Toward a coastwide network of Northeast Pacific coastal-ocean monitoring programs – a brief workshop report

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Dr. David Mackas is a biological oceanographer specializing in zooplankton time series and spatial patterns. Within PICES, he is a member of the Biological Oceanography Committee and Continuous Plankton Recorder Advisory Panel, and a member and outgoing Co-Chairman of the MONITOR Task Team. Despite (or perhaps because of) time spent in committees, he remains an advocate for dirty hands and wet boots. He is shown here aboard the CSS VECTOR downloading several bites of euphausiid data from a recently-deceased Squalus acanthias *BAUV (Bionic Autonomous Underwater Vehicle).*

After many years of planning and preparation, the Global Ocean Observing System (GOOS) is now rapidly coming on-line. It is already clear that GOOS will bring large changes in the rate and regularity with which the ocean is sampled. GOOS will also bring important new opportunities (and obligations) for individual data collectors and data users.

Many think that PICES will be an important and welcome player in these changing activities. In their presentations to PICES' Governing Council on behalf of the Intergovernmental Oceanographic Commission and GOOS Steering Committee (PICES 2002 Annual Report, pp. 37-39), Drs. Ji-Lan Su and Neville Smith noted the strong track record of PICES in compiling and analyzing "physics-to-ecosystems" cross-disciplinary time series, and successes in promoting alliances among member nations to study various parts of the North Pacific. Dr. Smith also pointed out the value of successful pilot projects for raising the profile of GOOS and ocean monitoring, and attracting new investment in ocean observation and data systems. The PICES Eleventh Annual Meeting (Qingdao, China, October 2002) also produced a recommendation by the MONITOR Task Team, that PICES should sponsor and endorse two North Pacific "GOOS pilot projects" focussed on the marginal seas and continental margin boundaries of the Northwest and Northeast Pacific (PICES 2002 Annual Report, p. 145). The Northwest Pacific pilot program was envisioned to be built around the expanding NEAR-GOOS program. The Northeast Pacific pilot program was envisioned as a coast-wide linkage of new and existing regional and national ocean monitoring programs in the California Current and Alaska Current systems.

As a step toward building such a Northeast Pacific monitoring network, PICES organized a 2-day (November 20-21, 2003) workshop on "Development of pilot coastal monitoring program(s) in the NE Pacific" in Victoria, Canada. Partial funding was provided by the Pacific Coastal Observing System (PaCOS) and the Gulf Ecosystem Monitoring Program (EVOS-GEM). The meeting was chaired by David Mackas (DFO Canada, and 2001-2003 Co-Chairman of the PICES MONITOR Task Team) and Skip McKinnell (PICES Deputy Executive Secretary), with coaching and cheerleading from John Hunter (US NMFS) and Phillip Mundy (EVOS, NPRB, US GOOS Steering Committee, and incoming Co-Chairman of PICES MONITOR). All participants are listed in Table 1. A full workshop report is planned as a 2004 PICES Scientific Report, but this article is intended as a quick-look summary of the discussions and recommendations.

We began with a discussion (really more an affirmation) of the need for ongoing time series, and the need for a coast-wide monitoring network. For many parts of the NE Pacific continental margin, we already have very good and detailed "snapshots" of local conditions. But one-time baseline sampling is clearly not enough. We now know that the ocean responds dramatically, at inter-annual and decadal time scales, to natural and anthropogenic forcing. "Now" is different from "then", and "tomorrow" will be different from "today". Sustained and systematic time series observations are needed to track these changes. Local repeated observations are the basic ingredient of time series. But we learn much more if we can also look at the larger spatial pattern of the changing ocean. A shared network of local and regional observations will give us this perspective.

Table 1. Participants of the PICES MONITOR Workshop on "Development of pilot coastal monitoring program(s) in the NE Pacific".

US Alaska	**Canada DFO**
Molly McCammon, AOOS	Robin Brown, IOS
Elizabeth Logerwell, NMFS	Kenneth Cooke, PBS
Bernard Megrey, NMFS	Howard Freeland, IOS
Jeffrey Napp, NMFS	Gordon McFarlane, PBS
Brenda Norcross, UAF	David Mackas, IOS
Phyllis Stabeno, PMEL	
	NEPTUNE/VENUS
US California Current	Christopher Barnes, UVic
David Martin (NANOOS)	Richard Dewey, UVic
Elizabeth Clarke (PaCOS)	Verena Tunnicliffe, UVic
Harold Batchelder (US GLOBEC)	
William Peterson, NMFS	**Mexico IMECOCAL**
Edmundo Casillas, NMFS	Lydia Ladah, CICESE
Republic of Korea	**PICES**
Suam Kim (PNU)	Ian Perry, Science Board
Sinjae Yoo (KORDI)	Alexander Bychkov, Secretariat
	Skip McKinnell, Secretariat

What and where: Extent and ingredients of a west coast monitoring network

The region of interest (Fig. 1) is large, and both politically and ecologically diverse. It extends across three national jurisdictions, from the tropics (southern tip of Baja California) nearly to the Arctic Circle (Bering Sea), and from the coast to slightly beyond the continental slope. But all parts are also strongly interconnected by shared atmospheric forcing, by the two major NE Pacific boundary currents (California and Alaska), and by the extensive alongshore migration and drift of many important species.

Starting from the south, Mexican programs (summarized by Lydia Ladah) include the IMECOCAL ship-based surveys of the southern part of the California Current, and a near-shore array of moored instruments (Baja COMNet). Both are new programs (~5-years duration), but have been productive and are hopeful for ongoing funding.

Within the United States, there is now strong and high-level commitment to a coastal ocean observing system. With this commitment comes strong agency and Congressional expectations for a robust governance system and clear deliverables. Some of this is already in place but much still needs to be developed. David Martin, Elizabeth Clarke and Molly McCammon described the planned structure: a "sustained ocean observing and prediction federation (Ocean.US)" made up of spatially-nested global, national "backbone", and intensive regional elements. For the US west-coast, four regions have been identified (southern California, central California, northern California-Oregon-Washington, and Alaska). In-region implementation plans are now being developed. Their full implementation is probably a decade or more away, but a substantial increase in funded activity is expected within the next 2-3 years. In the interim, key existing time series such as the US GLOBEC LTOPs and CalCOFI are seeking bridging funding from their parent agencies, and PaCOS and AOOS (Alaska Ocean Observing System) are working toward maintaining and expanding larger scale California Current, south and central Alaska, and Bering Sea "backbone".

Fig 1. The region of interest (bounded by the red dotted line).

Monitoring of the Canadian continental margin (located strategically between Alaska and the US "lower 48") is at present done mostly by the Department of Fisheries and Oceans. The DFO program consists of a combination of ship-based oceanographic and fishery assessment surveys (seasonal to biennial interval), instrumented moorings, and offshore Argo drifters. With the exception of the new Argo program, most have now been underway for about 20 years. Soon to join this mix is a major Canadian and US investment (approximately US$250M) in an extensive network of cabled seabed observatories covering Canadian inshore waters (VENUS), and extending seaward and southward across the Juan de Fuca tectonic plate (NEPTUNE). Installation of the NEPTUNE array is scheduled for 2007-2008. Once installed, the operational phase of NEPTUNE will continue for at least 30 years.

What can we look forward to during the next decade?

- Great improvements in the amount and diversity of up-to-date time series data;
- Changes in the dominant kinds of sensors and measurement platforms (certainly more buoys, drifters, … but perhaps a shortage of ships and ship time); and
- Expectations that data will be freely shared (which leads to the next topic).

Data and data management issues: Collection, archival, access, use and user expectations

Who will gather, store and use the pending flood of GOOS data? Part of the answer is "we will", with "we" being the familiar community of PICES marine scientists. But both the data originator and data user communities will be considerably broader than PICES. GOOS has developed with a strong and consistent emphasis on delivery to end-users outside the scientific community. The US GOOS Steering Committee and its governmental counterpart, the Ocean.US office, have recently completed a Data Management and Communications Plan, emphasizing these as top priorities for the US program. Continued careful planning and considerable program investment will be required to insure that raw data get transformed into information products that satisfy user needs.

For me, one of the high points of the workshop was the discussion stimulated by Harold Batchelder's presentation on "user expectations". Briefly, members of the scientific community are trained to want (and to collect) high quality raw data, to evaluate that data based on technical criteria, and to use the data to produce (or criticize) scientific interpretations of "how the world works". In contrast, many (perhaps most) non-scientist end-users will not particularly want (and lack the time and training for technical evaluation of) large volumes of raw data. They will however want and expect reliable, accessible and up-to-date interpreted summaries (attractively packaged). The goal and model for meeting this expectation is the oceanic equivalent of a TV weather channel or on-line website. This goal is not entirely unfamiliar – it is what PICES is attempting to meet with the North Pacific Ecosystem Status Report. And, fortunately for us, many things in the ocean vary a bit more slowly than the weather. But we will certainly have to automate and "contract out" a lot of the basic data collection, processing/archival and quality evaluation, if we want time to continue with interpretation and development of new knowledge.

Workshop recommendations

The final hours of the workshop were spent developing a list of needs and recommendations for action:

What is needed

- Integrated coast-wide monitoring and analysis are critical for a variety of societal needs. The appropriate spatial scale for a Northeast Pacific (NEP) Coastal Monitoring Network extends along the continental margin of North America from the Bering Sea through the Baja California Peninsula.
- Several long-term observation programs that currently contribute to understanding these linked coastal ocean regions are ending soon (*e.g*. NEP GLOBEC), but the need for them is not ending. We must design and implement their successors.

Role of PICES

- PICES provides a pool of expert, willing field scientists, data analysts and data managers, and a forum for coast-wide information exchange and ecosystem reporting (*e.g*. the North Pacific Ecosystem Status Report).
- PICES should encourage participation in the network by other groups (*e.g*. near-shore ecology and oceanography, instrument designers, information technology engineers).
- PICES MONITOR Task Team should establish an Advisory Panel that provides coordination and synthesis of NEP coast-wide monitoring.

Scope and governance

- The NEP coastal monitoring network should coordinate measurement and availability of a set of core variables in all regions, and also apply large-scale information to locally measured variables and issues.
- An international governance structure should be established to coordinate regional activities, data exchange, and synthesis.
- The governance structure should be implemented by MOUs between PICES and the appropriate national committees (*e.g*. GOOS and IOOS).
- To implement the above, a funded "PICESOOS" office should also be established.