CFAME workshop on "Developing a working plan for CCCC synthesis"

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Dr. Akihiko Yatsu is Head of the Population Dynamics Section at the National Research Institute of Fishery Science (NRIFS). His current work includes stock assessment of chub mackerel, spotted mackerel and Japanese sardine, and inter-annual and inter-decadal linkages of stock abundance and marine ecosystems in the Northwest Pacific. He is also the Co-Chairman of the PICES CFAME Task Team and Working Group 16 on Climate Change, Shifts in Fish Production, and Fisheries Management.

A workshop entitled "Developing a working plan for CCCC synthesis" was held by the Climate Forcing and Marine Ecosystem (CFAME) Task Team on May 14-15, 2005, in Victoria, Canada. In attendance were 23 scientists from Canada, Japan, Korea, Russia and the United States. The CFAME Task Team was formed in 2004 with the objective of synthesizing, over the next several years, regional and basin-wide studies of the PICES Climate Change and Carrying Capacity (CCCC) interdisciplinary program. The goal of the first CFAME workshop was to focus a broad range of hypotheses linking climate and marine production into a working plan for the Task Team.

The first day of the workshop was devoted to scientific presentations, while the second day was dedicated to developing both terms of reference and a working plan for the Task Team. The meeting opened with a statement on the purposes of the workshop by Co-Convenors, Drs. Kerim Aydin and Akihiko Yatsu. Then Dr. Kazuaki Tadokoro (Japan) gave an invited talk entitled "Decadal variations in mesozooplankton biomass in North Pacific with comparison of their environments". One of the highlights of his talk was a summary of the mesozooplankton biomass changes in the North Pacific after three regime shifts (Fig. 1). Dr. Harold Batchelder, CCCC Co-Chairman, reviewed plans for the 2006 PICES/GLOBEC Symposium on "Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis", and presented a perspective of CCCC activities. Dr. Michael Foreman attended on behalf of the Physical Oceanography and Climate Committee (POC) and discussed upcoming physical oceanographic model products which may be available for developing biological hypotheses. Dr. Jacquelynne King updated the participants on the recent efforts of the PICES Study Group on Fisheries and Ecosystem Responses to Recent Regime Shifts (FERRRS), and Dr. Skip McKinnell gave a presentation on the appropriate use of climate indices in biological correlation studies. Finally, Task Team members presented recent research from member countries. Emphasis in presentations was on linkages between climate forcing and ecosystem responses.

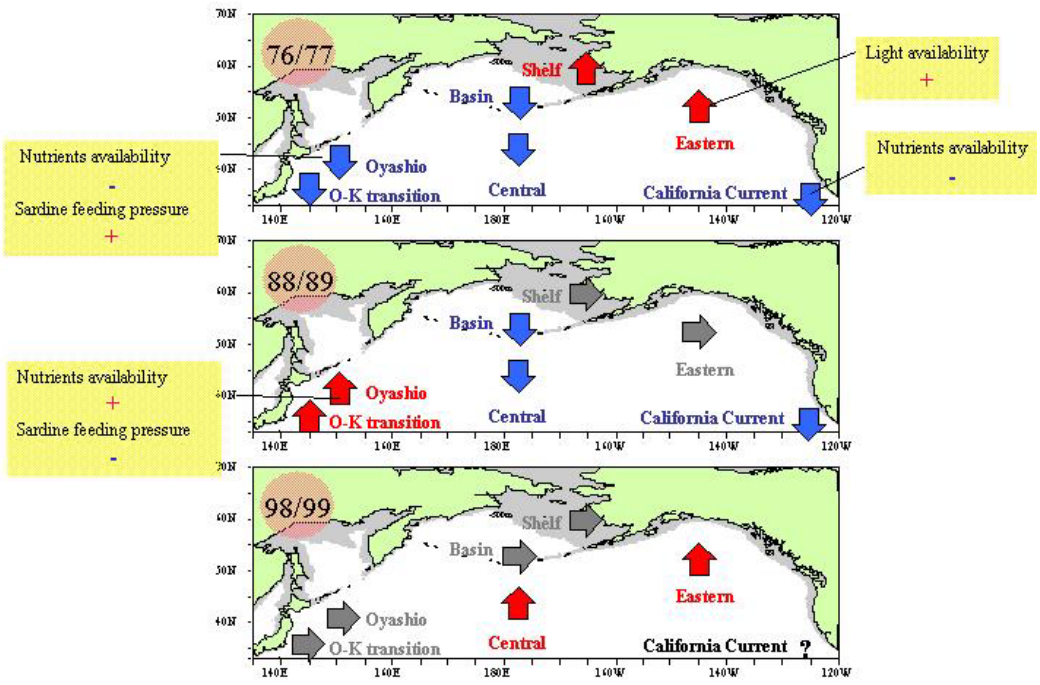

Fig. 1 Summary of the mesozooplankton biomass changes in the North Pacific after three regime shifts: 1976/77 (top panel), 1988/89 (middle panel) and 1998/99 (bottom panel). Red arrows indicate increase, blue arrows indicate decrease, and grey arrows show stationary state.

On the second day, discussion began with an examination of CCCC goals and objectives. The initial Implementation Plan of the CCCC program (PICES Sci. Rep. No. 4, 1996) defined "carrying capacity" as referring to the linkages through which zooplankton and high trophic level carnivore species dominance and productivity respond to changes in ocean climate. To this end, the initial implementation of the CCCC Program set out to develop a new theoretical and mathematical framework to extend the classical single species concept of carrying capacity into the multi-species and ecosystem domains, and to address how climate change affects ecosystem structure and the productivity of key biological species.

To facilitate these goals, CFAME members decided that the Task Team's terms of reference and initial Action Plan should consist of three components: (1) Mechanisms, (2) Ecosystems, and (3) Scenarios. For each of these components, a term of reference and initial action items were developed by break-out groups (see photos next page), then approved by the Task Team:

(1) MECHANISMS

Term of reference:

- CFAME shall act to develop conceptual models of key biological processes, such as growth, survival and recruitment, in relation to climate forcing and human-induced effects. Key processes may include temporal and spatial scale variability in bottom-up forcing and match/mismatch of different life history strategies. This task will be done through comparison, based on common methods, of key species or ecological equivalents identified as important for CCCC.

Action item:

- Hold a 3-day workshop in January 2006 on conceptual/regional models, with a specific goal of providing developed mechanisms for the Symposium on "Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis" (April 19-21, 2006, Honolulu, Hawaii).

This workshop will seek to develop regional and Pacific-wide conceptual models describing mechanisms linking climate to fish production by focusing on two methods. For the first method, attendees will develop mechanistic models for the following species in eastern and western ecosystems: pollock, sardine, herring, pink and chum salmon. This approach will include the refining of regional climate indices to specifically and directly represent processes of interest, while allowing for linkages to large-scale climate patterns or models. For the second method, attendees will identify the set of key fish or squid species in the following ecosystems: California Current, East China/Yellow Seas, and Sea of Okhotsk. The set of key species may differ over time within each ecosystem. The aim is to describe the mechanisms between climate, ecosystem history, food web structure, and life history strategies which have led to the selected species playing a pivotal role in their respective ecosystems. It is expected that these descriptions will contribute to understanding

patterns of variation and potential for changes in overall ecosystem structure, stability, or other ecosystem properties.

(2) ECOSYSTEMS

Terms of reference:

- CFAME shall act to review and develop the next generation of robust ecosystem indices, including physical forcing, species-specific responses, and ecosystem aggregate indices. The indices should represent key processes linking climate, ocean, and biology. The indices, as an ensemble, will focus on detecting and potentially predicting changes on a number of temporal scales, including seasonal, interannual, and interdecadal variability, and longer-term trends. Further, the indices should be tested against a range of plausible future scenarios of climate change, to ensure that they continue to track key processes.
- CFAME shall collaborate, for example, with the CCCC MODEL Task Team, in the development of multi-species, ecosystem, and comparative life history models that connect lower and upper trophic level processes, incorporating multiple life history strategies as well as a range of temporal and spatial scales. A preliminary result of this modeling will be describing differences in ecosystem structure and life history types as it may apply to predicting different responses to climate and human forcing.

Action items:

- Revise the definition of carrying capacity to include current knowledge;
- Hold a workshop prior to the PICES Fifteenth Annual Meeting (October 2006, Yokohama, Japan) on changes in ecosystem structure in response to climate forcing, in preparation for a 2007 joint POC/CFAME scenario exploration workshop (see under Scenarios, below).
- Collaborate with the PICES/NPRB (North Pacific Research Board) project entitled "Integration of Ecological Indicators for the North Pacific with emphasis on the Bering Sea".

(3) SCENARIOS

Terms of reference:

- CFAME shall act to build upon identified mechanisms to investigate a range of species and ecosystem responses to climate forcing scenarios and forecasts; *e.g.*, distributional changes, changes in ecosystem community structure (*e.g.*, replacement of species), and changes in survival at life stages.

Action items:

- Hold an interim POC/CFAME workshop in 2007 for climate modelers to provide regional indicators identified at the January 2006 workshop, and for CFAME to apply climate output to developed conceptual models.

It is hoped that this threefold approach will greatly aid the success of CCCC synthesis activities in the coming years.

Break-out groups on "Mechanisms" (top photo: Kazuaki Tadokoro, Sanae Chiba, Akihiko Yatsu, William Crawford, Sukyung Kang and Masahide Kaeriyama), "Ecosystems" (middle photo: Gordon (Sandy) McFarlane, Kerim Aydin, William Peterson and Vera Agostini) and "Scenarios" (bottom photo: James Overland, Brenda Norcross, Yoshiro Watanabe, Jacquelynne King and Takashige Sugimoto) discuss terms of reference and components of the CFAME Action Plan.