REPORT OF MONITOR TASK TEAM

Overview of activities during PICES XI

At PICES XI, the MONITOR Task Team convened or contributed to six workshops and committee meetings:

- Annual Task Team meeting (Oct. 19);
- A half-day workshop on *Requirements and methods for "early detection of ocean changes"* (Oct. 19);
- A 1-day CCCC Integration Workshop (Oct. 20);
- Continuous Plankton Recorder (CPR) Advisory Panel meeting (Oct. 20);
- CCCC IP/EC meeting (evening of Oct. 20);
- A half-day workshop on *Monitoring from moored and drifting buoys* (Oct. 23).

MONITOR Task Team meeting

The MONITOR Task Team met from 13:30-17:30 hours on October 19, 2002, to review accomplishments of the preceding year, and the status of various national and regional monitoring programs, made plans for the upcoming year and PICES XII, and made several specific proposals/recommendations to the PICES Science Board. The participation list and meeting agenda are appended as *MONITOR Endnote 1* and *MONITOR Endnote 2*.

MONITOR recommendations

MONITOR should convene a 2-day workshop immediately prior to PICES XII (October 2003, Korea) to *Assemble and critique a North Pacific Ecosystem Status Report*. Drs. Phillip R. Mundy, William J. Sydeman and Vyacheslav B. Lobonov volunteered to join Drs. David L. Mackas and Sei-ichi Saitoh as convenors. Format would be invited cross-disciplinary presentations from each nation or region, followed by plenary and/or breakout discussion of if, and how, these pieces fit together as a picture of the entire North Pacific. Our goal for the workshop is as an exercise in "process", rather than necessarily producing a polished final product. However, the prototype could usefully be 'published' on the PICES web site. We request full travel support for 2 people from outside the PICES community (one veteran of similar ICES activities, and one expert on "human dimensions" issues). We also request supplementary travel support (2 days accommodation and per diem) for ~25 workshop invitees from within the PICES community.

As contribution to developing liaison with GOOS and ICES, PICES should nominate/endorse as "pilot studies", two developing regional monitoring programs in Pacific coastal waters, one in the NW Pacific (NEAR-GOOS?), and one in the NE Pacific (CAOS and/or ACCEO).

PICES should continue to endorse, and encourage further development of, the very successful North Pacific CPR Program.

The long-standing CalCOFI time series is seriously threatened by an impending ~50% funding cut (effectively the State of California contribution; US federal funding remains in place). An official letter from PICES should be prepared noting the great past and present value of the CalCOFI time series, and the regional and global scientific costs of its cancellation. CalCOFI representatives (Checkley or Hunter) will notify PICES of potential addressees (university, state and federal government officials).

MONITOR Workshop on *Requirements and methods for "early detection of ocean changes"*

A half-day Workshop on *Requirements and methods for "early detection of ocean changes"* was convened on October 19. The following performance "wish list" for an observationally-based "ocean change index" was suggested in the Convenor's introductory remarks:

- Learning from past experience (reliable performance in retrospective re-analysis, few missed events, few false positives)
- Robust to possible new modes of change
- Timely (short time lag between event and detection)
- Provide information about cause of change (in addition to timing and magnitude)
- Efficient (high ratio of information to collection cost)
- Allow comparison among locations and variables, and input to numerical models
- Sustainable through time (not vulnerable to changes in methodology, not entirely dependent on research surveys)

Seven papers were presented (list of papers is included elsewhere in this Annual Report), ranging from design criteria and statistical methodologies (Overland, Radchenko, Batten) through excellent examples of long- and short-term time series sampling of both open ocean (Sugimoto) and continental margin/coastal sea systems (Wen, Oozeki, Suh).

The presentations were followed by a wide-ranging group discussion. Emerging themes are listed below:

Choice of variables

- ***Diversity is good***. Useful to combine data (different places, variables), but analysis should retain/display a reasonable sense of the full suite of input information, not just project all variables onto a single "index".
- Range of motivations for monitoring and analysis: global warming vs. pollution vs. fishing policy and economic forecast vs. damage from individual environmental events vs…..
- Useful to observe spatial pattern of time variation and try to link pattern to mechanism.
- Biological variables may have higher signal: noise ratio at interannual time scales than physical variables (because more auto-correlated in time?). But some important variables (*e.g.* mid-water fishes) are rarely monitored.
- Many new time series are developing.
- Quick-look processing and exploratory analysis of a subset of data points may give good summary of emerging pattern and help to guide subsequent analysis priorities and hypotheses.
- Promising new technologies (see below).

Choice of analysis method

- ***Diversity is again good.*** Many data analysis techniques are now available. Different strengths and weaknesses for each. No single technique has model assumptions that match the characteristics of our time series.
- Formal time series methods have difficulty with "short" series, especially near ends of records.
- Category and rank statistics perform well to provide overview - exploratory analysis??? May be less sensitive to deviations from statistical model.
- Need better theory of how ocean ecosystems function.

Opportunities for the present & near-future

- Many new time series are developing (more data).
- Quick-look subset of 'labor intensive' data retains good summary of full pattern (*e.g.* CPR experiment by Batten).
- Promising new technologies: satellite remote sensing, buoy and drifter networks, radar measurement of surface currents.
- Users more receptive to concept of ocean change, but need to move our output further along path "data to decisions" by greater outreach and communication effort.

CCCC Integration Workshop

Dr. Mackas gave a presentation summarizing MONITOR activities since 1998, and plans/priorities for the future. Key points include:

- MONITOR's role is not primarily *internal* integration within CCCC. More important role is to *connect CCCC to past and future* (much of the "past" and "future" has been/will be external to CCCC):
  - *Past* via identification of existing long time series;

- *Future* via developing ongoing monitoring network (GOOS etc.), and developing routine application of monitoring data (*e.g.* North Pacific Ecosystem Status Report).

- Important unfinished (perhaps permanent??) tasks and what we are doing about them:
  - *Detecting changes in the North Pacific ocean* – Many good ideas from the MONITOR Workshop on *Requirements and methods for "early detection of ocean changes"* regarding multivariate data collection and analysis and interpretation. Progress will continue because this is "interesting science". MONITOR's primary roles are to 1) promote access to data and tools, and 2) note major data gaps (*e.g.* micronekton).

- Outrearch to users or 'converting data to decisions' (via North Pacific Ecosystem Status Report):
  - Recommend 2-day workshop next year (with earlier homework) to assemble and critique an NPESP.

- Liaison with GOOS and ICES:
  - Recommend 2 (not 1) PICES pilot coastal ocean monitoring programs: CAOS (or broader CAOS + ACCEO), and NEAR-GOOS.

CPR Advisory Panel

The North Pacific CPR Program continues to perform well. Summary of CPR activities in 2002 (prepared by Dr. Sonia Batten) is appended as *MONITOR Endnote 3*.

MONITOR Workshop on *Monitoring from moored and drifting buoys*

A half-day Workshop on *Monitoring from moored and drifting buoys* was convened October 23, 2002, as part of PICES XI. The workshop was attended by 43 people from 8 countries.

Presentations included an overview of time-series network (Dickey), ARGO buoy operations (Ando, Riser), real-time buoy system (Nam), conventional moored buoy observation (Shevchenko), bio-optical drifting buoy and satellite validation buoy development (Iida, Saino), and recent activities of the North Pacific Data Buoy Advisory Panel (O'Donnell, McLaren). List of papers is included elsewhere in this Annual Report.

The presentations were followed by a wide-ranging group discussion. Emerging themes are listed below:

<u>Observation networking and maintenance</u>
- How to use coarse data sets for data assimilation in global observation network.
- How to protect sensor system from bio-fouling in long-term observation.
- Importance of cross-calibration between buoy systems, for example, TRITON buoys and ARGO buoys.
- Useful to apply recent smart communication technology for gathering buoy data in real-time.
- Useful to apply two-way communication skill for controlling observation interval and parameters, etc.
- ARGO buoy distribution is not uniform, need to deploy buoys in the southern hemisphere including Antarctic Ocean.

<u>New sensors and "smart" system</u>
- Biological and optical sensors will be required for monitoring biological and ecological environment. K-SOLO system attached to ARGO buoy is useful to monitor biological production.
- Need water sampling system for future buoy system.
- Need low power buoy system for long-term observation.
- AUV (Autonomous Underwater Vehicles) system will be combined with conventional buoy system (*e.g.*, NEPTUNE system).

<u>Requirements for the present and near future</u>
- Need to expand utilization and analysis of ARGO data sets (more analysis and integrated results for maintaining program).
- Data quality control is still important issue for long-term buoy observation.

MONITOR Endnote 1

Participation List

Members

Douglas F. Bertram (Canada)
Vyacheslav B. Lobanov (Russia)
David L. Mackas (Canada, Co-Chairman)
Phillip R. Mundy (U.S.A.)
Yutaka Nagata (Japan)
Yoshioki Oozeki (Japan)
Sei-ichi Saitoh (Japan, Co-Chairman)
William J. Syderman (U.S.A.)

Observers

Andrew Bakun (U.S.A.)
Sonia D. Batten (U.K.)
David M. Checkley (U.S.A.)
Ken Drinkwater (Canada)
Dong-Young Lee (Korea)
David L. Musgrave (U.S.A.)

MONITOR Endnote 2

MONITOR Meeting Agenda

1. Review accomplishments in 2002
   a. Report(s) on CPR North Pacific program, and April 2002 workshop on instrumentation of Volunteer Observing Ships (Batten)
   b. Reports on MONITOR workshops at PICES XI:
      - *Methods and requirements for "early detection of ocean changes*"
      - *Monitoring from fixed and drifting buoys*
   c. North Pacific component of the International Data Buoy Cooperation Panel (Mackas for McLaren)
2. Goals/activities of the GLOBEC Focus 1 Working Group on *Retrospective Analysis*, and liaison with MONITOR (Bakun)
3. Regional monitoring programs:
   a. ACCEO: Alliance for California Current Ecosystem Observations (Checkley)
   b. Status of GEM, Gulf of Alaska Ecosystem Monitoring, and NPRB, North Pacific Research Board (P. Mundy); Dr. Mundy reported that the GEM monitoring program for the Gulf of Alaska is now formally started, and that NPRB planning and approval are well underway. He noted the great value of PICES inputs in the design and review of these important emerging programs.
   c. CAOS: Coastal Alaska Observing System (Musgrave)
   d. NEAR-GOOS (Lee, Lobanov); Planning for NEAR-GOOS Phase II that will include significantly more biological components is underway.
   e. CoML NaGISA (Natural Geography of Inshore Areas); an Alaska pilot program is being funded through GEM.
4. Discussion of plans and progress toward a "North Pacific Ecosystem Status Report"
5. Scientific, logistic and methodological issues:
   a. Identify time series at risk (CalCOFI, Japan training ship cruises cut back to 60 days per year and 2 major N-S lines, M2 mooring in Bering Sea is funded for only one more year)
   b. Development of additional monitoring platforms (CODAR/high frequency radar shore stations for real time mapping of surface currents over large areas, potential Japan Sea VOS triangle between Japan, Vladivostok and Pusan)
6. Additional plans for 2003-2004:
   a. MONITOR workshop theme for PICES XII
   b. Further development of CPR time-series
   c. Liaison with GOOS
   d. Liaison with ICES - plans for pilot Ocean Status reports and for one or more pilot coastal ocean monitoring studies.

MONITOR Endnote 3

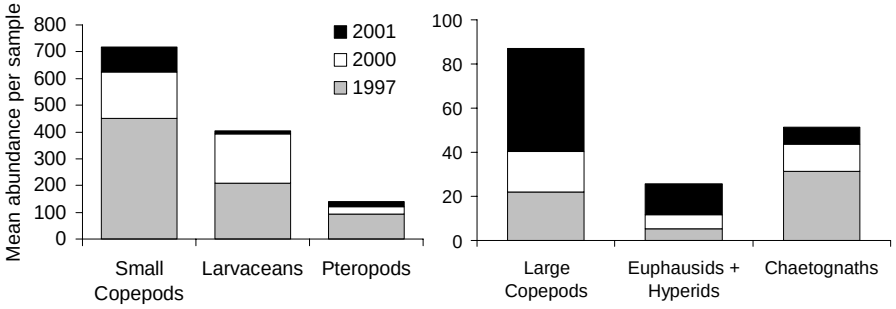
Summary of CPR (Continuous Plankton Recorder) activities in 2002

Sampling continued on both transects, funded by the EVOS GEM program. The Valdez Alaska-to-California transect was sampled in April, May, June (twice, owing to a re-routing because of a problem with the vessel on the first transect) and August. A period of dry-dock delayed the final routine transect until late October. Additional funding received during 2002 (from the North Pacific Research Board) enabled the sampling season to be extended through to winter, with transects sampled in December and January (2003). The Vancouver-to-Japan transect was sampled as usual in June and then again, with the additional funding, in October and December. For 2003, sampling the regular 5 Alaska-to-California transects is planned between March and September, and 3 Vancouver-to-Japan transects are planned for March, June and October.

Other, collaborative, projects began in 2002. A thermosalinograph was fitted to the vessel operating on the Valdez-to-Alaska transect (project led by S. Okkonen) which records underway temperature and salinity from the ship's water intake. The vessel makes about 4 runs each month between the two ports and so a wealth of data on horizontal water structure will be obtained from this instrument. A chlorophyll fluorometer is due to be fitted for Spring 2003.

The second collaborative project involves marine bird and mammal observations along the Vancouver-to-Japan transect (led by W. Sydeman). An observer was aboard in June 2002 for the first time and recorded over 112,000 observations. The focus was marine birds, with mammals being recorded where possible, and the most dominant group were shearwaters. Some birds feed directly on the larger plankton species sampled by the CPR (euphausiids and *Neocalanus* copepods) with the remainder feeding on small fish and squid species which themselves feed on zooplankton. This simultaneous data collection should enable trophic linkages to be investigated on the scale of the North Pacific. A second set of observations was made in October 2002, during the fall bird migration, and it is planned to have an observer on board during each of the three 2003 transects.

*The mean abundance (as stacked bars) of main groups of plankton in each of 3 summers for the **oceanic section** (42-59°N) of the CPR transect.*



Data from previous years of CPR sampling were further analysed. Samples were first collected in summer 1997, as a pilot project. This sampling took place when the northeast Pacific was anomalously warm (a warm period that extended throughout the 1990s but was particularly apparent during the 1997/98 El Niño). There is a growing consensus that 1999 saw a switch to a cool regime in the northeast Pacific, both the Pacific Decadal Oscillation (PDO) and the Northern Oscillation Index (NOIx) switched phases at this time. The CPR monitoring program began in 2000, and so data exist from a warm regime summer and two cool regime

summers (2000 and 2001 data are available). A comparison of zooplankton abundance and estimated biomass for these two periods shows that the climate shift occurring in 1999 is clearly evident in the CPR data. Before the shift, the anomalously warm oceanic region of the Gulf of Alaska contained large numbers of small species, chiefly copepods, and these were species of a more southerly origin (see Figure). The Alaskan shelf had very low numbers of copepods in the warm regime, and the implication is that rather than northern species being replaced by southern species (as happened in the oceanic Gulf of Alaska), northern species simply failed to do well on the shelf. After the climate shift the oceanic areas saw a return to larger organisms, and colder boreal species of copepods became more abundant. The Alaskan shelf saw a large increase in small boreal copepod species leading to higher recorded zooplankton abundance and biomass in the cool regime. This result fits very well with other more coastal studies, undertaken in the northeast Pacific (*e.g.* Peterson, the Newport Line and Mackas, British Columbia). Significantly, the oceanic areas appear to be as responsive to climate changes as do more coastal regions.