

## REPORT OF THE IMPLEMENTATION PANEL ON THE CCCC PROGRAM

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The Implementation Panel on Climate Change and Carrying Capacity Program (CCCC/IP) met from 0900-1300 hours on October 20, from 1400-1730 hours on October 21, from 13:30-17:30 hours on October 22, and from 09:00-13:00 on October 26, 2000. At the CCCC Workshops Plenary sessions, the Panel heard overviews of activities planned for the CCCC Workshops from the Task Team Chairmen, and results and recommendations from the Workshops (*CCCC Endnote 1*). Progress reports for 2000 and recommendations for activities in 2001 were received after the Task Team business meetings on October 22 (*CCCC Endnotes 2-5*). A session on October 26 involved a series of four invited talks and general discussion.

The Panel discussed issues with financial implications for PICES in 2001 and recommends:

### Publications

Reports of the 2000 CCCC Task Team Workshops be published in a single volume of the PICES Scientific Report Series.

### 2001 Workshops

The following meetings should be convened inter-sessionally:

- a 2-day BASS/MODEL Workshop on "Quantification of a food web model for the eastern Pacific gyres" (March 2001, Honolulu, U.S.A.; Convenors: Gordon A. McFarlane, Andrey S. Krovnin, Bernard A. Megrey & Akihiko Yatsu);
- a 3-day Workshop on "Impact of climate variability on observation and prediction of ecosystem and biodiversity changes in the North Pacific", co-sponsored by the Census of Marine Life through the Alfred P. Sloan Foundation, and the International Pacific Research Center (March 7-9, 2001,

Honolulu, U.S.A.; Convenors: Patricia Livingston & Vera Alexander);

- a MODEL Workshop to implement the improvements in the PICES NEMURO Model (venue, date and duration are subject to obtaining non-PICES funding support; Co-Convenors: Michio J. Kishi & Bernard A. Megrey).

The following meetings should be convened prior to the PICES Tenth Annual Meeting:

- a 1-day REX Workshop on "Temporal variations in size at age for fish species in coastal areas around the Pacific Rim" (Convenors: William T. Peterson & Douglas E. Hay);
- a ½-day REX/MODEL Workshop to include higher trophic levels to the PICES NEMURO Model (Convenors: William T. Peterson, Scott Rumsey, Michio J. Kishi, & Bernard A. Megrey);
- a 1-day BASS/MODEL Workshop to evaluate the results of the inter-sessional workshop models of the eastern and western subarctic gyres and of methods of simulating dynamic processes. (Convenors: Gordon A. McFarlane, Andrey S. Krovnin, Michio J. Kishi & Bernard A. Megrey).

### 2001 scientific sessions

A 1-day CCCC Topic Session on "Climate change impacts of the 1998/99 regime shift in the North Pacific Ocean and Bering Sea" be convened at the PICES Tenth Annual Meeting. There was some discussion as to whether the wording should be broadened to include all of the 1990s, but no decision was reached. Final wording was left for the Science Board to consider.

### Travel support

PICES provide financial support for:

- 1 REX and 2 MODEL scientists to attend the inter-sessional MODEL workshop;
- 2 scientists to attend the BASS/MODEL inter-sessional workshop in Honolulu;
- 1 scientist to attend the MONITOR workshop at PICES X;
- 2 scientists to attend the REX Workshop at PICES X.

#### Approval of new members

Science Board approve the following membership changes in the CCCC Program:

- Makoto Kashiwai (Japan) to replace Suam Kim (Korea) as CCCC Co-Chairman;
- David L. Mackas (Canada) and Sei-ichi Saitoh (Japan) to replace Bruce Taft (U.S.A.) and Yasunori Sakurai (Japan) as MONITOR Co-Chairmen;
- Charles B. Miller (U.S.A.) to replace Warren S. Wooster as CPR Chairman;
- Hidehiro Kato (Japan) and Thomas R. Loughlin (U.S.A.) to serve as BASS members;

#### **CCCC Endnote 1**

#### **CCCC Workshops Plenary Agendae**

##### CCCC Workshops Plenary Session #1, Friday, October 20, 2000

- 09:00-09:15 Opening remarks (D. Welch & S. Kim)
- 09:15-09:25 Overview of BASS workshop and activities (G.A. McFarlane & A.S. Krovnin)
- 09:25-09:35 Overview of MODEL workshop and activities (M.J. Kishi & B.A. Megrey)
- 09:35-09:45 Overview of MONITOR workshop and activities (B.A. Taft & Y. Sakurai)
- 09:45-09:55 Overview of REX workshop and activities (W.T. Peterson, T. Kobayashi & V.I. Radchenko)
- 09:55-10:05 Review of NPAFC-PICES Workshop objectives (V. Karpenko, NPAFC)
- 10:05-10:30 Coffee/tea break

- Peter S. Ross (Canada) and George L. Hunt (U.S.A.) to serve as MODEL members;
- Phil Mundy (U.S.A.), Douglas F. Bertram (Canada) and William Sydeman (U.S.A.) to serve as MONITOR members;
- Yutaka Watanuki (Japan) to serve as a REX member.

#### Relations with other Organizations, Programs, and Projects

As with last year's meeting, the Panel identified GOOS and GLOBEC as continuing high priorities, but viewed the development of closer links with the Sloan Foundation's Census of Marine Life initiative as a promising area to support.

#### Best Presentation Award

The CCCC Best Presentation Award was given to Dr. Shoko Hotta for her paper on "Factors affecting the growth of chum salmon in the western North Pacific revisited".

- 10:30-11:00 BASS Keynote speaker – Jeffrey J. Polovina "Investigating marine ecosystem dynamics with Ecosim"
- 11:00-11:30 MODEL Keynote speaker – Kenneth A. Rose "A review of the use of individual-based models as upper trophic level modelling tools"
- 11:30-12:00 MONITOR Keynote speaker – Ned Cyr "An overview of the LMR-GOOS strategic design"
- 12:00-12:30 REX Keynote speaker – Fritz C. Funk "Abundance and historical trends of herring in Alaskan waters"

##### CCCC Workshops Plenary Session #2, Saturday, October 21, 2000

- 14:00-14:15 Report of BASS Workshop and recommendations

14:15–14:30 Report of MODEL Workshop and recommendations  
 14:30–14:45 Report of MONITOR Workshop and recommendations  
 14:45–15:00 Report of REX Workshop and recommendations  
 15:00–15:15 BIO-MBM Workshop summary  
 15:15–15:45 Coffee/tea break  
 15:45–16:45 Status of National GLOBEC Programs (10 minutes maximum per country)  
 R.I. Perry, Canada  
 W.T. Peterson, U.S.A.  
 R. Wang, China

V.I. Radchenko, Russia GLOBEC-like programs  
 T. Sugimoto, Japan  
 Suam Kim, Korea  
 16:45–17:00 Report on GLOBEC International: Manuel Baranges  
 17:00–17:10 Report on GLOBEC-Int WG: Retrospective & Time Series Analyses - R. Ian Perry  
 17:10–17:20 Report on GLOBEC-Int WG: Process Studies - David L. Mackas  
 17:20–17:30 Report on GLOBEC-Int WG: Modelling – Francisco Werner  
 17:30–18:00 Discussion

## CCCC Endnote 2

### BASS Task Team Report

The BASS Task Team met in the morning of October 22, to review 2000 activities and plan activities for 2001. The Co-Chairmen welcomed participants and outlined the objectives of the meeting. The agenda was approved without changes.

#### 2000 activities and accomplishments

A 2-day BASS workshop on “Development of a conceptual model of the subarctic Pacific Basin Ecosystem(s)” was convened prior to the Ninth Annual Meeting in Hakodate (October 20 and 21, 2000). The workshop was well attended and highly successful.

At PICES VIII, BASS jointly with REX proposed convening a session entitled “Subarctic Gyre processes and their interaction with coastal and transition zones.” This was adopted by Science Board as the theme for their symposium at PICES IX.

The Advisory Panel on An Iron Fertilization Experiment in the Subarctic Pacific Ocean (IFEP) convened a 2-day Planning Workshop on “Designing the iron fertilization experiment in the Subarctic Pacific” in Tsukuba, Japan, prior to the PICES Ninth Annual Meeting (October 19-20, 2000). The objective of the workshop

was to initiate planning for the experiment, including logistics, ships, and funding, etc. The workshop was very successful thanks to 19 excellent presentations and the spirited discussions from the 36 participants. The Panel also met during the evening of October 25. A report of the IFEP appears as *BASS Annex 1*.

#### 2001 planned activities and recommendations

BASS proposed convening a 2-day workshop to examine the feasibility of using ECOPATH/ECOSIM as a tool to model higher trophic level components of the subarctic gyre system. The workshop will be held in March, 2001, in conjunction with the PICES/Sloan/ IPRC Census of Marine Life Workshop. The specific objectives include: (i) synthesizing all trophic level data to a common format, (ii) beginning to examine trophic relationships in both gyres using ECOPATH/ECOSIM/ ECOSPACE, and (iii) examining methods of incorporating the PICES NEMURO lower trophic model into the analysis. Co-convenors are Gordon A. McFarlane (Canada), Andrei S. Krovnin (Russia), Bernard A. Megrey (U.S.A.), and Akihiko Yatsu (Japan). BASS requests that PICES support 4 invited participants to attend the workshop.

BASS proposed a 1-day workshop to be held just prior to the Tenth Annual Meeting to evaluate the results of the inter-session workshop models of the eastern and western subarctic gyres and of methods of simulating dynamic processes.

BASS proposes a 1-day joint BASS/REX symposium to be held at the Tenth Annual Meeting. Two possible topics were suggested: (i) Underlying mechanisms controlling the expansion and contraction of Pacific sardine

populations in the Pacific Ocean; and (ii) Was there a regime shift in 1998/1999? Early physical and biological indications.

BASS endorsed a proposal by IFEP to convene a ½-day workshop or meeting at the Tenth Annual Meeting to refine the experimental design of the 2002 and 2003 experiments using information from the preliminary experiment in the western subarctic gyre in 2001 and Southern Ocean experiments in 2000/2001.

## **BASS Annex 1**

### **Report of the Advisory Panel on Iron Fertilization Experiment**

The Advisory Panel on An Iron Fertilization Experiment in the Subarctic Pacific Ocean (IFEP) met in the evening of October 25. The Co-Chairman, Dr. Shigenobu Takeda, welcomed the members of the Panel and observers (*IFEP Endnote 1*) and called the meeting to order. The agenda was reviewed and accepted without changes.

A 2-day IFEP Planning Workshop on "Designing the iron fertilization experiment in the subarctic Pacific" was convened in Tsukuba, Japan, prior to the PICES Ninth Annual Meeting (October 19-20, 2000). A report of the Workshop appears as *IFEP Endnote 2*. The objective of the workshop was to initiate planning for the experiment, including logistics, ships, funding, etc. The workshop was very successful thanks to 19 excellent presentations and spirited discussion among 36 participants.

Dr. Takeda introduced the schematic diagram of subarctic plankton ecosystem that includes new biological and geochemical processes reported during the workshop. He also listed similarity and differences in physical, chemical and biological characteristics between the eastern and western subarctic Pacific. Such differences have a close relationship with the zonal gradients in atmospheric iron deposition.

From the results of the workshop, Dr. Paul J.

Harrison proposed a central hypothesis for the iron enrichment experiments in the subarctic Pacific. The hypothesis was adopted by IFEP after modification according to the suggestions and comments from Drs. Kenneth Coale and Phillip W. Boyd, and other members (*IFEP Endnote 3*). The experiment should be driven by a scientific hypothesis and is to test the hypothesis on natural ecosystem and geochemical cycles, therefore the word "fertilization" would be replaced by "enrichment".

IFEP recognizes that it is very important to have a close linking between the Canadian and Japanese program. It is considered that scientists and ships from both Canada and Japan should perform the eastern and western experiments as a collaborative program to make the east-west comparison stronger by using the same methodology and team. The experiment needs the participation of American scientists and ships as well as scientists from other PICES countries to maintain the international activity achieved during the workshop. Due to the number of scientists that are needed to measure a wide variety of parameters, the experiment will require more than two ships. The R/V *J.P. Tully* (Fisheries and Ocean Canada) and R/V *Kaiyo-Maru* (Fisheries Agency, Japan) or T/S *Oshoro-Maru* (Hokkaido University, Japan) will be the base ships, both in the eastern subarctic experiment in July/Aug 2002 (Stn. P) and in the

western subarctic experiment in August 2003 (45-50°N, 160-165°E). The R/V *Hakuho-Maru* (University of Tokyo, Japan) is also available to perform the survey for studying the long-term responses in October 2003. A preliminary experiment in the western subarctic in June-August 2001 is also planning to use the R/V *Kaiyo-Maru*.

The Panel discussed the timeline of proposals for research and ship time. The IFEP members from each country were asked to gather information such as what they could measure/contribute to prepare the proposals as an international program. The information will be distributed to colleagues who are interested in participating.

#### **IFEP Endnote 1**

#### **Participation List**

##### Canada

Paul J. Harrison

##### Japan

Isao Kudo  
Shigenobu Takeda  
Atsushi Tsuda

##### People's Republic of China

##### Republic of Korea

##### Russian Federation

Lev M. Gramm-Osipov

IFEP recommends using a web site on the PICES home page to improve communication between IFEP members and other scientists (group of American scientists) who are proposing to participate the Canada-Japan experiments.

After the successful IFEP planning workshop, the IFEP felt strongly that the next step should be to convene a half-day mini-workshop or meeting at the PICES Tenth Annual Meeting in Victoria. This workshop would refine the details of the experimental design for 2002 and 2003 with information about a preliminary experiment in the western subarctic gyre in 2001 and Southern Ocean experiments in 2000-2001.

##### U.S.A.

Kenneth H. Coale  
William P. Cochlan

##### Observer

Philip W. Boyd (UK)  
Kenshi Kuma (Japan)  
Maurice Levasseur (Canada)  
Hiroaki Saitoh (Japan)  
Sei-ichi Saitoh (Japan)  
Mitsuo Uematsu (Japan)

#### **IFEP Endnote 2**

#### **Report on IFEP Planning Workshop**

#### **Designing the Iron Fertilization Experiment in the Subarctic Pacific**

Venue: Tsukuba, Japan, October 19-20, 2000  
Conveners: C.S. Wong and Shigenobu. Takeda  
Co-Sponsors: PICES and the Japan Central Research Institute of Electric Power Industry (CRIEPI)

#### **Objectives of the workshop**

- a. To establish the current knowledge about the role of iron in limiting phytoplankton production in the subarctic Pacific;

- b. To identify the specific questions that should be answered by the *in situ* iron fertilization experiment in the subarctic Pacific; and
- c. To initiate planning for the experiment, including logistics and funding, etc.

### Scientific Sessions

1. *General overview of IronEx and SOIREE, iron chemistry and biology in seawater*
2. *Physics in the North Pacific and Fe addition techniques*
3. *Biology in the North Pacific and IronEx*
4. *Chemistry in the North Pacific and IronEx*

The workshop was very successful thanks to 19 excellent presentations and the spirited discussion from the 36 participants.

### What do we know from IronEX I and IronEX II and SOIREE, etc.

- Iron limitation is clearly present in populations of phytoplankton in HNLC regions.
- Iron enrichment de-couples larger phytoplankton from the meso-zooplankton community.
- Evidence for carbon export in SOIREE is not clear. There may have been export of carbon, yet retention of iron. Evidence for carbon export in IronEX is clearer.
- Response in SOIREE was much slower than the response in IronEX.
- There is now more interest in the effect of iron enrichment in different macro-nutrient-limited regimes, specifically in low NO<sub>3</sub> regimes where N-fixation dominates N-uptake.
- A ship-based study of light limitation of iron enrichment in the SOIREE region showed that light limitation is present at 100 m.
- There is some interest in long-term addition experiments of low levels of iron.
- The role of meso-scale eddies is intriguing at Stn P. They may offer a way to track a patch of water for years, but the phytoplankton community in an eddy may be atypical of the Gulf of Alaska. Eddies

also have no surface water expression and so their relevance to an iron enrichment experiment is not clear.

- The European community has just sent the *Polarstern* to the southern ocean (in the Atlantic sector) to do a SOIREE-type experiment over a longer time (CARUSO).

### What do we still need to know?

- There is a need to study Station P and the NW Pacific, but other regions need to be studied as well.
- The fate of primary production (carbon): POC export flux, DOC, respiration and response of higher trophic levels (is there an increase in fish production?). The time scale is over a year, so the model approach is needed).
- What are the roles of ligands? What members of the community produce and take up ligands?
- Does zinc affect other enzyme processes?
- Need DMS/DMSP studies and other climate change biogases. Previous iron enrichment studies have measured DMS production. Should have both ships and aircraft for sampling. At Station P, ocean levels of DMS are very high and atmospheric levels are low.
- Need to know the factors that influence the carbon-to-nutrient-and-other trace metal export ratios.
- Iron might end up below the mixed layer during long-term commercial projects. It might become available the next summer after winter mixing.
- Would long-term iron enrichment drive a system toward another limitation (N, Si, Zn, Co, etc)?
- What is the impact of long-term iron enrichment on fish? Governments may see the fish production as a secondary benefit of the iron enrichment, so this question will be asked. The public may see this as a problem, due to “wrong” species benefiting, such as pennate diatoms that produce domoic acid. (These are not questions that can be addressed with the current experiment)

- What are the chemical processes associated with iron saturation and super-saturation of seawater?
- How does Fe(II) stay around so long in Fe enrichment patches?
- What are the major grazers on diatoms and how do they respond when diatom (pennate/centric) abundance increases?
- Understanding the dynamics of plankton ecosystem, export carbon flux and climate related gases to the iron enrichment is appropriate for the requests of Government and Industry who are seeking scientific information to assess the effect on future global atmospheric CO<sub>2</sub> and environmental impacts.

### **What do we hope to learn from an iron enrichment experiment at Stn P and WSG?**

What are the similarities and differences in the plankton ecosystem response to iron fertilization in the subarctic Pacific? There is a special interest in the east-west North Pacific comparison, which includes differences in dominant species (pennate/centric diatoms) and export flux (Org-C/Opal/CaCO<sub>3</sub>).

### **Canadian Program (extracted from the Canadian SOLAS Proposal)**

Canadian scientists are proposing to fertilize a 64 km<sup>2</sup> patch of ocean near Stn P in the NE subarctic Pacific during July/Aug 2002. Iron will be added 3 or 4 times during the three week experiment and a wide variety of physical, chemical and biological parameters will be measured. In particular, the expected increase in phytoplankton biomass and the subsequent carbon flux out of the photic zone, the drawdown in CO<sub>2</sub>, and the production of other climate change gases such as DMS will be carefully documented.

There are several reasons why an iron enrichment experiment should be conducted at Stn P in the NE subarctic Pacific. Stn P or Ocean Station Papa (50°N 145°W) has a 40 year time series of physical, chemical, and biological

parameters and thus it has one of the longest open ocean time series in the world. Three large intensive sampling programs have provided detailed information, especially on biological rate process studies (SUPER, WOCE, and Canadian JGOFS). This large published data set/time series will provide an excellent background to assess the annual and interannual natural variability for evaluating the magnitude of the response to the iron addition experiment. The subarctic North Pacific represents a latitudinal gradient between the polar (Southern Ocean) and equatorial regions and therefore an iron addition experiment at Stn P will allow a comparison among the three large HNLC regions and between the eastern and western gyres in the subarctic Pacific.

The subarctic NE Pacific has different physical, chemical and biological properties than the other two HNLC regions (Southern Ocean and Equatorial Pacific). In particular, it has a very shallow summer mixed layer depth, a strong, shallow pycnocline and low currents which should help to keep the iron patch intact and ensure the success of the experiment. The biodiversity of the plankton is different from the equatorial Pacific and Southern Ocean and therefore the response to the iron addition and the flux of carbon out of the photic zone may be different.

Unlike the equatorial Pacific, Stn P is in close proximity (3 days) to major research laboratories at the Institute of Ocean Sciences and the University of British Columbia and therefore it should be easier to document the longer term recovery from the iron addition. If the detailed documentation of the ecosystem response to a single iron addition is successful, this will allow us to proceed to the next phase, repeated iron additions and the longer term monitoring that this will require.

Key questions that have not been entirely resolved by previous iron enrichment experiments, are:

1. How does the change in biodiversity and foodweb structure differ for markedly

different ecosystems which have been perturbed by an iron addition?

2. What is the drawdown of CO<sub>2</sub> and especially the flux of carbon to the deep ocean?
3. How does the production of ligands influence the iron chemistry and the longevity of the phytoplankton bloom?
4. How does zooplankton grazing influence the formation of the bloom and the carbon flux (e.g. fecal pellet production)?
5. What is the long-term response and recovery of the ecosystem following an iron addition?
6. What is the magnitude of production of other climate change gases such as DMS during the bloom and how is the production influenced by phytoplankton species, microbial processes and grazing?

#### Objectives

1. To measure the response of bacteria, phytoplankton and zooplankton in terms of species, standing stocks and rate processes to the iron addition.
2. To measure the drawdown of CO<sub>2</sub> and the flux of carbon to depth.
3. To study the relationship between ligand production and the associated changes in the iron chemistry and their influence on the longevity of the phytoplankton bloom.
4. To assess the influence of zooplankton grazing on the phytoplankton bloom formation and carbon flux.
5. To follow the long-term response and recovery of the phytoplankton bloom.
6. To quantify the production of various climate change gases during the iron enrichment experiment and assess the factors which influence the production of these biogases.

#### Biological Oceanographic sampling

The upper 150 m will be sampled vertically (6-8 depths) each day using 12 acid-cleaned PVC samplers on a CTD/water sampler rosette system at the patch center (determined by SF<sub>6</sub> levels) and in the surrounding waters. Real-time vertical profiling of temperature, salinity, transmissivity, chlorophyll *a* fluorescence and underwater

irradiance (PAR, 400-700 nm) will be carried out. Discrete water samples will be analysed for:

- chlorophyll *a* (size-fractionated, >20, 5-20, 2-5 and 0.2-2 μm)
- heterotrophic bacterial abundance
- microzooplankton abundance
- phytoplankton abundance (flow cytometry, epifluorescence and light microscopy).

Additional samples will be incubated on deck to measure rates of:

- primary production (14°C, 24 h incubation, simulated *in situ* and size-fractionated as for Chl-*a*)
- bacterial production
- microzooplankton grazing

Mesozooplankton abundance will be assessed from 150-0 m vertical hauls. The Th:U activity ratio of particles in the upper water column will be collected using a submersible pumping system.

#### Geochemical measurements

Two types of sampling will be done: hydrocasts and underway sampling from the vessel's non-toxic seawater supply (intake 5 m subsurface) and analysed by fluorometry (calibrated with discrete chlorophyll *a* samples every two days, corrected for quenching during daylight hours), and using a bubble-segmented automated nutrient analysis system, respectively. Underway samples for dissolved iron will be conducted from a clean towed batfish sampling system, and samples for pCO<sub>2</sub> will be drawn from the vessel's non-toxic seawater system. Phytoplankton samples for the single-cell flavodoxin assay will be pre-concentrated onboard ship and later analysed shoreside. Sampling will be conducted by:

- Towed batfish: Continuous sampling will be made from a towed batfish with a clean pump and tubing for the following measurements (This is not a pumping undulating fish):
  - Conductivity/salinity sensor
  - SF<sub>6</sub>
  - fCO<sub>2</sub>, pH
  - nitrate



- iron
- chlorophyll-*a* (fluorometer)
- Hydrocasts by rosette CTD/Niskin samplers
  - T, S
  - O<sub>2</sub>
  - Chlorophyll *a*
  - Macro-nutrients (N, P, Si) by auto-analyzer
  - Iron by chemiluminescence
  - Particulate iron size-fractions, total iron, dissolved iron
  - SF<sub>6</sub>
  - DIC, TA, pH
  - DOC, DON, POC
  - DMS
- Free-drifting sediment traps (at 50 m intervals, 50-600 m) deployed and retrieved at 3 day intervals to obtain samples for detritus organic C, N, P, Si, PIC, Fe, Cd, Al, rare earth elements, Th/U ratios, coccolithophore counts, and planktonic species, and scanning electron microscope pictures.
- Deckboard perturbation experiments  
Algal carbon, growth rates and C:Chl *a* ratios, etc.

Drs. Wong and Harrison hope to have one or two strings of moored sediment traps, plus free floating traps. Moored traps would be at the control site. Floating traps would hopefully follow the patch. It will be difficult to keep the patch and traps together, but there is a real need for trap data to try to quantify and characterize export. Free-floating sediment traps may perform differently than moored traps. Therefore we should have free-floating traps in and out of the Fe patch.

There is a need to know more about micro-zooplankton and to know the effects of ligands and climate change biogases (including but not limited to DMS, CO<sub>2</sub>, N<sub>2</sub>O). SOIREE showed enhancement of nitrous oxide at the top of the thermocline. There will be aircraft-based sampling of gases and aerosols above the Fe

patch. The experiment expects to have access to the R/V *J.P. Tully* for four weeks, but anticipates sampling over a longer time if back-to-back cruises using a second vessel can extend sampling over 6 weeks. Cruises could be separated by several weeks if the patch could be found on the second cruise. Iron limitation at Stn P in July to August is severe, so project will be conducted during this period. The project will be part of the Canadian SOLAS project.

### Summary of Japanese programs

Japanese scientists are proposing to conduct a preliminary experiment of about 40 days duration in June-August 2001, using the R/V *Kaiyo Maru* in the Western Subarctic Gyre. The next effort is anticipated for August to mid-September 2003 using either the R/V *Oshoro Maru* or the R/V *Kaiyo Maru* to initiated the SF<sub>6</sub>/Fe patch and conduct the basic study. In October 2003, the R/V *Hakuho Maru* will be used for intensive sampling and measurements and assessing long-term responses. Sampling will occur in the Western Subarctic Gyre in the region 45-50°N, 160-165°E:

1. To measure the response of bacteria, phytoplankton and zooplankton in terms of species, standing stocks and rate processes to the iron addition;
2. To measure the drawdown of CO<sub>2</sub> and the flux of carbon export;
3. To study the interaction between biogeochemical processes in the surface water during the phytoplankton bloom and the production of climate gases in the atmosphere;
4. To study the relationship between phytoplankton (diatom) production and the higher trophic level (salmon); and
5. To assess the influence of iron supply on the characteristics of the plankton ecosystem in the western subarctic Pacific.

The proposal would be funded by:

- The Science and Technology Agency (2001-2005);

- Ministry of Education, Science and Culture (2001 Basic Science, 2002-2004 Scientific project with high priority);
- NEDO grant.

Japan SOLAS is still in the preparation stage. A study of the influence of natural atmospheric iron supply on the characteristics of the plankton ecosystem in the western subarctic Pacific will be one of the important topics. (Long cruise staying at a station in the high dust season in spring.)

#### **United States, SOFEX (by Kenneth Coale)**

- Experiment will be along 170 west, near SO-JGOFS site.
- Experiment will use SeaSoar type of device that pumps water to ship.
- SO-JGOFS found jump in silicate at Polar front near 62S, with increase south of front. SOFEX will do experiments N and S of front, to see which type of species is enhanced in each region (*Phaeocystis* and diatoms).
- Big complement of scientists and studies. There are ten more scientists than berths on ship. Lack of ship bunks is a general problem in iron enrichment cruises. For example, samples will be frozen for later analysis by Edie Rue and will run the only ligand study.
- SOFEX will need to find the northern patch after a week or more, and plan to use lagrangian drifters to keep track of the patch.

#### Methodology

- Need to standardize sampling methods to enable comparison among experiments in different HNLC regions. List of dominant species and their biomass is useful for the comparison. Export production is difficult to get quantitative samples?
- First step is the application of previous IronEx methodology (FeSO<sub>4</sub>, initial concentration level, Fe infusion timing, etc.) and then we may go to new method such as

the use of chelated iron (iron lignite), long-period and low-level iron supply, etc.

- Should add DMSP to list of samples.
- Micro-zooplankton are important grazers and dilution experiments are necessary to quantify coupling of primary production and grazing.
- Fe organic ligand study has technical problems.
- Analyses of biogases in the atmosphere are important, but how?
- Bag experiments have limitations. Small bags might not represent the ocean. Large bags are too difficult to manage. However there should be some role for bag experiments.
- Use of organic chelated iron (iron lignite) may provide carbon source for heterotrophic organisms.
- Stable isotope study will be done in SOFEX to see the proxy of paleo-oceanographic environment.
- After silicate in surface water will be used up, a re-infusion of Fe will give us some idea of the long-term change in dominant species.

#### Logistics issues

- The Stn P project needs a second ship. Kenneth Coale recommended that a U.S. ship may be available if a group of American scientists were to propose to participate. The US SOLAS program would be one way to generate support. It would help to have a Canadian-Japanese proposal ready. US scientists must start to prepare proposals now for Stn P 2002 cruise.
- A Canadian or US airplane would be useful for tracking the Fe patch. An airplane with a hyperspectral sensor would be really useful.
- ADEOS-2 will be launched soon. It will be useful (similar to SEAWIFS).

### IFEP Endnote 3

#### Proposed experimental summary

The North Pacific is characterized by relatively uniform distributions in temperature, salinity, macronutrients and light yet strong zonal gradients in atmospheric iron deposition exist between the eastern and western gyres.

We **hypothesize** that:

1. The difference in episodic iron deposition gives rise to distinct phytoplankton communities that characterize these biogeochemical provinces.
2. The biogeochemical response of any given province (air-sea flux of biogases, export flux of carbon) is driven by episodic events such as iron deposition.

To test these hypotheses (and offers as part of this program) an iron perturbation experiment, on the scale of the entire community is required such that the community response and resultant geochemical signal can be measured

#### Scientific questions

What is the fate/longevity of the bloom with an emphasis on ligand production and the response of the grazers (micro and mesozooplankton)?

What is the magnitude and characteristics of particles (Carbon flux) sinking at the end of the bloom?

What is the production of various climate change biogases (DMS, N<sub>2</sub>O, methane, etc.) during and after the bloom?

### CCCC Endnote 3

#### MODEL Task Team Report

The meeting of the MODEL Task Team was held from 0900-1230 hours on October 22, 2000. The Chairmen, Drs. Bernard A. Megrey and Michio J. Kishi called the meeting to order and welcomed the participants (*MODEL Annex 1*). The Task Team reviewed the draft agenda and it was adopted (*MODEL Annex 2*). During the meeting, participants: (i) Generated a list of desirable modifications to the PICES NEMURO Model (NEMURO), (ii) Met with the REX Task Team to discuss strategies for linking NEMURO to an upper trophic level herring model, (iii) Generally discussed options to link NEMURO to upper trophic level models, and (iv) Had a presentation on ECOSIM and discussed options for linking NEMURO to ECOSIM.

#### Plan of Work

- NEMURO Extensions
  - Add Fe limitation to phytoplankton production
  - Add microbial food web
  - Split ZL into copepods and euphausiids

- Add sinking rate of phytoplankton to detritus pool
- Parameterize NEMURO to a coastal region
- NEMURO Diagnostics
  - Code diagnostic and performance measures into NEMURO such as P/B, C/B ratios and ecotrophic efficiency calculations
  - Validate model output against data for each regional location
  - Perform side-by-side comparison of NEMURO Box Model and NEMURO MATLAB model to same equations and data
- Spatially Explicit Approach
  - Extend 1-D coupled model per above
  - Work toward eventually embedding NEMURO into larger scale 3-D ocean model similar to Kawamiya, Kishi and Sugihara (2000a) and Kawamiya, Kishi and Sugihara (2000b). (*MODEL Annex 3*)
- Linkages with other CCCC components

- Modify NEMURO per needs of REX and convene a joint workshop to achieve extension of NEMURO to include higher trophic levels
- Devise scheme to link NEMURO with ECOPATH/ECOSIM with the aim towards meeting the objectives of BASS
- Establish links with other programs such as GODAE, WCRP, CLIVAR
- Modifications of NEMURO as required to accommodate BASS and REX needs.

Workshop proposal and requests for travel funding

Title: Workshop to implement improvements to the PICES NEMURO Model

Likely location: North America

Likely date: Spring 2001

Convenors: Michio J. Kishi & Bernard A. Megrey

Objectives/Justification: In the past year, significant progress has been made on developing a PICES lower trophic level marine ecosystem model. This has mainly been a result of a highly focused international workshop held in Nemuro, Japan, in January 2000. At the workshop the model was built and it is currently operational. Improvements in the model since the workshop have been slow. At the same time interest in the PICES NEMURO Model from other CCCC Task Teams is growing and collaborative projects between MODEL, BASS and REX are planned to expand NEMURO to include higher trophic level components. For these co-operative endeavors to be successful more diagnostic work is required before the model can be useful.

MODEL would like to convene a small workshop (6-8 people) to carry out validation, calibration and regional comparison exercises on the NEMURO Model. The participants would consist of a core group of individuals who have been the driving force behind the design and implementation of NEMURO.

Funding requests: PICES provide travel support for 4 scientists to attend the workshop.

2000 achievements

- Successful CCCC/MODEL Workshop on *Lower Trophic Level Modeling*, (co-sponsored by the Japan International Science and Technology Exchange Center and Nemuro-city) convened January 31–February 3, 2000, in Nemuro, Japan;
- PICES Nemuro lower trophic level model of the marine ecosystem was created;
- Report of the 2000 CCCC/MODEL Workshop was published in the PICES Scientific Report No. 15;
- Article on the 2000 CCCC/MODEL Workshop was published in PICES Press.

2001 recommendations

- Convene a MODEL workshop to implement improvements to the PICES NEMURO Model;
- Increase interaction with BASS and REX to support their modeling initiatives through cooperative modeling workshops;
- Present these workshop proposals to the Science Board as a coordinated package of integrated activity underscoring the cooperation and interdependencies;
- Allocate time at the next Annual PICES Meetings for joint CCCC inter-sessional meetings;
- Encourage opportunities for more CCCC Task Team interaction (joint CCCC Task Team meetings are needed, so in Victoria, the Task Team meetings should be at non-overlapping times and places);
- Request that the PICES Secretariat provide

assistance to help MODEL build a web page to present NEMURO code, data and results; and

- Developed a plan to carry out a review of the CCCC Program relative to the objectives

stated in the original Implementation Plan, the current status of the program, and desirable future directions.

## MODEL Annex 1

### Participation List

#### Canada

Daniel M. Ware

#### Japan

Michio J. Kishi (Co-Chairman)

#### People's Republic of China

#### Republic of Korea

#### Russian Federation

Yuri I. Zuenko

#### U.S.A.

Bernard A. Megrey (Co-Chairman)

#### Observers

Sergio Hernandez (Mexico)

Sarah Hinckley (U.S.A.)

Sukyung Kang (Korea)

Gennady A. Kantakov (Russia)

Hiroshi Kuroda (Japan)

Andrew Leising (U.S.A.)

Cisco Werner (U.S.A.)

Kenneth Rose (U.S.A.)

Masako Saitoh (Japan)

S. Lan Smith (Japan)

Yasahiro Yamanaka (Japan)

## MODEL Annex 2

### Agenda

1. Introductions
2. Adoption of the Agenda
3. Achievements of the past year
4. Plan of work
5. Future workshop proposals
6. Improved interaction with BASS and REX
7. Recommendations

## MODEL Annex 3

### References

Kawamiya, M., M. Kishi, and N. Suginoara. 2000a. An ecosystem model for the North Pacific embedded in a general circulation model. Part I: Model description and characteristics of spatial distributions of biological variables. *Journal of Marine Systems* 25:129-157.

#### CCCC Endnote 4

Kawamiya, M., M. Kishi, and N. Suginoara. 2000b. An ecosystem model for the North Pacific embedded in a general circulation model. Part II: Mechanisms forming seasonal variations of chlorophyll. *Journal of Marine Systems* 25:159-178.

### MONITOR Task Team Report

### Continuous plankton recorder field program

The N. Pacific Continuous Plankton Recorder (CPR) pilot program was initiated in early 2000. Sampling was carried out on five north-south tracks and on one east-west track. The overall data recovery was very high (98%). Spatial resolution along the tracks was 18 km. Along track surface temperature data were also collected. As of early October 2000, sample processing has been completed for the March and April/May north-south tows and the preliminary analysis of these data was reported. *Neocalanus plumchrus* is one of the dominant copepods of the subarctic Pacific. It was present in the March samples from just outside Prince William Sound to 41°N but with no marked peaks of abundance. The majority of individuals were stage-2 copepodites. In April *Neocalanus* abundance was generally higher than in the previous month with maximum densities occurring between 44° and 54°N. There was a clear gradient in the apparent stage of development with most of the northern individuals still present as stage-2 copepodites whereas over 60% had reached stage-5 in the southern samples. Such a gradient might be expected, since the duration of development probably depends on temperature, but these data are the first to show this spatial relationship. Preliminary analysis of the zooplankton community structure has revealed distinct differences along the length of these two tows. The more coastal samples, off Prince William Sound and California, showed some similarities to each other and were clearly distinct from the more oceanic samples. Samples from the offshore region showed marked evidence of clustering. Further analysis will document the key species contributing to these differences. The demonstration of the existence of communities suggests that the sampling resolution attained on these tows is adequate to characterize regional community composition. Funding exists to collect and analyze a second year of pilot-program measurements.

The MONITOR Task Team recommends that PICES strongly back the principal investigators

in their efforts to find long-term funding support for this important monitoring program. The Task Team also recommends that letters of appreciation be written by PICES to the two participating shipping companies commending the extraordinary support that they have provided for this program. It was pointed out by the Task Team that interpretation of the zooplankton data would be enhanced if ancillary environmental data were collected. Specific suggestions were: (a) the collection of sea-chest temperature data; (b) collection of sea-chest water samples for salinity determination; and (c) underway measurement of fluorescence data.

The Report of Advisory Panel on Continuous Plankton Recorder is attached as *MONITOR Annex 1*.

### Ocean tracking network for the coastal ocean

Many marine animals remain confined to the continental shelf ecosystem for a significant fraction of their life history. For example, after entering the ocean from freshwater, Pacific salmon smolts generally move northward following the narrow continental shelf of North America. Sampling studies have shown that east of the Aleutian Is. chain all juvenile salmon remain over the shelf. The stocks that migrate northwestward move offshore when they reach the end of the Alaskan Peninsula. Some stocks of coho and chinook smolts remain as year-round residents of the coastal zone. Other stocks of Pacific salmon move south along the shelf. The different migration pathways probably have important implications as to survival of the stocks. Because the continental shelf is narrow, the migration corridor for the juveniles is a long thin region which can be monitored at many locations at relatively low cost. Monitoring of the movements can be done utilizing newly developed acoustic technology. Miniature uniquely identifiable pingers can be inserted in individual fish (or mammals). The pinger signals from each fish can be detected by moored receivers within a range of 0.6 - 1.0 km. As the shelf on the West Coast is usually less than 20 km wide, a string of 20-30 receivers

spanning the shelf and the upper continental slope out to 500 m depth should be capable of detecting all tagged animals crossing its path. About twenty acoustic listening lines could be deployed that would stretch from California to the Aleutian Is. This observing system could address the following scientific objectives:

- a. Determine the migration pathways of multiple species of animals and their rates of migration along the shelf;
- b. Establish which stocks of salmon move to the offshore Pacific or remain on the shelf;
- c. Establish the feeding grounds for shelf-resident marine animals;
- d. Determine the period of time animals remain as coastal residents in various sections of the coast expected to be significantly affected by climate change;
- e. Establish movement patterns for immature and maturing salmon by tagging these animals in the ocean one or more years prior to their return to their natal rivers.

The Task Team recommends that PICES recognizes the potential scientific benefits of the acoustic monitoring array and urges that PICES promote the timely evaluation of this proposal within the community to establish proof of concept.

#### Preservation of existing North Pacific monitoring programs

The Task Team identified three programs that were either likely to be canceled or were about to undergo substantial change:

- a. Station #2 Mooring. A biophysical mooring (designated station #2) has been main-tained for the last five years southwest of the Pribyloff Is. This time series data set has been used extensively to describe the variability of environmental conditions in this region. It is slated to be terminated this year. The Task Team recommends that PICES lobby in the scientific community for the continuance of this valuable time series.
- b. Bering Sea Section at 180°. The Japanese shipboard program in the N. Pacific is in

transition. The *R/V Oshoro-Mar* will not continue to occupy the section at 180. The ship will occupy a 165°W section, which will improve the coverage. The Japan Fishery Agency will take over the occupation of the 180° sections. There is concern that the quality of measurements set by the University of Hokkaido may not be maintained under this new arrangement. The 180° section is a key section with a long tradition of state-of-the-art observations. The Task Team recommends that PICES urge that every effort is made by the Japan Fisheries Agency to provide a data set comparable in quality to the *R/V Oshoro-Mar* measurements.

- c. Japanese Prefectural Monitoring of the Seas Adjacent to Japan. For the last 40 years the Japan Fishery Agency has supported a prefectural monitoring program in the coastal seas of Japan. Shipboard measurements are made from the coast out to 60 nautical miles. One of the justifications for this program is that the data are used for forecasting of coastal fishing conditions. An additional benefit is that it is very valuable climate data set. The Japan Fishery Agency has proposed a 50% cut in funds for this program. There is no identified alternative source of funds to maintain the program. The Task Team recommends that PICES call for an assessment of the effects of this proposed action on climate studies in this critical region.

#### PICES/GOOS interaction

The Task Team discussed at length the role of regional organizations, such as PICES, in planning and implementation of the Global Observing System (GOOS). It was pointed that it would be useful to consider the type of interaction that other regional organizations, such as ICES, have developed. An ICES Steering Group was set up "...to prepare an action plan for how ICES should take an active role in the further development and implementation of GOOS at a North Atlantic regional level with special interest in fisheries

oceanography". This Steering Group recommended that an observing system be developed with two elements: an Atlantic component focused on climate and a regional component focused on ecosystem dynamics the North Sea with emphasis on the need to improve management of fish stocks.

The Task Team recommends that PICES set up a Steering Group to define the direction that PICES should take in integrating their regional interests with GOOS. This Group would consider issues such as the identification of existing observing systems in the N. Pacific which could contribute toward a regional PICES GOOS, new observations required to complete the system, and possible eventual establishment of a Regional Analysis Center (RAC), along the lines suggested by LMR-GOOS. The Steering Group would comment on the possible benefits to PICES countries of providing an annual ecological assessment of the state of the North Pacific - as envisioned in the concept of a PICES RAC. The Steering Group would meet inter-sessionally and report to the Science Board at PICES X.

#### NEAR-GOOS Planning Workshop

PICES has recommended to NEAR-GOOS that they expand the types of data that they collect and archive. At present they only deal with physical oceanographic and meteorological data. In order to serve the climate community

well they need to include biological and chemical data. In August 2001, a NEAR-GOOS Forecasting Workshop (in conjunction with the Fifth IOC/WESTPAC Scientific Symposium) is planned to consider the strategy for better serving their scientific constituency in the future. They have requested that PICES be a joint sponsor of this workshop. In particular, because they do not have any in-house expertise in the area of data management of chemical and biological oceanographic data, they will require outside help in these areas.

The Task Team recommends that PICES work with the workshop planners to ensure that they have the necessary expertise for a successful workshop. This may require providing travel support for several PICES scientists to take part in the discussions.

#### Gulf Ecological Monitoring (GEM) program

In 1999 the Exxon Valdez Oil Spill Trustee Council dedicated a fund of \$120 M to support a program of research and monitoring in the northern Gulf of Alaska in perpetuity. The Trustee Council invites the scientific community of PICES to participate in the planning and implementation of this program. Because GEM represents a major contribution to monitoring in the PICES region, it was recommended that the MONITOR Task Team always includes a scientist representing this program.

## **MONITOR Annex 1**

### **Report of the Advisory Panel on Continuous Plankton Recorder Survey in the North Pacific**

The PICES Advisory Panel on Continuous Plankton Recorder (CPR) met during the evening of October 25. A list of those attending is attached (*CPR Endnote 1*).

#### The present Continuous Plankton Recorder Program



A report was distributed by Dr. Sonia D. Batten of Sir Alister Hardy Foundation for Ocean Sciences (SAHFOS), Plymouth, UK, on progress to date with CPR monitoring in the subarctic Pacific. A copy of that report is attached (*CPR Endnote 2*).

In brief, the initial year of sampling involved runs of the MV *Polar Independence*, a crude oil carrier, south from Valdez, Alaska, to Long Beach, California, in March, April-May, mid-June, July and August, 2000. One run by the MV *Skaubryn*, a container ship, was made from Vancouver toward Japan with CPR towing only to 155°E (just south of the tip of Kamchatka). Processing of the silks is more than half finished, starting at the earliest dates. A main result is that the winter-spring dominant copepods, the so-called “interzonal migrators” show a latitudinal gradient in maturation timing, completing preparation for summer-autumn diapause faster at lower than at higher latitudes. This is not unexpected, but has never been documented before. A temperature recorder towed with the CPR produced a good summary of SST along the track. No report is yet available from the east to west run. The Panel agreed that the reported results represent a substantial success for the program’s first year.

Since discussions with the shipping companies about schedules for 2001 are to begin shortly, we considered changes that might improve the science. Our only suggestion is to reorder sampling on the east-west line so that the western coastal section approaching Japan, including shelf areas, is covered. Since a standard set of “mechanisms” won’t cover this, we proposed sacrificing a central portion of the line to achieve this. It is recognized that this will cause CPR sampling to occur in the EEZs of both Russia and Japan, which may require permits from those countries.

Members, particularly the Chairman, were curious to know exactly how the CPR program was funded. It was explained that the initial two years of funding (\$250,000, half the initial request) are from the so-called Dinkum Sands

money, the product of a court settlement between the State of Alaska and the U.S. federal government. These funds are currently managed under the North Pacific Marine Research (NPMR) program by the Institute of Marine Science, University of Alaska Fairbanks, on behalf of the North Pacific Research Board (NPRB), which has not yet been constituted. The NPRB was established to handle the part of this court award that has been devoted to environmental research. The project is very likely to obtain approval for a 1-year extension after the first two years of work under the original grant are complete. CPR and projects of the NPMR are described at <http://www2.sfos.uaf.edu:8080/npmr>.

#### Future CPR and related monitoring in the subarctic Pacific

The Panel must begin work soon on funding for a follow-on program to this initial CPR study. The Panel agreed that a minimum improvement for long-term monitoring will involve a substantially modernized recorder or similar device. It should incorporate some much more rapid, more automated form of plankton enumerator such as an OPC. Probably, only data of much reduced systematic precision would be possible from any such enumerator, but their rapid output of data has its own value. The real requirement is a research program to design an optimized, modern monitoring approach to the subarctic Pacific. We anticipate that this approach will continue the use of vessels of opportunity. Discussion of potential components of a “fully found” vessels-of-opportunity program included:

- depth-cycling CPR, video plankton recorder, OPC;
- depth-cycling CTD and possibly nutrient analyzers;
- LIDAR and similar sensors that might be deployed from an outboard bridge wing;
- bird and mammal observers.

George Hunt was particularly enthusiastic about the potential of homeotherm watchers, and will prepare a document outlining that potential.

The Chairman and others will begin a search for support of this development effort. Several possible sources of support were discussed, but it is premature to report on them to the Science Board. This effort will be the main purpose and activity of the CPR Panel for some time to come.

#### Other monitoring efforts

Dr. Takashige Sugimoto reported on a vessel-of-opportunity program operated from the University of Tokyo Ocean Research Institute (ORI). Sampling is from the Norwegian flag vessel M/V *Skaugran*, a “ro-ro” container carrier operated by the same company as the M/V *Skaubryn*. This effort takes high frequency temperature and chlorophyll fluorescence measures from cooling water intakes. A filter sac is tied across a tap from this intake and filters plankton during night periods on trans-Pacific runs. These filters are preserved in formaldehyde and returned to ORI. Plankton are drained, weighed wet and returned to preservative as a taxonomic record. The

biomass estimates, scattered through the year and all across the North Pacific are plotted and contoured. No work has been done yet on plankton systematics. If arrangements can be made for the M/V *Skaugran* to tow a CPR, a cross-comparison of these techniques can be generated. For the moment, however, these programs are operating in isolation.

Gennady Kantakov provided some details of two monitoring programs operated out of his institute, SakhNIRO, Russia. These are collections made from ferries crossing from Sakhalin to Hokkaido and from Sakhalin across the northern tip of the Sea of Japan to the continent. SakhNIRO would like PICES to be aware of this monitoring, and the CPR Panel forwards that interest to the Science Board. Some of the results extend backward, although with breaks, to 1924. A recent program deploys a MacLane (see [www.mclanelabs.com](http://www.mclanelabs.com)) zooplankton pump sampler that automatically collects up to 50 samples (250 liter maximum of water filtered) over an interval up to one year. This sampler has been in place in La Perouse Strait since July 2000.

#### **CPR Endnote 1**

#### **Participation List**

##### Canada

David L. Mackas

##### Japan

Takashige Sugimoto

##### People’s Republic of China

##### Republic of Korea

##### Russian Federation

##### U.S.A.

Richard D. Brodeur

Charles B. Miller (Chairman)

Jeffery M. Napp

##### Observers

Christine Bain (U.S.A.)

Sonia D. Batten (UK)

George L. Hunt (U.S.A.)

Naoki Iguchi (Japan)

Gennady Kantakov (Russia)

Phil Mundy (U.S.A.)

Kaoru Nakata (Japan)

Bruce Taft (MONITOR Task Team)

Makoto Terazaki (Japan)

#### **CPR Endnote 2**

#### **CPR sampling of the North Pacific in 2000**

Background

At the MONITOR Workshop at the PICES Eighth Annual Meeting, it was announced that funding had been received to start a 2-year CPR program in the NE Pacific. In the original April 1999 proposal, we had intended to sample 2 transects 6 times each a year, from Valdez, Alaska, to Long Beach, California, and from Vancouver westwards into the Bering Sea. Since we received 50% of the asked-for funding, there were discussions at the workshop as to the best way to use the money to obtain a good temporal and spatial coverage. We resolved on towing the north to south transect 5 times between spring and late summer and the east to west transect just once, in June, to coincide with the probable Line P cruise.

Most of the funding would be spent on the taxonomic enumeration of the samples which therefore defined the number of samples that could be processed (about 450 per year). The decision was made to initially analyze every 4<sup>th</sup> sample (72 kms apart) except for the June north-south tow where every 2<sup>nd</sup> sample would be analyzed (36 kms apart). Additionally, every shelf sample would be analyzed. At the end of the year, once sampling success was known and some idea of the data obtained was available, it would be possible to analyze extra samples on particular tows to reach the target of 450.

Sampling in 2000

SAHFOS contacted two shipping companies which operated on the desired routes and received their support for the program. Polar

Tankers Inc. (originally ARCO Marine Inc.), who towed the initial pilot survey for SAHFOS in 1997, operated the crude oil carrier *Polar Independence* from Valdez to Long Beach throughout 2000. Seaboard International Shipping Company Ltd operated the container ship *Skaubryn* from Vancouver to Japan and were happy to tow a CPR on any of these trips. Both companies gave considerable support and assistance to SAHFOS, for example the towing davit had to be fitted to the *Polar Independence* whilst it was at anchor, outside of the oil terminal. Polar Tankers Inc. were also happy to allow a technician to accompany one of the tows. Seaboard International Shipping Company Ltd. arranged for transport of the CPR to and from Vancouver at a reduced rate through associated companies. These efforts were over and above helping with logistics through communicating ship schedules as soon as was practicable.

All of the towing for 2000 is now complete, and all of the samples and hardware are back at SAHFOS. The table below summarizes the dates of sampling, the number of samples obtained and the current status (as at the end of September) of the sample processing. Some explanatory notes are also given below the table. A map of the monthly tows is also shown in Figure 1 – many of the routes overlap, however some idea of variability in towing between months can be gained.

Considerable success was achieved this year - whilst the CPR is a robust sampling device and SAHFOS is experienced at running a CPR

Table

Tow	Identifier	Date of sampling	Number of samples collected	Number of samples processed	Status of taxonomic enumeration
Long Beach to Valdez	5AC	21/22 March	45	12	Processing complete
	6AC	22-24 March	37	10	
	7AC	24/25 March	47	12	
	8AC	25/26 March	43	16	
Valdez to Long	9AC	29 April-1 May	36	13	Processing complete

Beach	10AC	1/2 May	43	11	
	11AC	2-4 May	45	12	
	12AC	4/5 May	47	12	
Long Beach to 48°North	13AC	8-10 May	49	0	Towed by mistake <sup>1</sup>
	14AC	10/11 May	49	0	
Valdez to Long Beach <sup>2</sup>	15AC	17/18 June	45	23	Processing underway
	16AC	19/20 June	39	20	
	17AC	21/22 June	49	25	
Vancouver to Japan (until 155°East)	1VJ	24-26 June	49	14	Preliminary processing complete, awaiting quality control
	2VJ	26/27 June	31 <sup>3</sup>	7	
	3VJ	27-29 June	47	12	
	4VJ	29/30 June	47	12	
	5VJ	30 June- 2 July	49	13	
	6VJ	2/3 July	49	12	
Valdez to Long Beach <sup>4</sup>	18AC	19/20 July	40		Yet to be processed
	19AC	20/21 July	43		
	20AC	21/22 July	45		
	21AC	22/23 July	34		
	22AC	23/24 July	26		
Valdez to Long Beach <sup>5</sup>	23AC	23/24 August	45		Yet to be processed
	24AC	24-26 August	45		
	25AC	26/27 August	46		
	26AC	27/28 August	45		
	27AC	28/29 August	18		

*Notes:*

1. Captain mis-read instructions for June, and launched 2 tows before realising. These samples have been archived.
2. Owing to mistaken tow in May, only 3 of the 5 mechanisms were available for June tow (4 plus one spare were loaded).
3. A tear in the silk meant there was reduced sampling on this section – about 16 samples lost.
4. Since a technician was on board we used the spare to extend the towing a bit further.
5. Since this was the last tow, used the spare to extend towing. Conditions allowed further sampling into Prince William Sound.

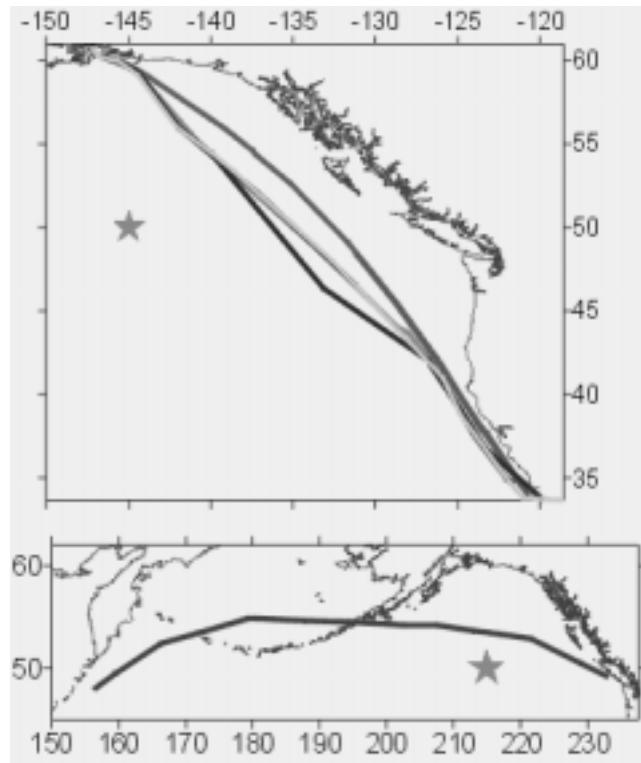


Fig. 1 Monthly tows in 2000: sampling was carried out on five north-south tracks (March – August) and on one east- west track (June-July). Station Papa (★) is shown for reference.

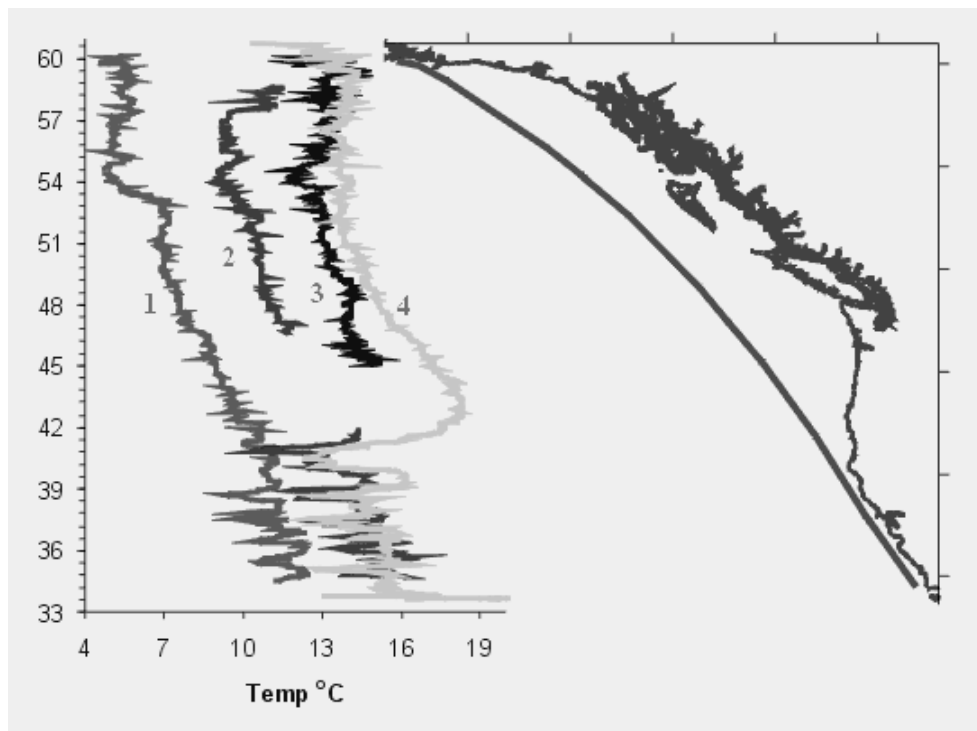


Fig. 2 Temperature logger results obtained in March (1), June (2), July (3) and August (4) of 2000. A “typical” tow is shown for guidance.

survey the success rate in the Pacific was better than we would have predicted.

In addition to sampling the plankton, SAHFOS also mounted a temperature recorder on the CPR towing between Valdez and Long Beach. This device, manufactured by VEMCO, whilst not giving precise temperature data, is inexpensive, reliable and capable of recording the expected range in temperatures from Alaska to California throughout the year. Some problems with setting up the time delay for the expected start of towing meant that not every tow had a full temperature record, however, for some of the tows temperature was recorded every 10 minutes. These data (Fig. 2) provide useful information on temperature structure at this large scale.

#### Analysis and feedback

Data for the first two tows are complete and checked, and so these data form the basis for some preliminary analyses which was presented at the PICES IX MONITOR meeting. A total of 68 different phytoplankton taxa and 79 zooplankton taxa have been distinguished on

these spring samples. Taxonomic resolution varies from separate stages of copepods in the case of *Neocalanus plumchrus* to phylum level in the case of fish larvae. A description of standard CPR processing will also be given during the meeting.

Some distribution patterns of *Neocalanus* are already evident and some assessment of spatial resolution at the zooplankton community level can also be made. There has been some debate amongst the analysts in SAHFOS during processing as to the resolution of *Neocalanus plumchrus* and *N. flemingeri* and advice from the Advisory Panel will be sought. We are also now in a good position to predict the number of samples that will be processed for 2000 according to the original protocol (probably 350) which leaves around 100 additional samples to be selected for processing. Some input from the Panel would be welcome.

In a few months SAHFOS will begin discussion with the shipping companies as to their schedules for 2001. If there are to be any recommended changes made to the sampling strategy then this would also be welcome.

## **CCCC Endnote 5**

### **REX Task Team Report**

The REX Task Team met from 0900-1230 hours on October 22, 2000. The Co-Chairman, Dr. William T. Peterson, called the meeting to order and welcomed the participants (*REX Annex 1*).

#### 2000 accomplishments

The report of the 1999 REX Workshop on "Herring and euphausiids population dynamics" was published in the PICES Scientific Report No. 15.

A 2-day REX Workshop on "Trends in herring populations and trophodynamics" was convened prior to the Ninth Annual Meeting in Hakodate (October 20 and 21, 2000). The workshop was well attended and highly successful.

At PICES VIII, REX jointly with BASS proposed convening a session entitled "Subarctic Gyre processes and their interaction with coastal and transition zones." This theme was adopted by the Science Board for their symposium at PICES IX.

#### 2001 planned activities and recommendations:

REX is interested in working with MODEL to add one upper trophic level component (herring) to the PICES NEMURO Model. To facilitate this activity, members of REX will work together to summarize parameters needed to model herring growth. Under this plan, the Task Team would convene virtual meetings over e-

mail. MODEL is proposing an inter-sessional workshop to implement improvements and include higher trophic levels to the PICES NEMURO Model, and REX would like to send representatives to such a meeting.

REX also recommend that some papers on modeling of herring dynamics become part of a ½-day joint workshop with MODEL to be held just prior to the Tenth Annual Meeting. This workshop will consider progress toward incorporating herring energetics in the NEMURO Model.

REX proposed a 1-day workshop on “Temporal variations in size-at-age for fish species in coastal areas around the Pacific Rim” to be held just prior to the Tenth Annual Meeting. The workshop will focus on size-at-age for fish species other than herring. Examples of fish species that we hope to consider include salmonids, clupeids (sardines, and anchovies), gadoids (hake and pollock), halibut, mackerels, etc. Temporal and special changes in pattern in size-at-age among species will be examined relative to climate variability/climate change. Environmental factors affecting at size-at-age will be also discussed. It is likely that this effort would continue for one-two years beyond PICES X. Since the next two PICES meetings will be held at “southern” locations, REX would like to encourage papers on “warmer water fishes” such as sardines, mackerels and anchovies.

The following inter-sessional activities are recommended:

- a. Begin an e-mail discussion on herring size-at-age for all stocks with an eye towards producing a PICES Scientific Report on this topic -- a review of size-at-age for all herring stocks around the Pacific Rim. This could be a unique way of looking at regional responses to basin-scale forcing and serve as a model for study of other fish species. By focusing on size-at-age, we can look at effects of climate change on fish from the perspective of changes in ecosystem productivity. Dr. Nikolai Naumenko (Russia) was requested to prepare data and

present paper (at the 2001 REX Workshop) on size-at-age for Russian herring stocks. This will complete our compilation of size-at-age data for herring around the Pacific Rim.

- b. Complete a matrix of life history parameters, growth parameters and environmental variables (seasonal cycle of temperature, nutrients, and biomass of phytoplankton and zooplankton) for as many herring stocks as possible. Make the data available to the MODEL Task Team. Consider completing a similar exercise for other coastal fishes where possible. Since these data are variable among years and may be showing long-term trends, produce matrices for the years 1970, 1980, 1990 and 2000.

A proposal was received to consider the topic “Phytoplankton, zooplankton and nekton synchrony in the use of the spring bloom event in the North Pacific” for the REX Workshop in 2002. The idea is that several PICES scientists have noted delays in the seasonal peaks in zooplankton biomass. Given the interest by REX scientists in herring, we would produce a review of spawning timing of herring stocks around the Pacific in relation to timing of the spring bloom and timing in peaks in zooplankton biomass. The first step in moving along this theme is to inventory the herring spawning timing, primary production and chlorophyll and secondary production information. Though our initial focus would be on herring, we would include other pelagic fishes as appropriate.

#### Requests for travel funding

REX request travel support for Dr. Nikolai Naumenko to attend the REX Workshop at the Tenth Annual Meeting. REX also request funding for two scientists to attend the inter-sessional MODEL Workshop. This latter request will be very minimal if the workshop is held in the U.S.A. or Canada. If the workshop is held in Nemuro, it is anticipated that all travel

expenses will be covered by the Japanese government.

**REX Annex 1**

**Participation List**

Canada

Japan

Tokimasa Kobayashi (Co-Chairman)

People's Republic of China

Republic of Korea

Russian Federation

U.S.A.

Brenda L. Norcross

William T. Peterson (Co-Chairman)

Observers

Funk, Fritz (U.S.A.)

Douglas E. Hay (FIS Chairman)

Takashi Minami (Japan)

Nikolai Naumenko (Russia)

Jake Schweigert (Canada)

Yoshiro Watanabe (Japan)