelagic nekton along the west coast of North America

Mingjiang Zhou (Invited)

Understanding harmful algal blooms in eutrophic coastal waters: Necessity of end-to-end studies

Jun-ya Shibata, Ryu Isonaka, Hideki Hamaoka, Kazumasa Matsumoto, Tetsuya Nanko, Todd W. Miller, Hidejiro Onishi, Tadao Kunihiro and Koji Omori

Relationship between food web structure of a lower trophic level community and transfer efficiency in a coastal sea

Sophia C. Johannessen and Robie W. Macdonald

Effects of local and global change on an inland sea: The Strait of Georgia, Canada

Poster Presentations

Svetlana Monakhtina

Skillfish (*Erilepis zonifer*): Traits of biology from a fishery near the Emperor Seamounts in the north-west Pacific Ocean

Fu-xin Sun, Ying Wang and Zhi-hong Wu

Study on bioaccumulation and elimination of *Chlamys farreri* to copper

Daoji Li, Haixia Liu and Ping Wang

Formation of summer hypoxia in the Yangtze River Estuary of China: “cold pool” and “thermal barrier” effects

Sayaka Matsumura, Hiroya Sugisaki, Hiroaki Saito, Yuji Okazaki and Tomohiko Kikuchi

Spatio-temporal changes in species diversity and assemblage structure of Euphausiids (Oyashio to Oyashio-Kuroshio Transition Region in the western north Pacific)

Kaoru Aoki, Kazuya Takeda, Satoshi Yamada, Takayoshi Yamashita and Tomohiko Kikuchi

Spatial-temporal distribution of *Aurelia aurita* in Mikawa Bay inferred from net sampling with a fish finder

Vladimir F. Krapivin and Ferdinand A. Mkrtchyan

Development of the simulation model of pollutant propagation in the Arctic Basin

Donhyug Kang, Hyungbeen Lee, Hye seon Kim, Woongseo Kim and Se-Jong Ju

Vertical signatures in acoustic estimates of zooplankton around the Yellow Sea Bottom Cold Water, Korea

Jeffery M. Napp, Carin Ashjian, Rodger Harvey, Mike Lomas, Mike Sigler and Phyllis Stabeno

Understanding ecosystem processes in the Bering Sea

Nora Deans, Thomas Van Pelt, Francis Wiese and Carolyn Rosner

Communicating ecosystem science: The Bering Sea Project

BIO Topic Session (S2)***Understanding the role of iron in regulating biogeochemical cycles and ecosystem structures in the North Pacific Ocean***

Co-sponsor: SOLAS

Co-Convenors: *Angelica Peña (Canada), Toshi Saito (Japan) and Mark Wells (USA)*Background

Iron plays a key role in regulating the biogeochemical cycles of carbon and nitrogen, and pelagic ecosystem structures in the North Pacific Ocean, yet our understanding of these effects remains limited. External sources of iron, such as Asian dust, rivers, sediments, and volcanoes, supply large amounts of iron to the North Pacific, while the physical processes of upwelling, meso-scale eddies, boundary currents, and tidal mixing transport deep waters with high iron concentration to the upper ocean. Biological uptake, zooplankton grazing, remineralization, and iron chemistry change the forms of iron and its distribution in the North Pacific Ocean. This session invited papers that address physical, biological and chemical processes controlling iron distribution and transformation, linkages between iron and ecosystem responses, and impacts on carbon and nitrogen cycles. Of special interest were papers that combine recent progress from field observations and modeling studies that relate iron cycling to ecosystem structures and carbon fluxes in the North Pacific Ocean.

Summary of presentations

The BIO Topic Session was held on Tuesday, October 26, 2010 and consisted of 11 oral presentations (including 2 invited talks). About 50 persons attended the session and generated interesting discussion. The papers presented at this session covered a wide range of topics from iron chemistry, sources, and distribution and iron impacts on plankton dynamics and DMS production. The first invited talk gave an introduction to iron chemistry and presented an overview on recent progress in studying how the chemical form of iron impacts its bioavailability. The second invited talk addressed the response of the marine ecosystem to natural iron fertilization by Asian dust. Dust storms carry a large amount of aerosol particles to the ocean which substantially affects surface biological production. The remaining talks covered a wide range of topics including mechanisms controlling dissolved iron distribution, sources and transport of iron by vertical winter mixing, eddies and currents, impact of Asian dust on DMS production, the role of zooplankton in smoothing the geographical heterogeneity of primary productivity generated by iron availability and the potential of ocean fertilization to sequester carbon. In addition, an overview of the activities of the international Surface Ocean-Lower Atmosphere Study (SOLAS) project was presented, including those which plans for iron related work.

List of papers*Oral presentations***Jay T. Cullen and Maria T. Maldonado** (Invited)

Iron speciation and bioavailability: Insight gained from analytical chemistry and microbial Physiology

Eric G. Roy and Mark L. Wells

Evidence for regulation of Fe(II) oxidation rates by organic complexing ligands in the Eastern Subarctic Pacific

Kazuhiro Misumi, Daisuke Tsumune, Yoshikatsu Yoshida, Takeshi Yoshimura, Keisuke Uchimoto, Tomohiro Nakamura, Jun Nishioka, Humio Mitsudera, Frank O. Bryan, Keith Lindsay, J. Keith Moore and Scott C. Doney

Mechanisms controlling dissolved iron distribution in the North Pacific: A model study

William Crawford

Advection of deep-sea and coastal water into the HNLC region of the northeast Pacific Ocean

Huiwang Gao, Xiaohong Yao, Jinhui Shi and Jianhua Qi (Invited)

Response of marine ecosystem to Asian dust fertilization from coastal sea to open ocean

Josiane Mélançon, Maurice Lévassieur, Martine Lizotte, Jean-Éric Tremblay, Gui-Peng Yang, Marjolaine Blais, Guangyu Shi, Hui-Wang Gao, Michael Arychuk, Keith Johnson, Nes Sutherland, Marie Robert and Wendy Richardson

Impact of Asian dust on plankton and DMS production in the Northeast Subarctic Pacific

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Jun Nishioka, Tsuneo Ono, Hiroaki Saito, Keiichiro Sakaoka and Takeshi Yoshimura

Oceanic iron supply mechanisms supporting the spring diatom bloom in the Oyashio region, western subarctic Pacific

Hiroaki Saito, Jun Nishioka, Atsushi Tsuda and Hiroaki Tatebe

The role of zooplankton in buffering geographical heterogeneity of primary productivity

Fei Chai, Peng Xiu, Huijie Xue, Lei Shi and Yi Chao

Modeling impacts of mesoscale eddies on iron cycle and biogeochemical processes in the Gulf of Alaska

Emilie Brévière

The international Surface Ocean - Lower Atmosphere Study (SOLAS) project and its midterm strategy

Hong Chen, Jianbo Han and Xiaomeng Wang

A review of the influence of ocean fertilization on marine biodiversity

BIO Topic Session (S3)

The Practical Handbook at 50: A celebration of the life and career of Tim Parsons

Co-Convenors: *James Christian (Canada) and Tsuneo Ono (Japan)*

Background

The importance of Strickland and Parsons' *A practical handbook of seawater analysis* to the development of oceanographic science is difficult to overstate. The first version of the manual, *A manual of sea water analysis*, was published by the Fisheries Research Board of Canada in 1960. Half a century on, we are in a position to examine the role that this manual and its descendants have played in the development of biological and chemical oceanography. This session explored the role that the development and standardization of analytical methods has played in the evolution of oceanography, and the evolution of our understanding of planktonic ecosystems that methodological innovation has catalyzed.

Summary of presentations

Topic Session S3 was held on Wednesday, October 27, 2010 and consisted of 7 oral presentations (3 invited and 4 contributed). We were fortunate to have had Tim Parsons in attendance. He made some introductory remarks that set the tone for the session: a wide ranging discussion that often focused on how much we still do not know.

Dr. David Mackas gave a presentation entitled "*You can learn a lot by looking*" in which he defended the role of observation unencumbered by stated hypotheses, as Dr. Parsons advocated throughout his career, but noted that Parsons had also been a strong advocate for controlled experiments (*e.g.*, CEPEX).

Dr. Yukihiro Nojiri gave a presentation on carbon system measurements, noting the substantial progress in this area over the past decades, the efforts at cross-calibration (*e.g.*, $p\text{CO}_2$ intercomparison experiments hosted by NIES), and the development of global data products.

Dr. Andrew Dickson discussed the measurement of pH and emphasized that maintaining consistent measurement quality requires ongoing effort and absolute standards against which differences among laboratories can be tested still do not exist.

Dr. Michio Aoyama discussed the development of Certified Reference Materials for nutrients in seawater, and the ongoing effort to develop methods by which measurements made by different laboratories can be compared.

Dr. Frank Whitney presented historical nutrient and oxygen data from Line P and discussed the efforts to maintain quality control in that long-standing program, also noting the importance of CRMs, open data sharing, and international efforts at cross-validation.

List of papers

Oral presentations

Yukihiro Nojiri (Invited)

Good on board practice for ocean carbon measurement and efforts toward international collaboration

David L. Mackas (Invited)

“You can learn a lot by looking”: The importance of exploratory observation (and occasional surprise) in biological oceanographic discovery

Michio Aoyama and David J. Hydes (Invited)

The new era of nutrients measurements in seawater with RM/CRM and the new manual: The joint IOC-ICES Study Group on Nutrient Standards (SGONS) and recent progress

James R. Christian

Evolution of marine microbial ecology

K. Banse, S.W.A. Naqvi, J.R. Postel and P.V. Narvekar

Twists in estimating temporal O₂ changes in oxygen minimum zones from old O₂ data

Frank Whitney and Janet Barwell-Clarke

Challenges in observing long term trends in oxygen and nutrients: Ocean Station P as an example

Andrew G. Dickson

Measuring pH in seawater: Prejudice, practice and pitfalls

BIO Topic Session (S4)

Census of Marine Life - Exploring ocean life: Past, present and future

Co-Convenors: *Michael Feldman, Clarence Pautzke, Andrew Rosenberg (U.S.A.) and Sinjae Yoo (Korea)*

Background

The Census of Marine Life (CoML) is a global scientific initiative to assess and explain the changing diversity, distribution, and abundance of marine species in the past and present, and to build the capacity to project future diversity. CoML is the initiative of unprecedented size and scope, engaging more than 2700 scientists and ocean professionals from over 80 countries with a common mission towards improving the understanding of life in the ocean. This session summarized the past 10 years of results and achievements from the global CoML program, and highlighted specific products and programs of CoML and how this new technology and data can be used and applied. The session included an overview talk, followed by representatives from many of the CoML projects including the seamounts project, the Mid-Atlantic ridge project, the tagging and tracking projects, the historical component of CoML, and the CoML synthesis team. Speakers discussed findings and discoveries, with particular attention to the information released at the CoML ‘Decade of Discovery’ events in London in early October 2010. Discussion focused on additional ways to apply the newly released CoML information to answer the growing global questions of ocean acidification and climate change, and the role of marine biodiversity information with managing through ecosystems approaches and marine spatial planning. The session concluded with a consideration of lessons learned from CoML, exploring some of the most successful (and some not-so successful) aspects of the program in the context of developing any future coordinated marine biodiversity efforts.

Summary of presentations

The session entitled “*The Census of Marine Life - Exploring ocean life: Past, present and future*” was held Friday, October 29 from 9:00–13:05. The session consisted of 10 oral presentations (3 invited) and included 2 posters. The goals of the session were to both disseminate the cumulative results of the decade long Census of Marine Life effort while exploring possible future directions and next steps for the science and the technology. The first speaker, Dr. Vera Alexander, provided an overview of the CoML leadership and

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explained some of the critical mechanisms which were needed to manage a global program consisting of over 2,700 participants in 80 different countries, including the unanticipated importance of the regionally led efforts. She also highlighted some of the legacies of CoML such as the network of scientists, the tools and technology developed (tagging and tracking, pyro-sequencing, *etc*), and the Ocean Biogeographic Information System or OBIS which contains 30 million individual observations of marine life. The second speaker, Dr. Tim Smith, focused on the historical component of CoML, highlighting that the human impact on the ocean began much earlier than previously thought, and that these long-term impacts need to be accounted for when managing the ocean. The next two speakers discussed some of the deep sea efforts of CoML, the number of new species discovered, and how much still remains unknown, as highlighted by Dr. John Dower's point of the 10s of thousands of known seamounts in the ocean, of which only about 400 have been explored. The next three speakers discussed the tagging and tracking projects of CoML, one of which utilized satellite tags on charismatic megafauna, the other which follows fish stocks with acoustic tags combined with an infrastructure of listening curtains along the Pacific continental shelf. The Tagging of Pacific Predators (TOPP) Project developed technologies to enable the use of animals as oceanographers, for example utilizing elephant seals to create temperature profiles of the Pacific as they migrate across the ocean. Dr. Elliot Hazen applied the TOPP results to develop models to measure seasonal and long-term habitat shifts of marine life as they relate to ocean temperature. This technology, combined with that of the Pacific Ocean Shelf Tracking project, have broad reaching applications toward making national and international observing systems operational, which Dr. Reginald Beach reinforced during his presentation of the recent National Ocean Partnership Program-sponsored workshop to obtain an operational biodiversity observing network. Dr. Paul Snelgrove, the final invited speaker, concluded the session by reviewing who led the CoML Synthesis team and by providing suggestions as to the next challenges in our oceans. Hiroko Sasaki, the lone early career scientist speaker of the session, from Hokkaido University, Japan, also presented on her cetacean research in the Bering and Chukchi Seas.

Overall, the session highlighted the value of communication across regions and disciplines with many of the speakers stressing that CoML would not have been nearly as successful without encouraging an atmosphere of collaboration. In addition, scientists should not ignore the value of communicating science, whether through visualizations or through images, art, and music to capture the public's imagination and support. Dr. Snelgrove closed by stating that the pressures on the ocean will worsen, not lessen, making it ever more important to continue the work of CoML to establish a baseline of what is in the ocean; figure out which species make the oceans function; and better provide managers with rational criteria for spatial management.

List of papers

Oral presentations

Vera Alexander, Patricia Miloslavich and Kristen Yarincik (Invited)

The Census of Marine Life – Evolution of a decade of worldwide marine biodiversity research

Tim D. Smith (Invited)

Confessions of a Convert: From fishery biology to historical marine ecology

John Dower

A World Census of Marine Life on Seamounts

Jose Angel A. Perez, Andrey Gebruk, Alexei M. Orlov, Stanislav Kobylansky and André Lima

Surveying the patterns of life in the understudied depths of the South Atlantic: Continuing the legacy of the MAR-ECO project (CoML) into the southern mid-Atlantic ridge

Steven J. Bograd, Barbara A. Block and Daniel P. Costa

Building a marine life observing system: Lessons from the Tagging of Pacific Pelagics (TOPP)

Elliott L. Hazen, Salvador Jorgensen, Ryan Rykaczewski, John Dunne, Steven Bograd, Dave Foley, Ian Jonsen, Arliss Winship, Daniel Costa and Barbara Block

Potential habitat shifts in Pacific top predators in a changing climate

John C. Payne

The future of POST

Reginald Beach, Daphne Fautin, J. Emmett Duffy, Heidi Sosik, John J. Stachowicz, Linda Amaral-Zettler, Tatiana Rynearson, Gustav Paulay and Hilary Goodwin

A national marine biodiversity observing network to inform ecosystem based management and science

Hiroko Sasaki, Keiko Sekiguchi and Sei-Ichi Saitoh

Cetacean habitat distribution in the eastern Bering Sea and Chukchi Sea

Paul V.R. Snelgrove (Invited)

Marine biodiversity in the 21st century: Making ocean life count

Poster Presentations

Hiroko Sasaki, Keiko Sekiguchi and Sei-Ichi Saitoh

Cetacean habitat distribution in the eastern Bering Sea and Chukch Sea

Joon Sang Park, Jang-Seu Ki and Jin Hwan Lee

The genus *Thalassiosira* (Bacillariophyceae): The surface ultrastructures of marginal fuftoportula and nuclear rDNA phylogenetic relationship

FIS Topic Session (S5)

Oceanographic and Demographic Processes Affecting the Reproductive Biology of Exploited Marine Stocks

Co-convenors: *Dr. Paul Spencer (USA), Dr. Chang Ik Zhang (R Korea) and Dr. Jin-Yeong Kim (R Korea)*

Background

Recent research has demonstrated several complexities in the reproductive processes of marine fish. First, for some cod and rockfish stocks there is evidence of a maternal effect upon larval quality such that larval viability increases with spawner age. Second, some iteroparous stocks show evidence of skipped spawning (*i.e.*, not all mature fish spawn in each year) that is related to environmental conditions and the life-history of the stock. Third, temporal changes in age at reproduction have occurred for some exploited stocks, and researchers are attempting to attribute this pattern to some combination of 1) demographic changes in age and size structure; 2) plastic responses to a changing environment; or 3) evolutionary responses to selective pressures. These complexities indicate that the production of reproductive output of marine stocks may be more complex than typically assumed in population models, and researchers are beginning to more fully incorporate reproductive biology in assessment procedures. The purpose of this symposium was to review field, laboratory, and modeling studies that may reveal how oceanographic variability, life-history pattern, and fishing pressure may affect the reproductive biology for North Pacific fish stocks, and consider how reproductive biology can best be incorporated into fishery assessment and management.

Summary of presentations

The topics identified above were addressed in 9 presentations and 7 posters which provided examples from a wide range of locations in the Pacific Ocean, as well the Antarctic Ocean and the east and west Atlantic Ocean.

Edward Trippel presented the keynote address in which he considered the implications of stock “juvenation” (the decrease in age structure) and increased temperatures upon reproductive output. A reduction in age structure is often associated with changes in spawning time, and reduced egg/larvae viability and survival. Additionally, increases in temperature are often associated with lower egg production, smaller egg size, and lower fertilization rates. Taken together, these two factors could combine to result in lower estimates of reproductive output, which could lead to erroneous interpretations of stock productivity when simple metrics such as spawning stock biomass are used.

Research on the relationship between environmental factors and spawning and larval distributions for eulachon and Pacific mackerel was also presented. For eulachon (an anadromous species), Doug Hay presented

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information indicating earlier spawning in northern rivers (*i.e.*, Alaska), which is hypothesized to be necessary to match the spring bloom, given the longer incubation periods in colder water. Additionally, spawning in traditional rivers has declined in nearly all areas south of Alaska, which could be attributed to climate change. However, marine abundances remain high, suggesting that the spawning locations may be changing. Ed Weber presented results from a Generalized Additive Model (GAM) that predicted Pacific mackerel larval distribution as a function of several environmental indices, including temperature, salinity, oxygen, and mixed layer depth. The current survey design for monitoring larval distribution and abundance does not consider environmental factors, which could be useful for allocating sampling effort for future surveys.

Cindy van Damme and Steve Parker presented research on reproductive processes. Van Damme proposed a conceptual model in which fecundity type (*i.e.*, determinate or indeterminate spawning) is affected by a number of factors, including spawning period, body condition, relative fecundity, latitude, temperature, and food availability. Principal component analyses applied to European groundfish indicate that fecundity type is not fixed, and can be regulated by food availability. Steve Parker presented research on Antarctic toothfish in the Ross Sea, which illustrated both the complexity of oogenesis and difficulty in obtaining samples at the optimal time and location. Oogenesis for this species is a multi-year process, but due to ice extent samples, are limited to a brief period in the summer in the northern and slope areas (which undersamples the smaller fish). Skipped spawning does occur, but primarily in the younger fish and not in fish in the northern area. The age at 50% maturity has been updated from 9 years to 16 years, which has decreased yield by about 15%.

Studies on measures of reproductive output, and their management implications, were presented by E.J. Dick and Joel Webb. For Pacific rockfish, Dick observed weight-specific relative fecundity (*i.e.*, relative fecundity increases with size), which is not consistent with the commonly used assumption that spawning stock biomass is proportional to egg production. A state-dependent life-history model was used to model allocation between growth and reproduction, and the pattern of increasing relative fecundity with size is consistent with survival costs associated with reproduction. These results suggest that stock assessments could be improved by utilizing observations on weight-specific relative fecundity and evaluating variable natural mortality rates with age. Joel Webb presented research on snow crab in the Bering Sea shelf, and demonstrated that fecundity is affected by both female age and temperature. Lower temperatures increase the embryo incubation time and can change the reproductive cycle from an annual cycle to a biennial cycle. Cold temperatures also disproportionately affect younger crabs due to their spatial distribution, and older crabs have an increased proportion of barren egg clutches. These factors affect both the magnitude and the pattern of estimated time series of reproductive output, which can affect fishery management reference points.

Other topics presented during this session included a study presented by You Jung Kwon on the growth of rock bream in the Jeju marine ranching area of South Korea, and a study presented by Peng Sun on the effect of gill net fisheries upon phenotypic traits such as size at age and age at maturity. A variety of topics were presented in the poster session, including 1) examination of life-history patterns for Gulf of Alaska species; 2) several studies examining size at maturity, fecundity, and spawning distributions of marine groundfish and invertebrates; 3) a study examining how the embryonic survival rate could affect size-dependent mortality; and 4) a study on the efficacy of closed areas for stocks with a maternal effect in larval survival.

List of papers

Oral presentations

Edward A. Trippel (Invited)

Demography, degrees and development of scientific advice for fisheries management

Doug Hay, Megan Moody, Bruce McCarter and Thomas W. Therriault

Is climate change responsible for changes in the distribution, abundance and spawning of the anadromous eulachon (*Thaleichthys pacificus*) in the North Pacific? A synthesis of available information

Edward D. Weber and Sam McClatchie

Effect of water-mass properties on the spawning location of Pacific Mackerel *Scomber japonicus* in the California Current

Steven J. Parker and Paul Grimes

Oogenesis in Antarctic toothfish and implications for fisheries management

You Jung Kwon, Chang Ik Zhang and Hyeok Chan Kwon

Estimation of biological parameters for rock bream, *Oplegnathus fasciatus*, in Jeju marine ranching area of Korea

Cindy J.G. van Damme, Mark Dickey-Collas, Olav S. Kjesbu and Adriaan D. Rijnsdorp

Fecundity regulation mechanisms in fish with different spawning strategies

Edward J. Dick

Modeling the reproductive potential of rockfishes (*Sebastes* spp.)

Joel B. Webb, Laura M. Slater, Ginny L. Eckert and Gordon H. Kruse

Variability in reproductive potential of eastern Bering Sea snow crab, *Chionoecetes opilio*, demographic and environmental effects

Peng Sun, Zhenlin Liang, Wei Yan and Huaming Yu

Chief cause for the change of fish phenotypic traits: Fishing gear selectivity

Poster Presentations

Miriam J. Doyle and Kathryn L. Mier

Species life history patterns and early life ecology as indicators of vulnerability and response of fish populations to climate change in the Gulf of Alaska

Jie Zheng, Gordon H. Kruse and Bill Bechtol

Temporal changes in size at maturity and their impacts on stock assessment and fishery management for eastern Bering Sea Tanner crab

Laura M. Slater, Joel B. Webb, Kirsten A. MacTavish and Douglas Pengilly

Preliminary analysis of demographic and geographic processes influencing Tanner crab fecundity in the eastern Bering Sea

Paul Spencer, Sarah Kraak and Edward A. Trippel

Evaluation of closed areas for fish stocks with maternal effects in larval survival

Rui-Jing Wan, Feng Zhou and Xiujuan Shan

Impacts of temperature and salinity on species composition of ichthyoplankton and distribution of fish spawning ground in the Changjiang River estuary and its adjacent waters

Susanne F. McDermott, Daniel W. Cooper, Jared L. Guthridge, Ingrid B. Spies, Mike F. Canino, Pamela Woods and Nicola Hillgruber

Effects of maternal growth on fecundity and egg quality of wild and captive Atka mackerel (*Pleurogrammus monopteryrius*)

Sukgeun Jung and Il Su Choi

Size-dependent mortality of Pacific cod (*Gadus macrocephalus*) based on their reproduction and growth

FIS/BIO Topic Session (S6)

Observations of ecosystem mixing under climate change

Co-Convenors: *Sanae Chiba (Japan), John Field (U.S.A.), Jin-Yeong Kim (Korea), Franz Mueter (U.S.A.) and Laura Richards (Canada)*

Background

As the ocean environment changes, we expect species to respond by changing their distribution. Species could expand into habitats newly made available to them and avoid or shrink their abundances in habitats that are no longer viable. Because species respond to these environmental changes at different rates, previously isolated species now interact. We coin the term “ecosystem mixing” to describe the pulling apart and re-mixing of ecosystems and species interactions in a changing environment. For example, Humboldt squid expanded their range northward along the west coast of North America in recent years, encountering new prey species, potentially including important stocks of juvenile salmon. In this session, we considered the consequences of ecosystem mixing. Papers were invited that describe case studies of ecosystem mixing from a physical, biological and/or socio-economic perspective, especially as they impact the predators and/or prey of key species (such as those important for fishery harvests).

Summary of Presentations

The session consisted of 16 oral presentations with contributions from all PICES countries and from several ICES countries. Invited presentations focused on large-scale bio-geographic shifts in the North Atlantic linked to variability in the subpolar gyre (Hátún), two case studies from the Bering Sea on how changes in the extent of cold bottom waters modulate predator-prey interactions (Ciannelli) and a review of how a highly plastic species, the Humboldt squid (*Dosidicus gigas*), may benefit from a rapidly changing world due to its high tolerance of environmental variability, the ability to migrate rapidly, a very plastic diet, high fecundity, a very rapid growth rate and a short life span (Gilly). Hátún *et al.* showed how large-scale exchanges in water masses driven by atmospheric variability, and the consequent mixing of Arctic, Boreal and Lusitanian biological provinces result in changes to the food web from phytoplankton through to pilot whales. Beyond the regional effects, Hátún *et al.* also discussed the likelihood of hemispheric teleconnections (based on similar productivity patterns between the North Atlantic and the North Pacific), a theme that was echoed by Alheit and Wagner, who discussed the importance of low frequency oscillations driven by atmospheric forcing of ocean gyres and the consequent impacts to species distributions, productivity and interactions (particularly of small pelagics) in the Northeast Atlantic.

Changes in spatial distribution in response to temperature variability were also reported from the North Pacific for all trophic levels from phytoplankton in the East China Sea (ECS, Cai *et al.*), over zooplankton in the Gulf of Alaska (Batten and Walne), Eastern Bering Sea (Pinchuk and Coyle), and ECS (Cai *et al.*), to fishes off Korea (Kim *et al.*) and in the ECS (Cai *et al.*). While most studies considered changes in horizontal distribution, Kulik discussed the potential effects of changes in vertical distribution of mesopelagic fishes in the northwestern Pacific. The effect of temperature-related changes in spatial distribution on trophic interactions was a recurring theme and is a concern in many regions where such changes affect commercially important species. Examples included predation by arrowtooth flounder on walleye pollock in the eastern Bering Sea (EBS, Ciannelli and Hunsicker), feeding success and energy density of juvenile walleye pollock in the EBS (Whitman *et al.*), predation of mackerel on blue whiting (Loeng *et al.*), predation of Humboldt squid on Pacific hake, sardine, rockfish and salmon in the California Current (Field *et al.*), and changes in zooplankton dynamics that alter the prey field for fish and other predators (Pinchuk and Coyle). To the extent that climate variability drives these changes in distribution and trophic interactions, such linkages may provide an opportunity for prediction. For example, Loeng *et al.*, hypothesized that blue whiting recruitment is driven by gyre-mediated changes in their distribution that affect the spatial overlap and predation of mackerel on eggs and larvae of whiting. A combination of field observations, hypothesis testing, and modeling studies will be needed to quantify these and similar relationships to produce reliable predictions.

A variety of modeling studies were presented to explore the effects of climate change on zooplankton productivity (Hjøllo *et al.*, presented by H. Loeng), on the feeding, growth and survival of larval cod (Kristiansen *et al.*), on the probability of range expansions in eastern *versus* western boundary currents (Kowalke *et al.*), and on changes in the distribution of skipjack tuna in the western North Pacific (Mugo *et al.*). The latter study used a novel application of Ecological Niche Factor Analysis (ENFA) to model skipjack tuna habitat in the western North Pacific, concluding that future warming trends are likely to drive both distributional (northward) and ontogenetic (earlier) changes in skipjack migration relative to current patterns.

While most presentations focused on the effects of temperature changes, at least two studies discussed the importance of oxygen levels in determining the abundance and spatial distribution of fish and invertebrates. Low oxygen conditions on the continental shelf off the U.S. west coast were generally associated with reduced abundances and a lower diversity of demersal fish and invertebrates (Keller *et al.*). However, the Humboldt squid can tolerate low oxygen conditions and appears to take advantage of the reported shoaling of the oxygen minimum layer and other changes in the mesopelagic environment off California (Gilly and Markaida). Such adaptations highlight the complex responses of biological communities to a changing climate and the difficulties of predicting the effects of climate change on spatial distributions and trophic interactions. Reliable predictions will require not only a better understanding of the mechanisms controlling the vertical and horizontal distribution of marine organisms, but also improved models to predict future oxygen levels and other chemical properties that provide important physiological limits on distribution.

List of papers

Oral presentations

Hjálmar Hátún (Invited)

Large-scale shifts in the North Atlantic bio-geography forced by the subpolar gyre

Jürgen Alheit and Carola Wagner

Impact of Atlantic Multidecadal Oscillation (AMO) on NE Atlantic ecosystems

Lorenzo Ciannelli and Mary Hunsicker (Invited)

Predator-prey spatial distribution patterns and spatial overlap in relation to climate driven environmental variability

Jin Yeong Kim, Heeyong Kim and Il Su Choi

Variation in occurrence of warm and cold water species in response to climate changes off Korea

Robinson Muggo, Sei-Ichi Saitoh, Akira Nihira, Tadaaki Kuroyama, Takahiro Toyoda, Shuhei Masuda, Hiromichi Igarashi, Toshiyuki Awaji and Yoichi Ishikawa

Potential impact of global warming on skipjack tuna habitat in the western North Pacific

Luke D. Whitman, Neal E. McIntosh, Scott A. Heppell and Kelly J. Benoit-Bird

Variation in the distribution and energy density of juvenile walleye pollock in the southeastern Bering Sea

William Gilly and Unai Markaida (Invited)

Adaptability and plasticity of Humboldt squid, *Dosidicus gigas*, in conjunction with environmental perturbation

John C. Field, Ken A. Baltz, William Matsubu, Graham E. Gillespie, Julia S. Stewart, William F. Gilly and William A. Walker

Foraging ecology of the Humboldt squid in the California Current

Gregory Kowalke, David L. Mackas and Julie Keister

Do circulation patterns make the eastern North Pacific especially susceptible to zoogeographic shifts?

Vladimir Kulik

The role of mesopelagic fishes in ecosystem vertical mixing in the north western Pacific

Trond Kristiansen, Charles Stock, Ken Drinkwater and Enrique N. Curchitser

Effects of climate change on the phenology of spring blooms and consequences for the survival of larval cod

Alexei I. Pinchuk and Kenneth O. Coyle

Emergence of the Arctic hyperiid *Themisto libellula* on the southeastern Bering Sea shelf as a result of the recent cooling and their potential impact on pelagic food web

Sonia Batten and Anthony Walne

Variability in northwards extension of warm water copepods in the NE Pacific

Harald Loeng, Hjálmar Hátún, Jens Christian Holst, Mark Payne and Aril Slotte

The rise and fall of the northern blue whiting stock

Aimee Keller, Victor Simon, W. Waldo Wakefield, Keith Bosley, M. Elizabeth Clarke, John A. Barth and Stephen D. Pierce

Expansion and shoaling of the oxygen minimum zone off the U.S. west coast in relation to demersal fish distribution and biomass

Rong-shuo Cai, Hongjian Tan, Qing-liang Yang and Ji-long Chen

The response of sea surface temperature in the offshore area of China to variations in the East Asian Monsoon under global warming and its marine ecological effects

FIS/MEQ Topic Session (S7)

Economic relation between marine aquaculture and wild capture fisheries

Co-Convenors: *Ingrid Burgetz (Canada), Dohoon Kim (Korea), Minling Pan (U.S.A.) and Qingyin Wang (China)*

Background

Considering the growing role of marine aquaculture in both seafood production and consumption as well as the close relationship between marine aquaculture and wild ocean capture fisheries, this session focused on the economic relationships of marine aquaculture to capture fisheries. Such relationships include (1) marine

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aquaculture products as a substitute and/or complement for wild caught products owing to consumer preference, price, and availability; (2) the synergies between aquaculture and fishing (use of fish processing trimmings, resilient coastal communities and maintaining working waterfronts), and (3) economic considerations regarding potential environmental effects (positive and negative), interactions between capture fisheries and marine aquaculture (*e.g.*, feed inputs in marine aquaculture derived from captured fisheries, aquaculture stock enhancement, and aquaculture structures as fish aggregating devices).

Summary of Presentations

This session was the first topic session on economics and social science at a PICES Annual Meeting. The past activities of PICES had mainly focused on physical and biological sciences, such as ecology, ecosystems, fisheries, oceanography, and biogeochemistry, *etc.* Topic session S7 was developed in response to the new FUTURE science program endeavors to provide a greater role for social and economic scientists in PICES. It was an important step toward enhancing research and management of marine living resources from a socio-economic perspective.

The session attracted broad participation of economists and experts from all the PICES member countries. This session consisted of 12 oral presentations, including 7 invited papers. The lead convenor, Minling Pan (U.S.A.), gave a brief introduction on the background and objectives of the topic session in the opening. The keynote speaker, Michael Rubino (U.S.A.), manager of the NOAA Aquaculture Program, outlined the economic issues and research needs raised by the potential expansion of domestic marine aquaculture, and in particular, the potential economic effects of marine aquaculture on capture fisheries. Dr. Rubino indicated that the economic ramifications of expanding aquaculture in the United States, along with environmental and food safety concerns, are the subject of much debate and widely differing views. Aquaculture may be a way to substantially increase domestic seafood production. Hatchery-based stock replenishment may be a way to restore depleted commercial and recreational fisheries. Associated economic benefits of these aquaculture activities may include the creation of jobs from coastal communities to the agricultural heartland, maintenance of working waterfronts, and synergies with commercial fishing such as use of fish processing trimmings. But concerns have been raised that domestic aquaculture may compete with domestic wild fisheries depressing prices for wild caught fish. Additional concerns include the economic consequences of potential environmental and social effects of aquaculture on wild capture fisheries and traditional fishing communities.

Other contributed papers reported case studies that discussed economic relations between marine aquaculture and wild capture fisheries from different aspects or demonstrated analytical models to measure the linkage/trade-off between these two. For example, Di Jin (U.S.A.) presented an integrated economic-ecological model developed for coastal New England by incorporating an aquaculture sector in the CGE model and by examining the forage fish and aquaculture link in a marine food web context. Yajie Liu (Norway) presented an analytical framework that aims to explore the ecological and economic impacts of genetic interaction between farmed and wild salmon over generations. The model was constructed based on the Atlantic salmon fishery and salmon farming in Norway. Hisashi Kurokura (Japan) illustrated how the development of the aquaculture industry (tuna culture) had influenced the consumer preference and consumption behaviors by cultured tuna in Japan. Kelly Davidson (U.S.A.) presented a study on consumer preferences for farm-raised *versus* wild-caught fish in Hawaii. Seong-Kwae Park (Korea) presented the historical trends of wild caught fish and farmed (marine) fish consumption in Korea. His study predicted that farmed fish would replace wild fish gradually, not rapidly, over time. Chen Sun (China) addressed the influence of marine aquaculture on the fishery industry supply chain and consumption in China. Both studies noticed that the economic trade-off between costs of sacrificing marine environmental quality and benefits from marine culture aquaculture expansion.

List of papers

Oral Presentations

Michael C. Rubino (Invited)

Potential economic effects on wild capture fisheries from an expansion of marine aquaculture in the United States

Di Jin (Invited)

Aquaculture and capture fisheries: An integrated economic-ecological analysis

Yajie Liu, Ola Diserud, Kjetil Hindar and Anders Skonhøft (Invited)

An ecological-economic model of genetic interaction between farmed and wild Salmon

Masahito Hirota and Yoshinobu Kosaka

The TASC (Total Allowable Scallop Culture) in Japan: An approach for the issue on the overproduction in Yezo giant scallop cultivation in Mutsu Bay

Heedong Pyo

Analyzing recovered effects of marine contaminated sediment cleanup project on wild capture fisheries in Korea

Galina S. Gavrilova

Capture fisheries and mariculture of the marine invertebrates in Peter the Great Bay (Japan Sea)

Toyomitsu Horii

Impacts on fishery products of the Tiger Puffer, *Takifugu rubripes*, by stock enhancement

Shang Chen, Li Wang, Tao Xia, Guoying Du and Dachuan Ren (Invited)

Quantification of maricultural effects on coastal ecosystems services: Sanggou Bay case from China

Seong-Kwae Park and Dong-Woo Lee (Invited)

Economic relation between marine aquaculture and wild capture fisheries: Case of Korea

Hisashi Kurokura, Akira Takagi, Yutaro Sakai and Nobuyuki Yagi (Invited)

Tuna goes around the world on sushi

Chen Sun (Invited)

The influence of marine aquaculture to the fishery industry chain in China

Kelly Davidson and Minling Pan (Invited)

Consumers' willingness to pay for aquaculture fish products vs. wild-caught seafood – A case study in Hawaii

FIS/POC/BIO Topic Session (S8)

Impact of climate variability on marine ecosystems: Understanding functional responses to facilitate forecasting

Co-sponsored by: *ICES*

Co-Convenors: *Jürgen Alheit (Germany), Suam Kim (Korea), Harald Loeng (Norway), James Overland (U.S.A.) and Yasunori Sakurai (Japan)*

Background

Understanding the role of natural variability, occurring over a variety of temporal and spatial scales, is essential for effective management of marine ecosystems in the wake of predicted global change. Evidence suggests that climate variability can trigger regime shifts in marine ecosystems. Regime shifts are characterized by a reorganization of marine communities, species dominance, and tropho-dynamic relationships. Often, synchronous shifts occur in aquatic ecosystems that are separated by thousands of kilometers. This finding suggests that atmospheric teleconnections are mediating regional system changes. We postulate that comparative studies of ecosystems that have experienced regime shifts will provide insights into the expected responses of marine organisms to climate change. Papers were invited that went beyond simple pattern matching. The primary focus was on understanding shifts in the pelagic realm, including phytoplankton, zooplankton, small pelagic fishes, gadids, and squids, with preference given to research that provides evidence of the functional responses and relationships that underlie regime shifts, and to statistical or modeling studies that successfully simulate observed shifts.

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Summary of presentations

This session was held on Tuesday, October 26, 2010 and consisted of 20 oral presentations (including 4 invited talks) plus 15 posters. The session was jointly organized by PICES and ICES, as a part of 2010 WG-FCCIFS activities. The first invited paper, by Hans O. Pörtner, described that the whole organism responses to warming or cooling link to ecosystem response, and that climate warming emphasizes the need for a common understanding of thermal limitation by physiologists and ecologists nowadays. He introduced the concept of oxygen and capacity limited thermal tolerance (OCLT) in relation to climate change. His recent works showed that a mismatch in oxygen supply *versus* demand causes a limitation in aerobic scope and finally transition to anaerobic metabolism, paralleled by the development of molecular stress events. In fact, functional characters in polar species may reflect adaptation to excess oxygen availability rather than limitation.

The second invited paper by Kazuaki Tadokoro showed geographical comparison of the decadal-scale variations in marine ecosystems in the North Pacific Ocean. A decreasing trend in nutrients was observed in the surface layer of the Gulf of Alaska, Oyashio waters, Kuroshio-Oyashio Transition waters, Kuroshio, western subtropical waters, and East China Sea, and Chl-*a* concentration and zooplankton biomass also represented a significant decreasing trend in the waters, which suggest that global warming decreases the productivity of the lower ecosystems simultaneously among the regions.

The third invited speaker, Shin-ichi Ito, talked about multi-trophic level ecosystem modeling for understanding the mechanism of small pelagic fish species alternation associated with climate regime shifts. Various modelings and statistical techniques were used for coupling physical, biochemical-plankton (NEMURO: North Pacific Ecosystem Model for Understanding Regional Oceanography) and Japanese sardine (*Sardinops melanostictus*). His model reasonably reproduced weight decrease of sardine during the higher stock period. Moreover, the model reproduced expansion of the habitat area and decrease of prey plankton during the period.

The fourth invited paper by Franz J. Mueter showed long-term forecasts of walleye pollock dynamics in the eastern Bering Sea based on estimated responses of recruitment and growth to climate variability. Recent advances in our understanding of the role of climate variability in regulating lower trophic levels in the eastern Bering Sea support a dome-shaped relationship between the recruitment of walleye pollock and surface temperatures during late summer. He also speculated that future recruitment may not be reduced as much as the temperature relationship alone would suggest because of (1) reduced cannibalism on larval and early juvenile stages and (2) larger size-at-age of older juveniles and adults, which is likely to increase reproductive output.

The remaining talks covered a wide range of topics and geographical regions. Most oral presentations showed regional examples on ecosystem responses in relation to climate variability, and geographical coverage was well balanced: 4 from the Atlantic Ocean, and 15 from the Pacific Ocean (6 focused on the eastern Pacific, 6 on the western Pacific, and 3 on the Bering Sea). In the Poster Session, one presentation co-authored by C.J. Jang and S. Yoo, which received the Best Poster award for a POC-sponsored topic session (see list at the end of the Session Summaries report), demonstrated variability of mixed layer depth (MLD) and its relation with chlorophyll (CHL) concentration in the North Pacific Ocean on seasonal to year-to-year timescales. The variability of MLD is well correlated with CHL variability in some regions in the North Pacific Ocean, including the Kuroshio Extension (KE) region. The good correspondence between MLD and CHL suggests that increased MLD helps to entrain deep nutrients into the upper ocean and thus to maintain high CHL in the KE.

The Best Poster award was shared between Sarah Ann Thompson for “*Comparing pathways of functional response of top predators to seasonality of upwelling in the California Current*”, and Chan Joo Jang for “*Variability of mixed layer depth and its relation with chlorophyll concentration in the North Pacific Ocean*”. See the list of awards at the end of this Session Summaries report).

List of papers

Oral presentations

Hans O. Pörtner (Invited)

Oxygen and capacity limited thermal tolerance (OCLT): Linking climate to ecosystem change

Julie E. Keister, Emanuele Di Lorenzo, Sanae Chiba, Vincent Combes, Cheryl A. Morgan and William T. Peterson

Climate-related changes in ocean transport control zooplankton biogeography around the North Pacific basin

Yury Zuenko, Ludmila Chernoiivanova, Alexander Vdovin and Elena I. Ustinova

Saffron cod fluctuations in the Japan Sea: An evidence of match/mismatch hypothesis

William R. Crawford and James R. Irvine

Climate variability and ecosystem response in Pacific Canadian coastal waters

Kazuaki Tadokoro, Yuji Okazaki, Tsuneo Ono and Hiroya Sugisaki (Invited)

Geographical comparison of the decadal-scale variations in marine ecosystems in the North Pacific Ocean

Ken Drinkwater, Glen Harrison, Erica Head, Padmini Dalpadado, Jim Carscadden and George Lilly

Comparison of the ecosystem responses to climate forcing and fishing between the Labrador Sea and the Norwegian/Barents seas

Jürgen Alheit, Michele Casini, Wulff Greve, Thomas Pohlmann, Anne Sell, Ralf Vorberg and Carola Wagner

Climate variability drives anchovies and sardines into North and Baltic Seas

Joachim P. Gröger, Gordon H. Kruse and Norbert Rohlf

Climate cycles and population dynamics of North Sea herring

Anne B. Hollowed, Steven Barbeaux, Ned Cokelet, Stan Kotwicki, Patrick Ressler and Christopher Wilson

Effects of climate change on pelagic ocean habitats and their potential role in structuring Bering Sea and Gulf of Alaska ecosystems

Shin-ichi Ito, Takeshi Okunishi, Atsushi Kawabata, Hiroshi Kubota, Akinori Takasuka, Taketo Hashioka, Hiroshi Sumata and Yasuhiro Yamanaka (Invited)

Multi-trophic level ecosystem modeling for understanding the mechanism of small pelagic fish species alternation associated with climate regime shifts

Richard D. Brodeur, James J. Ruzicka and John H. Steele

Investigating alternate trophic pathways through gelatinous zooplankton, krill, and planktivorous fishes in an upwelling ecosystem using end-to-end models

William J. Sydeman, Jarrod A. Santora, Sarah Ann Thompson, Kyra L. Mills, John C. Field, Brian K. Wells, Baldo Marinovic and Bryan A. Black

Numerical responses of krill predators to variation in krill abundance and spatial organization

Seokjin Yoon, Hiroya Abe and Michio J. Kishi

Variance estimation of the growth and food sources of the Manila clam by global warming in a subarctic lagoon, Japan

Harald Loeng

Impacts of climate change on the Arctic Ocean and adjacent seas

Franz J. Mueter (Invited)

Long-term forecasts of walleye pollock dynamics in the eastern Bering Sea based on estimated responses of recruitment and growth to climate variability

Oleg Bulatov

Climate fluctuations and walleye pollock biomass dynamics

Bryan A. Black, Isaac D. Schroeder, William J. Sydeman, Steven J. Bograd and Brian K. Wells

Winter and summer upwelling modes and their biological relevance in the California Current Ecosystem

Masahide Kaeriyama, Hideaki Kudo, Hideki Kaeriyama and Katherine W. Myers

Spacio-temporal changes in the feeding pattern of Pacific salmon, *Oncorhynchus* spp., in the North Pacific Ocean ecosystems during 1958–2009

Melissa A. Haltuch and André E. Punt

On the promises and pitfalls of including decadal-scale climate forcing of recruitment in demersal fish stock assessment

Yongjun Tian, Hideaki Kidokoro and Tsuneo Goto

Long-term changes in the condition factor of small pelagic fishes in the Japan Sea and the impact of the late 1980s regime shift

Poster Presentations

Vanessa R. von Biela, Christian E. Zimmerman, Thomas E. Helser, Bryan Black and David C. Douglas

Terrestrial and marine correlates to black rockfish (*Sebastes melanops*) growth in the California and Alaska Coastal Currents

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Michael A. Litzow, Franz J. Mueter and Dan Urban

Can rising variance predict sudden shifts in populations and ecosystems? A test using Alaskan crustacean data

Elena A. Shtraikhert, Sergey P. Zakharkov and Tatyana N. Gordeychuk

Inter-annual variability of the spring chlorophyll *a* concentration maximum in the Peter-the-Great Bay (Sea of Japan) in 1998-2010

Se-Jong Ju, Chang-Rae Lee and Ah-Ra Ko

Latitudinal variation of lipid contents and compositions in copepods, *Euchaeta* and *Pleuromamma* spp., from the Northwest Pacific Ocean: Its implication in feeding ecology

James J. Ruzicka, Thomas C. Wainwright, Richard D. Brodeur, Jeannette Zamon, Elizabeth Daly, Cheryl A. Morgan and Robert L. Emmett

Interannual variability in the Northern California Current food web structure: Inferring trophic pressures upon juvenile salmon

Suam Kim, Sangwook Yeh, Chung-Il Lee, Sukyung Kang, Hyunwoo Kang, Jin-Hee Yoon, Jung Jin Kim and Sinjae Yoo

Forecasting practice on the common squid (*Todarodes pacificus*) population responding to climate/oceanographic changes

Sarah Ann Thompson, William J. Sydeman, Jarrod A. Santora, Robert M. Suryan, Bryan A. Black, William T. Peterson and John Calambokidis

Comparing pathways of functional response of top predators to seasonality of upwelling in the California Current

Jun Shoji, Syun-ichi Toshito, Ken-ichiro Mizuno and Yasuhiro Kamimura

Possible effects of global warming on fish early life stages: Shift in spawning season and latitudinal distribution can alter growth of juvenile fishes through the changes in daytime length

Chan Joo Jang and Sinjae Yoo

Variability of mixed layer depth and its relation with chlorophyll concentration in the North Pacific Ocean

Ken-ichiro Mizuno, Yasuhiro Kamimura and Jun Shoji

Effect of temperature on growth of black rockfish *Sebastes cheni* juveniles in seagrass and macroalgae beds

Hee Dong Jeong, Sang-Woo Kim, Yong Kyu Choi, Jeong Min Shim and Kee Young Kwon

A striking difference of coastal SST related to climate change in the eastern coast of Korea

Jackie R. King, Vera N. Agostini, Chris J. Harvey, Gordon A. McFarlane, Michael G. Foreman, James E. Overland, Nicholas A. Bond and Kerim Y. Aydin

Climate forcing and the California Current ecosystem

Ann E. Edwards and Shannon Fitzgerald

Predicting resilience to ecosystem change in a far-ranging, pelagic, generalist forager

Oleg N. Katugin, Konstantin A. Karyakin and Alexander A. Nikitin

Contrasting distribution patterns of the common squid (*Todarodes pacificus*) in Peter the Great Bay (Japan/East Sea) in 2008 and 2009

Mikhail A. Zuev and Oleg N. Katugin

Distribution patterns of the gonatid squids (Gonatidae, Oegopsina) in the northern Sea of Okhotsk in 1990-2008

MEQ Topic Session (S9)

Conceptual and numerical models of HAB dynamics

Co-conveners: *William Cochlan (U.S.A.) and Shigeru Itakura (Japan)*

Background

Each PICES member country has conceptual models of harmful algal bloom dynamics that link the physics, chemistry and biological aspects of bloom development and decay. The biology gives us information on ecosystem structure but also describes elements contributing to success of a particular species. The chemistry focuses on nutrient dynamics, ratios and preferences among species. Physical processes detail cell and nutrient delivery to the coast. While conceptual models are descriptions of HAB dynamics without numbers, numerical models include rate estimates. In theory, each of these would be supported with the same physical, chemical and ecological foundation, overlain with the unique considerations of different water types and second order ecosystem structure. However, these models vary widely between species and among countries. There have been no comprehensive intercomparisons among these conceptual and numerical models to identify their

similarities and differences. The focus of this session was to seek commonalities among models and to identify the unique second order aspects needed to describe the distribution and dynamics of HAB in different PICES regions.

Summary of Presentations

This session was held on Wednesday, October 27, 2010 and consisted of 8 oral presentations, including 3 invited talks. The session started with the first invited speaker, Wolfgang Fennel, presenting his paper on the construction of models with reference to HABs. The points touched upon were that:

- Not everything can be modeled, but ask the right questions; one has to deal with a certain amount of mathematics and computing;
- New modelers are encouraged to start with simple box models and MATLAB software;
- HAB modeling can be done as continuous distributions or as individual particles;
- State variables as a concentration of individuals/volume (number and a unit); process rates are the rate of change of state variables such as T, O₂, and S; dynamics are rates of change over time; the interface would be growth rates, mortality rates, vital function, or toxicity;
- Example models are the Gulf of Maine Model (Anderson *et al.*, 2000; McGillicuddy *et al.*, 2003) and Baltic Sea Model (Koyonen, 2001; Neumann *et al.*, 2002);
- Truncation issues remain, as upper and lower trophic levels; spatial dimensions such as advection and diffusion; linkage of physics to biology;
- Stacked box models; each box with its own equations with parameters spanning the boundary (inputs and outputs);
- Baltic Sea 3D model showing algal bloom modeling and comparison to specific results to what occurred (satellite chlorophyll).

The second invited speaker, Ted Smayda, discussed modeling HABs and the need for a conceptual template that is harmonious with empirical evidence. Points included:

- C, S, and R-strategists for dinoflagellates;
- Hierarchy and niche growth including cellular, population, and community growth as different things needs to be considered;
- Other problems needing examination: PvsE (carbon dumping and irradiance problem), allometric influence on growth rates, and the paradox of high Ks values;
- Smayda, 1997 and Smayda, 1996 (growth rates for many organisms under natural light, photo period and temperatures);
- Cell quota (volume) may be more important than actual cell concentration in some cases (Perez-Ruzala *et al.*, 2002);
- About a 22 year “wavelength” in Diatom:Dinoflagellate ratio;
- “Insect swarm ecology” may be similar to dinoflagellate blooms and probably share common attributes.

Jenny Lane spoke on the development of toxigenic *Pseudo-nitzschia* bloom models in Monterey Bay, California, at a single monitoring site in a model domain. Points included:

- upwelling events and extreme river discharge correlate with intensity of blooms;
- Predictor variables, found in Lane *et al.*, 2009;
- Chlorophyll-*a* anomaly only predicts blooms well about 56% of the time;
- SPATT bags and resin is picking up DA adequately and generally mirrors toxin content in mussels.

Her presentation won a Best Oral Presentation award for an MEQ-sponsored Topic Session (see list at the end of the Session Summaries report).

Shigeru Itakura discussed the different seeding strategies and bloom dynamics in enclosed embayments for *Chattonella* and diatom blooms. Points included:

- *Chattonella* and diatom blooms do not occur concurrently in Ariake Bay, Japan;

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- Flushing of the bay is important for diatom concentration: no or reduced flushing (low tidal cycles) will increase diatom concentrations; high tidal events flush water well from the bay and keep diatom concentrations low;
- *Chattonella* germination temperature is about 20°C; light does not seem to be an important factor for germination (Ariake Bay is a shallow mud flat);
- Diatom germination from the resting stage is more reliant on light intensities and can germinate within hours, given the right conditions.

Don Anderson talked about the Gulf of Maine model for predicting *Alexandrium* blooms.

- Good predictions for years leading up to 2010 using the models and the previous years cyst survey maps;
- 2010 not a good predictive year; physical water qualities were different due to intrusion of a water mass not previously considered that altered predicted conditions.

Jack Rensel discussed *Heterosigma* blooms and fish killing incidents in the Salish Sea and the development of a conceptual model to predict *Heterosigma* blooms.

- Link between low sockeye salmon returns following a year with high *Heterosigma* blooms;
- Possible effect of *Heterosigma* blooms killing/weakening outmigrant salmon, reducing their success of return;
- Several ecotypes of *Heterosigma* being found currently;
- Initiation sites include English Bay and southern Strait of Georgia.

Angelica Peña discussed the use of a bio-physical ROMS model developed to study factors influencing phytoplankton bloom dynamics.

- Two nutrient sources are found for the area: outflow from Juan de Fuca Strait (river runoff; possible anthropogenic sources) and upwelling;
- Nutrient sources have different signatures, concentration of nutrients and ratios.

List of papers

Oral presentations

Wolfgang Fennel (Invited)

Construction of models with reference to HABs

Theodore J. Smayda (Invited)

Modeling harmful algal blooms: The need for a conceptual template harmonious with empirical evidence

Jenny Q. Lane, Peter T. Raimondi and Raphael M. Kudela

The development of toxigenic *Pseudo-nitzschia* bloom models in Monterey Bay, California, and their application at a single monitoring site within the model domain

Shigeru Itakura, Ichiro Imai, Satoshi Nagai and Mineo Yamaguchi

Chattonella (antiqua/marina) versus diatoms - Different seeding strategies and their bloom dynamics in enclosed embayments

Tamiji Yamamoto and Ryoko Sakai (Invited)

Numerical modeling of the slow-growing, motile harmful alga *Gymnodinium catenatum* in Inokushi Bay, a small inlet in southern Japan

Donald M. Anderson, Dennis J. McGillicuddy, Jr., Bruce A. Keafer and Ruoying He

Bloom dynamics of the red tide dinoflagellate *Alexandrium fundyense* in the Gulf of Maine: A synthesis and progress towards a forecasting capability

J.E. Jack Rensel

Modeling fish-killing blooms of *Heterosigma akashiwo* in the Salish Sea

Angelica Peña and Michael G. Foreman

Phytoplankton bloom development in the Juan de Fuca Eddy: Insights from a simple biophysical model

MEQ/FIS Topic Session (S11)*Identifying vulnerable marine ecosystems in the North Pacific*Co-sponsored by: *the North Pacific Fisheries Management Council*Co-Convenors: *R. Ian Perry (Canada) and Chang-Ik Zhang (Korea)*Background

The Food and Agriculture Organization (FAO) and the Convention on Biological Diversity (CBD) have been encouraging the sustainable use of marine living resources by the identification of vulnerable marine ecosystems (VMEs) and ecologically and biologically significant areas (EBSAs), in particular but not exclusively in international waters, and have developed criteria. The broad purpose for identifying such areas is to prevent significant adverse impacts and to protect the marine biodiversity and services that these ecosystems provide.

To achieve these objectives, researchers and managers must be able to identify areas where VMEs are known, or are likely, to occur. Outstanding questions related to VME identification include what characteristics should be used to classify these systems, how can current information on VMEs and EBSAs be consolidated, and how can models which predict the locations of such areas be developed and tested. PICES member countries are beginning to identify VMEs that meet a variety of biological and socio-economic objectives. However, no comprehensive comparison of the different methods or assessment of their performance against established ecological, social and economic objectives exists to provide guidance on the appropriate tools to be used. This session brought together researchers and managers engaged in ecosystem-based management to address two objectives: (1) to compare current approaches and datasets used to identify Vulnerable Marine Ecosystems/Ecologically and Biologically Sensitive Areas by different member countries in order to develop a list of appropriate tools and (2) to explore how the criteria for these areas (such as defined in the FAO Guidelines FIEP/R881 and CBD Resolution UNEP/CBD/COP/DEC/IX/20) can be used to identify VME/EBSA-type areas in the high-seas of the North Pacific Ocean. Both benthic/demersal and pelagic systems were considered, as they may have different characteristics. Presentations and methods developed for shelf and coastal waters were included because they could provide guidance and case studies for open ocean situations. This review of international experiences with applying approaches and data to identify VMEs and EBSAs helped to contribute to the international discussion and evaluation of these issues, and to the application of measures to protect these significant regions.

Summary of Presentations

The majority of the presentations in this session focused on the issues of approaches, tools, and data sets available to identify Vulnerable Marine Ecosystems (VMEs) and Ecologically and Biologically Sensitive Areas (EBSAs) in the North Pacific. Kim *et al.* noted that the term VME is subject to variable interpretation, potentially referring to populations of particular vulnerable taxa, entire benthic assemblages or communities, ecosystems and associated processes. Criteria for identifying VMEs include uniqueness or rarity of species or habitats, their functional significance, fragility, and structural complexity as well as life histories that limit the probability of recovery. Gregr *et al.* concluded that the EBSA concept represents a parsimonious and encompassing marine classification approach that is applicable to shelf and high seas ecosystems. They also recognized that physical properties are often used as proxies for (poorly sampled or poorly known) biological distributions, and that remotely-sensed data which are available at high temporal frequency can be used to identify dynamic boundaries that are significant for biological distributions and therefore of VMEs and EBSAs.

Three papers (Suryan *et al.*, Santora *et al.*, and Jahncke *et al.*) explored the use of remotely-sensed data to identify locations of persistent high biological activity in the California Current System. Suryan *et al.* used

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time series of remotely-sensed chlorophyll data and marine bird distributions to identify pelagic “hot spots” of biological activity. They related these locations to persistent upwelling fronts (often related to bathymetric features), in which *persistence* of the feature over time provided stronger correlations with marine bird densities than did the instantaneous concentration of chlorophyll. Santora *et al.* linked seabird and large whale distributions with locations of elevated krill abundances (krill “hot spots”), and found these were often not directly associated with the locations of strong upwelling centres but did depend on the productivity generated from these centres. Jahncke *et al.* used seabird distributions as high trophic level integrators to identify EBSAs in the California Current System, and found they generally matched the locations of existing U.S. National Marine Sanctuaries, although some EBSAs were not covered by marine reserves. Jamieson, using the example of EBSAs in British Columbia, recognised that identifying EBSAs is the first marine spatial planning step to developing a network of functional Marine Protected Areas. Ishida *et al.* described the integration of protected areas with different fishing activities in the Tosa Bay region of Japan to protect and sustain key fish populations, following the Japanese concept that people and fishing activities can be sustainable aspects of marine ecosystems along with species persistence.

Finney *et al.* described the development of models to predict distributions of vulnerable benthic species, such as corals, on the B.C. continental shelf, and thereby to determine potential habitats on a probabilistic basis. Kim *et al.* described a Korean approach to identifying VMEs on oceanic seamounts, by requiring all Korean vessels fishing in such areas to report their catches of VME-indicator organisms such as corals, sponges, and other benthos. These data are being used to assess the locations and cumulative impacts of fishing on these vulnerable taxa. Hayashibara *et al.* discussed the need for research to confirm that areas with corals identified from fishing activities are in fact high-density and significant ecosystems, but they also recommended that such areas should be protected initially until detailed studies can be conducted (*i.e.* taking a precautionary approach). Parker *et al.* described the approach adopted by CCAMLR to manage impacts of fishing to VMEs in the Southern Ocean. They have determined that:

- 23 taxa (phyla to species) qualified as vulnerable to longline gear;
- most data on distribution and impacts comes from the fishery itself;
- impact assessments integrate fishing threats and biological impacts;
- recovery models suggest the long-term impacts are low, and that recovery can occur relatively quickly especially if areas are closed when detected; and
- there is the need to investigate the effects of other ecological constraints on this system.

Overall, the session met its objectives, although it was noted that the majority of work is currently being conducted on the identification of VMEs and EBSAs in the North Pacific, with less research to date on the responses of these areas to disturbance by fishing and the potential recovery times.

List of papers

Oral presentations

Edward J. Gregr, Andrea Rambeau and R. Ian Perry

Identifying ecologically and biologically sensitive areas in the eastern North Pacific

Doo-Nam Kim, Jae-Bong Lee, Kyu-Jin Seok and Dong Woo Lee

Investigating Vulnerable Marine Ecosystems (VMEs) from Korean distant-water fisheries

Steven J. Parker and David A. Bowden

Criteria to select benthic invertebrate taxa to monitor potential impacts to vulnerable marine ecosystems: Lessons from the Southern Ocean

Glen Jamieson

Moving from EBSAs to a protected area network: Framework considerations and progress challenges in Canada’s Pacific waters

Jessica L. Finney, Isabelle M. Côté, Randall M. Peterman and Edward J. Gregr

Using the overlap of predicted cold-water coral habitat and bottom-contact fisheries to identify vulnerable marine ecosystems in British Columbia, Canada

Takeshi Hayashibara, Mai Miyamoto and Takashi Yanagimoto (Invited)

Investigation of the cold-water corals in the Emperor Seamount Area by Fisheries Agency of Japan

Yukimasa Ishida, Kazuaki Tadokoro, Akihiko Yatsu and Mitsutaku Makino

Japanese-type marine protected areas (MPAs) and their contributions to biodiversity and fisheries in Tosa Bay, southern Japan

Robert M. Suryan, Jarrod A. Santora and William J. Sydeman

Biological “hotspots” of the California Current revealed by satellite imagery: Temporal and spatial variability and implications for biodiversity conservation

Jarrold A. Santora, William J. Sydeman, John Field, Robert M. Suryan and Stephen Ralston

“Hot zones” of krill in the California Current: Application to marine spatial management?

Jaime Jahncke, Nadav Nur, Lance Morgan and Astrid Scholz

Identifying vulnerable marine ecosystems in the California Current System

MEQ/FUTURE Topic Session (S12)

Anthropogenic forcing in North Pacific coastal ecosystems: Understanding changes in ecosystem structure and function

Co-Sponsored by: *IMBER*

Co-Convenors: *Blake Feist (U.S.A.), Hiroshi Kawai (Japan), Olga Lukyanova (Russia), Steven Rumrill (U.S.A.) and Thomas Therriault (Canada)*

Background

The North Pacific marine environment has provided a diverse and valuable series of ecosystem services to coastal communities for many thousands of years. Ocean and land-based anthropogenic activities are now widely recognized to have a strong influence on ecological processes throughout the North Pacific marine ecosystem. Anthropogenic influences such as commercial fishing, aquaculture, pollution, and urbanization are particularly strong in coastal waters where they impose a wide variety of multiple stressors that can impact fundamental ecosystem functions, critical processes, and marine biodiversity. Changes in the physical and biological environment perturb native communities, often resulting in disruption of species interactions and trophic relationships that can negatively impact productivity and diminish ecosystem resilience. In addition, large scale processes such as regime shifts, ocean oscillations, and climate variability can alter near-shore processes. For example, introduced species can negatively impact native communities, and commercial shipping and recreational activities can be a powerful vector for changes in the geographic distribution of marine and estuarine species. Similarly, changing ocean conditions have facilitated the continued pole-ward range expansion of a number of marine organisms, often with unknown impacts on the ecosystems they are moving into. Recent range expansion (*e.g.*, Humboldt squid) and population eruptions (*e.g.*, jellyfish) on both sides of the Pacific have had negative consequences for native flora and fauna.

Application of an ecosystem-based approach to coastal management would provide a template to better understand multiple stressors in coastal systems. Continuing to study and manage these stressors independently as single problems must be replaced by examining multiple stressors within the context of the ecosystems they are altering. Further, global climate change is expected to have clear consequences with respect to future species introductions, establishment, and range expansion. Ignoring complex interactions will only hinder management efforts. Thus, integrating non-indigenous species invasions with existing anthropogenic stressors will facilitate a holistic approach to addressing the challenges facing our coastal marine ecosystems.

Summary of Presentations

This session explored the characterization, understanding, and forecasting of the influence of multiple anthropogenic stressors in North Pacific coastal ecosystems. For example, how do non-indigenous species interact with other anthropogenic stressors? The presentations dealt with a high-level overview of stressors in

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various North Pacific ecosystems (*e.g.*, overharvesting, urbanization, habitat alteration and loss, mariculture, HABs, pollution, non-indigenous species, *etc.*) and the types of impacts that have been observed, especially those linked to changes in biodiversity and productivity (*e.g.*, extinctions, species interactions, trophic cascades).

List of papers

Oral Presentations

John J. Stachowicz (Invited)

Changing biodiversity and the functioning of coastal marine ecosystems

Steven S. Rumrill, Alicia R. Helms and Adam S. DeMarzo

Potential influence of multiple anthropogenic stressors on restoration and recovery of native Olympia oysters (*Ostrea lurida*) in the Coos Bay estuary, Oregon, USA

Olga N. Lukyanova, Sergei A. Cherkashin and Mikhail V. Simokon

Multiple stressors impact on the ecosystem of Peter the Great Bay (Japan/East Sea)

L.I. Bendell

Influence of near bottom mariculture structures on intertidal diversity

Thomas A. Okey, Andrew Day, Laura A. Loucks, Jennifer Spencer and Kathryn Wallace (Invited)

An application of Integrated Ecosystem Assessment in the marine areas of the West Coast of Vancouver Island to support integrated planning and management

Jameal F. Samhuri, Cameron H. Ainsworth, D. Shallin Busch, William L. Cheung and Thomas A. Okey

The importance of community interactions for predicting climate change impacts

D. Shallin Busch, Cameron H. Ainsworth, Jameal F. Samhuri, William L. Cheung, John Dunne and Thomas A. Okey

Evaluating uncertainty in estimates of how climate change may impact Northeast Pacific marine ecosystems

R. Ian Perry, Diane Masson, David L. Mackas and Gisele Magnusson

Developing ecosystem-based management in a human-dominated marine system: The Strait of Georgia, Canada

Lingbo Li, Tony Pitcher and Robert Devlin

Investigating potential ecological impacts of growth-hormone transgenic coho salmon using a marine ecosystem model

Toshiyuki Yamaguchi, Yuu Ohshiro, Masashi Kiuchi, Michio Otani, Ikuo Ueda and Hiroshi Kawai (Invited)

The introduction of the Titan Barnacle, *Megabalanus coccopoma* (Darwin, 1854) (Cirripedia: Balanomorpha) to Japan

Vasily I. Radashevsky

World wide dispersal of mudworm *Boccardia proboscidea* Hartman, 1940 (Annelida, Spionidae)

Shang Chen, Tao Xia, Guoying Du, Huiyang Wang, Li Wang and Dachuan Ren

Quantification of influence of *Spartina* spp. invasion on coastal wetland ecosystem services: Yancheng case study, China

Thomas W. Therriault, Claudio DiBacco, Leif-Matthias Herborg and Graham E. Gillespie

The importance of scale for predicting impacts of stressors in nearshore environments: An example using European green crab (*Carcinus maenas*) invasions in British Columbia

Peter S. Ross, Donna Cullon, Andrea Buckman and John K.B. Ford

Climate change may exacerbate pollution impacts in marine mammals of the North Pacific Ocean

Burke Hales, Jesse Vance, Sue Cudd, Mariona Segura, Wiley Evans and Alan Trimble

Changing carbonate chemistry and the future of oysters in the eastern North Pacific boundary system

Tatiana Yu. Orlova, Inna V. Stonik, O.G. Schevchenko and Vladimir I. Ponomarev

Long-term changes in phytoplankton communities in Amursky Bay (the north-western part of the East/Japan Sea) under eutrophic conditions

Elizabeth Logerwell, Mary Baker and Amy Merten

Natural resource damage assessment in Arctic waters

Xianshi Jin, Xiujuan Shan, Xiansen Li, Jun Wang, Yi Cui and Tao Zuo

Long-term variations of ecosystem structure in the Laizhou Bay, China

Vjacheslav. S. Labay

Variability of macrobenthos structure in coastal waters of northern Sakhalin Island (Okhotsk Sea) around oil- and gas extracting objects

Tatiana V. Morozova, Tatiana Yu. Orlova, Boris A. Burov, Alexander Yu. Lazaryuk, Sergey P. Zakharkov and Vladimir I. Ponomarev

Dinoflagellate cysts as indicators of eutrophication in the Amursky Bay, Sea of Japan (East Sea)

Poster Presentations

Vjacheslav. S. Labay

Malacostraca (Crustacea) – A new species in coastal waters of Aniva Bay (Okhotsk Sea, Sakhalin Island)

Takeo Kurihara, Hideki Takami, Takeharu Kosuge, Susumu Chiba, Masatsugu Iseda and Takenori Sasaki

Area-specific temporal changes of species composition and species-specific range shifts in rocky-shore molluscs associated with a warming Kuroshio Current

Ferdinand A. Mkrtchyan, Vladimir F. Krapivin, V.I. Kovalev, V.V. Klimov

An adaptive system to identify pollutants on the water surface

Alexandra S. Kondakova and Andrey P. Chernyaev

Anthropogenic hormone substances in coastal waters of Peter the Great Bay (Japan/East Sea)

Andrey P. Chernyaev and Anna S. Vazhova

Oil pollution in Nakhodka Bay (Japan/East Sea)

Yasuhiro Kamimura and Jun Shoji

Effects of environmental conditions on growth-selective survival of juvenile black rockfish *Sebastes cheni* in a vegetated habitat in the central Seto Inland Sea, Japan

Yulia V. Koudryashova, Tatiana L. Chizhova, Evgeniya E. Solodova and Nina N. Belcheva

Age-specific oxidative stress response to cadmium in the scallop *Mizuhopecten yessoensis*

Alexander Sevastyanov, Anastasia Chernova and Tatyana Lishavskaya

Results of long-term pollution monitoring in Peter the Great Bay (Sea of Japan)

Takuma Morita, Yuji Iwamoto and Jun Shoji

Significance of estuarine habitat as nursery for yellowfin sea bream *Acanthopagrus latus*: Comparison of feeding, growth and possible predators for larvae and juveniles in two habitats around Ohta River estuary northern Hiroshima Bay, Japan

Young Shil Kang, Won-Chan Lee, Sok Jin Hong and Dong-Wook Kim

Seasonal and spatial variability in the zooplankton community in Masan Bay, Korea

Jung-Hoon Kang, Oh Youn Kwon, Kyoungsoon Shin and Man Chang

Distribution of potentially risky heterotrophic *Noctiluca scintillans* and port specific capacity based on port baseline surveys in Korea

Guo Ying Du, Shang Chen, Tao Xia, Dachuan Ren, Li Wang and Min Wang

Valuation of ecological capital in coastal area of Shandong province, China

Ik Kyo Chung, Jung Hyun Oak, Sang-Rae Lee and Jeong Ha Kim

Estimation of the seaweed biomass by the extensive field survey

Hee Won Park, Jae Bong Lee, You Jung Kwon, Chang Ik Zhang and Sung Il Lee

Estimating optimum size of stock enhancement in marine ranching ecosystem

Sangjin Lee and Mark Walton

Threats to marine and coastal biodiversity in the NOWPAP region

POC/BIO/MONITOR/FUTURE Topic Session (S13)

Comparing the two major gyres of the subarctic North Pacific - Seasonal and interannual variability and its predictability

Co-Convenors: *James Christian (Canada), Emanuele Di Lorenzo (U.S.A.), Shin-ichi Ito (Japan), David L. Mackas (Canada), Vyacheslav B. Lobanov (Russia) and Atsushi Tsuda (Japan)*

Background

The subarctic North Pacific contains two major gyres; the western subarctic gyre and the Alaskan gyre. Both gyres are mainly driven by the subarctic wind field and are expected to be synchronized with each other. However, the real responses are not so simple. For example, the western subarctic gyre shows large seasonal variability in the western boundary current (Oyashio), while the Alaskan stream does not show large seasonal variability. In addition to these physical characteristics, chemical and biological characteristics are different. For example, iron supply is larger in the western subarctic gyre because the distance from the terrestrial

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sources is closer than in the Alaskan gyre. This, in turn, affects the duration, composition, and magnitudes of phytoplankton and zooplankton production. Therefore, ecosystems also differ between in the two gyres. To achieve better understanding of the mechanisms of the subarctic response to atmospheric forcing, comparisons of the responses of the two gyres are essential. Although severe winter conditions have limited observational activity in the two gyres, recent progress in observational networks, including satellites, drifters and Argo floats, have improved our understandings of the two gyres. Such progress enables better comparison of the two gyres, which was enhanced by discussions in this session.

Summary of Presentations

About 50 persons attended and seven presentations were made. An invited talk by Hiroshio Kawamura (co-authored with Osamu Isoguchi) reviewed seasonal-to-interannual variability of the Oyashio transport, as indexed by several methods. Large seasonal variability is controlled by barotropic response to wind stress curl associated with intensity and location of the westerlies, while interannual variability is controlled by barotropic and baroclinic responses. The second paper by Howard Freeland showed a test case of volume, heat and salt conservation estimates made using Argo floats data. He derived vertical upwelling velocity as 8.9×10^{-7} m/s in the Alaskan Gyre, which is larger than some previous estimates. Sachihiko Itoh compared characteristics of cyclonic and anti-cyclonic eddies in the two gyres and found similarity between cold-core anticyclonic eddies in the western subarctic gyre and low salinity-core anticyclonic eddies in the Alaskan gyre. The invited talk by Joaquim Goes showed a technique to estimate nitrate concentration from satellite-derived sea-surface temperature and Chl-*a* concentrations. Seasonal changes of the nitrate can then be used to estimate annual “new” primary production, and to examine their spatial and interannual differences. Results showed a strong basin-scale response to the ENSO. Rui Saito showed excellent east–west comparison of individual size and abundance of zooplankton based on *Oshoro-maru* survey line data. He found a larger body size of copepods and hydrozoans in the western subarctic gyre. An invited talk by Sanae Chiba reviewed climate impact on lower trophic level ecosystems and its predictability in the two gyres. Both phenology and productivity show strong low frequency variability in both gyres that is strongly linked to temperature and stratification variability indexed by PDO. Many of the plankton responses show opposite temporal phase in the two gyres, as expected by the east–west dipole pattern of the PDO. In the final paper, Hiroaki Saito discussed between-species differences in the vertical distribution and life history timing of dominant *Neocalanus* copepods, and used a modelling approach to investigate the advective trajectories of copepods spawned in various parts of the subarctic Pacific. Transport speeds are high and trajectories very long in the western gyre and especially in the Kamchatka, Oyashio and KOE regions. He estimated fractional exchange of populations between various subregions, and showed that the seasonal and interannual variability observed at any single site is strongly influenced by the mixture of upstream source populations.

Taken together, the papers showed that in comparison to the Alaska Gyre, the Western Subarctic Gyre can be characterized as one of cooler temperature, higher nutrients, richer in iron, higher primary production, larger-size phytoplankton, larger-sized zooplankton. Those differences are caused by the interaction between differences in upstream conditions, wind-stress distribution, interaction between subtropical gyre, and distance from terrestrial iron source. However, the knowledge on seasonal and interannual variability remains limited and enhancement of *in situ* observations are expected. Additionally, comparable approaches are essential to improve our comprehensive understandings, and to predict future responses to global warming.

At the end of the session, the convenors expressed their regret and surprise that relatively few papers (7 orals and 3 posters) were submitted to the session. However, the quality of the papers was high. Continuing efforts towards the progress of comparative studies in the subarctic gyres were encouraged.

List of papers

Oral Presentations

Osamu Isoguchi and Hiroshi Kawamura (Invited)

Seasonal to interannual variations of the western boundary current of the subarctic North Pacific using altimeter data

Howard Freeland

Heat and salt conservation in the N.E. Pacific

Sachihiko Itoh, Ichiro Yasuda and Hiromichi Ueno

Warm and cold-core anticyclonic eddies in the western subarctic North Pacific

Joaquim I. Goes, Helga do R. Gomes, Kosei Sasaoka and Toshiro Saino (Invited)

The role of the Aleutian Low Pressure System in regulating phytoplankton biomass, primary production and export production across the subarctic Pacific Ocean basin

Rui Saito, Atsushi Yamaguchi, Ichiro Imai, Sei-Ichi Saitoh and Kenshi Kuma

East-west comparison of the zooplankton community in the Subarctic Pacific during the summers of 2003-2006

Sanae Chiba (Invited)

An overview of ecosystem state variability in the subarctic North Pacific: East-west synchrony and contrast

Hiroaki Saito, Atsushi Tsuda, Hiroaki Tatebe

West meets East: Inter-gyre transportation of *Neocalanus* copepods

Poster Presentations

Shin-ichi Ito, Yugo Shimizu, Shigeho Kakehi, Taku Wagawa, Akira Kusaka and Masatoshi Sato

Seasonal variation of the Oyashio transport compared with the Alaskan Stream

Yuichiro Kumamoto, Akihiko Murata, Shinya Kouketsu, Michio Aoyama, Shuichi Watanabe and Masao Fukasawa

A comparison of dissolved oxygen concentration in intermediate layer between the western and eastern subarctic gyres of the North Pacific from 1985 to 2007

Yugo Shimizu, Taku Wagawa, Shin-ichi Ito, Shigeho Kakehi, Akira Kusaka and Masatoshi Sato

Velocity structure and transport of Oyashio measured by vessel-mounted acoustic Doppler current profiler along repeat hydrographic section A-line

POC/MEQ/FUTURE Topic Session (S14)

Marine renewable energy development in coastal and estuarine environments around the North Pacific

Co-Convenors: *George Boehlert (U.S.A.), Michael Foreman (Canada), Glen Jamieson (Canada) and Kuh Kim (Korea)*

Background

This was the first session at a PICES Annual Meeting dealing with the topic of marine renewable energy. Projects under active development throughout the world are typically designed to directly extract energy from waves, tides, currents, wind, osmotic, or thermal gradients or indirectly from biomass energy. These novel technologies will require new emplacements, moorings, or other structures in marine and estuarine environments with attendant intrusions upon the environment, including acoustic signals, changes to mixing, and electromagnetic fields. Marine renewable energy sources are able to provide clean energy, but their effects on the physical and biological environment are not well understood and should thus be of interest to PICES member countries.

Summary of Presentations

Papers were presented by authors from four PICES member countries (Canada, Japan, Korea, and United States) and by invited speaker, Henry Jeffrey from the University of Edinburgh, UK, who spoke on “*Ocean energy: A European perspective*”. As co-author of the UK Roadmap for Ocean Renewable Energy and a principal in the SuperGen project, he shared a great deal of experience on the European experience. His talk was followed by three national/regional talks; Tokio Wada (with co-author Ken Takagi) discussed “*Status and perspectives of the utilization of marine renewable energy in Japan.*” Keyyong Hong (with co-authors Seung-Ho Shin and Seok-Won Hong) discussed “*Current status and future perspectives of marine renewable energy development in Korea*” George Boehlert (with co-author Philip Malte) presented on “*Wave and tidal energy*”

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research in the Pacific Northwest: The Northwest National Marine Renewable Energy Center”.

After the break, invited speaker, Brian Polagye, discussed the outcomes of an international workshop held in Seattle in March, 2010 in his talk “*Environmental effects of tidal energy development*”. The proceedings of this workshop will be available soon as a NOAA Technical Memorandum. The final paper by Michael Foreman (with co-authors Dario Stucchi, Kyle Garver and Thomas Grime) discussed “*A circulation model for the Discovery Islands, Canada: The first step in assessing tidal energy potential and impacts*”. Discussion for an additional 30 minutes led by the convenors explored several questions.

The session was not particularly well attended, with approximately 35 participants at the start and 15 at the end. Only one paper was not presented, as Yong Jun Cho was not at the meeting. The acoustics in the very large room were quite poor, and would have benefited from portable microphones and also lowering of the screen in the very high-ceilinged room.

List of papers

Oral Presentations

Henry Jeffrey (Invited)

Ocean energy: A European perspective

Tokio Wada and Ken Takagi

Status and perspectives of the utilization of marine renewable energy in Japan

Keyyong Hong, Seung-Ho Shin and Seok-Won Hong

Current status and future perspectives of marine renewable energy development in Korea

George W. Boehlert and Philip C. Malte

Wave and tidal energy research in the Pacific Northwest: The Northwest National Marine Renewable Energy Center

Brian Polagye (Invited)

Environmental effects of tidal energy development

Yong Jun Cho, Min Kyun Kim

On the likelihood of Power-Breaker as wave energy extractor and its hydraulic characteristics

Michael Foreman, Dario Stucchi, Kyle Garver and Thomas Grime

A circulation model for the Discovery Islands, Canada: The first step in assessing tidal energy potential and impacts

MONITOR Topic Session (S15)

Development and use of ocean observing and forecasting systems in coastal and marine management

Co-Sponsored by: *ICES*

Co-Convenors : *Jonathan Hare (U.S.A.), Vyacheslav B. Lobanov (Russia), David L. Mackas (Canada), Phillip R. Mundy (U.S.A.), Youngjae Ro (KOREA) and Hiroya Sugisaki (Japan)*

This session was developed to advance the objectives of the PICES Technical Committee on Monitoring, the PICES FUTURE program (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) and the ICES-GOOS Steering Group. These groups have terms of reference related to the coordination of Global Ocean Observing Systems, the development and evaluation of forecasting systems, and their application to ocean management. The session focused on examples where ocean observations and forecasts have been used in PICES and ICES products.

Methodological advances and issues were also presented to promote the development of observing and forecasting capabilities. In addition, the session served as a forum to bring ocean observing, ecological forecasting and resource management communities together to better link observing and forecasting efforts with the need to provide scientific advice for marine and coastal resource management.

Summary of Presentations

The session had a total of 19 oral and 8 poster presentations from all 6 PICES member countries and 2 from Ireland and Malaysia. Unfortunately, there were few presentations on ICES issues in spite of this session being jointly sponsored with ICES. Glenn Nolan, the invited speaker, provided an overview of the hydrographic studies across the North Atlantic, and Jon Hare, one of the convenors, presented results from the Northeast U.S. CPR program. This information will be very helpful for collaboration between ICES and PICES in the future. Sue Moore (substituting for Drs. Gillian Lichota and John Calder) made a presentation on the monitoring activities by the Pacific Arctic Group as a part of activities of SAON (Sustaining Arctic Observing Networks; John Calder is SAON's the new *ex-officio* member of MONITOR). The importance of information exchange between the Arctic and sub-Arctic was made clear by this presentation.

The afternoon session began with an invited presentation by Dr. Sonia Batten who described the current status of CPR under the title of "*The Continuous Plankton Recorder - A lengthy history and a global future*". She provided an excellent report on the CPR status as well as the utilization of records in estimating the ecosystem status in Arctic waters. Next, U.S. observation history of salmon returns in relation to California current conditions was given by Dr. Bill Peterson. Physical oceanographer, Dr. David Foley, gave a very interesting talk about the Chinook salmon habitat along the California coast based on the statistical analysis of salmon return data along with physical conditions. This talk was a very refreshing and exceptional one. Lastly, Dr. Réka Domokos talked about the acoustic investigation of bigeye tuna at Cross Seamount. In this session, three talks were related with fishes and their return and/or survival story.

The concluding session began with an invited presentation by Jonathan Hare who shared the experience accumulated during 50 years of continuous plankton recorder (CPR) and expendable bathythermograph (XBT) observations from ship-of-opportunity platforms over the northwest continental shelf of the Atlantic Ocean. The observations document biological responses of plankton abundance, community structure and phenology within the context of physical observations that document the effects of climate change. Although the observations have increased fishery managers' understanding of ecosystem structure, the only operational management application to date is a right whale calving model. Even so, the calving model demonstrates that the ship-of-opportunity approach makes available a wealth of observations on which both ocean science and management communities could base operational management applications.

The use of satellite-derived oceanographic observations to guide management of a fish stock assessment survey was described by Carrie Holt in the next talk. The objective is to develop models that focus survey effort for the target species, Pacific hake (*Merluccius productus*), so that survey managers can maximize the benefit from the available ship time. Improved performance of models of fish distribution was achieved by incorporation of a measure of frontal activity, SST gradient. Dong-Jim Kang reported on the development of a new instrument and mooring for gathering and transmitting real-time continuous vertical profiles of hydrographic, chemical and ecological variables at depth. Using the same principle as the Argo drifter, the instrument autonomously collects observations by alternately rising and sinking about a mooring, and the components of the mooring send the data to the surface for distribution over a satellite communications system. Sei-Ichi Saitoh described an operational application of satellite remote sensing and marine-GIS to development of sustainable marine fisheries and their management. The integrated coastal fisheries information system defines a potential coastal fishing zone for squid by combining satellite and buoy observations with 4-D VAR data assimilation, ecosystem modeling, and marine-GIS spatial modeling. Dani Evenson addressed the development and application of an experimental forecast model for migratory timing of salmon using retrospective analysis of satellite, surface weather and NCEP reanalysis model data. The application of the experimental model in 2010 produced accurate timing forecasts 2 weeks in advance of the 2010 fishing season, so the project will proceed to deploy an operational product for fishery managers in 2011. The final talk of the session was by David Welch who described an application of the POST acoustic telemetry array toward the solution of a complex salmon fishery management problem. The application of the POST array permits the location of marine mortality to be more precisely defined, which promises to allow objective examination by policy makers of the relative importance of salmon farms as sources of mortality for wild salmon juveniles.

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The Best Poster award for a topic session/workshop sponsored by MONITOR was received by Dr. Hisashi Yamaguchi for the presentation titled “*Variation of satellite chlorophyll-a in the East China Sea based on local satellite algorithm with reduced influence from suspended sediment*” (see list at the end of the Session Summaries report)

List of papers

Oral Presentations

Glenn Nolan, Eugene Colbourne and Hedinn Valdimarsson (Invited)

The ICES Working Group on Oceanic Hydrography (WGOH): Building on over 100 years of North Atlantic observations

Molly McCammon, Carl Schoch and Darcy Dugan

Alaska Ocean Observing System: Lessons learned in developing an end-to-end observing system

Vyacheslav B. Lobanov

North-East Asian Regional Global Ocean Observing System: The story of success and current requirements for coastal and marine management

Kwang-Soon Park, Dong-Young Lee, Ki-Cheon Jun, Sang-Ik Kim, Jae-II Kwon and Jung-Woon Choi

Introduction of Korea operational oceanographic system (KOOS)

Toshio Suga (Invited)

Profiling floats as tools for biogeochemical and biological monitoring

Gillian B. Lichota and John A. Calder (*presented by Sue Moore*)

Monitoring Pacific Arctic ecosystem change through development of a Distributed Biological Observatory (DBO)

Yoichi Ishikawa, Toshiyuki Awaji, Teiji In and Sei-Ichi Saitoh

Development of coastal data assimilation system for environmental monitoring/forecasting

Jerome Fiechter, Gregoire Broquet, Andrew M. Moore and Hernan G. Arango

A data assimilative, coupled physical-biological model for the Coastal Gulf of Alaska

Yasumasa Mivazawa, Toru Miyama, Sergey M. Varlamov, Xinyu Guo and Takuji Waseda

Application of the Ensemble Kalman Filter to the Kuroshio variations around the Kii Peninsula

Sonia Batten (Invited)

The Continuous Plankton Recorder - A lengthy history and a global future

William Peterson, Edmundo Casillas, Jay Peterson, Cheryl A. Morgan and Jennifer Fisher

Forecasting returns of coho and Chinook salmon in the northern California Current: A role for long term observations

David G. Foley

Identification and monitoring of Chinook salmon habitat along the California coast

Réka Domokos

Acoustic investigation of bigeye tuna at Cross Seamount

Jonathan A. Hare, Jack A. Jossi and Joseph M. Kane

Fifty years of ship-of-opportunity observations on the northeast U.S. continental shelf: Results and management applications

Carrie A. Holt, Ashleen Benson, Brigitte Dorner, Melissa A. Haltuch, Megan O'Connor and Mary Thiess

Forecasting Pacific hake distribution at fine spatial scales using satellite-derived oceanographic data

Dong-Jin Kang, Kyung-Ryul Kim, Kyung-II Chang and Ki Wan Kim

E-RAP (EAST-1 Real-time Automatic Profiler): Its development and application

Sei-Ichi Saitoh, Toru Hirawake, I Nyoman Radiarta, Tomonori Isada, Robinson Mugo, Fumihito Takahashi, Ichiro Imai,

Yasuhiro Sakurai, Michio J. Kishi, Masaaki Wada, Toshiyuki Awaji and Yoichi Ishikawa

New challenge of integrated coastal fisheries information system in southern Hokkaido, Japan

Phillip R. Mundy and Dani F. Evenson

Use of ocean observations to develop forecasts in support of fishery management operations

David W. Welch

Applications of coastal ocean acoustic telemetry arrays for marine fisheries: Making research cost-effective and policy relevant

Poster Presentations

Megan O'Connor, Melissa A. Haltuch, Carrie A. Holt, Brigitte Dorner, Ashleen Benson and Mary Thiess

Forecasting the north-south distribution of Pacific hake using coastal upwelling indices and oceanographic model outputs

Hisashi Yamaguchi, Young Beak Son, Eko Siswanto, Joji Ishizaka, Sinjae Yoo, Yu-Hwan Ahn, Sang-Woo Kim, Junwu Tang, Hiroshi Kawamura and Yoko Kiyomoto

Variation of satellite chlorophyll *a* in the East China Sea based on local satellite algorithm with reduced influence from suspended sediment

Tadafumi Ichikawa and Hiroya Sugisaki

Long term variations of abundance and size composition of copepod communities off southern Japan using bench-top Video Plankton Recorder system (B-VPR)

Huade Zhao, Xuemei Xu, Minghao Li and Juying Wang

The partial pressure of carbon dioxide and air-sea fluxes in the northern Yellow Sea of China

Hikomichi Igarashi, Nozomi Sugiura, Shuhei Masuda, Takahiro Toyoda, Yoshihisa Hiyoshi, Yuji Sasaki, Mitsuo Sakai, Taro Ichii, Takushi Kindaichi, Jun-ya Tanaka, Masaharu Oomizu, Yoichi Ishikawa and Toshiyuki Awaji

Improved approach for the identification and prediction of neon flying squid abundance and distribution in northwestern North Pacific using an integrated 4D-VAR data assimilation system

Vadim Burago, Georgiy Moiseenko and Igor Shevchenko

Modeling spatial distribution of the ocean chlorophyll *a* concentration from remote sensing data

Xiang Pu, Huiwang Gao, Zhe Liu and Yunjun Yu

Simulation of non-point source nutrient flux and its impact on water quality of coastal ocean: A case study on Jiaozhou Bay in China

Howard Freeland

Argo: A decade of success, what have we learned and what comes next?

BIO Paper Session

Convenor: *Michael Dagg (U.S.A.)*

Background

This session continued the tradition of providing oral and poster presentations on all aspects of Biological Oceanography in the North Pacific and its marginal seas that were not covered in the more specific BIO Topic Sessions (S2, S3, S4, S6, S8, and S13). Papers on marine birds and mammals were especially encouraged this year.

Summary of presentations

There were 18 oral and 14 poster presentations for this session, once again indicating its popularity as an outlet for a diverse set of papers oriented towards issues in Biological Oceanography that are not specifically addressed by focused Topic Sessions. Oral presentations were given by scientists from all PICES member countries. The initial set of talks, before morning coffee, focused on euphausiids with presentations from Korea (Ju *et al.*), U.S.A. (Shaw *et al.*, and Batchelder and Lindsay) and China (Du *et al.*). It was good to see these important but understudied organisms receiving more attention. It should be noted that the presentation by Du *et al.* titled "Feeding rates of adult *Euphausia pacifica* on natural particle assemblages in the coastal upwelling zone off Oregon, USA." received the BIO award for Best Oral presentation by an early career scientist for a BIO-sponsored Topic Session/Workshop. The euphausiid papers were followed by excellent contributions about other components of the pelagic food web, including phytoplankton, zooplankton, fish, birds and mammals, and the benthic environment was also represented by the presentation of Dolganova. The highly successful poster session featured a wide range of topics, including the recipient of the BIO Best Poster award by Dumbauld and Chapman titled "Can an introduced parasitic bopyrid Isopod *Orthione griffensis* cause extinction of mud shrimp *Upogebia pugettensis* populations in U.S. west coast estuaries?" The BIO-P session was well attended throughout the day, indicating broad interest from the PICES community. (See the list of awards at the end of this Session Summaries report).

List of papers

Oral presentations

Se-J. Ju, H.S. Kim, W.S. Kim, D.H. Kang and A.R. Ko

Understanding the role of the Yellow Sea Bottom Cold Water Mass ($\leq 10^{\circ}\text{C}$) on the survival strategy of *Euphausia pacifica* throughout the hot summer in the Yellow Sea

C. Tracy Shaw, Leah R. Feinberg, Hongsheng Bi and William T. Peterson

Cohort data for the euphausiid *Euphausia pacifica* based on biweekly sampling off Newport, OR, USA

Xiuning Du, William T. Peterson and C. Tracy Shaw

Feeding rates of adult *Euphausia pacifica* on natural particle assemblages in the coastal upwelling zone off Oregon, USA

Harold P. Batchelder and Brie J. Lindsey

On adding a stage-structured model of krill to NEMURO

Kenji Tsuchiya, Yoshiki Tomoko, Hideo Miyaguchi, Kenichi Mori, Tomohiko Kikuchi and Tatsuki Toda

Typhoon-driven variations in productivity and species composition of phytoplankton in Sagami Bay, Japan

Atsushi Yamaguchi, Yurika Hanamiya, Hikaru Watanabe and Hiroto Murase

Macrozooplankton diel vertical migration and carbon flux in the summer, western North Pacific Ocean

Bridget E. Ferriss and Timothy E. Essington

Regional patterns in mercury concentrations of yellowfin and bigeye tuna in the Pacific Ocean

Anastasia S. Dolganova

The current condition of *Polychaeta* of the northwestern shelf of Bering Sea

Angelica Peña and Diane Masson

Modelling plankton dynamics in the Straits of Georgia and Juan de Fuca

Meredith L. Elliott, Jaime Jahncke, Moira Galbraith and David L. Mackas

Copepod assemblages as indicators of ocean conditions in Central California

Hidefumi Fujioka, Atsushi Tsuda and Ryuji J. Machida

A molecular method for species identification of early life stages of *Neocalanus plumchrus* and *Neocalanus flemingeri* using Real-Time PCR

Tomoko Yoshiki, Tsuneo Ono, Akio Shimizu and Tatsuki Toda

Egg development time and hatching success of deep sea spawning calanoid copepods, genus *Neocalanus*

Todd W. Miller, Richard D. Brodeur, Koji Omori, Robert L. Emmett and Hideki Hamaoka

A stable isotope trophic assessment of upper trophic level nekton in the Northern California Current ecosystem

Chiyuki Sassa and Youichi Tsukamoto

Interannual comparison of diet of larval jack mackerel *Trachurus japonicus* in the southern East China Sea during 2002-2005

Ah-Ra Ko, Dae-Yeon Moon, Seok-Gwan Choi, Kyung-Hoon Shin and Se-Jong Ju

Lipid metabolism of minke whale and pacific white-sided dolphin in Korean waters and implications for feeding ecology

Olga Yu. Tyurneva, Yuri M. Yakovlev, Vladimir V. Vertyankin, Glenn Gailey, Olga Sychenko and Judy E. Muir

Discovering a new feeding area for calf-cow pairs of Western Gray Whales on the south-east shelf of Kamchatka in 2009 and their utilization of different feeding regions within one season

Hector D. Douglas III, Alan M. Springer, Suzanne Budge and Lacey Aucoin

Fatty acid and stable isotope analyses reveal consumption patterns of planktivorous auklets and variability in ecosystem productivity

George L. Hunt, Jr., Stephani Zador and James Ianelli

Declines of northern fur seals at the Pribilof Islands: Forage fish depletion, competition with adult pollock and arrowtooth flounder, or fishing activity?

Poster Presentations

Alexander V. Zavolokin (presented by V. Kulik)

Forage base of Pacific salmon (*Oncorhynchus* spp.) in the Northwest Pacific Ocean in 2004-2009

Ludmila S. Belan and Tatyana A. Belan (presented by A. Chernova)

Composition and distribution pattern of macrozoobenthos on the continental shelf of the Okhotsk Sea near NE Sakhalin Island

Brett R. Dumbauld and John W. Chapman

Can an introduced parasitic bopyrid Isopod *Orthione griffenis* cause extinction of mud shrimp *Upogebia pugettensis* populations in U.S. west coast estuaries?

Sarat C. Tripathy, Joji Ishizaka, Tatsuya Shibata, Eko Siswanto and Yoshihisa Mino

Evaluation of Vertically Generalized Production Model (VGPM) in Ariake Bay, Southwestern Japan

Evgeniya E. Vekhova, Michael I. Kusaykin and Konstantin V. Kiselev

The phytoplankton contribution to the diet: A comparison of two mussels (Mollusca: Bivalvia) from different biotopes of the Sea of Japan

Katsumi Takavama, Tatsuro Watanabe, Hideyuki Kawamura and Iori Tanaka

Reproducibility of chlorophyll *a* and nutrient variability in the Japan Sea by the threedimensional ecosystem-circulation model

Hyun Woo Kim, Yong-Rock An, Tae-Geon Park, Zang Geun Kim, Dae-Yeon Moon and Seok-Gwan Choi

Validity of a photo-identification method for spotted seals in the Baekryongdo, Korea

Yuji Okazaki, Kazuaki Tadokoro and Yugo Shimizu

The vertical distribution of krill in the Oyashio and mixed water regions, western North Pacific

Tae-Geon Park, Yong-Rock An, Zang-Geun Kim, Seok-Gwan Choi and Dae-Yeon Moon

Distribution of the spotted seal, *Phoca largha*, along the coast of Baekryeongdo in 2006 - 2008

Shin-ichi Ito, Hiroshi Kuroda, Takahiko Kameda, Takeshi Okunishi, Enrique N. Curchitser, Kate Hedstrom and Jerome Fiechter

A test of a coupled physical and lower-trophic-ecosystem model NEMUROMS in the North Pacific

Xiu-ning Du and Guang-xing Liu

Phytoplankton community structure and its relation to hydrographic conditions in the North Yellow Sea in autumn, 2007

Youngju Lee, Joong Ki Choi

Phytoplankton dynamics and primary production of the Yellow Sea in winter and summer

Brie J. Lindsey and Harold P. Batchelder

Potential spawning behaviors of *Euphausia pacifica* in the upwelling region of the Oregon coast: A 2-D modeling exploration

Natalia M. Aminina, Irina A. Kadnikova, Yeon-Kye Kim and Ho-Dong Yoon

Comparison of UV-absorbing and antioxidant activity of seaweed extracts

FIS Paper Session

Co-Convenors: *Gordon H. Kruse (U.S.A.) and Mikhail Stepanenko (Russia)*

Background

Papers addressing general topics in fishery science and fisheries oceanography in the North Pacific and its marginal seas are invited, except those covered by Topic Sessions S5, S6, S7, S8, S10 and S11.

Summary of presentations

The FIS Contributed Paper Session included 19 oral presentations and 30 poster presentations. Many of the poster presentations were originally proposed as oral presentations, but 19 talks were the maximum that could be accommodated for oral presentation during the two half-day sessions allotted for the FIS Contributed Paper Session. Presentations covered a wide range of invertebrates (*e.g.*, caridean shrimps, snow crab, common squid) and both pelagic (*e.g.*, Pacific herring, northern anchovy, Pacific salmon) and demersal (*e.g.*, walleye pollock, greenlings, Pacific cod) fish species. The first session began with three papers on genomics and genetics, including an overview on adaptive and behavioural responses to climate change and other genetic studies that focused on Atlantic cod and Pacific herring. Other oral presentations addressed a very broad diversity of fishery science topics. Specific research included studies of growth, geographic, depth and seasonal distributions, processes operating during early life history that regulate year-class success, population dynamics related to environmental factors including climate change, and ecosystem approaches including modelling. Poster presentations address an even wider diversity of fishery science topics. Additional topics covered in posters included fish abundance estimation, reproductive biology, stock-recruitment relationships, bioenergetics and over-wintering mortality, ecology of fished species including predator-prey relationships, assessments of fisheries and fishing effects, effects of oceanography on fish distributions, use of remote

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sensing technology, and management strategy evaluations that include ecosystem effects. The FIS Contributed Paper Session was very successful based on the number of oral presentations and posters, diversity of species and topics, high quality of the presentations, and the level of attendance by PICES members during these two half-day sessions.

List of papers

Oral presentations

Jennifer L. Nielsen

Adaptive and behavioral responses to a changing climate: A genomic perspective

Stewart Johnson, Marije Booman, Sophie Hubert, Brent Higgins, Tudor Borza, Jennifer Kimball, Cynthia Stone, Gary Simpson, Marlies Rise, Charles Feng, Tiago Hori, Jennifer Hall, Edward A. Trippel, Sharen Bowman and Matthew L. Rise

Atlantic Cod Genomics: Development of tools, resources and applications

Anna V. Dakus

The use of molecular techniques for population genetic analysis of the Pacific herring (*Clupea pallasii*) in the northwestern Pacific

Angela M. Johnson, Lorenzo Ciannelli and W. Waldo Wakefield

Effects of hypoxia on the juvenile demersal fish community structure in nearshore Central Oregon waters

Motomitsu Takahashi, David M. Checkley, Jr., Marisa N.C. Litz, Richard D. Brodeur and William T. Peterson

Responses in growth rate of larval northern anchovy to anomalous upwelling in 2005 in the northern California Current

Vladena V. Gertseva, Jason M. Cope and Sean E. Matson

Growth variability of the splitnose rockfish (*Sebastes diploproa*) in the Northeast Pacific Ocean: Pattern revisited

Hye-Min Park, Jung Nyun Kim, Hae Won Lee, Byeong Gyu Hong, Jin Ho Bae, Hyeong Gi Kim and Chul-Woong Oh

Vertical distribution and reproductive aspects of caridean shrimps in the deep-water of the East Sea, Korea

Tetsuichiro Funamoto, Satoshi Honda, Yuho T. Yamashita, Masayuki Chimura and Kazushi Miyashita

Distribution of walleye pollock (*Theragra chalcogramma*) larvae around Funka Bay, Japan: Relationships with environmental factors

Kerim Aydin and Troy Buckley

An analysis of 30 years of seasonal and geographic variability in marine food webs through fish food habits and stable isotope analyses

Jennifer L. Boldt, Thomas W. Therriault, Marc Trudel, Tyler Zubkowski and Jake Schweigert

Recruitment strength indices for northern British Columbia stocks of Pacific herring

Akihiko Yatsu

A two-stanza outbreak hypothesis for the Pacific stock of Japanese sardine during the 1970s

Jung Jin Kim, William T Stockhausen, Yang-Ki Cho, Chang Sin Kim and Suam Kim

Inter-annual variability in larval dispersion of common squid *Todarodes pacificus* during the 2000s

Akira Okuno, Tatsuro Watanabe, Katsumi Takayama, Naoto Honda, Koji Kakinoki and Osamu Katoh

Numerical simulation of the larval transport of snow crab *Chionoecetes opilio* in the Japan Sea

Elizabeth A. Daly and Richard D. Brodeur

Shifting trophic utilization by juvenile Chinook salmon in coastal marine waters: An interdecadal perspective with implications for climate change

Beverly Agler and Greg Ruggerone

Growth of the Bristol Bay and Yukon River, Alaska, chum salmon in relation to climatic factors and inter-specific competition

Bernard A. Megrey, Jason S. Link, Thomas J. Miller, Tim Essington, R. Ian Perry, Alida Bundy, Ken F. Drinkwater and Erlend Moksness

Can production models be used as a tool to examine factors that influence productivity of marine systems?

Louis W. Botsford, Matthew D. Holland, J. Wilson White and Alan Hastings

Population dynamic effects of fishing and climate change on upper trophic levels in the northeast Pacific

Shang Chen, Dachuan Ren, Dong Wang, Jingmei Li, Tao Xia and Guoying Du

Marine ecological capital assessment: Concepts and frameworks

James R. Irvine, Kim D. Hyatt, Janelle Curtis and Ray Lauzier

Science-based ecosystem approaches under Canada's Wild Salmon Policy

Poster Presentations

Michio J. Kishi, Kenta Awa and Takeshi Terui

Ecosystem approach for management of chum salmon coupled with NEMURO

Sang-Rae Lee, Tae Keun Rho, Jung Hyun Oak, Tongsup Lee, Jin Ae Lee and Ik Kyo Chung

Metagenomic approach to plankton species diversity of the East Sea of Korea

Thomas C. Kline, Jr.

Estimating over-winter mortality of age-0 Pacific herring based on loss of energy content and implications for recruitment

Yu-Chun Huang and Wen-Bin Huang

Maturation of female Pacific saury *Cololabis saira* (Brevoort) in the northwestern Pacific from the Taiwanese fishery catch

Takaomi Kaneko, Takashi Yamakawa and Ichiro Aoki

Formularization and internalization of the future external diseconomies produced by present fishing activities

Thomas C. Wainwright and Laurie A. Weitkamp

Climate effects and Oregon coast coho salmon: A multi-ecosystem approach

Hideaki Kudo, Akihiro Etoh and Masahide Kaeriyama

Attempt to estimate spawning escapement of chum salmon, *Oncorhynchus keta*, using aerial census by radio-controlled helicopter

You Jung Kwon, Doo-Hae An, Keith Bigelow and Dae-Yeon Moon

Effects of fishery factors on catch rate of bigeye tuna, *Thunnus obsesus* and yellowfin tuna, *Thunnus albacare* in the Korean tuna longline fishery

Hyeok Chan Kwon, Chang Ik Zhang and You Jung Kwon

Estimation of population parameters for filefish (*Stephanolepis cirrifer*) in the Japan/East Sea of Korea

Hiroshige Tanaka, Seiji Ohshimo and Chiyuki Sassa

Trophic relationships of small pelagic fish in the East China Sea and Sea of Japan: A stable isotope approach

Yuichiro Kogura, James E. Seeb, Noriko Azuma, Hideaki Kudo, Syuiti Abe and Masahide Kaeriyama

Genetic population structure of lacustrine sockeye salmon, *Oncorhynchus nerka*, in Japan

Alexei M. Orlov, Vadim F. Savinikh and Eugeny F. Kulish

Pacific sleeper shark in the North Pacific: New data on distribution and size composition

Kevin Thompson

Factors affecting the diets of groundfish in the Gulf of Alaska

Elizabeth Logerwell, Kimberly Rand and Tom Weingartner

Arctic cod (*Boreogadus saida*) and snow crab (*Chionoecetes opilio*) distributions relative to oceanography in the Alaskan Beaufort Sea, August, 2008

Ryuji Yukami, Mari Yoda, Seiji Ohshimo and Hiroshige Tanaka

Stock size fluctuations in chub and spotted mackerel in the East China Sea and Sea of Japan from 1973 to 2008

Hector D. Douglas III, Alan M. Springer, Suzanne Budge, Igor Ermakov and Werner Gellermann

Discriminating variation in consumption patterns and carotenoid content of juvenile Pacific Salmon with fatty acid analysis and Raman spectroscopy

Ji-Hyeon Kim, Jung Nyun Kim, Tack-Yoon Oh, Jin Ho Bae, Hyeong Gi Kim and Chul-Woong Oh

Age, growth and reproductive biology of Filefish *Tamnaconus modestus* in the Southern Sea of Korea

Sukgeun Jung and Il Su Choi

Estimating abundance of Pacific cod (*Gadus macrocephalus*) by applying a mark-recapture method during the spawning season in Jinhae Bay, Korea

Heui Chun An, Bong Seong Bae, Kyoung Hoon Lee, Chang Doo Park and Chae Sung Lee

Evaluation of LED fishing lamps for jigging and angling boats

Jae Bong Lee, Soo Jeong Lee, Jong Hee Lee, Young Jae Shin, Yeong Min Choi, Dong Woo Lee and Chang Ik Zhang

Seasonal variations in the composition of fisheries resources in the coastal ecosystem of Youngil Bay, Korea

Jong Hee Lee, Jae Bong Lee and Chang Ik Zhang

Forecasting variations of fishery and ecosystem risk indices for large purse seine and twopaired trawl fisheries in Korean waters using IFRAME

Graham E. Gillespie, Antan C. Phillips and Lindsay C. Orr

Population dynamics and biological characteristics of the invasive European green crab, *Carcinus maenas*, in British Columbia, Canada

Tatiana Tunon and Gottfried Pestal

Authorship patterns in 30 years of DFO research documents: Is applied fisheries research like other science?

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Gottfried Pestal and Tatiana Tunon

Visualizing a complex spawner-recruit model for sockeye salmon

Jung Hyun Lim and Chang Ik Zhang

Estimation of population ecological characteristics of Thomas's rapa whelk, *Rapana venosa*, along the west coast of Korea

Hee Won Park and Chang Ik Zhang

Study on the ecological characteristics of *Mugil cephalus* in waters south of Korea

Soo Jeong Lee, Hyeok Chan Kwon, Sang Cheol Yoon, Yeong Min Choi and Chang Ik Zhang

Age and growth of *Gomphina veneriformi* along the east coast of Korea

Jae Bong Lee, Young Jae Shin, Jong Hee Lee, Yeong Min Choi, Jae Seong Lee, Dong Woo Lee and Inja Yeon

Spatial biomass distribution of *Corbicula japonica* in the Seomjin River of southern Korea

Hyun Jeong Lim, Kwang Jae Park, Sang Ho Baik, Tae Seek Lee, In Kwon Jang, Hyun Sob Han and Phillip R. Mundy

Recovery of the productivity of shellfish aquaculture in the Western Sea of Korea after the *Hebei Spirit* oil spill

Theresa A'mar

Incorporating ecosystem forcing through predation into a management strategy evaluation for the Gulf of Alaska walleye pollock (*Theragra chalcogramma*) fishery

POC Paper Session

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

Background

Papers were invited on all aspects of physical and biogeochemical oceanography and climate in the North Pacific and its marginal seas, except those covered by Topic Sessions S8, S13 and S14.

Summary of presentations

The session consisted of 18 oral presentations and 6 posters covering a wide range of physical and biogeochemical oceanographic research. Unfortunately two scheduled oral presenters (Qiao and Ishchenko) were unable to attend the meeting and their slots could not be filled in time. Kyung-Il Chang, Ichiro Yasuda, Nicholas Bond, and Mike Foreman chaired sub-sessions over the 1-day presentation period. The morning portion included interesting talks related to: (1) water characteristics in the Yellow and Japan-East Seas (Ro), (2) projected climate changes to upper ocean stratification (Capotondi), (3) CO₂ air-sea fluxes in the western Arctic Ocean (Chen), (5) sea level and ocean colour features in the Northeast Pacific as revealed by satellite imagery (Crawford), (6) a warming signal in the upper layers of the East/Japan Sea (Na), (6) low frequency sea-level variability in the Japan/East Sea (Trusenkova), and (7) numerical simulations of winter mixed layer south of Japan (Kuroda).

The early afternoon session largely focused on Arctic and sub-Arctic Seas. Stabeno compared recent cold (2007–2010) and warm (2001–2005) periods on the eastern Bering Shelf, Bond described factors controlling the extent of Bering Sea ice in spring, Ustinova described extreme winter events in the Okhotsk and Bering Seas, Trusenkova described her multivariate analysis of winds over the Japan/East Sea using scatterometer data, and Gao described changes in the Arctic carbon sink from 1999 to 2008. In the final sub-session, Chang described anomalous upwelling features off the east coast of Korea, Ladd described the Pribiloff Eddy in the eastern Bering Sea, Ladychenko described eddies in the northwestern Japan/East Sea, Nieto described the affects of mesoscale structures in the California Current on the distribution and survival of fish, Ueno described observations of the Kenai Eddy in the Alaskan Stream, and Liu described tide-induced Lagrangian eddies in Jiaozhou Bay.

The Best Presentation award in a sponsored POC-sponsored session was given to early career scientist, Hiroshi Kuroda, for his talk “*A numerical study on the winter mixed layer on the shelf-slope region south of Japan*” in this Contributed Paper Session. (See the list of awards at the end of this Session Summaries report).

List of papers

Oral presentations

Young Jae Ro

Linking tropical oceanic conditions to water characteristics in the subtropical western Pacific marginal seas

Antonietta Capotondi, Michael Alexander, James Scott, Enrique Curchitser and Nicholas Bond

Climate change in upper-ocean stratification as inferred from the IPCC AR4 models

Liqi Chen, Zhongyong Gao and Weijun Cai

Precision evaluation of air–sea fluxes of CO₂ in the western Arctic Ocean under rapid sea ice shrinking and its implication to global climate change

William R. Crawford

Features of the northeast Pacific Ocean

Hanna Na, Kwang-Yul Kim, Kyung-II Chang, Kuh Kim and Shoshiro Minobe

Warming signal in the upper layers of the East/Japan Sea

Olga Trusenkova and Dmitry D. Kaplunenko

Low frequency variability of sea level in the Japan/East Sea estimated from AVISO satellite altimetry

Hiroshi Kuroda, Takashi Setou, Yuichi Hirota, Manabu Shimizu and Kazuhiro Aoki

A numerical study on the winter mixed layer on the shelf-slope region south of Japan

Phyllis J. Stabeno, Nicholas A. Bond and Jeffrey M. Napp

Eastern Bering Sea shelf: Comparison between a cold period (2007–2010) and a warm period (2001–2005)

Nicholas A. Bond, Phyllis J. Stabeno, Albert J. Hermann and Muyin Wang

What controls the extent of ice in the Bering Sea in spring?

Elena I. Ustinova and Yury D. Sorokin

Winter extreme events in the thermal state of the Okhotsk and Bering Seas

Olga Trusenkova

Multivariate analysis of wind stress and curl over the Japan/East Sea based on satellite scatterometry data

Zhongyong Gao, Liqi Chen and Heng Sun

Developments of the Arctic carbon sink from 1999 to 2008

Jae-Hyung Park and Kyung-II Chang

Characteristics of anomalous coastal upwelling detected off the east coast of Korea in summer 2007

Carol Ladd, Phyllis J. Stabeno and Julia O’Hern

The Pribilof Eddy in the eastern Bering Sea

Svetlana Y. Ladychenko, Vyacheslav B. Lobanov and Dmitry D. Kaplunenko

Evolution and hydrographic structure of mesoscale eddies formed in the northwestern Japan Sea

Karen Nieto, Sam McClatchie and Edward D. Weber

How does mesoscale oceanic structure in the California Current System affect the distribution and ultimately the survival of larval fish?

Hirofumi Ueno, Hiroji Onishi, Sachihiko Itoh, Ichiro Yasuda, Yutaka Hiroe, Toshio Suga and Eitarou Oka

Observations of a Kenai eddy along the Alaskan Stream south of the Aleutian Islands

Guangliang Liu, Zhe Liu, Huiwang Gao and Shizuo Feng

Simulation of the Lagrangian tide-induced residual current in Jiaozhou Bay, North China

Poster Presentations

Zhongyong Gao, Liqi Chen and Heng Sun

CO₂ system in the Bering Sea

Talgat R. Kilmатов, Elena V. Dmitrieva and Olga I. Trinko

The indirect estimation of the climatic trend of kinetic energy production in the North Pacific

Zhongyong Gao, Liqi Chen and Heng Sun

Summertime CO₂ system distribution and air–sea CO₂ fluxes in the Bering Sea

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Yugo Shimizu, Lynne D. Talley, Shin-ichi Ito, Shigeho Kakehi and Taku Wagawa

Spreading pattern and transport of the Okhotsk Sea Intermediate Water to the northwest Pacific revealed by profiling floats with optode and hydrographic observations

V.V. Moroz

Peculiarities in intermediate water characteristics in the Komandor–Kamchatka area

Tae-Hoon Kim and Guebuem Kim

Basin-scale low N:P ratios and DOC export in the East/Japan Sea

TCODE Topic Session (E-Poster)

Monitoring and Ocean Observing Systems

Convenor: *Toru Suzuki (Japan)*

Background

Integrated Ocean Observing Systems have recently received significant attention for monitoring and reporting the status of coastal, continental shelf and even deep ocean ecosystems. Ocean Observing Systems enhance our ability to collect, deliver, and use ocean information, and they deliver the data and information needed to increase understanding of our oceans and coasts, so decision makers can take actions to improve safety, enhance the economy, and protect the environment. Ocean Observing System information is also used to initialize numerical ecosystem models. Contributions to this session demonstrated the application of ocean observing systems that support the FUTURE goals of improved understanding, status reports, outlooks and forecasts through the use of electronic display systems, including interactive web sites and animations.

Summary of presentations

Igor Shevchenko demonstrated PICES TCODE geospatial portal using GeoNetwork, which is open source software based on international and open standards for services and protocols including web-based interactive map viewer, on the PICES rented server. The geospatial portal stored the PICES digital document library and metadata collected under the PICES Metadata Federation and TINRO-Centre provides a great contribution to maintain the server.

Tony Koslow showed the California Cooperative Oceanic Fisheries Investigations (CalCOFI) which is developing on the web-based information-management system known as DataZoo. The DataZoo information environment aggregates 2- or 3-dimensional physical and biological data, enhancing data access and contributing to the coherence and quality of the long-term CalCOFI data. DataZoo includes datasets ranging from species level counts and hydrographic profiles to biogeochemical measurements and core CalCOFI data sets as well as data from California Current Ecosystem Long-Term Ecological Research Program and others partner programs.

Richard Dewey demonstrated the VENUS (Victoria Experimental Network Under the Sea) coastal observing system with real time data displays and user controlled interactive experimental systems including CTD measurement, time series of dissolved oxygen, turbidity, ADCP currents, echo-sounder images of fish and zooplankton. He also demonstrated the access to the on-line data archive and real time signals through the Internet from Saanich Inlet and the Strait of Georgia, Canada. The mobile assets such as Gliders, AUVs, water columns profilers, and geospatial mapping of marine conditions will be supported in future.

These systems can access to remote databases through the Internet and visualize data interactively by using recent information and communication technologies, and are expected to develop along with improvement of information and communication technologies.

List of papers*Poster Presentations***Igor Burago, Bernard A. Megrey, Georgiy Moiseenko, Olga Vasik, Tatiana Semenova and Igor Shevchenko**

Using the PICES rented server

Karen Baker, Edward D. Weber and J. Anthony Koslow

CalCOFI information management and data delivery

Richard Dewey and Verena Tunnicliffe

VENUS: Real time ecosystem monitoring from a coastal observing system

BIO Workshop (W1)***Marine ecosystem model inter-comparisons (III)***Co-convenors: *Harold P. Batchelder (USA), Shin-ichi Ito (Japan), Guimei Liu (China) and Yvette Spitz (U.S.A.)*Background

The objective of the Marine Ecosystem Model Inter-comparison Project (MEMIP) was to compare the performance of various lower trophic level marine ecosystem simulation models at predicting the abundance and distribution of coastal zooplankton functional groups. Models with high performance were used to examine the future state of the marine ecosystem to global climate change. This workshop built upon the discussions and planning accomplished at the successful workshop held at PICES-2009. The workshop was a technical, hands-on, one with focus on parameterizing, executing and calibrating three test bed versions of a biogeochemical lower trophic level (LTL) marine ecosystem models. At each test bed it was planned to run 3 to 6 ecosystem models. Specific ecosystem models (*i.e.*, NPZD, NEMURO and CoSINE) were executed. Some models were tuned to run in a specific region and others were applied to areas different from where they were calibrated. Model skill assessment was evaluated. The models were used to identify important mechanisms that control secondary production, zooplankton biomass and variability, as well as bounding the levels of uncertainty in model predictions by calculating ensemble statistics. Eventually, comparisons at multiple locations will provide information on the spatial-temporal robustness of particular model structures and parameterizations. The products of the comparison will contribute to FUTURE by estimating the uncertainty and the limits of forecasting.

Summary of Workshop

Eighteen scientists from all 6 PICES member countries, plus Norway, participated in the 3rd MEMIP workshop that was held Saturday–Sunday, October 23–24, 2010. After reviewing the current status of MEMIP and describing the general goals and objectives, we heard an interesting invited talk by Guimei Liu of China on a nowcast/forecast model in the South China Sea. Hal Batchelder and Shin-ichi Ito described the datasets that are available and the data that have been prepared and place on the “orion” server at the Alaska Fisheries Science Center. Following a question regarding the continued availability of “orion”, which was provided by Bern Megrey, Batchelder agreed to contact the appropriate people at AFSC to determine if it would be possible to continue MEMIP use of “orion” for another two years. Jeff Napp was contacted and indicated that he would approve such use following a written request from the MEMIP group. Batchelder agreed to prepare a request shortly, following the conclusion of PICES-2010. In addition, we will request an additional user account be established for a new active member of MEMIP, Jerome Fiechter of the U.S.A.

Our original goal was to have at least one, and hopefully two, regional 2D models configured to provide a well-defined and consistent physical test bed for the testing of multiple ecosystem models. Toward that end, Dr. Yvette Spitz configured a domain for the Newport, Oregon line prior to the meeting, and was expected to

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have a domain configured for the Seward (GAK) line shortly following the meeting. We had agreed at the MEMIP-2009 workshop to freeze the ROMS code based on a November 2009 version. However, two participants during the workshop (Peña and Fiechter) indicated that the biological codes in ROMS were extensively reconfigured in summer 2010. This was the first major reorganization of the biological codes in ROMS in more than 5 years. The changes were significant and would simplify the addition of new models, thus the MEMIP team agreed to update to the most recent version. The adoption of this will greatly simplify the addition of new ecological models. More importantly, the new version has a more accurate advection-diffusion code for biological tracers. We retrieved the new ROMS code from the ROMS repository and installed it on "orion". Thanks to the concerted work of Peña and Spitz during the workshop, test codes were successfully compiled and run. Unfortunately, it was not possible to recode the Spitz model of the Newport system (our working testbed) into the new version during the workshop.

During the final two hours of the workshop, the group held a broad-ranging discussion of MEMIP's future directions (short- and long-term), products and deliverables, and a timeline for completing the outlined tasks. The group agreed that MEMIP should focus on activities that will advance the main deliverables of the project, namely:

- Parameterize, execute (and optionally calibrate) multiple ecosystem models (3–6) in each of three test bed regions;
- Quantitative skill assessment;
- Identify mechanisms that are important controls on the level and variability of secondary production (= zooplankton biomass) at each test bed site;
- Bound the levels of uncertainty in model predictions by calculating ensemble statistics.

We believe the above list is in priority order (highest to lowest), mostly because the activities logically proceed from the first to the last.

Given the desire of the MEMIP to conclude the project's activities by PICES-2012, we felt that it would be best to continue with the planned 2D comparisons of the A-Line, GAK and Newport Lines. We agreed that we should attempt multiple simulations to generate ensembles of outputs using different ecosystem models, parameter values and different forcing years. A timeline was established so that all of the model simulations will be completed before the PICES-2011 ASC in Khabarovsk, Russia. A 1.5-day workshop immediately preceding the PICES-2011 ASC was proposed. The focus of this 4th MEMIP workshop will be quantitative model-model and model-data analysis and comparison of the results of the simulations.

List of papers

Oral presentations

Guimei Liu, Hui Wang and Fei Chai (Invited)

Developing Nowcast/Forecast Ecosystem Model in the South China Sea

Harold Batchelder

Data types and availability for the CCS (Newport) and GOA (Seward) test bed locations

Shin-ichi Ito

Data types and availability for Western Subarctic (A-Line) test bed location

Harold Batchelder (with input from all)

Test beds, Ecosystem Models Available, Computer Platforms for MEMIP

Yvette Spitz

Demonstration: How to merge/modify an ecological model into ROMS/Compiling Example

Small group activity

Whet your modeling appetite before lunch; identify biological models to implement

Implement new ecosystem models into ROMS and run existing codes

Meet in plenary to discuss problems/troubleshoot

Continue implementation of models

Yvette Spitz

Demonstration: Running a model; an example from the Oregon Shelf; BC's, IC's, surface forcing

Continue implementation of models/run models if ready/debugging

More debugging
 More debugging, and hopefully some successful model runs
 Debugging, debugging, debugging...

Workshop Convenors

Progress Review, Timetable, Next steps include post-simulation analyses, Action Item Identification

FIS Workshop (W2)

Beyond Lagrangian: Modeling migratory fish behavior in Global Circulation Models

Co-Convenors: *Enrique Curchitser (U.S.A.), Shin-Ichi Ito (Japan) Michio Kishi (Japan) and Skip McKinnell (PICES)*

Background

The advent of high resolution coupled atmosphere–ocean circulation models and the creation of repositories of high resolution 4-D ocean hindcasts and future scenarios, as well as advances in modeling of higher trophic levels and the constantly increasing computer power, has made it possible to add virtual fish to these models. The ability to study virtual fish in a virtual ocean has a potential to elucidate past phenomena and potentially, to predict future behavior. Recent developments in satellite data availability, in data assimilating physical models, and in tagging technologies for fishes, all increase the chance to improve our understanding of fish migration mechanism. However, fish behavior is complex. It is a consequence of genes, the physical, chemical and biological environment and their interaction, and perhaps even from learned behavior. This makes the modeling of fish behaviors very complex, and suggests that a team approach to model building might be desirable. The purpose of this workshop was to understand the current state of development in modeling fish behaviour. Presentations discussed the successes (and failures) in modeling migratory fish behavior. Presentations related to data availability to evaluate fish behavior models and laboratory experimental approaches to investigate fish behavior were also welcomed. Based on the results and opinions expressed at the workshop, the convenors discussed the desirability of establishing a group that will focus its attention on developing and advancing the state of fish behavioral modeling.

Summary of Workshop

The workshop ended much better than it began. In his introduction, Skip McKinnell told the 25 participants that the invited speaker was unable to fly to Portland. This news was complemented by a second withdrawal, caused by a corrupted file on a memory stick. However, with a quick rearrangement of the schedule and some welcome volunteer presenters from an enthusiastic audience, the topic came to life. In the end, it was the last group to leave the venue that afternoon.

Prof. James Anderson from the University of Washington began with a talk that focused on micro-scale turbulent influences on salmon migration. He described how fish use rheotaxis, chemotaxis, and geomagnetotaxis during migration and how the relative amounts of each vary according to developmental stage. Brian Burke, also from the University of Washington, considered three issues of concern when modeling animal migration: the choice of temporal and spatial scales in the model, responses to local stimuli, and model validation. He concluded that the correct choice of scale is important, that migration needs more than responses to local factors, and that model validation needs to consider the nature of the observations. Chloe Bracis, the third speaker from the University of Washington, was interested in determining whether salmon can return to their home river from widely distributed locations in the ocean by imprinting the magnetic field imprinted as juveniles. Migration simulations using the inclination and intensity of the magnetic field gave favourable results when compared with arrival timing at two Snake River hatcheries where the stocks have very different run timing. Steven Teo described how new technologies are being used to follow

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the migrations of large pelagic fishes such as sharks and tunas. The data from these observational systems will provide critical observations for model validation.

Michio Kishi of Hokkaido University presented the results of a modeling study of Japanese chum salmon migration and growth that he had undertaken with colleagues. Migration directions were based on a vector sum of best growth direction and advection direction. Model results were compared with observed mean size at age in two years of different oceanic conditions. Migration based on an SST rule resulted in meridional migration but not zonal migration. John Payne, of the Pacific Ocean Shelf Tracking Project (POST) introduced the kinds of observational data that POST is providing and raised some interesting questions about the assumptions needed to model these data.

In the discussion that followed, participants found two important missing pieces of information to model fish migrations. One is prey density distributions and the other is vertical distribution of fishes. For phytoplankton distribution, satellite images are available but for zooplankton, the data are limited. In the North Atlantic, the Continuous Plankton Recorder is used to collect information on the spatial distribution of zooplankton. But the data is restricted to the surface layer. For forage fishes, there is even less data than for zooplankton and the information about the vertical distribution of the target species is also limited. Much more systematic data, which includes ocean environments, prey, and target species distributions is needed to model fish behaviors. Additionally, improvements of zooplankton models are encouraged. Even if such a kind of systematic data is available, it is still difficult to define the mechanism of the fish behaviors. To define the happiness of target species with multiple parameters, data assimilation methods seems effective, but simplified laboratory experiments and endocrinological analysis are essential to elucidate the mechanisms.

The participants encouraged the convenors to pursue, within PICES, the scientific challenge of modeling animal behaviours in the ocean. However, the convenors noted an imbalance of North Americans over Asians at the workshop, so they felt that it was premature to discuss the formation of a migration modeling group. Instead, the workshop convenors chose to propose a topic session on migration modeling for PICES 2011 (Khabarovsk, Russia) to allow greater participation by Asian modelers and to gauge the overall interest in this relatively specialized, but important discipline. The topic session was later endorsed by Science Board.

List of papers

Oral Presentations

James Anderson

Seeking principles for modeling fish migratory behavior - A cross discipline approach

Dongwha Sohn, Lorenzo Ciannelli, Janet T. Duffy-Anderson and William T. Stockhausen (withdrawn)

Modeling the drift pathways of Greenland halibut (*Reinhardtius hippoglossoides*) from spawning to settling locations in the eastern Bering Sea using the Dispersal Model for Early Life Stages

Chloe Bracis

Successes and limitations modeling fish behavior with limited data

Brian J. Burke, James J. Anderson and Edmundo Casillas

Evaluating behavioral rules potentially used by migrating salmon

Steven L.H. Teo, Suzy Kohin, Heidi Dewar, David Wells and Candan Soykan

Movement patterns of pelagic sharks and tunas in the Northeast Pacific

MEQ Workshop and a Laboratory Demonstration (W3) and HAB-S Meeting
New technologies and methods in HAB detection: I. HAB species detection

Co-conveners: *Ichiro Imai (Japan) and Vera Trainer (U.S.A.)*

Background

We begin a series of workshops and lab demonstrations focusing on new technologies in harmful algal bloom (HAB) research and monitoring. The first workshop in this series included demonstrations of new methods in organism detection with concentrated information on HAB species. This workshop and integrated demonstrations included demonstrations and lectures describing equipment and methods from the following list: environmental sampling platform (ESP), FloCam, sandwich hybridization assay (SHA), qPCR, FISH, and *in situ* sensors including gliders. This series will continue in the future with demonstrations on automated nutrient samplers, modeling, remote sensing, and other techniques.

Summary of Workshop

There were 22 scientists in attendance: U.S.A. (14), Canada (1), Japan (4), Korea (1), and Russia (2)

Satoshi Nagai (FRA, Research Institute of Fisheries and Environment of Inland Seas, Japan) described recent developments in molecular diagnostic technology for HAB detection. With loop mediated isothermal amplification (LAMP), there is no need to denature double stranded DNA into single strands, and it is an isothermal reaction (one temperature throughout, 60–65°C).

Vladi Cherepakhin (Accuri Cytometers Inc., U.S.A.) described the use of Accuri Flow Cytometry. The flow cytometer weighs only 25 lbs and is highly portable (easily shipped). Power consumption is the same as a laptop computer. It uses negative pressure to pick up samples using peristaltic pumps using a proprietary method that avoids pulsing flow. Fluorometric detectors are arranged around the flow cell so there is no need for dichroic mirrors, and so no alignments, adjustments or calibrations are needed. It has a high dynamic range and a zoom feature included in the software for viewing data. An automatic sampler capable (add on) is capable of sampling from 24, 48, 96 well formats. (Performance validation (using beads) was provided.) Bacteria and viral detection can be used via nucleic acid stain, dye and side scatter. The documented upper size of core portion is 40 microns, but 70 micron particles have been used with no problems. The system is about \$40K complete. A sorting capability is being developed, but there is no certainty that it will be compatible with current units.

Ichiro Imai (Hokkaido University, Japan) described work on the detection of *Alexandrium tamarensis* cysts with a real-time PCR. The toxic species in Japan are: *A. tamarensis*, *A. catenella*, *Gymnodinium catenatum*, *A. minutum*, *A. tamarensis*, and others. From 1993–2001 there has been an expansion of PSP events, especially in southern Japan. The first record of a PSP occurrence in Osaka occurred in 2002 with re-occurrences every year between 2006–2010. Accumulations of toxin have been found in Manila clams, Arch shell, brackish-water clams, and Japanese cockles. qPCR (quantitative PCR) using real-time PCR is species-specific quantification and has high sensitivity. The method is described in Kamikawa *et al.* 2007 in Harmful Algae Vol. 6. Calcaflour white staining is used for vegetative cells and primuline for cysts. The method involves sonicating, size fractioning, washing via centrifuge. Visually, *A. tamarensis* and *A. catenella* have very similar cysts. In Osaka Bay, however, there was no detection of these species. There was good agreement between real-time PCR and primuline staining method as far as concentrations of cysts. They exist in a 10–27°C temperature range throughout the year, and no vegetative cells are seen at temperatures >15°C. Real-time PCR detected cysts at a low density (<10 cysts/gram wet weight sediment) and cysts were detected throughout the year even though germination begins in winter when water temperatures decrease below 15°C. Laboratory cultured cells and cysts were used to calibrate PCR product to numbers of cysts. The top 3 cm of sediment was used for analyses. It was noted that the cysts found below 1 cm of sediment have been shown to be much different (older, possibly more compromised) than the newer ones above 1 cm.

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Kate Hubbard (University of Washington, U.S.A.) is working on *Pseudo-nitzschia* populations and their molecular detection in Puget Sound. She used PCR primers for the ITS1 region where the length and sequence is specific to different species. Using the ARISA method, sequence lengths used were compared with Genbank and other clone libraries. Relative abundance was achievable with this method, but not absolute abundance. Twelve *Pseudo-nitzschia* species were detected, with populations from March being very different from populations taken in August. The August populations were also more diverse. In spring the most common species was *P. delicatissima* but in August, it was more diverse. In spring, *P. granii* was found in coastal and inland areas but it is considered to be a more oceanic species. Spring temperatures were more homogenous than in August because of downwelling. Again, in spring *P. delicatissima* and *P. granii* were found and in August *P. pungens*, *P. multiseriis*, *P. heimii* and *P. Americana* were found. The inland and coastal communities were more distinct in summer than in spring, and coastal populations were distinct from inland populations.

Mark Wells (University of Maine, U.S.A.) described Raman-based barcoding for identification of toxic marine pathogens and phytoplankton. There is a growing need for biosensors that are not species specific, are compact, robust, and have low power requirements. Nanotechnology can be used to detect bioanalytes and species can be detected through linkage to these bioanalytes or through direct sensing of the species themselves. The detection involves a vibrational spectroscopy method (Raman spectroscopy). Surface Enhanced Raman Scattering (SERS) is up to 15 times more sensitive than regular Raman.

Nick Adams (NOAA, U.S.A.) described the population structure of *Pseudo-nitzschia australis* and DA production in Washington State. He used microsatellite markers developed for *P. pungens* and *P. australis* to identify and differentiate individuals and to detect population parameters such as Hardy-Weinberg equilibrium. Most Pacific Northwest (PNW) isolates of *P. pungens* isolates are unique and all were unique from the North Sea isolates. All PNW isolates deviated from Hardy-Weinberg and had significant linkages (dis)-equilibrium. There were two populations present in PNW isolates analyzed via STRUCTURE, a software program (both Hardy-Weinberg and linkage (dis)-equilibrium were present). For *P. australis*, progress to date has involved 25 individuals only and all but 2 isolates were distinct, suggesting a single population. Twenty-five individuals include isolates from Washington and California only.

Jim Birch (MBARI, U.S.A.) discussed an Environmental Sampling Platform (ESP) and recent detection of marine microbes. ESP can preserve or lyse cells (with further processing). It can be used with SHA, qPCR, etc. The annual southern California bloom event at Newport Beach was studied using two ESPs and gliders. On April 20, a drop in water temperature was recorded on ESPs and by the end of April, *P. multiseriis* and some *P. australis* came into the assemblage (corresponding increase in DA detected as well). Cooler temperatures at the end of month correlated with phytoplankton growth and upwelling event. Development of a third generation ESP is underway and he is working to place it in a glider-type platform/vehicle instead of static location (buoy).

Bruno Soffientino (Wet Labs Inc., U.S.A.) noted that instruments for HAB detection are new to Wet Labs as they are an optics company by trade, making optical detectors for fluorescence, absorbance, scattering. They have wet chemistry applications such as phosphate, ammonium and other nutrient analysis, but there are separate units for each analysis. Gas *et al.* (2009) developed the ELISA method for whole cells of *A. minutum*. Bead use is problematic because of the need to keep the beads in suspension. A tangential flow filter that is easier on cells is being used, but the pre-filter size (10 microns) may be an issue in more turbid or high productivity areas. The service time is 3–6 months, but it is probably much less than that in turbid or high productivity areas.

List of papers

Oral presentations

Satoshi Nagai (Invited)

Recent developments in molecular diagnostic technology for HAB detection

Katie Flynn Bush, Juli Dyble Bressie, Chris Navas and Clare E. Rogers

A novel, portable flow cytometer facilitates algal population quantification in cultures and environmental samples

Ichiro Imaj, Tomotaka Shiraishi, Ken-Ichiro Ishii, Keigo Yamamoto, Masaki Nakajima and Satoshi Nagai

Detection of *Alexandrium tamarense* (Dinophyceae) cysts in bottom sediments with real-time PCR assay: Cyst dynamics and occurrence of bloom in Osaka Bay, the Seto Inland Sea

Katherine Hubbard, Claire H. Ellis and E. Virginia Armbrust

Molecular detection and insights into differentiation of Eastern Pacific *Pseudo-nitzschia* communities from the open ocean to the Puget Sound estuary

Vera L. Trainer, Mark S. Strom, Qiuming Yu and Mark L. Wells

A proposal for raman-based barcoding for the identification of toxic marine pathogens and phytoplankton

Nicolaus G. Adams, Piper Schwenke and Vera L. Trainer

Population structure of *Pseudo-nitzschia australis* and its association to domoic acid production in the waters of Washington State

James Birch, Scott Jensen, Brent Roman, Doug Pargett, Christina Preston, Roman Marin, Cheri Everlove and Christopher Scholin

Remote detection of marine microbes, their genes and gene products using the Environmental Sample Processor (ESP)

Satoshi Nagai and Shigeru Itakura

Demo: Simple, rapid, specific and cost-effective method for identifying *Alexandrium tamarense* and *A. catenella* using "LAMP" method

Katie Flynn Bush

Demo: Flow Cytometry

Poster Presentations

Bich-Thuy L. Eberhart, Brian D. Bill, Nicolaus G. Adams, Soram Hong and Vera L. Trainer

Pseudo-nitzschia and cellular domoic acid levels along the coastline of the Pacific Northwest, USA: Summer 2009

Brian D. Bill, William P. Cochlan and Vera L. Trainer

Kinetics of nitrogen uptake and transient ammonium uptake response by the toxigenic diatom *Pseudo-nitzschia turgidula*

POC Workshop (W4)

PICES Working Group on Evaluations of Climate Change Projections (WG 20): Progress and FUTURE

Co-Convenors: *Michael G. Foreman (Canada) and Yasuhiro Yamanaka (Japan)*

Background

Presentations and discussions were carried out on: (1) progress related to the WG 20 Terms of Reference, (2) status of, and future work on, the final report, and (3) follow-up activities that conform to FUTURE objectives and needs.

Summary of Business Meeting and Discussions

After introductory formalities and Muyin Wang kindly agreeing to act as the rapporteur, Mike began the meeting began with a recap of the WG terms of reference (TORs) and his personal summary (Appendix 1) of activities addressing each one. It was generally felt that significant progress had been made with the IPCC GCM evaluations (#1), the development of regional climate models (RCMs) (#3), collaboration with other PICES groups like CFAME and WG25 (#2), and convening PICES and international workshops/sessions (#5).

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As WG20 completed its tenure at this PICES meeting, a primary discussion point was the structure and content of the final report. It was agreed that each of the WG member chapters should summarize work accomplished versus the TORs and be 10-20 pages long. With an expectation of contributions from all members, the following chapter outline was put forward:

- 1) Acknowledgments, Abbreviations & Acronyms, Executive Summary
- 2) Introduction: background, Terms of Reference, membership, outline
- 3) Wang, Overland, Bond: GCM downscaling procedures & examples
- 4) Di Lorenzo, Miller: regional climate modeling & covariability in North Pacific
- 5) Foreman & colleagues: RCM development for BC shelf waters
- 6) Christian: GCM carbon cycle development
- 7) Curchitser, Hermann: RCM development for the NE Pacific and Bering Sea & two-way coupling of this RCM into the NCAR GCM
- 8) Ustinova, Zuenko: evaluation of climatic variability in Far Eastern Seas
- 9) Navrotsky: interactions between climate and ecosystems
- 10) Yamanaka, Hasumi, & colleagues: ecosystem projections for the Kuorshio/Oyashio system
- 11) Jang, Pang, Yeh, Oh & colleagues: GCM projections of changes to mixed layer depth
- 12) Qiao, Wang, Wu & colleagues: Chinese contributions
- 13) Summary and recommendations

It was emphasized that the final report is considered “grey literature” and will not be formally reviewed. As such, individual chapters should only give highlights of work that is either planned for publication, or has already been published. For specific PICES formatting requirements authors were referred to http://www.pices.int/publications/scientific_reports. Rosalie Rutka from the PICES Secretariat will be the technical editor and although she prefers MS Word files, she will accept other formats (*e.g.*, LaTeX equations will be converted to MathType). Tables can either be in Word or Excel (no images of tables) and though the figures can be in any one of the common various formats (*e.g.*, eps, tiff, jpg), they should be good quality and use greyscale if colour is not necessary. Tables and figures can be put at the end of each chapter and Rosalie will fit them into the text later. Chapters should be sent to Mike by December 31, 2010, with earlier submissions preferred.

As PICES Science Board and Governing Council are particularly interested in the recommendations from this WG, Mike presented four possibilities (Appendix 2) that will hopefully be expanded and extended in the final report. Draft TORs for a new working group on “North Pacific Climate Variability and Change” that was proposed by Emanuele Di Lorenzo and Shoshiro Minobe were also presented and discussed along with the four recommendations. Several comments were made asking for clarification of terminology (*e.g.*, conceptual mechanistic model), time scales, and scope, and these were recorded so they could be passed on to Di Lorenzo and Minobe. Possible membership (*e.g.*, the need to bring in new people) was also discussed.

Hiroaki Saito, chair of the COVE Advisory Panel, gave a brief summary of the COVE meeting on October 22. COVE fully supports the proposed new “climate” working group and is proposing both another new working group on “Ecosystem Responses to Multiple Stressors” and a workshop on “Indicators of Status and Change within North Pacific Marine Ecosystems: a FUTURE workshop” to occur just before or after the Inter-session Science Board meeting in April.

Anne Hollowed gave a brief summary of recent activities of the ICES/PICES joint WG on Forecasting Climate Change Impacts on Fish and Shellfish. Though this WG ends in 2011, their high productivity has spawned discussion on how it will continue within each the ICES and PICES frameworks. Regardless of how the group is re-structured, there will be an ongoing need for IPCC GCM and RCM projections so Anne was supportive of WG20 recommendations on how that might be done.

No other business was discussed and the meeting was adjourned at about 5:00pm. Mike thanked all members for their contributions over the four year tenure of the working group.

Meeting Agenda

- 1) Welcome, introductions, opening remarks
- 2) Changes to, adoption of, agenda and appointment of rapporteur
- 3) Update on FUTURE & its Advisory Panels (Hiroaki Saito)
- 4) Review of WG Terms of Reference & summary of accomplishments
- 5) WG20 Final Report:
 - a. Organization, contents, formatting
 - b. Chapter assignments & deadlines
 - c. Recommendations for FUTURE
 - i. TOR for a new WG
- 6) Other business
- 7) Adoption of meeting report for presentation at POC committee meeting

Attendees

Mike Foreman (Canada)
 Jim Christian (Canada)
 Elena Ustinova (Russia)
 Enrique Curshitser (USA)
 Muyin Wang (USA)
 Art Miller (USA)

JungJin Kim (Korea)
 Hanna Na (Korea)
 Tom Royer (USA)
 Jae Hak Lee (Korea)
 Anne Hollowed (USA)
 Yury Zuenko (Russia)
 Chan Joo Jang (Korea)
 Sinjae Yoo (Korea)
 Dong-Jin Kang (Korea)
 Toshi Saino (Japan)
 Yuichiro Kumamoto (Japan)
 Hiroaki Saito (Japan)

Observers

Kyung-Il Chang (Korea)
 Jae-Hyoung Park (Korea)
 Teresa A'mar (USA)
 Tim Lee (USA)

Appendix 1: Summary of WG20 Activities versus Terms of Reference

- a. To analyze and evaluate climate change projections for the North Pacific and its marginal seas based on predictions from the latest global and regional models submitted to the Inter-governmental Panel on Climate Change (IPCC) for their 4th assessment report
 - Several Wang/Overland/Bond publications evaluating global climate models (GCMs) & their projections in North Pacific & Arctic
 - Di Lorenzo, Miller & colleagues: NPGO analyses of IPCC model results
 - Hasumi & colleagues continued analyses & improvements to Japanese GCM (MIROC)
 - Yamanaka & colleagues continued analyses of ecosystem models coupled to Japanese GCM
 - Qiao & colleagues studied GCM improvements by addition of surface waves
 - Ustinova & colleagues evaluated climate variability in Far Eastern seas
 - Jang & colleagues studied GCM projected mixed layer depth changes in North Pacific
 - Foreman & colleagues evaluated GCM winds off BC
- b. To facilitate analyses of climate effects on marine ecosystems and ecosystem feedbacks to climate by, for example computing an ensemble of the IPCC model projections for the North Pacific and making these projections available to other PICES groups such as CFAME
 - Worked with CFAME
 - Joint workshops at PICES annual meetings & April 2008 workshop in Hawaii
 - Contributed to final report & co-authored publication

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- Working with WG25 – ICES/PICES WGCCIFS
 - Foreman, Yamanaka are WG25 members
 - Co-convened downscaling session at, & members participated in, Sendai symposium
 - Manuscripts submitted to ICES J Mar Sci
 - Yamanaka & colleagues continued development & analyses of ecosystem model coupled to Japanese GCM
- c. To facilitate the development of higher-resolution regional ocean and coupled atmosphere-ocean models that are forced by, and take their boundary conditions from, IPCC global or regional models
- RCMs developed, or under development, for
 - California shelf (Aquad, Miller, Di Lorenzo)
 - NE Pacific & Bering Sea – fully coupled to NCAR GCM (Curchitser et al.)
 - BC shelf (Foreman et al.)
 - Washington-Oregon shelf (Bond, Hermann, Curchitser)
 - Kuroshio region (Kurogi, Hasumi, Tanaka)
 - Curchitser participated in RCM workshop in September
 - Japanese have 0.25° resolution GCM
- d. To facilitate the development of local and regional data sets (*e.g.*, SST, river flow, sea ice cover) incorporating information from climate model projections as well as observations and historical re-analyses
- Augmenting a data set of buoy wind measurements off the BC coast by filling gaps over the last decade with values from a NASA archive & analysing 50 year time series for trends in magnitude or timing
 - Argo float data freely available (Freeland has given several summaries at POC meetings)
 - See recommendation #3
- e. To ensure effective two-way communication with CLIVAR
- CLIVAR representatives gave presentations at several WG20 annual meetings
 - Close relationship with ESSAS (Wang, Curchitser)
- f. To convene workshops/sessions to evaluate and compare results
- Annual workshops at all PICES meetings, 3 jointly with CFAME
 - Participated in CFAME workshop, Honolulu, April 2008
 - Co-convened downscaling session at “Effects of Climate Change in the World’s Oceans”, Gijón, May 2008
 - Co-convened downscaling session at “Climate Change Effects on Fish and Fisheries”, Sendai, April 2010
- g. To publish a final report summarizing results.
- Proceeding

Appendix 2: Draft Recommendations for the Final Report

- 1) Continue evaluating IPCC GCM (and RCM) results:
 - a. Jim Overland, Muyin Wang, Chan Joo Jang (and others?) plan evaluations of new AR5 outputs when they are available (winter 2010-11?)
 - b. WG25 (Forecasting Climate Change Impacts on Fish and Shellfish) will be interested in these forecasts
 - c. The RCM community is hoping to have a chapter in AR5
 - d. Besides continuing Japanese GCM/ecosystem model studies (Yamanaka and colleagues), several North Pacific RCMs are under development that are being, or could be, coupled to ecosystem models (*e.g.*, Curchitser, Hermann, Rose *et al.*)

- e. This activity may not warrant a new WG but the work should be part of COVE and/or SOFE
- 2) Continue analyses of North Pacific inter-annual to inter-decadal variability. This would be an extension of the PICES 2009 workshop convened by Di Lorenzo and Minobe.
 - A new WG, under POC and with COVE's support, has been proposed (Appendix 3 has draft TORs)
 - IPCC-AR5 will include decadal predictions. Unlike GCM predictions that should only be evaluated statistically, these decadal predictions should be directly comparable with subsequent observations. An analysis of these predictions could be part of SOFE.
 - 3) Establish live-access servers or ftp sites to archive and provide easy access to results from RCMs, analogous to the PCMDI archive for IPCC GCM results.
 - This would address WG20 TOR #4, something that was not adequately accomplished during the tenure of that WG
 - It would also provide fisheries scientists (e.g., WG-FCCIFS) with climate change variables on much finer spatial scales than can be resolved with the GCMs.
 - This could be a possible activity for the COVE or SOFE Advisory Panels and the TCODE Committee.
 - 4) Provide and regularly update lists of links to GCM/RCM sites like NARCCAP (North American regional climate model results, <http://www.narccap.ucar.edu/>) and to relevant publications like the "Guide to Best Practices on the Use of Climate Models" (Overland *et al.*)

Appendix 3: Proposal for a new Working Group: "North Pacific Climate Variability and Change"

Motivation:

Need to develop essential mechanistic understandings of North Pacific climate variability & change that can better guide the formulation of process-based hypotheses underlying the links between ecosystem dynamics and physical climate.

Draft Terms of Reference:

1. Develop conceptual mechanistic models or frameworks of North Pacific climate variability & change that can be readily used by ecosystem scientists to explore hypotheses of the links between ecosystem dynamics and physical climate.
2. Summarize the current understanding of mechanisms of Pacific climate variability, and evaluate the strengths of the underlying hypotheses with supporting evidence.
3. Coordinate, in conjunction with ecosystem scientists, the development & implementation of process-based models to hindcast the variability of available long-term biological time series.
4. Provide improved metrics to test the dynamics of the IPCC models.
5. Understand and fill the gaps between what the physical models can currently produce and what ecosystem scientists suggest are important physical forcing factors required for predicting species and ecosystem responses to climate change.
6. Maintain linkages with, and summarize the results from National & International programs/projects such as CLIVAR, IMBER, US CAMEO, ESSAS, Japanese Hot Spot in the Climate System, POMAL, CREAMS EAST-I, POBEX, and others.
7. Convene workshops & sessions to evaluate and compare results
8. Publish a final report summarizing results.

Possible Co-Chairs: E. Di Lorenzo (U.S.A.), S. Minobe (Japan), M. Foreman (Canada)

Objectives

Present and discuss drafts of chapters for the final WG20 Report and finalize recommendations to PICES/FUTURE. The following list of possible chapters was put forward at the April WG20 meeting in Sendai, Japan:

- Introduction: Background and Terms of Reference
- Wang, Overland, Bond: GCM downscaling procedures & examples

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- Di Lorenzo, Miller: Regional climate modeling and covariability in North Pacific
- Foreman and colleagues: RCM development for BC shelf waters
- Christian: GCM carbon cycle development
- Curchitser, Hermann: RCM development for the NE Pacific and Bering Sea and two-way coupling of this RCM into the NCAR GCM
- Ustinova, Zuenko: Evaluation of climatic variability in Far Eastern Seas
- Navrotsky: interactions between climate and ecosystems
- Yamanaka, Hasumi, and colleagues: Ecosystem projections for the Kuroshio/Oyashio system
- Jang, Pang, Park, Yeh, and colleagues: GCM projections of changes to mixed layer depth
- Qiao, Wang, Wu and colleagues: Chinese contributions

Informal Agenda:

1. Review of WG20 Terms of Reference and what was accomplished
2. Discussion of proposed chapter topics and presentations of recent research that might be included
3. Updates on chapter assignments and setting of deadlines
4. Recommendations for follow-up work and/or groups within FUTURE Summary of Seoul Advisory Panel meeting, August 16-18
5. Adjournment to local pub/restaurant

POC/BIO Workshop (W5)

Carbon data synthesis (III)

Co-Convenors: *Masao Ishii (Japan) and Robert M. Key (U.S.A.)*

Background

This workshop will continue the implementation of the North Pacific carbon data synthesis. Investigators who submit data to the workshop will collectively review the progress of the QA/QC process, and discuss the degree of success of the techniques applied and whether different or additional approaches are necessary. This is a highly “hands-on” activity that will involve data originators who submit data to the synthesis, and investigators participating in the synthesis process, and will lead directly to value-added data products and collective publications.

Summary of presentations

Sixteen participants from four countries were in attendance. Masao Ishii reviewed the 2nd PACIFICA Data Synthesis Workshop and the objective of this 3rd carbon data synthesis workshop. This was followed by a review of our activities, the datasets we have collected, and the decisions we made in the 2nd workshop in June this year for the variables used in the crossover analysis and inversions. Dr. Ishii then outlined the progress to be made at the workshop in a 2nd level QC to examine each adjustment value, either additive or multiplicative, for salinity, DIC, TA, oxygen and nutrients for each cruise that has been suggested from crossover analysis, and filling in the adjustment table.

Invited speaker, Robert Key, gave a talk about the perspective on global data synthesis and commented on its future sustainable operation. Total sample counts of PACIFICA amounts to 132×10^3 and the total of GLODAP, CARINA and PACIFICA amounts to 931×10^3 . Assembly of high-quality calibrated open ocean data will continue to improve and expand for the foreseeable future with the addition of other parameters (*e.g.*, helium/tritium data). He and colleagues were also trying to assemble data from regions not covered in v1.1 (Arctic and marginal seas). He declared that data should be available to the public (<1 year post cruise) with *no*

restrictions as individual data and compiled products, but that there needed to be a site/manager (CDIAC?), sustainable operation *without* the need for major team efforts, ability to create custom data products, a standard method for each new cruise (immediate 1st QC, metadata collection, quick 2nd QC check, *etc.*), and regular product updates (as needed, annual?).

Toru Suzuki discussed the progress being made on PACIFICA data collection in 2009/2010 and its 2nd level QC. After the 2nd workshop in June 2010, data from two cruises in the equatorial Pacific conducted by KAIYO/JAMSTEC were revised. New data of CLIVAR Repeat Hydrography along P21E and P21W sections conducted by MIRAI/JAMSTEC in 2009 were added. They are to be opened by the end of this year. PACIFICA now includes datasets from total of 305 cruises; <http://pacifica.pices.jp/table/>. These original datasets have been converted to the WHP Exchange Format. Suzuki reviewed the method of 2nd level QC that used Matlab runs for crossover analysis and inversions as well as the outlines of several runs that have been made on the demands of working groups. The results of Matlab runs have been uploaded to <http://pacifica.pices.jp/offset/figs/>. (See http://pacifica.pices.jp/offset/figs/00_README.txt for details.)

Michio Aoyama reported that a 2nd level QC of salinity data was completed and the adjustment was assigned for each cruise. Datasets from 16 cruises that showed extremely large offsets in the preliminary runs of cross-over analyses were excluded in the 2nd level QC. Stations located in the Kuroshio and Kuroshio Extension (29.4°–36°N, 131°–150°E) were also excluded from the cross-over analysis. The crossover analysis and inversions were then made *without* correcting for the offsets from standard seawater used in each cruise and *without* selecting the core cruises (ver. 20101017). The suggested adjustment is consistent with the offset of standard seawater used in each cruise.

Tsuneo Ono informed participants that DIC observations along A-line in the Oyashio region off Hokkaido have been made by MRI and Hokkaido University until 2001 in the top 1500m of the water column. The observations were made by FRA after 2001 and samples from deeper layers are beginning to be taken. Large offsets that are seen in deep layers in some cruises are considered to be attributed *not* to the natural variability but to the analytical offsets.

Subgroup meetings

Carbon working group

- A total of 37 cruises were selected as core cruise. They include all CLIVAR Repeat Hydrography cruises (16 cruises), 18 cruises in a total of 37 WHP cruises, and 3 “good” cruises of repeat lines (137°E, 155°E).
- These core cruises for the 2nd QC are common for DIC and TA, but TA was not measured on 7 core cruises (6 for WHP, 1 for MRI-JMA).
- 18 core cruises in a total of 37 WHP cruises (reference cruises) are the ones that meet all the following requirements:
 - Cruises in which DIC has been measured,
 - CRM has been used for the QC of DIC measurements,
 - Cruises are long sections that have crossovers with other core cruises,
 - Suggested adjustments (or offset corrections) for DIC in the preliminary runs of crossover analyses, those of Lamb *et al.* (Deep-Sea Res. II, 2002), or GLODAP are within $\pm 4 \mu\text{mol kg}^{-1}$.
- 3 “good” cruises for repeat lines (137°E, 155°E) are the ones that used CRM in DIC analysis and have been suggested to be of good DIC quality in the preliminary runs of crossover analyses.
- No significant DIC offset among these core cruises was seen in inversion runs for core cruises in v.20101015. Among CLIVAR Repeat Hydrography cruises, TA also showed no significant offsets, but adjustments have been suggested for the same WHP cruises as had corrections applied in GLODAP.
- For core cruises, no significant difference in suggested adjustment was seen between the crossover analysis for $z > 2000\text{m}$ and that for $z > 1500\text{m}$.
- The carbon working group looked at the results of crossover analyses. For each cruise to which large adjustment was suggested for either DIC or TA, they looked at the offset(s) from the core cruise(s) and specified the adjustment. Basically, results from $>2000\text{m}$ were referred to, but those from $>1500\text{m}$ were

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referred to for cruises in which data from deeper layers (>2000m) are not available or sparse.

- What we should do for carbon 2nd level QC next is:
 - Repeat primary QC of “old” (before June 2001) Line-P data.
 - Generate additional crossovers for spatially restricted time series programs such as Line P and A-Line by reducing minimum number of common stations and, if necessary, expanding the search radius,
 - Manually apply offsets,
 - Rerun inversion with high weight for core cruises,
 - Toru Suzuki will post cruise data and Adjustment Table to the website.
 - Collect any outstanding metadata (cruise dates, ship, chief scientist, PI for each measurement, use of CRMs, scale and temperature for pH, nutrient standards, references to publications that used data from this cruise).

Oxygen and nutrients working group

- No core cruise has been selected for oxygen and nutrients (nitrate, phosphate, and silicic acid).
- The oxygen and nutrients working group looked at the results of inversions (v.2000m_20101017/) for each parameter for each cruise. They judged if the result of inversion could be adopted or other numerical value should be adopted for adjustment on the basis of number of crossovers and so on. For oxygen, those cruises with the suggested adjustments larger than 1% were examined. For nutrients, offsets from the cruises in which the reference material for analysis of nutrients in seawater (Aoyama *et al.*, 2010) were basically regarded as the adjustments. Inversion will be repeated with core cruises assigned.
- What we should do for oxygen-nutrients 2nd level QC next is:
 - Assign core cruises (basically the cruises in which nutrients reference material have been used),
 - Define user weight for time-series,
 - Revise crossover criteria so that more crossovers are available (*e.g.*, for Line P and A-Line),
 - Then re-examine the offset in each parameter in each cruise.

2nd level QC of CFCs (A. Murata)

Ken'ichi Sasaki is at sea; Akihiko Murata took his place and reported on the progress of 2nd level QC of CFCs.

- Ken'ichi Sasaki and John Bullister are working on the 2nd QC for the data from Japanese and US cruises, respectively.
- The method of 2nd QC of CFCs in PACIFICA is the same as in CARINA (Steinfeldt *et al.*, Earth Syst. Sci. Data, 2: 1–15, 2010). They looked at the relationships between pCFC-11 and pCFC-12, which should fall into the historical range of that in the atmosphere if these parameters have been properly measured. They also looked at the saturation levels of CFC-11 and CFC-12 in surface layers ($\pm 10\%$ of saturation).
- The adjustment was assigned in 5% intervals.
- It appeared that 1st level QC is yet needed for several Japanese cruises.

Discussion on the data products

- PACIFICA will not include datasets that have already been included in GLODAP and CARINA (*e.g.*, P6 by MIRAI/JAMSTEC in 2003 will not be included in PACIFICA since it has already been included in CARINA). PACIFICA will also not include the data from Hawaii Ocean Time-series.
- We will open the collection of original datasets from CDIAC and MIRC (need metadata), except datasets from Line-P and P21(2009), soon on the web.
- We will open the data products that have gone through the 2nd QC once it is finished.
- We will separate the database into 3 domains: Open Pacific, Arctic Mediterranean Sea (north of Aleutians) and marginal seas. However, no progress has been made on the data collection from marginal seas since PICES-2009.
- Toru Suzuki will prepare Adjustment Table on MIRC's website.
- We will communicate via the web and e-mail. At present, we have no plan for further data synthesis workshops.
- We will document the PACIFICA data collection and 2nd level QC, and submit to Earth System Science Data (Special section?). Potential papers are summary, salinity, carbon, oxygen, nutrients, and CFCs.

List of papers

Oral Presentations

Masao Ishii, Masahide Wakita, Akihiko Murata, Toru Suzuki, Alex Kozyr and Robert Key
Second-level quality control of PACIFICA synthesized database

Robert M. Key (Invited)
Expanding the ocean interior carbon data collection

Toru Suzuki
Review for the method of cross-over analyses and inversions for secondary QC of PACIFICA

- Subgroup-1: Secondary QC of CO₂ parameters - 1
- Subgroup-2: Secondary QC of oxygen and nutrients - 1
- Subgroup-1: Secondary QC of CO₂ parameters - 2
- Subgroup-2: Secondary QC of oxygen and nutrients - 2
- Subgroup-1: Secondary QC of CO₂ parameters - 3
- Subgroup-2: Secondary QC of oxygen and nutrients - 3
- Subgroup-1: Secondary QC of CO₂ parameters - 4
- Subgroup-2: Secondary QC of oxygen and nutrients - 4
- Subgroup-1: Secondary QC of CO₂ parameters - 5
- Subgroup-2: Secondary QC of oxygen and nutrients - 5

Michio Ishii
Report from sub-group - 1

T. Ono
Report from sub-group - 2

A. Murata
Secondary QC of data from Bering Sea

K. Sasaki
Secondary QC of CFCs
Discussion on the future plan: Opening of PACIFICA to the public
Discussion on the future plan: Scientific products

Best Presentations for Committee/Program-sponsored Topic Sessions or Workshops at PICES-2010

Science Board Best Oral Presentation

Shin-ichi Ito (Tohoku National Fisheries Research Institute, FRA, Japan) on “Projection of Pacific saury response to future climate change” co-authored with Takeshi Okunishi, Michio J. Kishi and Muyin Wang

Science Board Best Poster

Sayaka Matsumura (Graduate School of Environmental Sciences, Yokohama National University, Japan) on “Spatio-temporal changes in species diversity and assemblage structure of Euphausiids (Oyashio to Oyashio-Kuroshio Transition Region in the western north Pacific)” co-authored with Hiroya Sugisaki, Hiroaki Saito, Yuji Okazaki and Tomohiko Kikuchi

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

Xiuning Du (Hatfield Marine Science Center, U.S.A.) on “Feeding rates of adult *Euphausia pacifica* on natural particle assemblages in the coastal upwelling zone off Oregon, USA” co-authored with William T. Peterson and C. Tracy Shaw

Best Poster for the BIO-sponsored Contributed Paper Session

Brett R. Dumbauld (USDA-ARS, Hatfield Marine Science Center, U.S.A.) on “Can an introduced parasitic bopyrid Isopod *Orthione griffenis* cause extinction of mud shrimp *Upogebia pugettensis* populations in U.S. west coast estuaries?” co-authored with John W. Chapman

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

Hye-Min Park (Pukyung National University, Busan, Korea) on “Vertical distribution and reproductive aspects of caridean shrimps in the deep-water of the East Sea, Korea” co-authored with Jung Nyun Kim, Hae Won Lee, Byeong Gyu Hong, Jin Ho Bae, Hyeong Gi Kim and Chul-Woong Oh

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Best Poster for the FIS-sponsored Contributed Paper Session

Yuichiro Kogura (Graduate School of Fisheries Sciences, Hokkaido University, Japan) on “Genetic population structure of lacustrine sockeye salmon, *Oncorhynchus nerka*, in Japan” co-authored with James E. Seeb, Noriko Azuma, Hideaki Kudo, Syuiti Abe and Masahide Kaeriyama

Best Oral Presentation by an early career scientist for the MEQ-sponsored MEQ Topic Session on “Conceptual and numerical models of HAB dynamics” (S9)

Jenny O. Lane (University of California Santa Cruz, Santa Cruz, U.S.A.) on “The development of toxigenic *Pseudo-nitzschia* bloom models in Monterey Bay, California, and their application at a single monitoring site within the model domain” co-authored with Peter T. Raimondi and Raphael M. Kudela

Best Poster for the MONITOR-sponsored Topic Session on “Development and use of ocean observing and forecasting systems in coastal and marine Management” (S15)

Hisashi Yamaguchi (Graduate School of Environmental Study, HyARC, Nagoya University, Japan) on “Variation of satellite chlorophyll *a* in the East China Sea based on local satellite algorithm with reduced influence from suspended sediment” co-authored with Young Beak Son, Eko Siswanto, Joji Ishizaka, Sinjae Yoo, Yu-Hwan Ahn, Sang-Woo Kim, Junwu Tang, Hiroshi Kawamura and Yoko Kiyomoto

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

Hiroshi Kuroda (National Research Institute of Fisheries Science, Yokohama, Japan) on “A numerical study on the winter mixed layer on the shelf-slope region south of Japan” co-authored with Takashi Setou, Yuichi Hirota, Manabu Shimizu and Kazuhiro Aoki

Best Poster for the POC-sponsored Topic Session on “Impact of climate variability on marine ecosystems: Understanding functional responses to facilitate forecasting”(S8)

Sarah Ann Thompson (Farallon Institute for Advanced Ecosystem Research, U.S.A.) on “Comparing pathways of functional response of top predators to seasonality of upwelling in the California Current” co-authored with William J. Sydeman, Jarrod A. Santora, Robert M. Suryan, Bryan A. Black, William T. Peterson and John Calambokidis

Best Poster for the POC-sponsored Topic Session on “Impact of climate variability on marine ecosystems: Understanding functional responses to facilitate forecasting”(S8)

Chan Joo Jang (Korea Ocean Research and Development Institute, Ansan, Korea) on “Variability of mixed layer depth and its relation with chlorophyll concentration in the North Pacific Ocean” co-authored with Sinjae Yoo

Best Oral Presentation by an early career scientist for the FUTURE-sponsored Topic Session on “Anthropogenic forcing in North Pacific coastal ecosystems: Understanding changes in ecosystem structure and function”

D. Shalin Busch (NOAA Fisheries, Northwest Fisheries Science Center, Seattle, U.S.A.) on “Evaluating uncertainty in estimates of how climate change may impact Northeast Pacific marine ecosystems” co-authored with Cameron H. Ainsworth, Jameal F. Samhouri, William L. Cheung, John Dunne and Thomas A. Okey