

Report of the CFAME workshop to develop a work plan for CCCC synthesis

by Kerim Aydin

A workshop entitled “*Linking climate-forcing mechanisms to indicators of species ecosystem-level changes: A comparative approach*” was held by the PICES CFAME (Climate Forcing and Marine Ecosystem Response) Task Team on May 21–23, 2007, in Seattle, U.S.A. In attendance were 10 scientists from Canada, Japan, the Republic of Korea, and the United States (**Photo 1**). The CFAME Task Team was formed with the objective of synthesizing regional and basin-wide studies of the PICES–GLOBEC Climate Change and Carrying Capacity (CCCC) interdisciplinary program.

The goal of the workshop was to finalize working hypotheses of mechanisms linking climate to key species and ecosystem processes in three major marine ecosystems: the California Current, the Yellow/East China Sea, and the Oyashio/Kuroshio Current regions, and to link climate variability to changes in ecosystem productivity, structure, and function. This finalized set of hypotheses will form the basis for collaboration with the PICES Physical Oceanography Committee (POC) to extract necessary climate variables from modeled scenarios for future climate reported by the Intergovernmental Panel on Climate Change (IPCC). The first stage of this collaboration will occur at the POC/CCCC workshop on “*Climate scenarios for ecosystem modeling*” to be convened on October 26–27, 2007, at PICES XVI in Victoria, Canada.

The workshop began with review presentations on each of the selected ecosystems given by Akihiko Yatsu (Oyashio/Kuroshio), Seok Hyun Youn (Yellow/East China Sea), and

Jacquelyne King (California Current). Following the review, a method of comparison was designed which involved selecting a subset of **controlling climate variables**, and ranking the importance of these drivers for each ecosystem (**Table 1**).

To refine these general controlling factors into specific information requests from IPCC models from which to forecast local conditions, a subset of dominant species was chosen for each ecosystem, and an interaction matrix was created for each species in each ecosystem. These interaction matrices link the climate variables in Table 1 to the following five life history traits for each selected species: range, recruitment (spawning success and juvenile survival), spawning behavior, feeding and growth, and adult survival. This linking was performed for one example species in each ecosystem, with the tables for all species to be completed by CFAME members and colleagues between the inter-sessional workshop and the workshop at PICES XVI.

After the development of these tables as a method for comparing species and ecosystem processes, the workshop participants discussed the overall challenge of predicting the future of marine environments undergoing long-term climate change. In particular, while the relative predictive units of concern to society were considered to be “fish stocks and the assemblage of stocks in an ecosystem”, it was important to stress that absolute productivity (*e.g.*, “carrying capacity”) of marine species would be difficult or impossible to forecast given our current knowledge.



Photo 1 Participants of the 2007 CFAME inter-sessional workshop; left to right, back row: William Crawford (Canada), Gordon (Sandy) McFarlane (Canada), James Overland (U.S.A.), Seok Hyun Youn (Korea), Brenda Norcross (U.S.A.), George Hunt (U.S.A.); front row: Jacquelyne King (Canada), Kerim Aydin (CFAME Co-Chairman, U.S.A.), Christopher Harvey (U.S.A.) and Akihiko Yatsu (CFAME Co-Chairman, Japan).

Table 1 Preliminary ranking of relative importance of climate drivers in three selected ecosystems, with ranking ranges from 0 (unimportant) to 3 (highly important).

Climate variable	Oyashio/Kuroshio	Yellow/East China Sea	Califorina Current
Stratification	3	1	3
Temperature	3	3	3
River discharge	0	3	1
Currents	3	2	3
Current-carried nutrients/outside production	1 (from Sea of Okhotsk)	1	3 (Subarctic Current)
Air input (dust)	2	3	0
Eddies/meanders	3	0	3
Winds – turbulence	3	2	3
Winds – upwelling	3 coastal, otherwise 0	0	3
Winds – deep mixing	0	0	0
Tidal mixing	0	3	3 near Juan de Fuca Strait, otherwise 0

To this end, a focus on comparative processes was recommended. For example, rather than predicting absolute recruitment or biomass, it was suggested that the mechanism tables be used for predicting shifts in overall ecosystem structure, especially with regard to the control of production. Under what climate scenarios could an ecosystem shift from “bottom-up” to “top-down” production, and how would such a shift impact the overall

structure of the ecosystems? Types of possible shifts were drawn from the history of CCCC research, particularly from past symposia/sessions on recruitment and ecosystem control. The summarizing of predicted changes in controlling mechanisms in an ecosystem context, as forecast from IPCC scenarios, was thought to represent an excellent final synthesis of CCCC/CFAME activities as they might lead to future integrated programs within PICES.



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PICES Calendar

- ICES/PICES Theme Sessions on “*Integrating observations and models to improve predictions of ecosystem response to physical variability*”, “*Comparative marine ecosystem structure and function: Descriptors and characteristics*” and “*The ecosystem approach: What’s the impact on marine science, science-based advice and management of marine ecosystems*” at the ICES Annual Science Conference, September 17–21, 2007, Helsinki, Finland.
- International Symposium on “*Reproductive and recruitment processes in exploited marine fish stocks*” (co-sponsored by NAFO, PICES and ICES), October 1–3, 2007, Lisbon, Portugal.
- PICES Sixteenth Annual Meeting, October 26–November 4, 2007, Victoria, Canada.
- 1st CLIOTOP Symposium on “*Climate impacts on oceanic top predators*” (co-sponsored by GLOBEC, IMBER, SCOR, PICES, EUR-OCEANS, NOAA, IRD, CLS, PFRP, CIBNOR, CICIMAR), December 3–7, 2007, La Paz, Mexico.
- International Symposium on “*Effects of climate change on the world’s oceans*” (co-sponsored by ICES, PICES, IOC, GLOBEC, SCOR and WCRP), May 19–23, 2008, Gijón, Spain.
- International Symposium on “*Coping with global change in marine social–ecological systems*” (co-sponsored by GLOBEC, EUR-OCEANS, FAO, IRD, PICES, SCOR, IMBER), July 8–11, 2008, Rome, Italy.
- PICES Seventeenth Annual Meeting, October 23–November 2, 2008, Dalian, China.