

MONITOR WORKSHOP TO REVIEW PROGRESS IN MONITORING THE NORTH PACIFIC

(Co-convenors David L. Mackas and Sei-Ichi Saitoh)

A half-day workshop was convened by the MONITOR Task Team on the afternoon of October 6, 2001, immediately preceding the PICES Tenth Annual Meeting in Victoria, British Columbia, Canada. The overall workshop goal was to familiarize participants with the range of present monitoring activities in the PICES region, and with both near-future and longer-term plans and opportunities.

The group heard and discussed seven presentations on the March 2001 PICES/CoML/IPRC workshop in Honolulu, on ongoing or soon-to-begin time series data collection programs in the North Pacific, and on some of the challenges and opportunities in archival and analysis of historic time series data. Presentation titles and topics are very briefly summarized in the following bulleted paragraphs. Extended abstracts for some presentations follow.

- **Overview of the Workshop on “Impact of climate variability on observation and prediction of ecosystem and biodiversity changes in the North Pacific”** (Patricia Livingston, Alaska Fisheries Science Center, NOAA, U.S.A.; Pat.Livingston@noaa.gov)

A 3-day workshop co-sponsored by PICES, the Census of Marine Life program (through Alfred P. Sloan Foundation) and the International Pacific Research Center, was held March 7-9, 2001, in Honolulu. The workshop (proceedings published as PICES Scientific Report No. 18) catalogued existing time series observation programs in the North Pacific, and discussed plans for future North Pacific operational monitoring activities, and the roles of international organizations and programs with interests in these activities. An important outcome of the meeting was a proposal for a regularly-updated “North Pacific Ecosystem Status Report”, coordinated through PICES, and perhaps involving the development of “Regional Analysis Centres” to facilitate analysis of ongoing time series.

- **Progress report from the PICES Continuous Plankton Recorder (CPR) pilot project** (Sonia Batten, Sir Alistair Hardy Foundation, UK; soba@wpo.nerc.ac.uk)

This report summarized for a broader audience the material previously presented to the CPR Advisory Panel (see Endnote 1 to the MONITOR Task Team report in the 2001 PICES Annual Report). The CPR is towed behind commercial ships of opportunity and samples mesozooplankton abundance and species composition in the upper layer. Group discussion focused on potential value-added measurements which might be included, *e.g.* ship-mounted sensors for temperature, salinity, fluorescence, nutrients, ocean color, and acoustic backscatter; depth profiles of temperature and/or salinity using expendable probes; visual observations of seabirds and marine mammals; and collation of measurements along the CPR track with broader surrounding spatial coverage from satellites and drifting buoys.

- **Updates on GEM (Exxon Valdez Oil Spill Trustee Council’s “Gulf Ecosystem Monitoring” Initiative) and U.S. GOOS plans in the North Pacific** (Phillip Mundy, Exxon Valdez Oil Spill Restoration Office, U.S.A.; phil_mundy@oilspill.state.ak.us)

A large endowment fund is now in place to support (on a permanent basis) long-term time series observations in the coastal ocean off Alaska. Requests for proposals are being issued, and monitoring activities, both partnered and fully-funded, will increase steadily through the remainder of this decade. GEM is a regional program within the larger PICES area. GEM welcomes PICES expertise (and example) in the optimal design of the program. U.S. GOOS is developing additional regional programs centered in the Gulf of Maine, the California Current, and the Gulf of Mexico.

- **A proposal for a North Pacific Action Group of the international WMO/IOC Data Buoy Cooperation Panel** (Ron McLaren, Environment Canada; ron.mclaren@ec.gc.ca)
- **Report on the August 2001 NEAR-GOOS Workshop** (Yoshioki Oozeki, National Research Institute of Fisheries Science, Japan; oozeki@affrc.go.jp)

A network of moored and drifting buoys provides real-time meteorological and near-surface oceanographic data from various locations throughout the ocean. Coverage in the oceanic North Pacific is very sparse. A proposed North Pacific Action Group, sponsored collaboratively by PICES and the International Data Buoy Cooperation Panel, would provide a forum for sharing information on deployment opportunities and data use.

- **Review of Mexican oceanographic IMECOCAL program** (Gilberto Gaxiola, Centro de Investigación Científica y de Educación Superior de Ensenada, Mexico; ggaxiola@cicese.mx)

IMECOCAL (Investigaciones Mexicanas de la Corriente de California) is a new program which extends the spatial coverage of the present CalCOFI program to the southern part of the California Current off Baja California (roughly 22-32°N). The program completes quarterly cruises, coordinated in time with CalCOFI surveys, and samples a broad range of hydrographic, planktonic and fisheries oceanographic variables. Training of graduate students is an important component of the program. Data reports and a more detailed program description are posted at the IMECOCAL web site (<http://ecologia.cicese.mx/~imecocal>).

The NEAR-GOOS Ocean Environment Forecasting Workshop was held August 27-31, 2001, in Seoul, Republic of Korea. The overall workshop goal was to discuss the status and need of a forecasting capability in the NEAR-GOOS region. NEAR-GOOS obtains operational physical oceanographic and meteorological time series in the marginal seas of Northeast Asia. There is a strong emphasis on rapid availability of data, some in real time, and more detailed data as “delayed mode” through the Japan Oceanographic Data Center. NEAR-GOOS databases are not yet set up to handle biological and chemical data, and PICES advice for practical and useful data collection systems for these variables would be useful.

- **Building global ocean profile and plankton databases for scientific research** (Sydney Levitus, National Oceanographic Data Center, NOAA, U.S.A.; Sydney.Levitus@noaa.gov)

The Global Oceanographic Data Archaeology and Rescue (GODAR) project (historical data) and the IOC World Ocean Database project (new data) were described and evaluated for the PICES audience. Quality screening methods, and transcription and formatting protocols are important issues for these large databases. The presentation described some useful approaches, and also gave examples of applications.

PICES Continuous Plankton Recorder pilot project

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Background

The Continuous Plankton Recorder (CPR) is towed behind commercial ships of opportunity and samples mesozooplankton abundance and species composition in the surface ~10 m. During 2000

and 2001, a total of 12 transects were carried out in the North Pacific (Fig. 1). Samples have been processed up to spring 2001, together with a pilot transect in summer 1997. The north-south (N/S)

route was operated by an oil tanker and the east-west (E/W) route by a container vessel. Over 95% of planned sampling was successfully achieved and some additional temperature data were collected on most of the north-south transects.

Results summary

Species distribution data through 2000 were presented for the north-south transect for key copepod species. One significant finding was that the surface development duration of *Neocalanus plumchrus* copepodites varied along the transect by up to 5 weeks, and was probably influenced by temperature (Batten *et al.*, in press). This species spends only about 3 to 4 months in the surface waters but is probably the most important copepod, in terms of biomass, in the Gulf of Alaska in spring/early summer.

The April 2000 transect was selected for a more intensive spatial analysis. Instead of every fourth sample being processed (which is the normal practice), almost every sample was processed. Autocorrelations of abundance against distance for

the most common taxa were carried out and showed that the decorrelation length scale is about 60 km. This analysis suggests that the current routine sampling resolution of the CPR (sample spacing of 72 km) is appropriate for the Gulf of Alaska.

As expected, an analysis of the mesozooplankton community on the east-west transect revealed distinguishable differences in community structure between geographic regions such as the Bering Sea, Aleutian shelf and the Gulf of Alaska. This result supports the idea that CPR data can be used to detect shifts in community composition on a temporal as well as a spatial basis. With currently available data, interannual comparisons are limited, however, comparison of mesozooplankton abundance between the pilot north-south sampling in summer 1997 with the same period in 2000 showed large changes, with zooplankton abundances in 1997 about 5 times higher in the open Gulf of Alaska. Although interpretation needs to be tempered by the limited sampling available for 1997, the results may be related to the 1997/98 El Niño event.

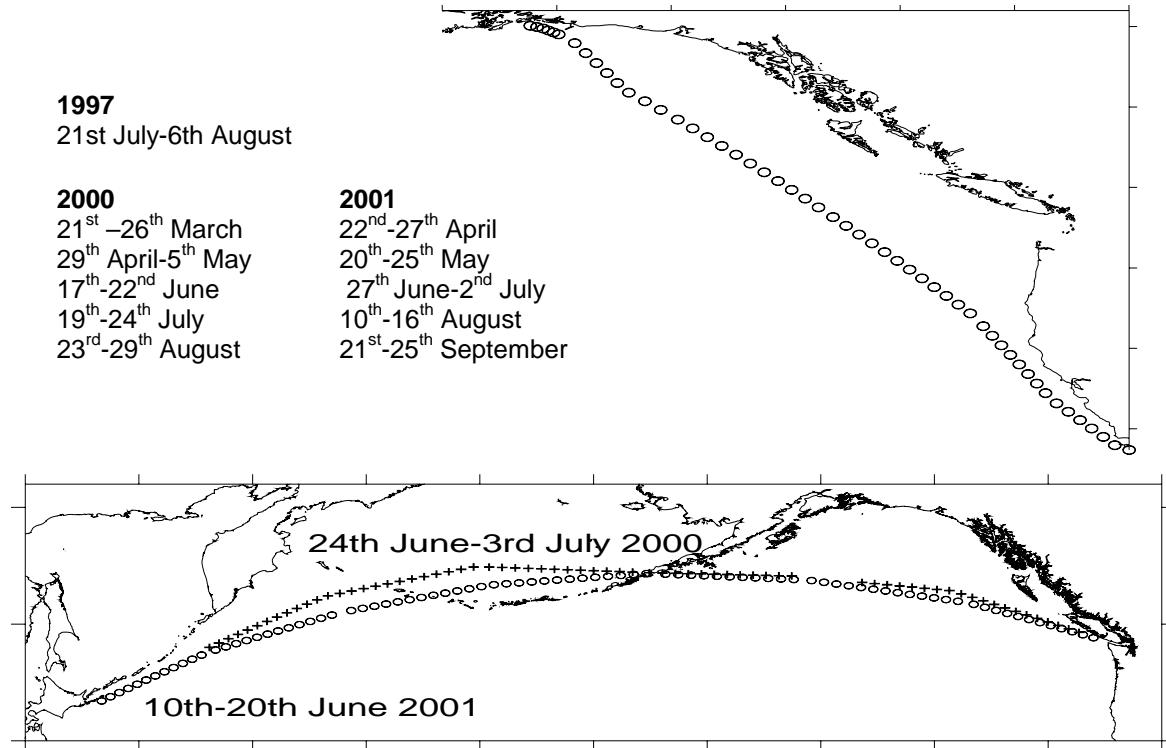


Fig. 1 Upper panel shows the N/S transect, run 5 times in 2000 and 2001, and once in 1997. Lower panel shows the E/W transect, run once in 2000 and 2001. Symbols indicate sample positions.

Group discussion

The main focus of the discussion was the possible future enhancement of the CPR program. Value-added measurements were proposed which might be included, e.g. ship-mounted sensors for temperature, salinity, fluorescence, nutrients, ocean colour, and acoustic backscatter; depth profiles of temperature and/or salinity using expendable probes; visual observations of seabirds and marine mammals; and collation of measurements along the CPR track with broader surrounding spatial coverage from satellites and drifting buoys.

The fitting of a thermosalinograph to the vessel was given a high priority since much of the physical processes occurring in the North Pacific are salinity-driven. There was also enthusiasm for

adding sea-bird/mammal observers to the vessel as a potential way to obtain trophic interaction information (including inferences on intermediate levels such as squid and forage fish).

There was support within the group for holding an inter-sessional workshop on the design and implementation of a possible ship-of-opportunity monitoring package, which might include many of the parameters listed above.

Reference

Batten, S.D., Welch, D.W., and Jonas, T. Latitudinal differences in the duration of development of *Neocalanus plumchrus* copepodites. *Fisheries Oceanography*. (in press).

GEM (Exxon Valdez Oil Spill Trustee Council's "Gulf Ecosystem Monitoring" initiative) and U.S. GOOS plans in the North Pacific

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A new endowment has been put in place by the Exxon Valdez Oil Spill Trustee Council to fund (on a permanent basis) long-term time series observations in the coastal ocean of the Gulf of Alaska. The Gulf of Alaska Ecosystem Monitoring and Research Program (GEM) is one of three U.S. government endowments established within the past five years to provide for marine research and long-term monitoring in Alaskan waters. GEM is a regional program focusing primarily on the northern Gulf of Alaska within the larger PICES area. The first GEM invitation for proposals will be issued in August 2002, for funding in calendar year 2003, however two pilot projects are already underway. The oceanographic mooring at station 1 of the Seward Line (GAK-1), and the continuous plankton recorder (CPR), operated on a vessel of opportunity between Valdez and Long Beach, are being evaluated on a trial basis for their abilities to contribute to the permanent monitoring program. Recommendation of the PICES CPR

Advisory Panel were instrumental in obtaining the support of GEM for the CPR project. GEM welcomes, and hopes to rely upon, PICES expertise and recommendations in the optimal design and implementation of the GEM program. Starting in 2003, GEM monitoring activities, both partnered and fully-funded, will increase steadily through the remainder of this decade, until the annual income stream is fully allocated.

GEM design and implementation is being closely coordinated with the newly constituted North Pacific Research Board (NPRB), which administers an endowment supporting marine research in all Alaskan waters. NPRB has indicated interest in partnering with GEM on an extended CPR project during calendar year 2002, and is expected to issue an invitation for proposals sometime next year. The third research endowment which GEM is following closely is the Northern Fund of the Pacific Salmon Treaty, which is now amassing capital, and which

presently has no plans to start funding work. The three funds together should contribute in excess of U.S. \$20 million annually to research and monitoring in the PICES area when all are fully operational, about 2004.

In addition to the help received from PICES, GEM development is being assisted by the steering committee of the U.S. Global Ocean Observing System (U.S. GOOS). U.S. GOOS is providing recommendations on the basic components of an observing system to support modeling of climatic and oceanographic processes in the coastal environment. The Steering

Committee is also assisting development of other regional marine observing programs centered in the Gulf of Maine, the California Current, and the Gulf of Mexico. In the long-term, U.S. GOOS hopes to contribute to marine research in the PICES region by providing the scientific basis for a continuing appropriation from the U.S. Congress for a system of ocean observing tools consisting of Argo profiling floats, a remotely telemetered drifting buoy array, coastal moorings, GPS-capable tide gauge stations, volunteer observing ship transects, and data management and assimilation that will support oceanographic modeling and forecasting.

A proposal for a North Pacific Action Group of the international Data Buoy Cooperation Panel

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Established in 1985, the Data Buoy Cooperation Panel (DBCP) is an official joint body of the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization (WMO). The Panel consists of representatives of the WMO and member states of the IOC interested in participating in its activities.

The most important task of the DBCP is to co-ordinate drifting and moored buoy programmes at the international level, with a view to increase the number of buoys deployed and maintain high quality archived and real time oceanic and atmospheric data. The Panel encourages the free exchange of data and international co-operation by the formation of regional and global Action Groups, such as the European Group on Ocean Stations and the International South Atlantic Buoy Program. An Action Group within the DBCP is an independent self-funded body that maintains an observational buoy programme providing meteorological and oceanographic data for real time and/or research purposes in support of relevant WMO and IOC programs. The goals of an Action Group are to provide good quality and timely data to users, to encourage the distribution

of data via the GTS and to promote the exchange of information on buoy activities and technology.

Action groups exist for the North Atlantic, South Atlantic, Arctic, Indian and Antarctic oceans. The work of Action Groups is reflected in the number of buoy observations in their relevant areas of responsibility. Compare with other regions, the North Pacific is relatively undersampled. At the October 2000 meeting of the DBCP, Canada made a commitment to determine the level of interest within the scientific community currently doing research in the North Pacific Ocean to form an Action Group for this area.

The demonstrated success of other Action Groups would indicate that the co-operative efforts of agencies already working in the North Pacific, could contribute substantially to increasing the number of oceanographic and meteorological observations over what is currently available.

PICES members are encouraged to discuss the formation of such an Action Group with their colleagues within their own, or other oceanographic or meteorological agencies, who might be able to contribute to and benefit by

membership in an Action Group for the North Pacific. Additional information on the work of the Panel, as well as technical information on

buoys and other ocean buoy programs can be found at the DBCP web site located at <http://dbcp.nos.noaa.gov/dbcp/>.

The Mexican oceanographic North Pacific program: IMECOCAL

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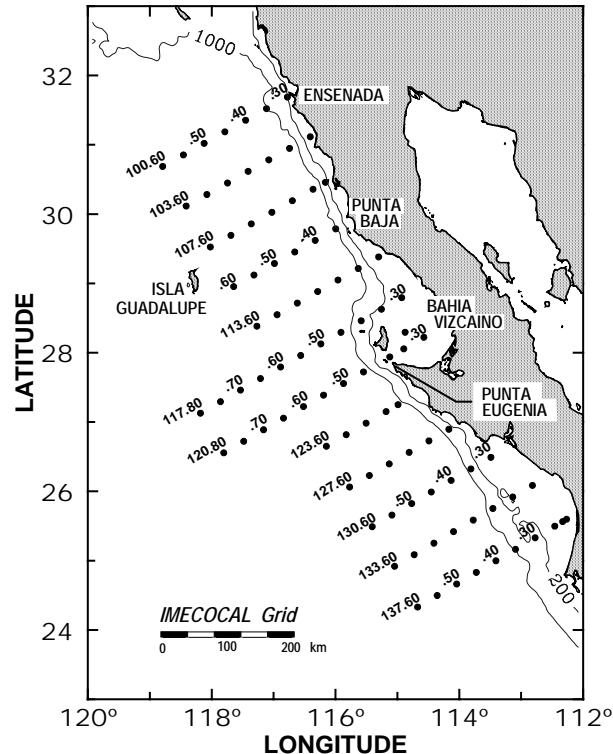


Fig. 2 IMECOCAL surveys station locations.

In September 1997, a consortium of seven Mexican academic institutions began a new oceanographic program off Baja California Mexico, as named IMECOCAL (Investigaciones Mexicanas de la Corriente de California). The IMECOCAL program was initiated with a 3-year grant from the Inter-American Institute of Global Change Research (IAI), and a four-year grant from the National Council of Science and Technology (CONACYT-Mexico). This grant was extended to five more years, covering the oceanographic surveys at least until 2004. Some funds came from the National Science Foundation (NSF-USA), under a joint grant with the Scripps Institution of Oceanography (SIO-UCSD).

The main goal of the IMECOCAL program is to understand how physical processes regulate the changes in the pelagic ecosystem of the southern region of the California Current. For that objective we are developing a long-term monitoring project to study the climatic and oceanographic variability effect in this region, maintaining core oceanographic measurements during the surveys, and collecting sea level and atmospheric data on island and land stations (Fig. 2). We are conducting modelling studies to explore plankton and small pelagic fish response to regional and global physical forcing as well as to local anthropogenic perturbations on the coastal areas. Also, we are looking to develop a new generation of research oceanographers for the program, with fellowships for graduate students doing their thesis in physical oceanography, plankton, paleoecology, small pelagic fisheries, nutrient chemistry, primary production, and climate change.

We followed the CalCOFI (California Cooperative Fisheries Investigations) sampling grid off Baja California, which was abandoned in the 1980s by U.S. marine scientists. Quarterly IMECOCAL cruises are conducted using the CICESE *R/V Francisco de Ulloa*, in January, April, July, and October. These cruises are coordinated in time with the CalCOFI surveys, in order to have an integrated description of the pelagic ecosystem of the California Current, from Point Conception, California, to the southern region of Baja California. The core oceanographic observations at each station include CTD profiles to a 1000-meter depth to measure temperature, salinity, dissolved oxygen, and fluorescence, and 200-meter Rosette casts to collect water samples with 5-litre Niskin bottles.

Water is analysed to determine dissolved oxygen, nutrients (NO_3 , NO_2 , SiO_2 , PO_4), phytoplankton pigments (chlorophyll *a*, and phaeopigments), phytoplankton cell counts, particle and phytoplankton light absorption, and pigment phytoplankton composition (HPLC analysis). Oblique bongo net tows (505-micrometer mesh) are taken from the first 200-meters, using one cod-end to estimate zooplankton (biomass and group analysis), and the other for ichthyoplankton abundance. In addition, 100-meter vertical CALVET net tows are made to capture macrozooplankton, including ichthyoplankton (fish eggs and larvae). Casts for *in situ* primary

production determinations as well as irradiance and radiance profiling are carried out daily at the mid-day stations. Also, photosynthesis-irradiance curves are made, to have the first systematic phytoplankton photosynthetic data in the southern California Current region. These data are expected to be used, together with bio-optical and satellite (SeaWiFS) information to estimate primary production over meso- and larger-scales. Occasionally we use a SIMBAD to determine near-surface water leaving radiance, in order to develop local pigment algorithms for remote colour sensors in collaboration with colleagues at SIO-UCSD.

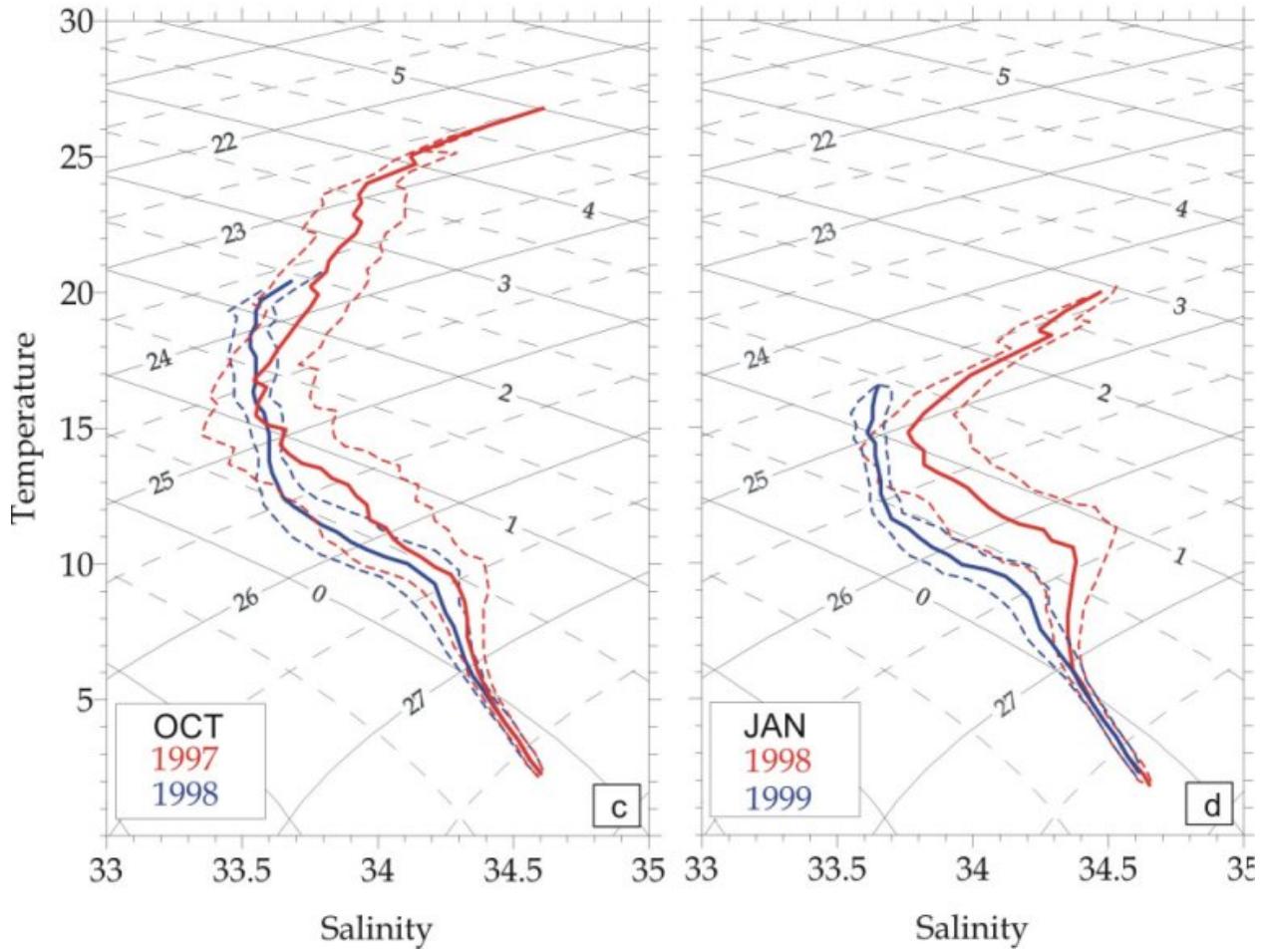


Fig. 3 T-S diagrams in the IMECOCAL zone measured during the El Niño: October 1997 to January 1998 (red lines) and the La Niña: October 1998 to January 1999 (blue lines). Redrawn from Reginado Durazo.

Near-surface temperature, salinity, and chlorophyll-fluorescence (Fig. 3) are monitored continuously underway, simultaneously with an

acoustic Doppler current profiler (ADCP). A CUFES (Continuous Underway Fish Egg Sampling) system is used between stations, and

when the vertical net tows are made. This system allows to enhance our understanding of the small-scale distribution of fish eggs in this region of the California Current (Fig. 4). Together with the CalCOFI program, we are studying the transboundary production and abundance small pelagic fish in relation to the environmental variability.

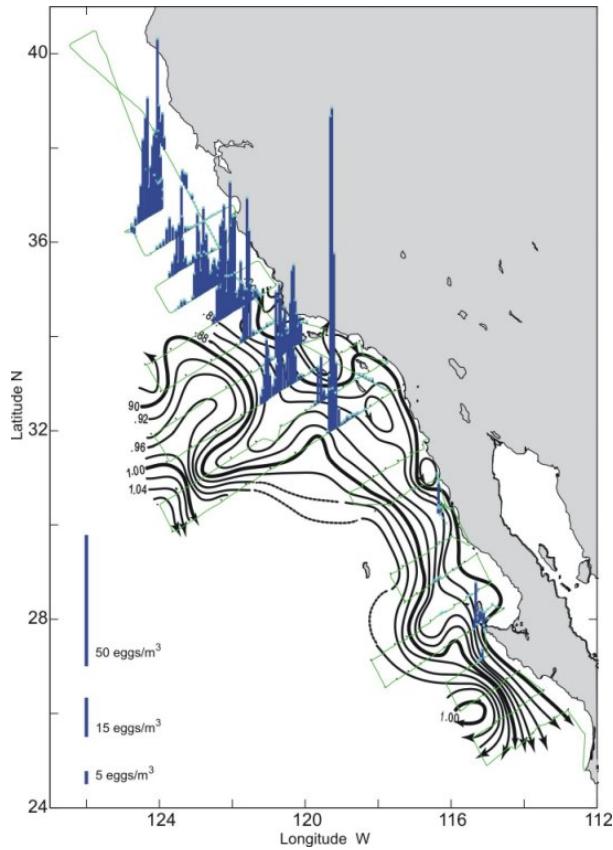


Fig. 4 Distribution of sardine eggs (CUFES data) compared to zooplankton biomass from CalCOFI (Ron Lynn) and IMECOCAL (Bertha Lavanegos and Timothy Baumgartner) data in April, 2000.

In addition to the monitoring surveys, IMECOCAL maintains sea level pressure gauges at an oceanic island (Guadalupe Island, 29°N, 118°W), and at an onshore location (San Quintin Bay, ~31°N). These paired instruments permit to monitor the sea surface pressure gradient between the island and the coastal station in order to

provide a measure of the along-shore mean flow in the region. The instruments have been operating since January 1999 in collaboration with the Mexican Navy. Also, meteorological stations are maintained at several locations along the Peninsula of Baja California.

Preliminary information derived from our 1997-2002 surveys is held in a database for the program collaborators and the international scientific community. We already have important results from our study area; derived from the seventeen surveys, the three meteorological stations, and the two sea level gauge stations. About 60% of the samples are analysed, generating twelve data reports, more than ten scientific contributions, and four MSc theses. Fourteen graduate students are working on their thesis related to information collected on the surveys, and six scientific papers should be published during the next two years. We expect to complete the database of all the core data by the end of this year. For more information about sharing data, please contact with our Data Manager (loyasa@cicese.mx), and visit our web site (<http://www.ecologia.cicese.mx/~imecocal>).

IMECOCAL Collaborators

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Building global ocean profile and plankton databases for scientific research

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Founded in the International Geophysical Year (IGY), the World Data Center (WDC) System was established to prevent the loss of valuable scientific data gathered during the IGY by providing a permanent archive for these data. During the past ten years, the World Data Center for Oceanography, Silver Spring, has expanded its role by including all oceanographic data received as part of its archive, and by leading projects to increase the comprehensiveness of its electronic database. This presentation describes efforts at the WDC to develop global, comprehensive, integrated, scientifically quality-controlled electronic ocean profile-plankton databases that are available internationally without restriction. A description of upper ocean temperature changes using the data from World Ocean Database 1998 will be given.

IOC Global Oceanographic Data Archaeology and Rescue (GODAR) project

Data archaeology is the process of locating historical ocean data at risk of loss due to media decay. In contrast, data rescue is the digitization, quality control, and entry of historical data into global, regional, national comprehensive, integrated, electronic databases.

The GODAR project was approved in 1993 and is on-going. International cooperation within the project continues to be excellent. All countries contacted are contributing data. Six regional GODAR workshops have been held worldwide that encompass all countries that make oceanographic measurements (Table 1). These meetings were attended by approximately 175 oceanographic data managers and scientists and have resulted in the identification of substantial amounts of data that are at risk of loss due to media decay (magnetic tape and paper).

Table 1 List of GODAR meetings.

GODAR I	Obninsk	Russia	May, 1993
GODAR II	Tianjin	China	Mar., 1994
GODAR III	Goa	India	Dec., 1995
GODAR IV	Malta		Apr., 1995
GODAR V	Cartagena	Colombia	Apr., 1996
GODAR VI	Accra	Ghana	Mar., 1997

The International GODAR Review Meeting held in Silver Spring, Maryland, U.S.A., in July 1999 concluded that the project is successful with more than 2 million temperature profiles, and 600,000 plankton observations collected. The next phase is to add 'sea level' data to the project.

Current GODAR projects include MEDBLACK and MEDAR/MEDATLAS by European Community and IOC/IODE GODAR-WESTPAC by countries bordering the western Pacific. The Japan Oceanographic Data Center takes the lead in the GODAR-WESTPAC project.

Data collected as a result of the GODAR project were made available, both on-line and on CD-ROM, as part of World Ocean Atlas 1994, World Ocean Database 1998, and World Ocean Database 2001 (available March 2002).

IOC World Ocean Database project

The IOC World Ocean Database Project was approved in July 2001. Its goal is the development of global and regional, comprehensive, integrated, scientifically quality-controlled ocean profile and plankton databases. The project hopes to encourage the exchange of modern ocean profile and plankton data, and to emphasize the development of regional atlases and quality control procedures.