REPORT OF MODEL TASK TEAM

The meeting of the MODEL Task Team was held from 08:30-12:00 hours on October 17, 2004. The Co-Chairmen, Drs. Shin-ichi Ito and Francisco E. Werner called the meeting to order and welcomed the participants (*MODEL Endnote 1*). The proposed agenda was reviewed and adopted (*MODEL Endnote 2*). During the meeting, participants:

- summarized the achievements and accomplishments of MODEL over the past year;
- reviewed the results and products of an APN/PICES workshop held the same week in Honolulu, immediately prior to the PICES Thirteenth Annual Meeting;
- discussed the PICES Strategic Plan and PICES Capacity Building;
- reviewed discussion of future strategies of the CFAME Task Team resulting from the CCCC workshop on "Linking open ocean and coastal ecosystems II";
- reviewed the current status and future perspectives of the 3-D NEMURO model;
- discussed future perspectives and funding related to activities of MODEL;
- planned activities of MODEL for 2005 and beyond;
- discussed the membership of MODEL and selection of a new MODEL Co-Chairman.

MODEL accomplishments in 2004 (Agenda Item 2)

A successful workshop on "Summary and synthesis of contributions from NEMURO and NEMURO.FISH" (sponsored by Fisheries Research Agency of Japan, FRA) was held December 4-6, 2003, at the National Research Institute for Fisheries Science, Yokohama, Japan. The main results of the workshop were:

- successful modeling (validated by field data) of lower trophic ecosystems at several sites in the North Pacific;
- successful modeling of fish growth of Pacific herring and saury;
- extension of NEMURO to a 3-D basin-wide and global model;
- agreement to publish scientific contributions of NEMURO and NEMURO.FISH as a special issue of *Ecological Modelling*.

A workshop on "Development of a model on coupled responses of lower and higher trophic levels for climate variability in the North Pacific" (co-sponsored by FRA and PICES) was held August 20-23, 2004, at the Alaska Fisheries Science Center, Seattle, U.S.A. The main results of the workshop were:

- decision of clear editorial policy for the *Ecological Modelling* special issue on NEMURO and NEMURO.FISH;
- definition of objectives and preparatory arrangements for an APN/PICES workshop.

A 4-day APN/PICES workshop on "Climate interactions and marine ecosystems" (co-sponsored by the Asia Pacific Network and PICES) was convened from October 10-13, 2004, at the Ala Moana Hotel, Honolulu, U.S.A. The main results of the workshop are noted in a later section. A report of the workshop will be published in PICES Press in January 2005.

A ½-day CCCC/MODEL Topic Session on "Modeling approaches that integrate multiple spatial scales and trophic levels between shelf and open ocean" was convened at PICES XIII. The summary of the session is included elsewhere in this Annual Report.

APN/PICES workshop on "Climate interaction and marine ecosystems" (Agenda Item 3)

Drs. Francisco E. Werner and Bernard A. Megrey were principal investigators and co-convenors of the workshop. The project, which started in June 2004, is one-year in duration, and the workshop was held to review progress to date and define future activities. Fourteen

participants from all PICES member countries were in attendance. The objectives of the project are to study geographic and temporal variations of marine ecosystems (through fish, using Pacific herring as a target) in the North Pacific as determined by climate (bottom-up) forcing, with possible consideration of future climate change scenarios. Among the main results were:

- the workshop attendees were informed of the developments of the NEMURO and NEMURO.FISH models;
- methods for estimating parameters quantitatively were discussed as relevant to applications to new sites;
- new sites were selected for study to complete the east-west basin-scale comparison;
- new fish species were targeted including sardines, anchovies and mackerel, among others.

The APN funding and project run through June 2005, and over the coming months communication will continue through a portal to be established by Dr. Megrey at the Alaska Fisheries Science Center. The portal will also be used to post all model codes and available data for access by all workshop participants.

Discussion of PICES Strategic Plan and PICES Capacity Building (Agenda Item 4)

Dr. Ito briefly reviewed the PICES Strategic Plan and PICES Capacity Building. The main results of the follow-up discussion on possible MODEL contributions were:

- agreement to hold a training session of NEMURO and NEMURO.FISH as a part of a workshop which was proposed to a new APN program (PI: Dr. Michio Kishi);
- preparation of users' manuals and documentation of NEMURO and NEMURO.FISH, and request funding for translation costs of the above documentation from English to Chinese, Japanese, Korean and Russian languages, as a capacity building component of PICES.

CFAME future strategy (Agenda Item 5)

Dr. Ito briefly reviewed the results of the discussions of CFAME's future strategies presented at the CCCC workshop on "Linking open ocean and coastal ecosystems II". During the coming year, as CFAME continues to develop its future strategies, MODEL members agreed to keep close collaboration with CFAME.

Plans for 2005 and beyond (Agenda Item 6)

MODEL adopted the following three objectives as targets to apply NEMURO and NEMURO.FISH (*MODEL Endnote 3*).

- Geographic variation in fish growth (*Goal 1 of PICES Strategic Plan*);
- Understanding regime shifts (*Goal 2 of PICES Strategic Plan)*;
- Global climate change effects on energy pathways and fish production (*Goal 2 of PICES Strategic Plan).*

The following plans were outlined to meet these objectives:

<u>PICES XIV</u>

- Convene a ½-day CCCC/MODEL Topic Session on "Modeling climate and fishing impacts on fish recruitment" (*MODEL Endnote 4*).

<u>Inter-sessional meetings</u>

- Convene a workshop in October 2005, in Japan (hosted by FRA), to build up a multi-species model using NEMURO.FISH; Dr. Kishi submitted a proposal to APN for US$10,500, for an International workshop on "Toward quantitative understanding of natural fluctuations of marine coastal fisheries of sardines and anchovies and their impact on fishing-dependent human communities", and if funded, the proposal will support participation of Chinese, Indian, and Bangladeshi young scientists for the workshop; co-funding has also been requested from FRA, IAI, IOC and PICES (*Goals 5 and 6 of PICES Strategic Plan*).

Publications

- Submit papers on NEMURO and NEMURO.FISH models and their applications for review and publication as a special issue of *Ecological Modeling* (*Goal 8 of PICES Strategic Plan*);
- Prepare users' manuals and documentation of NEMURO and NEMURO.FISH for publication on the PICES website (*Goal 8 of PICES Strategic Plan*).

On-going and proposed projects

Two existing MODEL-related funded efforts are underway:

- APN: "Climate interaction and marine ecosystems" (PIs: Drs. Francisco E. Werner and Bernard A. Megrey);
- FRA: "Development of model on coupled response of lower and higher trophic level ecosystems for climate variability in the North Pacific" (PI: Dr. Shin-ichi Ito).

Three MODEL-related projects proposed for funding were reported:

- APN: "Toward quantitative understanding of natural fluctuations of marine coastal fisheries of sardines and anchovies and their impact on fishing-dependent human communities" (PI: Dr. Michio Kishi);
- FRA: "Regional comparison of growth of sardine and anchovies through bottom-up process and modeling approach toward it" (PI: Dr. Shin-ichi Ito);
- NOAA/NMFS: "Software framework for integrating marine ecosystem models" (PI: Dr. Thomas C. Wainwright).

Requests for travel (Agenda Item 7)

MODEL requests support for the following travel:

- 1 invited speaker for the CCCC/MODEL Topic Session on "Modeling climate and fishing impacts on fish recruitment" at PICES XIV (October 2005, Vladivostok, Russia);
- 2 scientists to attend the CCCC/MODEL inter-sessional workshop, to build up a multi-species model using NEMURO.FISH (October 2005, Japan).

Current status and future perspectives of 3-D NEMURO model (Agenda Item 8)

Dr. Yasuhiro Yamanaka reviewed the current status of the 3-D NEMURO model. Available output is limited to a coarse resolution model (1 degree in both longitude and latitude). However, fine resolution model (less than 1/10 degree) hydrodynamic integrations (without biology) have already been completed, although issues dealing with the large size and transfer of the output still need to be resolved. The 3-D NEMURO model with fine resolution integration will be available within two years. Before starting the integration of the model, spatial parameter sensitivities are needed to modify the parameters of the 3-D NEMURO model.

Membership of MODEL Task Team (Agenda Item 9)

Chairmanship and membership of MODEL were discussed. It was recommended that:

- Dr. Werner's term as Co-Chairman be extended until October 2005, with Dr. Wainwright serving as Co-Chairman-elect after PICES XIV;
- Drs. Hiroaki Saito and Toshio Katsukawa of Japan be replaced by Dr. Goh Onizuka;
- Dr. Hao Wei (People's Republic of China) join MODEL as a member;
- Drs. Peter S. Ross (Canada), Jae-Hak Lee (Republic of Korea), and Linda Jones (U.S.A.) formally rotate off MODEL as they have not participated in recent meetings;
- Additional members from Canada, People's Republic of China, Republic of Korea and Russia be recruited.

Recommendations to CCCC-IP/EC (Agenda Item 10)

1. Convene a CCCC/MODEL workshop in October 2005, in Japan (hosted by FRA), to build up a multi-species model extending NEMURO.FISH; support participation of two scientists in the workshop;
2. Convene a ½-day CCCC/MODEL Topic Session at PICES XIV (joint with FIS and possibly CFAME) on "Modeling climate

and fishing impacts on fish recruitment"; support one invited speaker for the session;
3. Publish users' manuals and documentation of NEMURO and NEMURO.FISH on the PICES website, and provide funding for translation costs of the above documentation from English to Chinese, Japanese, Korean and Russian languages, as a capacity building contribution.
4. Approve changes in MODEL chairmanship and membership requested under Agenda Item 9.

MODEL Endnote 1

Participation List

Members

Shin-ichi Ito (Japan, Co-Chairman)
Michio J. Kishi (Japan)
Bernard A. Megrey (U.S.A.)
Hiroaki Saito (Japan)
Jake Schweigert (Canada)
Thomas C. Wainright (U.S.A.)
Francisco E. Werner (U.S.A., Co-Chairman)
Sinjae Yoo (Korea)
Yury I. Zuenko (Russia)

Observers

Mao-Cheng Cui (China)
Irina Ishmukova (Russia)
Hee-Dong Jeong (Korea)
Jin Yeong Kim (Korea)
Alexander Leonov (Russia)
Yasuhiro Yamanaka (Japan)

MODEL Endnote 2

MODEL Task Team Meeting Agenda

1. Welcome and introduction of new members
2. Review of MODEL accomplishments after PICES XII
3. Review of 2004 APN/PICES workshop
4. Discussion of PICES Strategic Plan and PICES Capacity Building
5. Future strategies of CFAME Task Team and MODEL's role in these plans
6. Planning for 2005 and beyond
   a. PICES XIV (October 2005)
   b. APN project
   c. FRA (Japanese Fisheries Research Agency) project
   d. Joint workshop between APN, IAI, IOC, FRA (October 2005)
   e. CCCC/GLOBEC Synthesis Symposium (April 2006)
   f. PICES XV (October 2006)
7. Requests for travel to future meetings
8. Other new business
9. Rotation of membership
10. Recommendations to CCCC-IP/EC

MODEL Endnote 3

MODEL adopted hypotheses to apply NEMURO and NEMURO.FISH

Hypothesis 1: Geographic variation in fish growth. Differences in environmental conditions, and resulting differences in lower trophic conditions, can account for the differences in herring growth rates among selected sites in the North Pacific ecosystem. There exist long-term data sets on herring size-at-age from locations in the North Pacific. These data sets show that herring growth rates over the past decades have varied consistently among the different locations. Understanding how much environmental conditions account for differences in herring growth is important for predicting climate change effects and for effective management of these types of fisheries in the future.

Hypothesis 2: Understanding regime shifts. Synchronous changes in herring growth rates across locations may be accounted for by basin-wide decadal-scale changes in environmental conditions. Preliminary examination of herring growth rates at several locations has shown sudden shifts in growth rates occurring in the same years across all locations. Where possible, we will combine long-term datasets on herring growth, with regional and local long-term climate and weather records, and use a common NPZ model coupled to the fish growth model to examine consequences of environmental regime changes. Understanding how regime shifts in climatic regimes cascade up the food-web is a good opportunity for using past conditions to infer future effects of climate change.

Hypothesis 3: Global climate change effects on energy pathways and fish production. Climate change may result in energy being diverted from the pelagic pathway and shunted through the microbial pathway, resulting in less food for pelagic fish and consequently slower fish growth rates. We will use the common coupled NPZ and fish model, the long-term datasets, and defined climate change scenarios to predict how climate change would affect energy cycling, shift the dominance among different phytoplankton and zooplankton groups, and affect fish growth and production in the North Pacific ecosystem. Model simulations will be performed under present-day (baseline) environmental conditions, and for a suite of realistic climate change (IPCC; Intergovernmental Panel on Climate Change, http://www.ipcc.ch) scenarios. Comparing these linkages and pathways under baseline and climate change scenarios for a variety of locations that have different environmental conditions (*e.g.*, shallow coastal ocean versus the deep open ocean) will aid in the interpretation and generalization of our results.

MODEL Endnote 4

Proposal for a ½-day CCCC/MODEL Topic Session at PICES XIV on "Modeling climate and fishing impacts on fish recruitment"

To model the state of fish populations, both individual growth and the population number are necessary. Recently the PICES MODEL Task Team has generalized ecosystem models for the North Pacific and applied the prototype model of lower trophic levels (NEMURO) for the growth of individual fish, at present Pacific saury and herring. However, the same developments were not implemented at the fish population level. Clearly, the abundance depends strongly on reproductive success and fish survival during early life stages, and these are, in turn, affected by the environment. This session will review existing models and related scientific knowledge on fish recruitment under varying environmental conditions, and create a foundation for their incorporation in the ecosystem model for the North Pacific and its regions.

Recommended convenors: Yury I. Zuenko (Russia, MODEL) and representatives (potentially) from both FIS and CFAME.