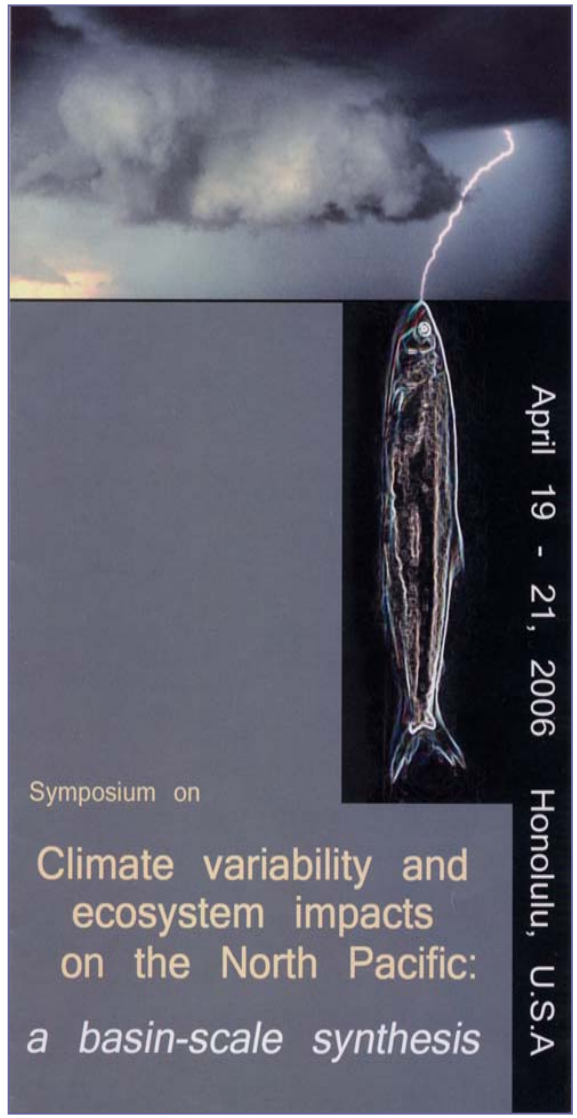
Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis



PICES, GLOBEC International, Pacific Islands Fisheries Science Center—NOAA, North Pacific Fisheries Management Council, North Pacific Research Board, Western Pacific Regional Fisheries Management Council, Pelagic Fisheries Research Program, Scientific Committee on Oceanic Research, U.S. GLOBEC, and Korea Ocean Research & Development Institute

Climate Variability and Change through “Time”


1987
TIME
The Heat Is On
How the Earth's Climate Is Changing
Why the Ozone Hole
SPECIAL REPORT Fighting for Global Markets
1989
PLANET OF THE YEAR
TIME
1992
TIME
COMING TO SAVE
2001
TIME
ARMING
2002
SPECIA
HOW TO SAVE THE EARTH
2005
ON JIHAD ■ NEIL YOUNG SINGS
AKING
CANES
SE?
2006
SPECIAL REPORT GLOBAL WARMING
TIME
BE WORRIED. BE VERY WORRIED.
Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well
EARTH AT THE TIPPING POINT
HOW IT THREATENS YOUR HEALTH
HOW CHINA & INDIA CAN HELP SAVE THE WORLD—OR DESTROY IT
THE CLIMATE CRUSADERS

Climate Variability and Change through Time

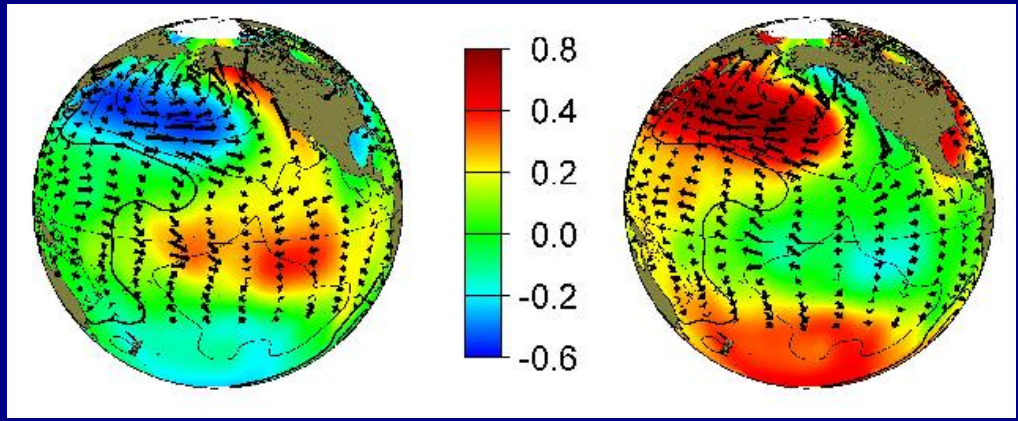
Pacific Decadal Oscillation (PDO)

PDO Anomaly Patterns

SST – colors

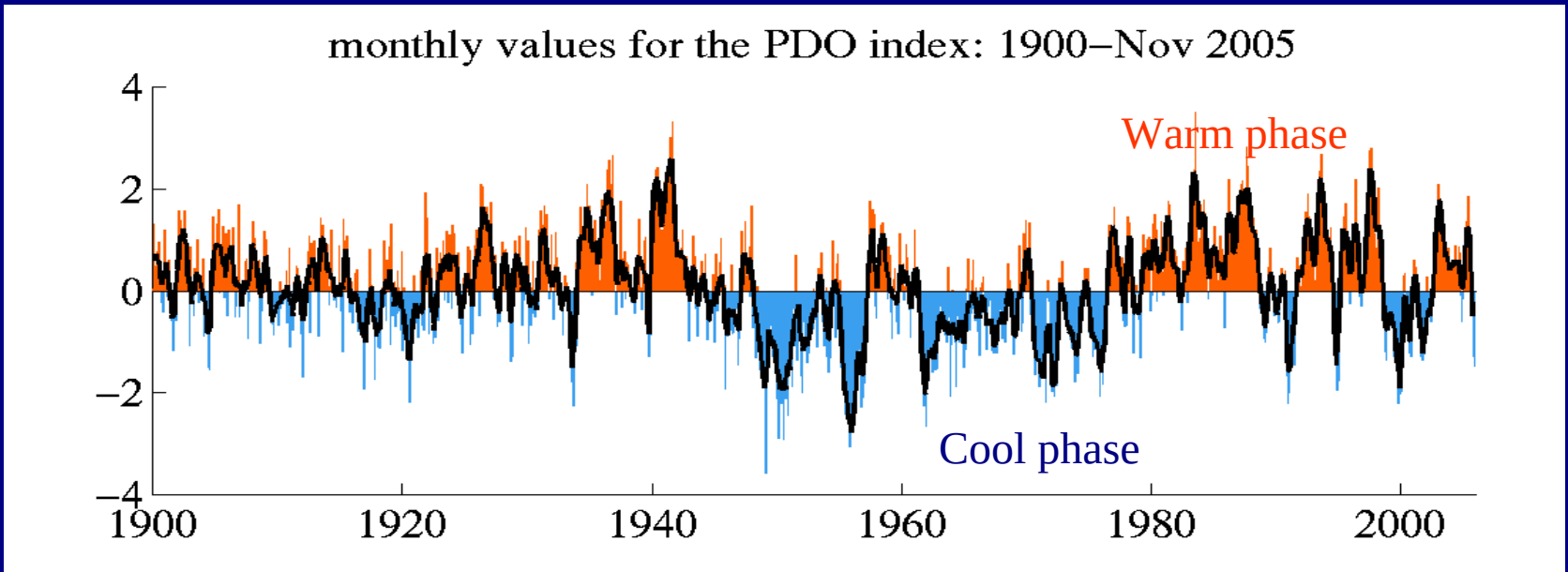
SLP – contours

Windstress - arrows



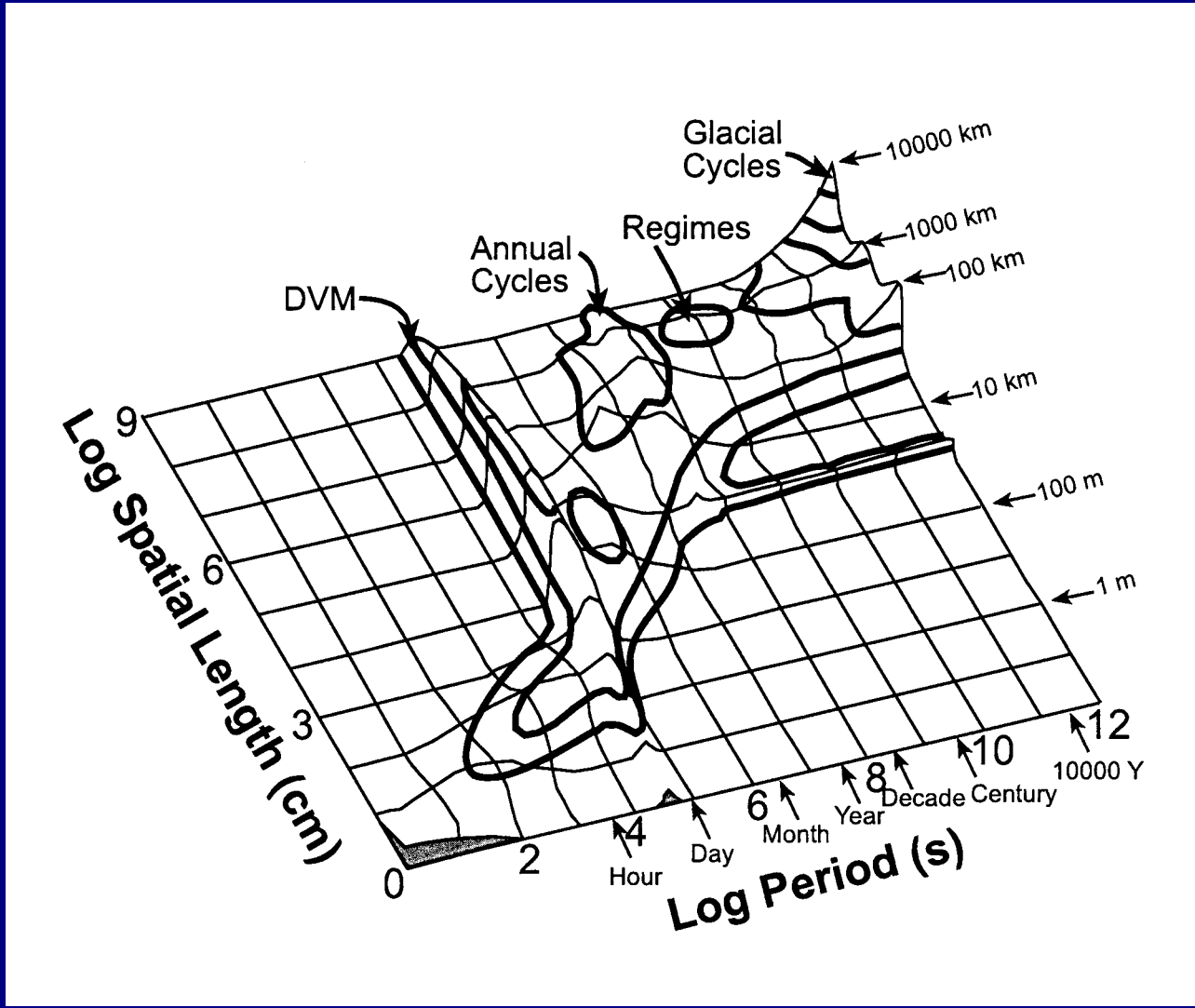
Warm phase

Cool phase



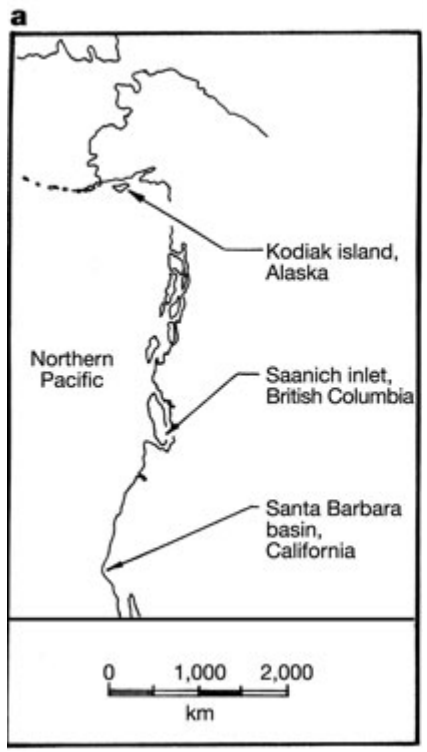
http://jisao.washington.edu/pdo/

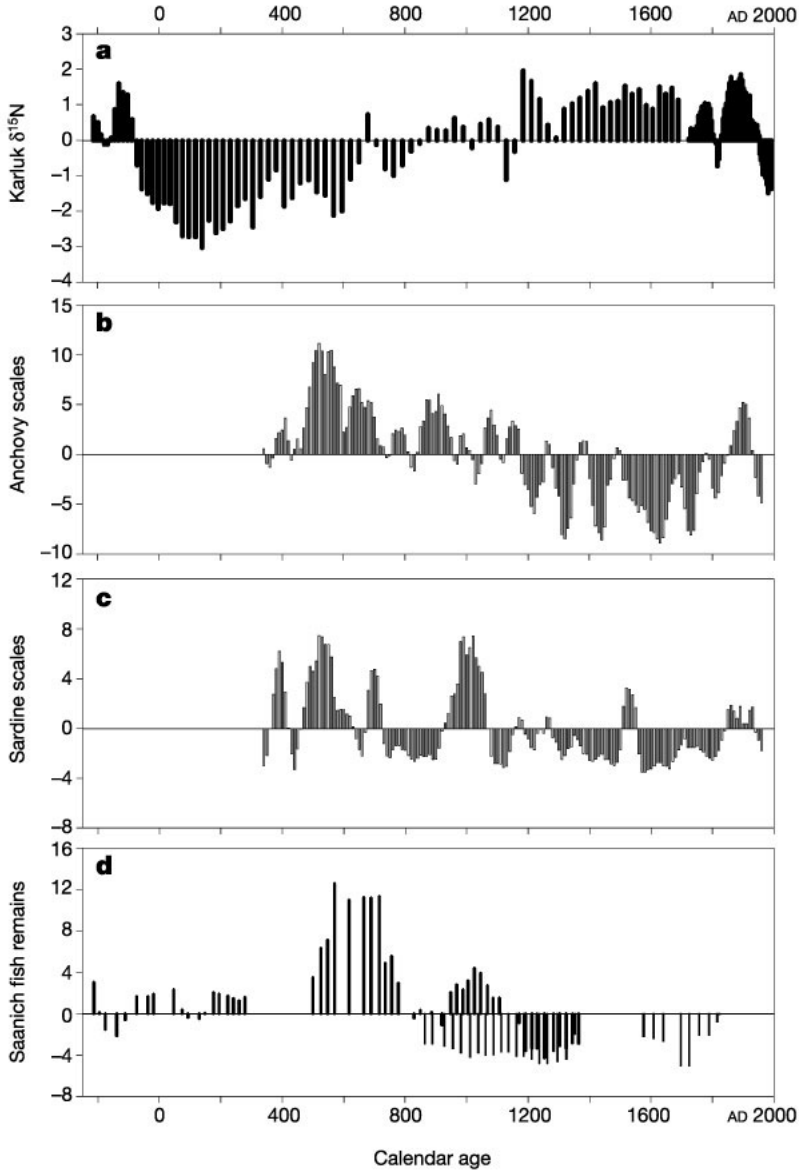
Ocean Pattern and Process in Time and Space



(modified from Haury et al., 1978)

Reminder: CCCC since 1995; catch/climate observations since ca. 1900; missing longer term variability—indicated by paleoclimatology; paleoecology





Finney et al. (2002; Nature, 416, 729)

Climate Change and Carrying Capacity (CCCC) Mission

- Provide a strategy for determining the carrying capacity for higher trophics in the subarctic North Pacific (salmon, pollock, birds, mammals, etc.)
- Develop a plan for a cooperative study of how changes in ocean conditions affect the productivity of key fish species in the subarctic North Pacific and coastal zones of the Pacific rim

(1993)

On the importance of the CCCC program to PICES…

Chairman of PICES, 1992-1996

"*We are trying to think of how to move PICES along to the next stage of its life. It functions but hasn't really yet accomplished anything that impacts marine research in the region*"

Warren Wooster in a November 1995 letter to William T. Burke (Prof. of Law and Marine Affairs, Univ. Washington)

1995 – PICES CCCC accepted as a regional program of the IGBP GLOBEC International Program

- Ultimate CCCC Goal: “to forecast the consequences of climate variability on the ecosystems of the subarctic Pacific”

CCCC General Question

- “how do interannual and decadal variation in ocean conditions affect the species dominance, biomass, and productivity of the key zooplankton and fish species in the ecosystems of the PICES area?”
- Applied to:

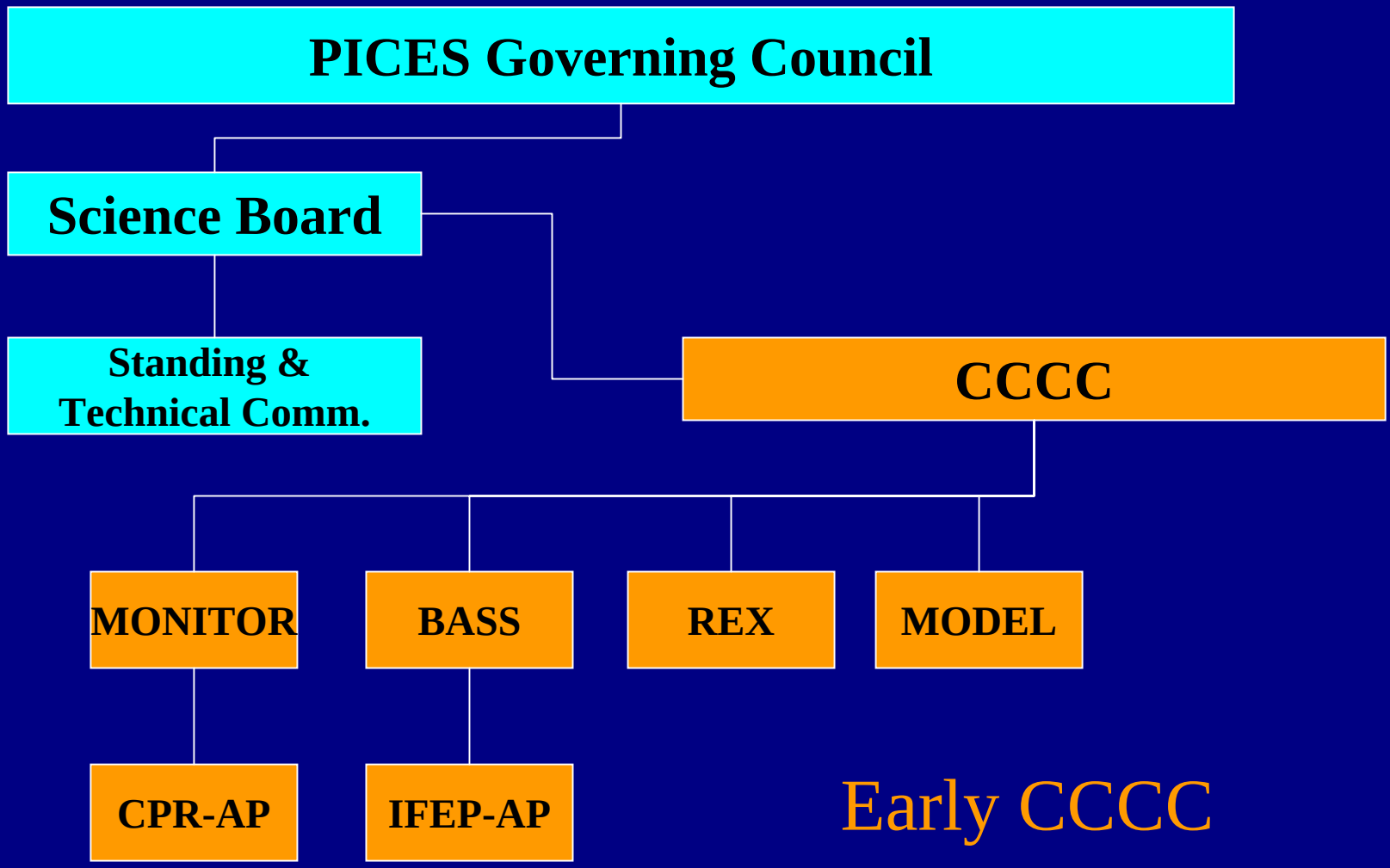
Physical forcing	LTL Response
Ecosystem Interactions	HTL Response

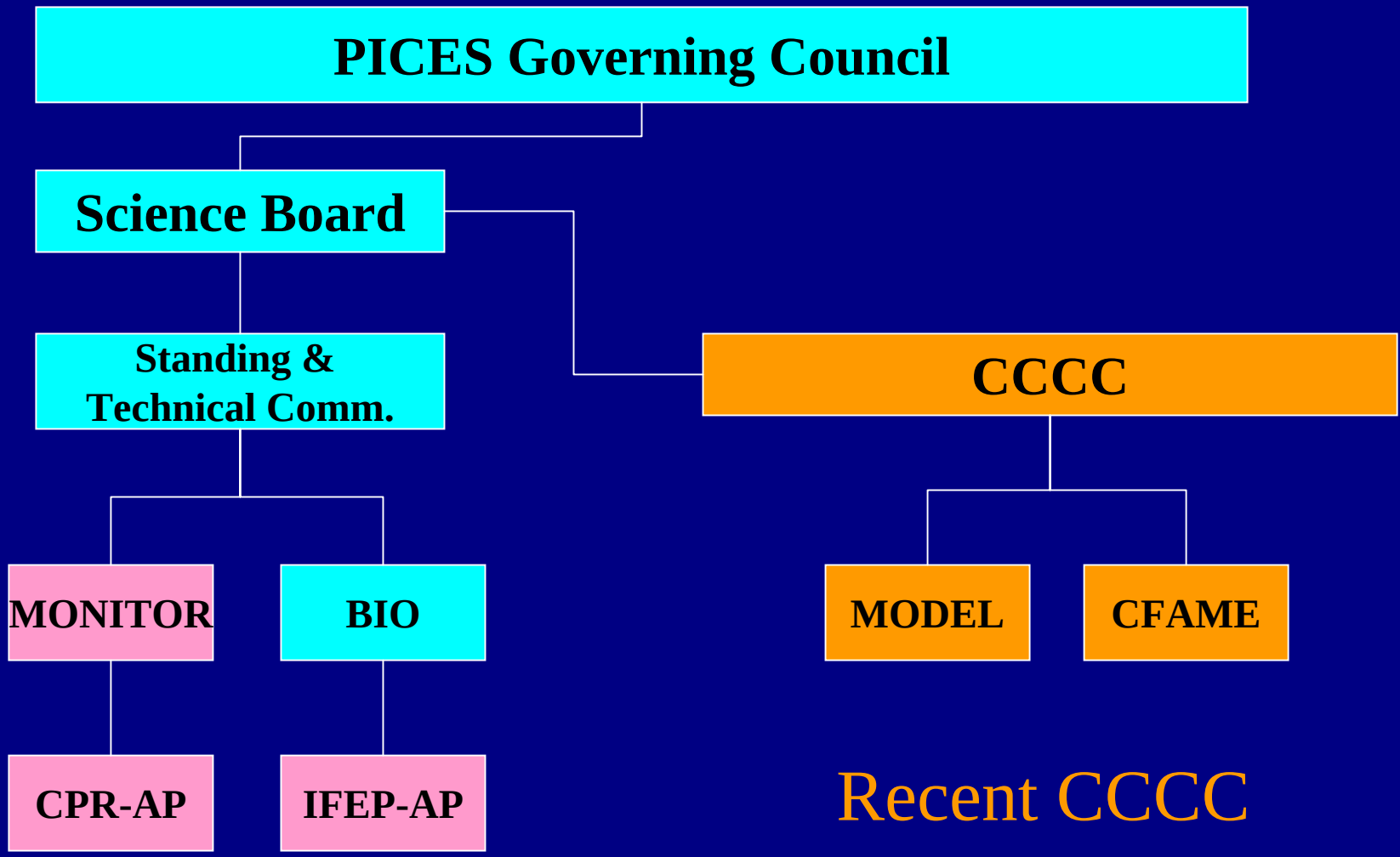
1997-CCCC TOR revised to

- Integrate and stimulate national activities on the effects of climate variations on marine ecosystems of the subarctic North Pacfic
- Determine how the PICES scientific committee and WGs can support the program
- Identify national/international research programs with which CCCC could coordinate
- Provide scientific direction

CCCC Implementation Panel establishes 4 Task Teams (TT)

- MODEL – to advance the development of conceptual and modeling studies
- BASS (BASin Scale) – to develop the basin-scale component
- REX (Regional EXperiments) – to develop interregional comparisons among national studies
- MONITOR (a little later) – to review, improve and design a monitoring system for ocean and ecosystem observations in the NoPac; assist in developing a coordinated program to detect and describe events that strongly affect the NoPac; provide a liaison role to GOOS


PICES Governing Council
Science Board
Standing & Technical Comm.
CCCC
MONITOR
BASS
REX
MODEL
CPR-AP
IFEP-AP
Early CCCC


PICES Governing Council
Science Board
Standing & Technical Comm.
CCCC
MONITOR
BIO
MODEL
CFAME
CPR-AP
IFEP-AP
Recent CCCC

GLOBEC INTERNATIONAL STRUCTURE

GLOBEC Scientific Steering Committee

C. Werner (SSC Chair)

RESEARCH FOCI

1 - Retrospective Analysis WG (J.Alheit)

2 - Process Studies WG (R. Harris)

3 - Prediction and Modelling WG (B de Young & M. Kishi)

4 - Feedback from Ecosystem Changes WG (R. Ommer & I. Perry)

GLOBEC I.P.O.

M. Barange (Exec. Dir)

NATURAL ENVIRONMENT RESEARCH COUNCIL

REGIONAL PROGRAMMES

PICES- Climate Change and Carrying Capacity (H.Batchelder & S. Kim)

ICES- Cod and Climate Change (G. Otterson & K. Drinkwater)

Southern Ocean (E. Hofmann)

Small Pelagic fish And Climate Change (C. Roy & D. Checkley)

National Activities	Multinational Activities
Brazil, Canada, Chile, China, France, Germany, Italy, Japan, Netherlands, Mexico, Norway, Portugal, Turkey, Ukraine, USA, UK	BENEFIT (S. AFRICA) LIFECO (EC) TASC (EC)

PICES Study Group on Future Integrative Scientific Program

SG tasks are to:

- Solicit ideas for a new integrative program
- Review and assess potential themes of broad interest
- Solicit feedback from the PICES community
- Provide recommendations to GC

SGFISP – Future Directions in Establishing a New Program

- Build upon the successful CCCC program
- Move from climate variability to global change
- Bring climate into management models
- Key Elements – Forecasts, human dimension, mechanisms, scenarios

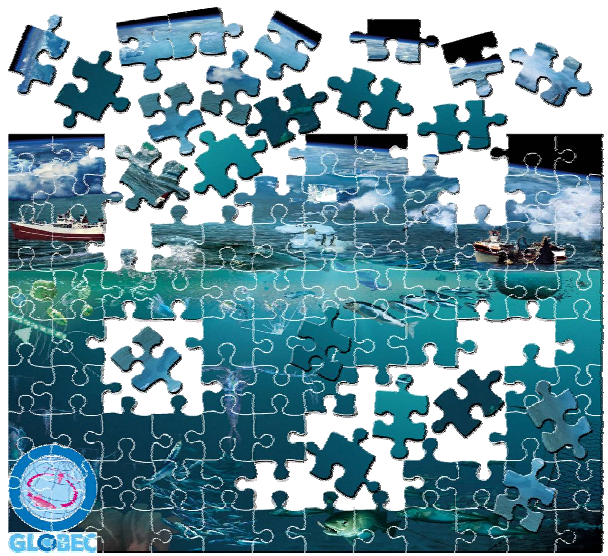
SGFISP – A Possible Name?

- FUTURE
  - **F**orecasting and
  - **U**nderstanding
  - **T**rends,
  - **U**ncertainty and
  - **R**esponses of
  - **E**cosystems

Final Thoughts . . .

Analysis. **1. A resolution of anything, whether an object of the senses or of the intellect, into its constituent or original elements; an examination of the component parts of a subject, each separately, as the words which compose a sentence, the tones of a tune, or the simple propositions which enter into an argument. It is opposed to synthesis.; 2. (Logic) The tracing of things to their source, and the resolving of knowledge into its original principles.**

Synthesis. **1. Composition, or the putting of two or more things together, as in compounding medicines; 2. (Logic) The combination of separate elements of thought into a whole, as of simple into complex conceptions, species into genera, individual propositions into systems;--the opposite of analysis.**



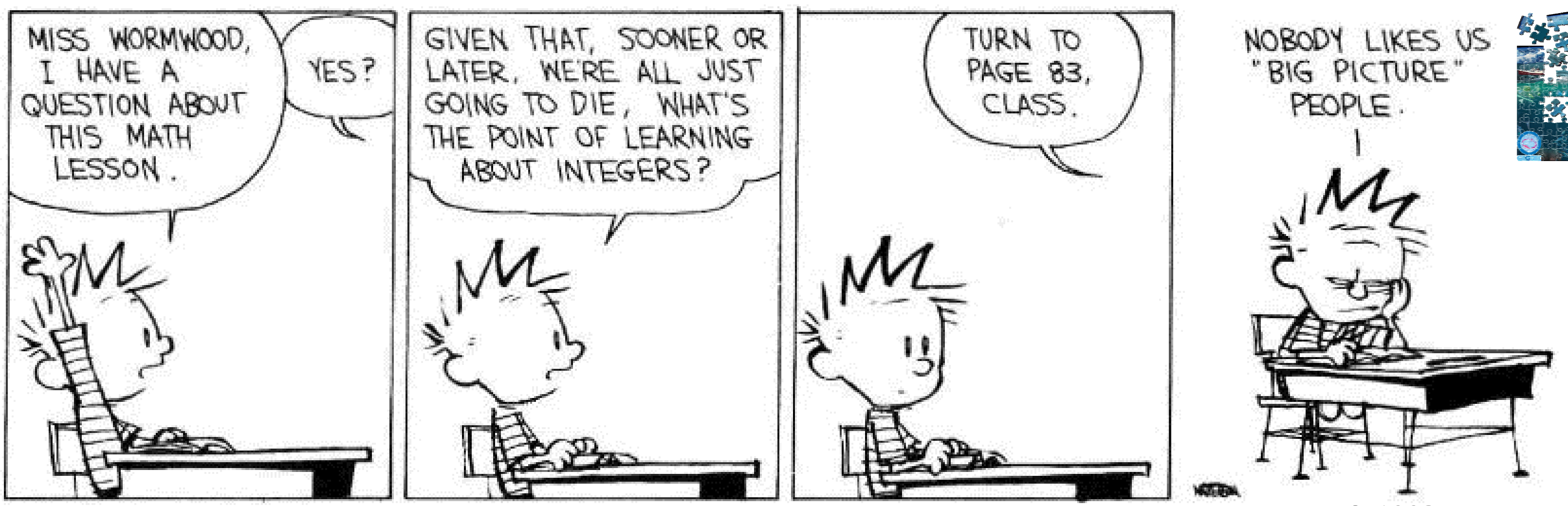
Final Thoughts . . .become a big picture thinker!

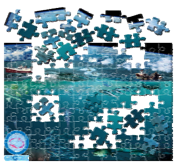
***Analysis*. 1. A resolution of anything, whether an object of the senses or of the intellect, into its constituent or original elements; an examination of the component parts of [illegible] which compose a sentence, the tones of a tune, or the simple propositions which enter into an argument. It is [illegible] to their source, and the resolving of knowledge into its original principles.**

As scientists we do this well.

Now we need to focus on Synthesis

***Synthesis*. 1. Composition, or the putting of two or more things together, as in compounding medicines; 2. <u>(Logic) The combination of separate elements of thought into a whole, as of simple into complex conceptions, species into genera, individual propositions into systems;--the opposite of analysis.</u>**





Central Scientific Issues (CCCC *Implementation Plan)*

Physical Forcing:

What are the characteristics of climate variabilty, can interdecadal patterns be identified, how and when do they arise?

Lower Trophic Level Response

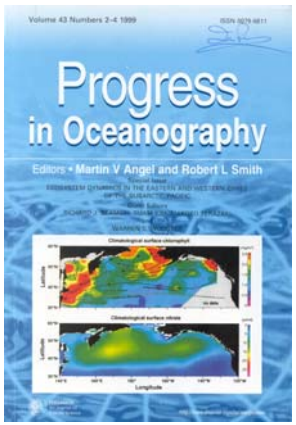
How do primary and secondary producers respond in productivity, and in species and size composition, to climate variability in different ecosystems of the subarctic Pacific?

Higher Trophic Level Response

How do life history patterns, distribution, vital rates, and population dynamics of higher trophic level species respond directly and indirectly to climate variability?

Ecosystem Interactions

How are subarctic Pacific ecosystems structured? Is it solely through bottom-up forcing, or are there significant intra-trophic level and top-down effects?



Symposium proceedings will be published as a special issue of Prog. Oc. YOU ARE ENCOURAGED TO SUBMIT MS FOR THIS ISSUE BY 30 JUNE to hbatchelder@coas.oregonstate.edu

Volume 43 Numbers 2–4 1999

ISSN 0079-6611

Progress in Oceanography

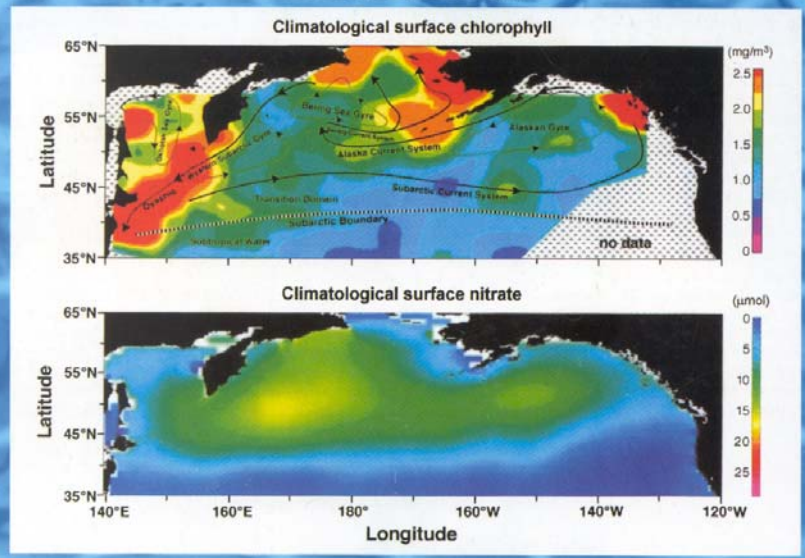
Editors • **Martin V Angel and Robert L Smith**

Special Issue

ECOSYSTEM DYNAMICS IN THE EASTERN AND WESTERN GYRES OF THE SUBARCTIC PACIFIC

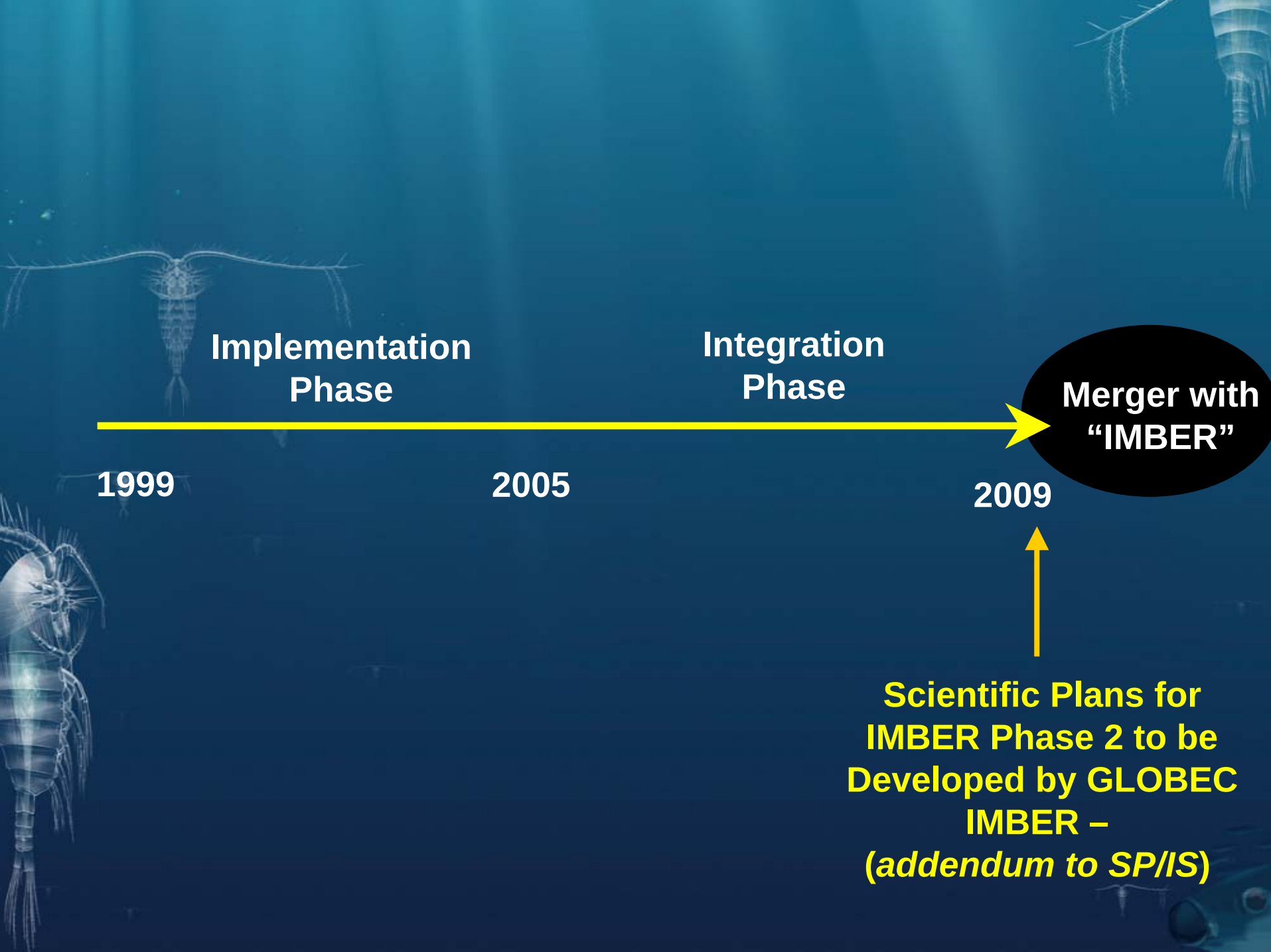
Guest Editors

RICHARD J. BEAMISH, SUAM KIM, MAKOTO TERAZAKI and WARREN S. WOOSTER



PERGAMON
An imprint of
Elsevier Science

http://www.elsevier.com/locate/pocean


Implementation Phase
Integration Phase
Merger with "IMBER"
1999
2005
2009
Scientific Plans for IMBER Phase 2 to be Developed by GLOBEC IMBER – (addendum to SP/IS)

GLOBEC's Blueprint to Integration and Synthesis

A. What encapsulates GLOBEC's philosophy

- Multi/ interdisciplinary **international collaboration**
- Physical-biological **interactions**
- From key species to ecosystems/ from individuals to populations
- **Coupled models** as integrative tools
- Multi-scale (time, space, institutional) analysis

B. What body of knowledge does GLOBEC contribute to?

- **Ecosystem Structure and Function**
  - How are ecosystems structured and how does structure affect function
  - Demonstrate **the role of Climate variability** in affecting marine ecosystem changes
  - Identify the **relative role** of ecosystem components (plankton, fish, humans) in ecosystem functioning
  - Enhanced understanding of the **role of high trophic levels** and top-down controls (hierarchical)

- **Forcings**
  - Determine the space/time **modes of variability** in natural climate processes
  - Highlight the mechanisms behind ecosystem **teleconnections**
  - Recognise the **role of Humans** as forces of change

- **Physical/ Biological/ Human interactions and Feedbacks**

C. What innovative methodologies is GLOBEC introducing/ advancing?

- Sampling and technological advances in support of GLOBEC science
- Coupled Models (trophic, scale, time) to investigate structure, function and variability
- Retrospective studies (particularly multidecadal to centennial) on past ecosystem states
- Comparative approach (mostly regional)

D. Efforts for transferring information to management bodies

- Policy (providing conceptual understanding of ecosystem function)
- Managers (providing tools to incorporate climate-driven variability)
- Communities (enhancing communication on GEC and marine sustainability)

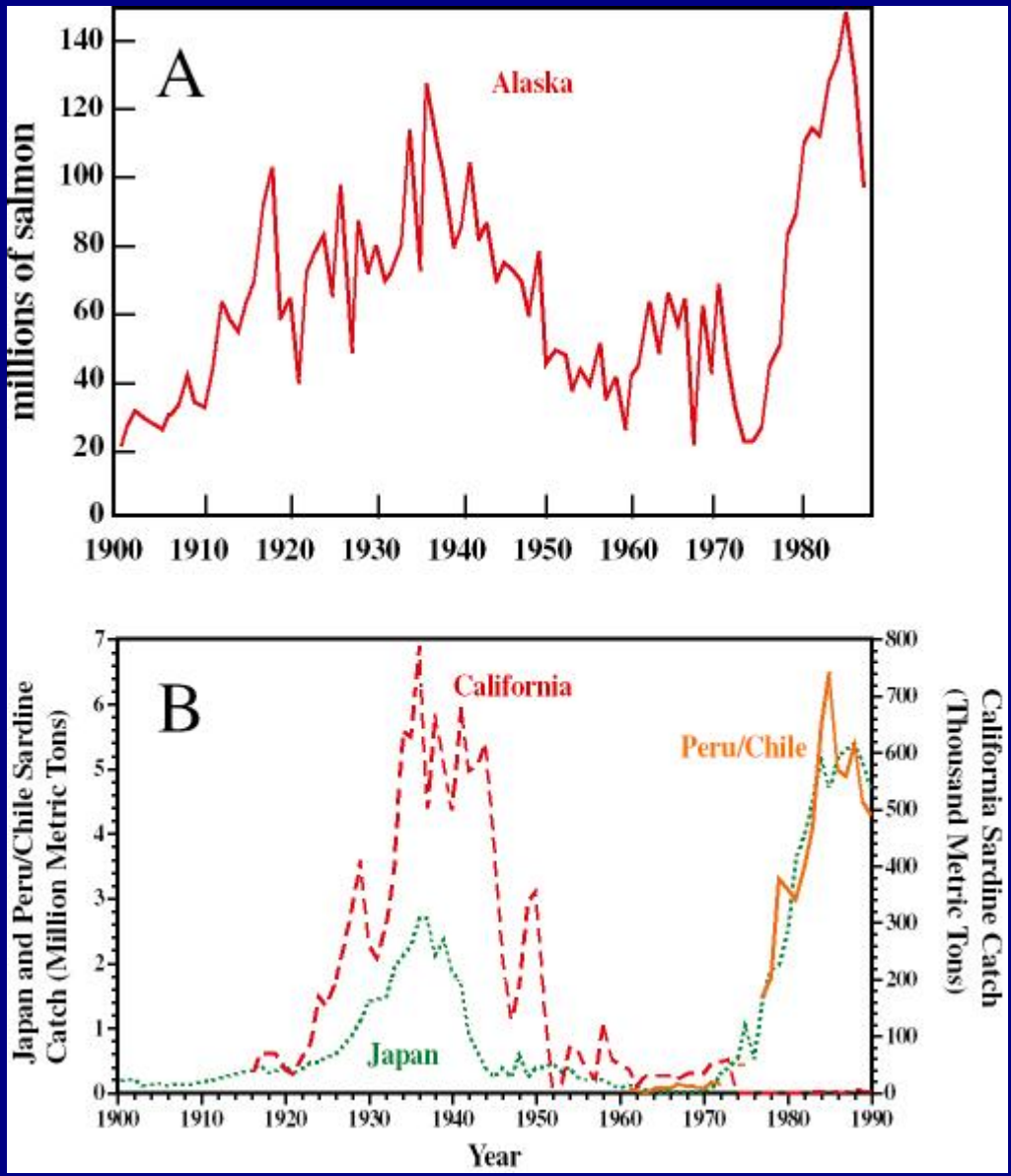
E. What education/ outreach objectives are we conducting?

- Curriculum development
- Web-based approaches
- Animations (scenarios)
- Lessons learned

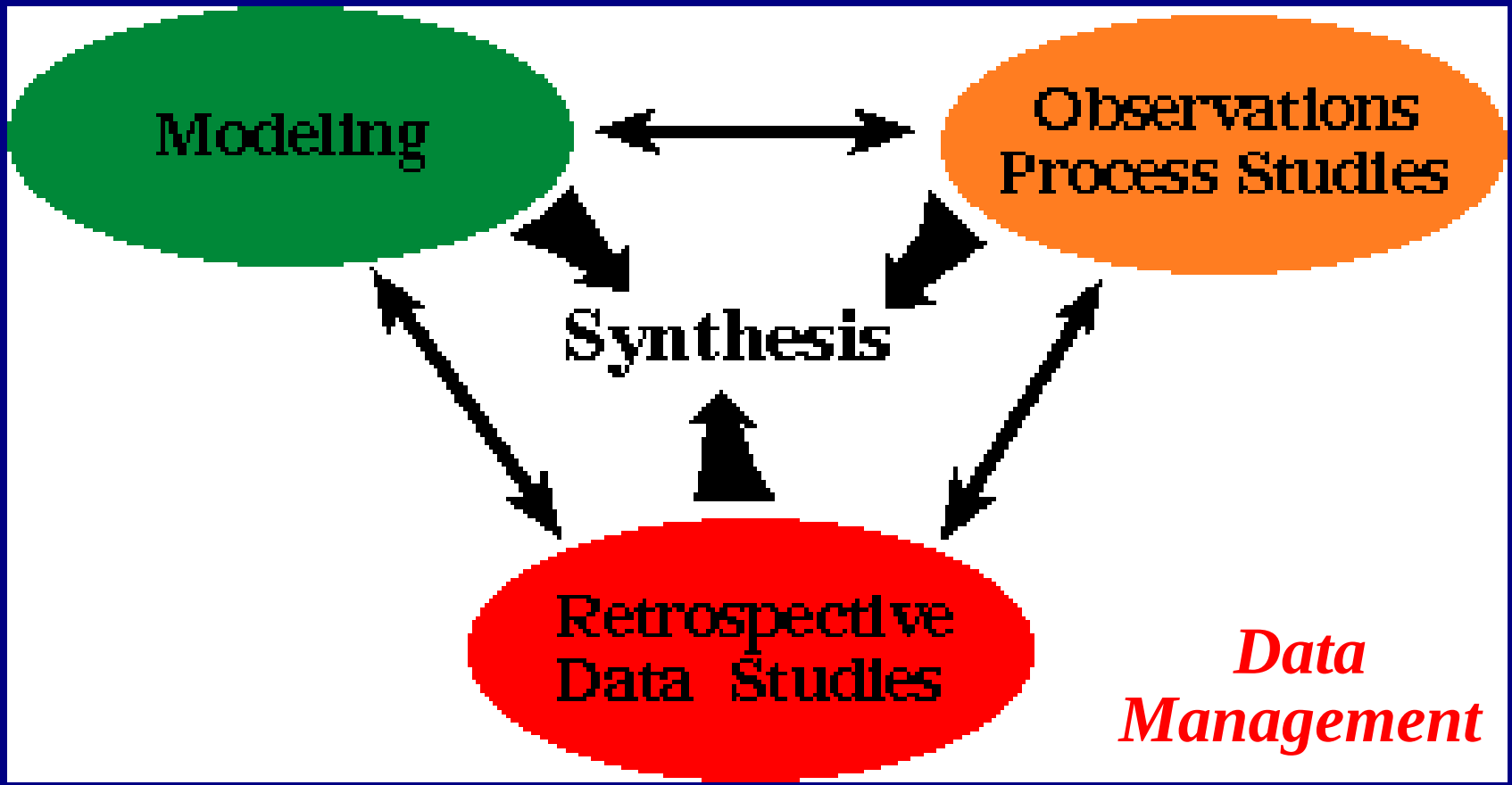
GLOBEC Synthesis

- Targeted workshops
- Task Teams
- Synthesis books
- Final science brochure and summary for Policy makers

Synchronous Population Fluctuations?



CCCC uses the GLOBEC Approach



Distribution of Steller Sea Lions (from North Pacific Universities Marine Mammal Research Consortium website)

1-CCSS; 2-CCSN; 3-SE-SCAK; 4-EBS; 5-WBS; 6-OKH; 7-OY-KU; 8-JASE; 9-BOHAI; 10-EACH

WSG-Western Subarctic Gyre; ESG-Eastern Subarctic Gyre

Distribution of Steller Sea Lions (from North Pacific Universities Marine Mammal Research Consortium website)

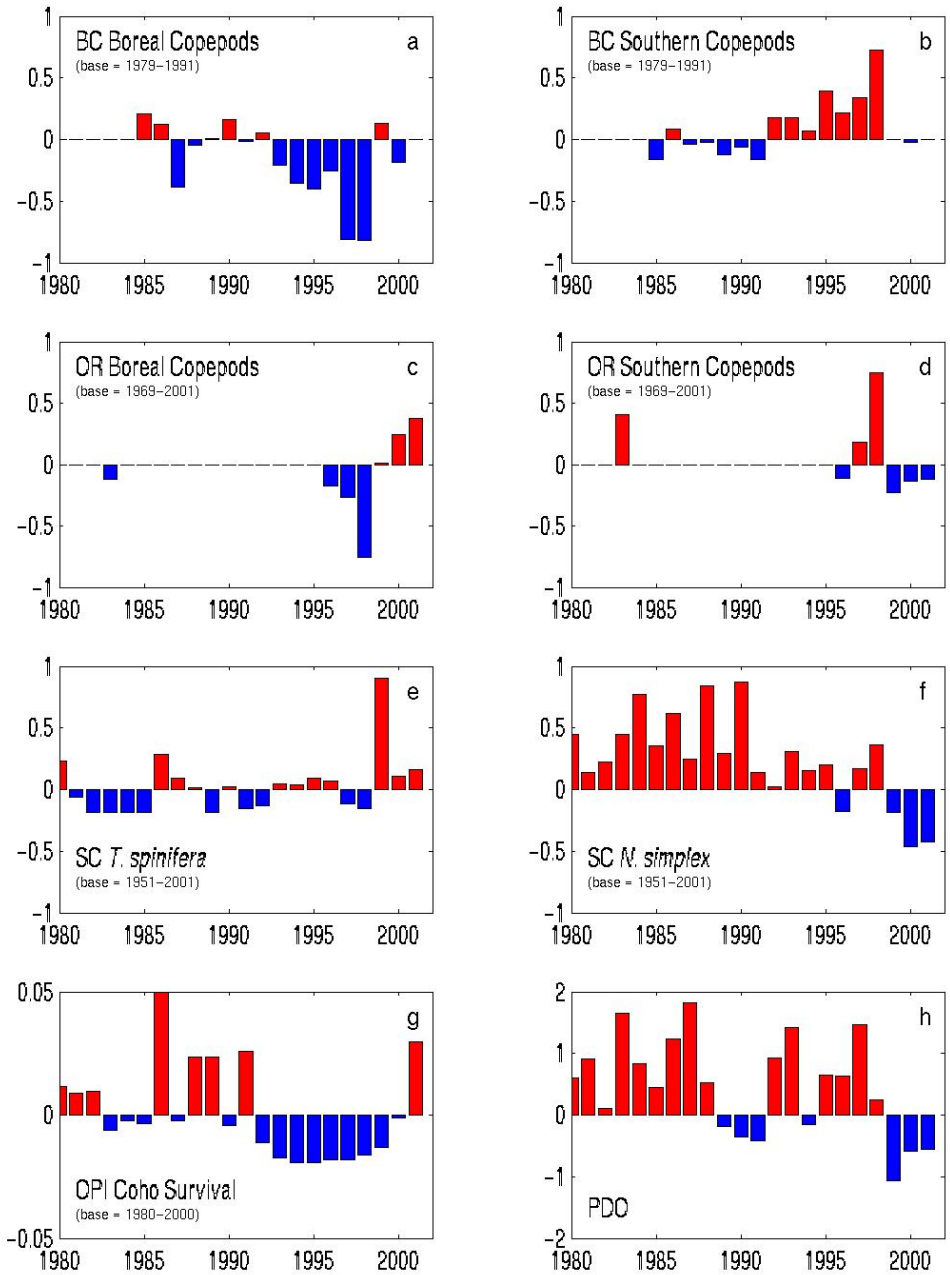
Ecosystem Status Report

- Summarize what is known about the NoPac ecosystem (every 1-2 years?) [climate, oceanographic and fisheries data]
- Identify data gaps requiring further study
- Ecosystem based management of marine fisheries requires integration of environmental data into traditional stock assessment advice
- First ESR to be available in draft form for 2002 PICES Mtg

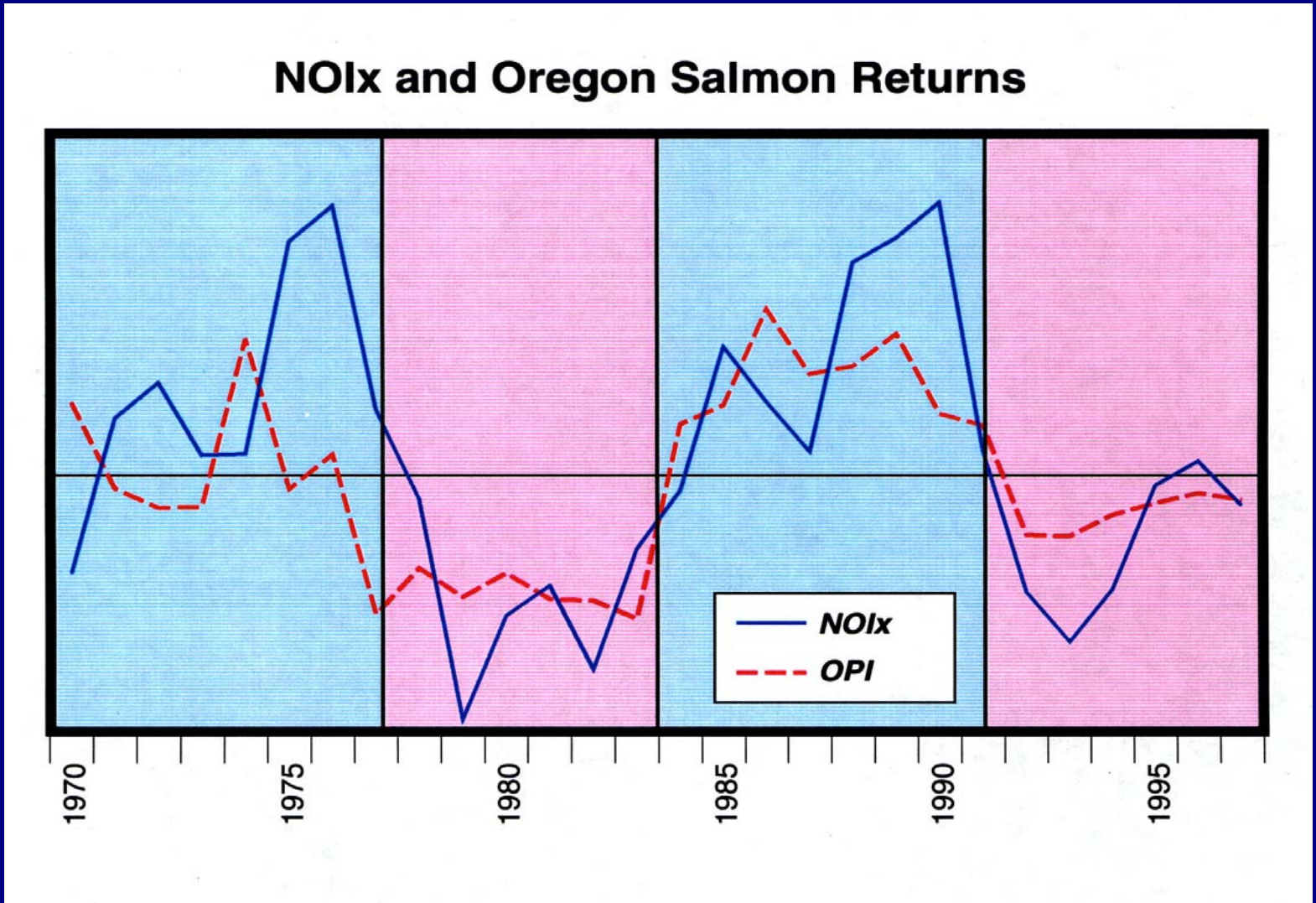
1998 Regime Shift?

- Boreal Copepods increase
- Southern Copepods decline
- Shift in euphausiid species composition in SoCal
- Marked increase in Coho survival

Parallel pattern in PDO, but the mechanisms are not known

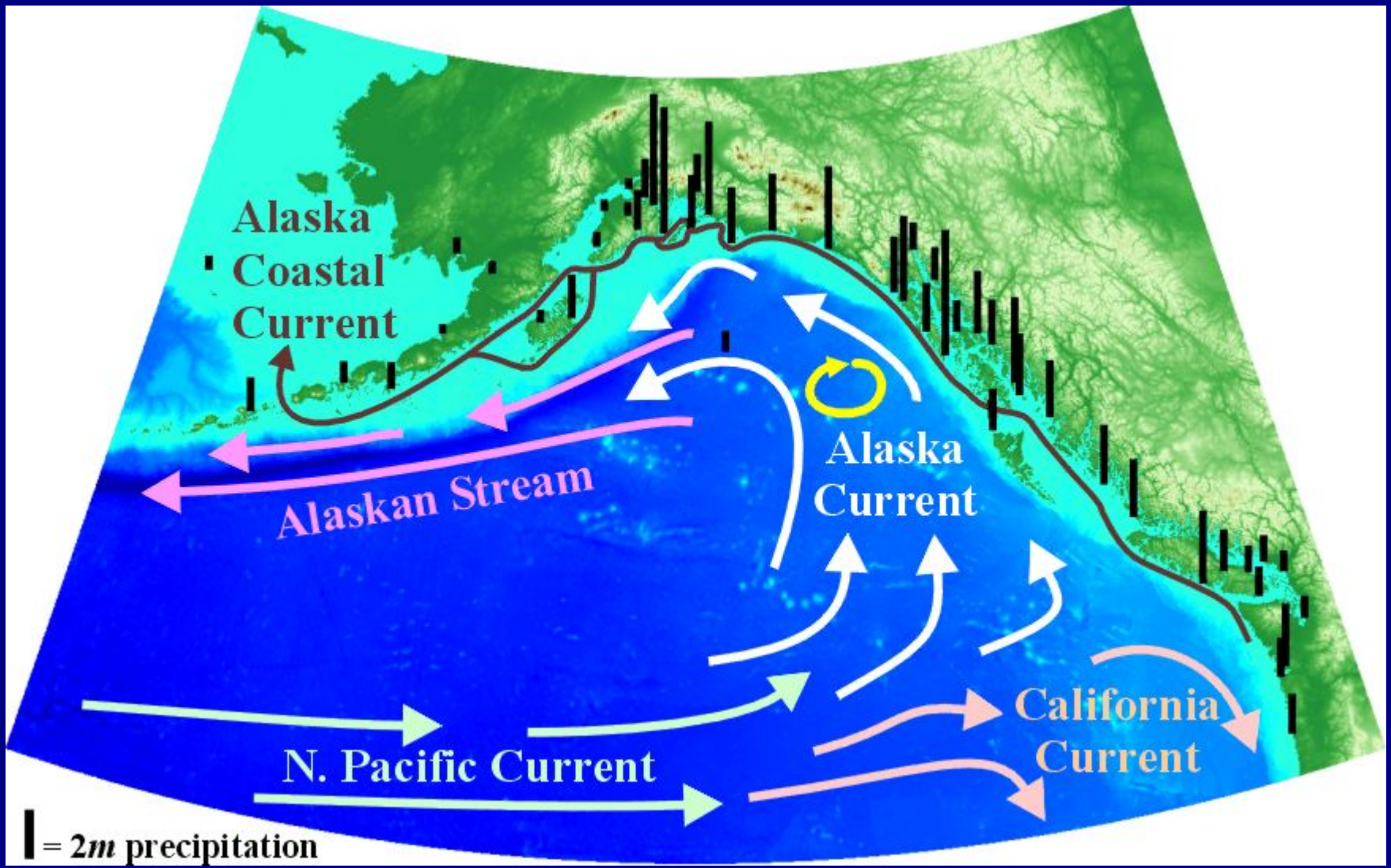


Evidence for Climate Connections to Salmon Catch?



(figure courtesy of F. Schwing)

Introduction: Gulf of Alaska Circulation



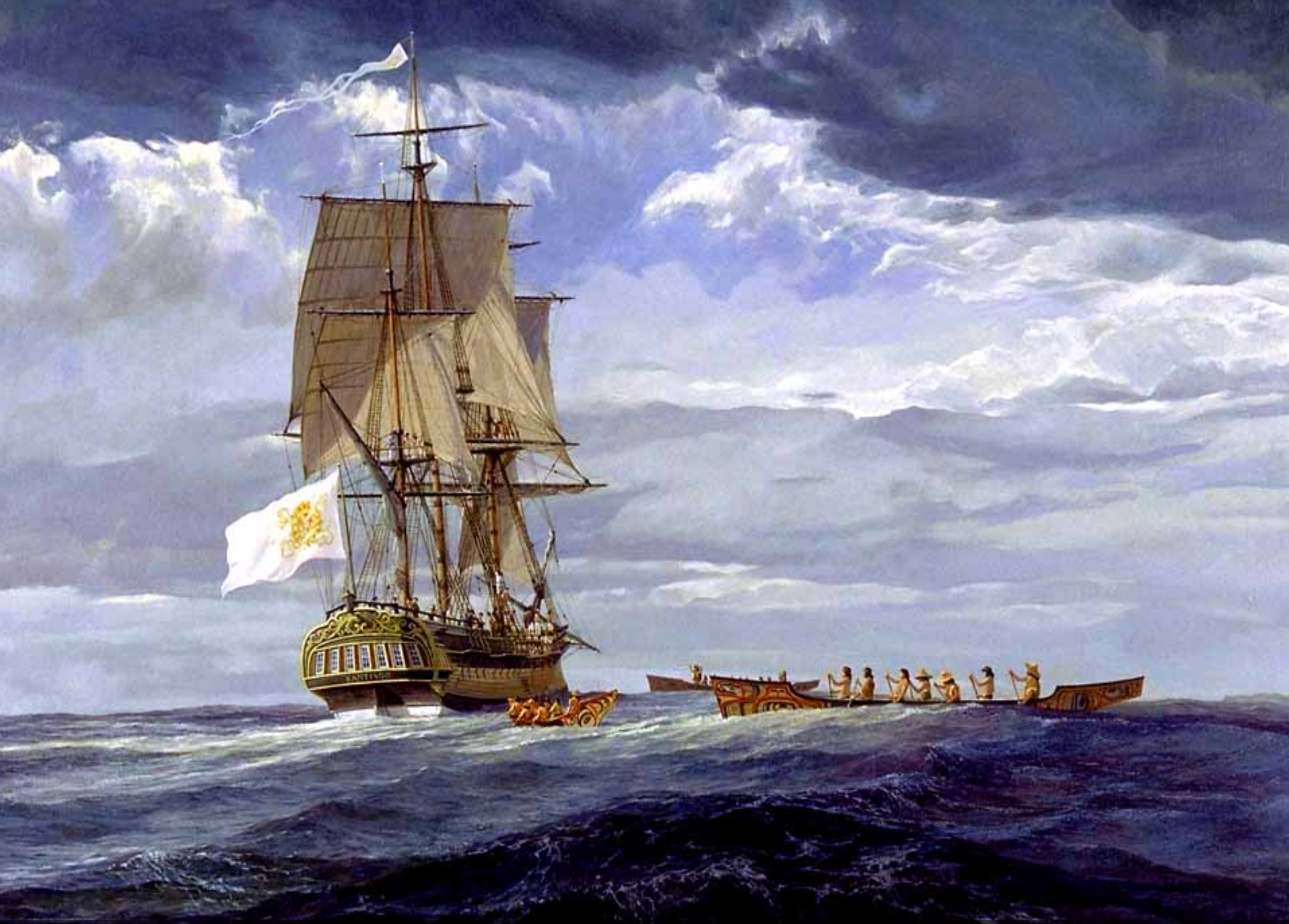
• The **Alaska Coastal Current** is a wind and buoyancy driven coastal current directly influencing the distribution of freshwater, biota and pollutants around the Gulf of Alaska

A REVIEW OF THE PICES CLIMATE CHANGE AND CARRYING CAPACITY (CCCC) PROGRAM

R. Ian Perry — **Fisheries & Oceans Canada, Pacific Biological Station, Nanaimo, B.C.**

Anne B. Hollowed — **NOAA, Alaska Fisheries Science Center, Seattle, WA**

Takashige Sugimoto — **Ocean Research Institute, University of Tokyo, Tokyo**

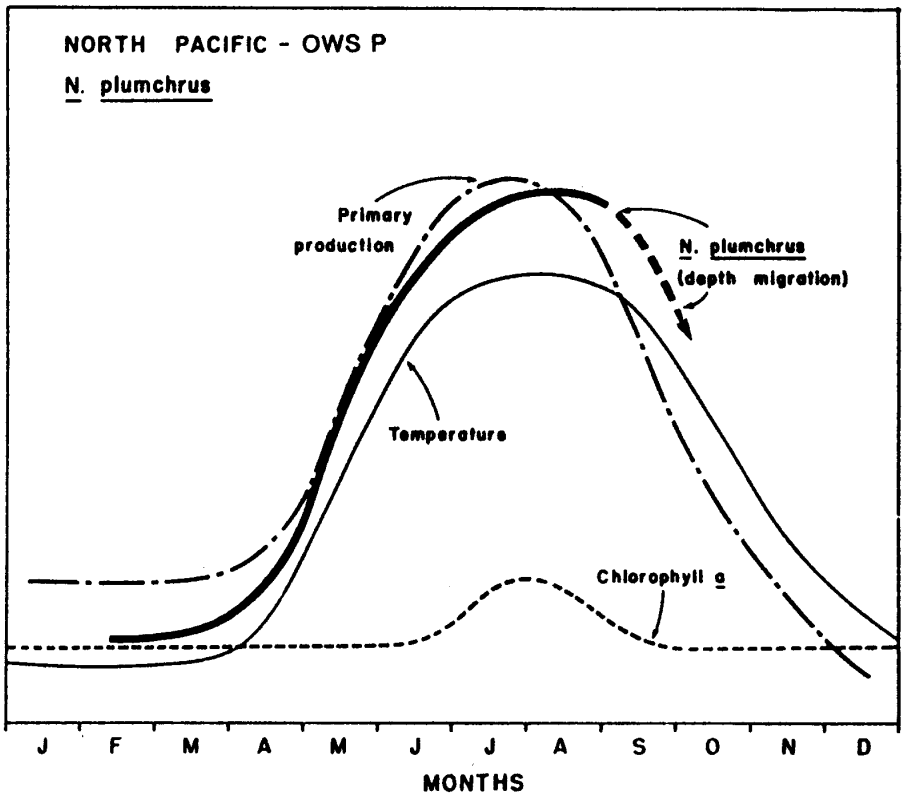


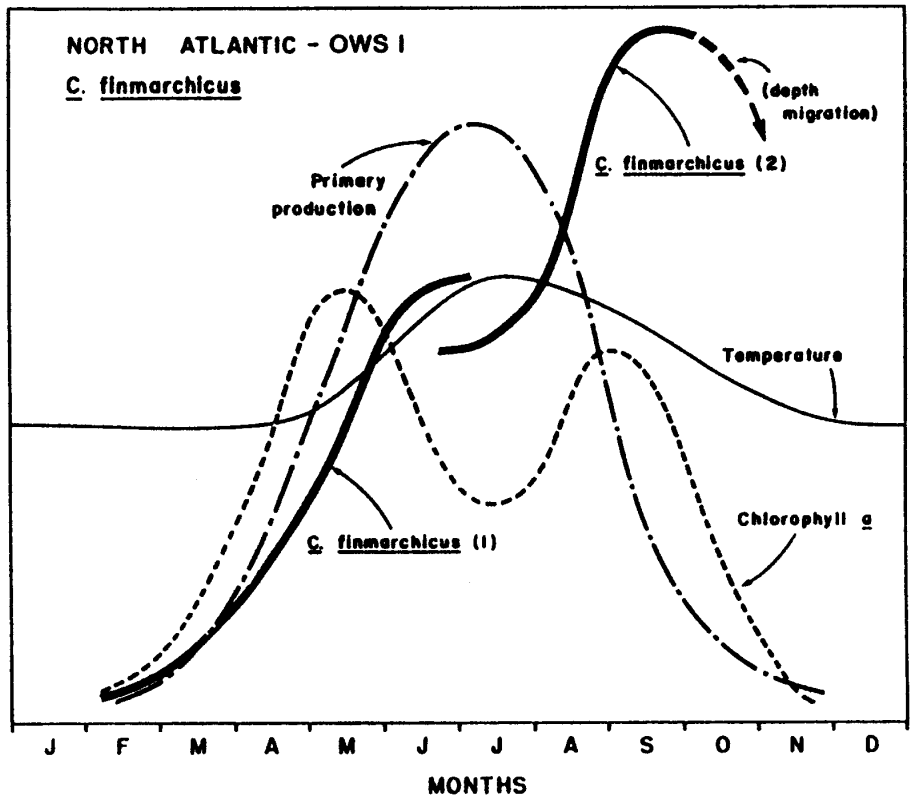
"The Santiago", Gordon Miller (1997), with permission (source: Canadian Museum of Civilisation)

Abundance estimates of marine mammals in the North Pacific prior to industrial exploitation

Large whales:	
Blue	**5,000**
Humpback	**63,000**
Sperm	**1,250,000**
Gray	**15,000**
North Pacific Right	**?**
Sea otters:	**300,000**
Fur seals (Bering Sea)	**3,000,000**

1960's-1970's view: Ecosystems in the NE Pacific functioned differently from NW Pacific and North Atlantic.





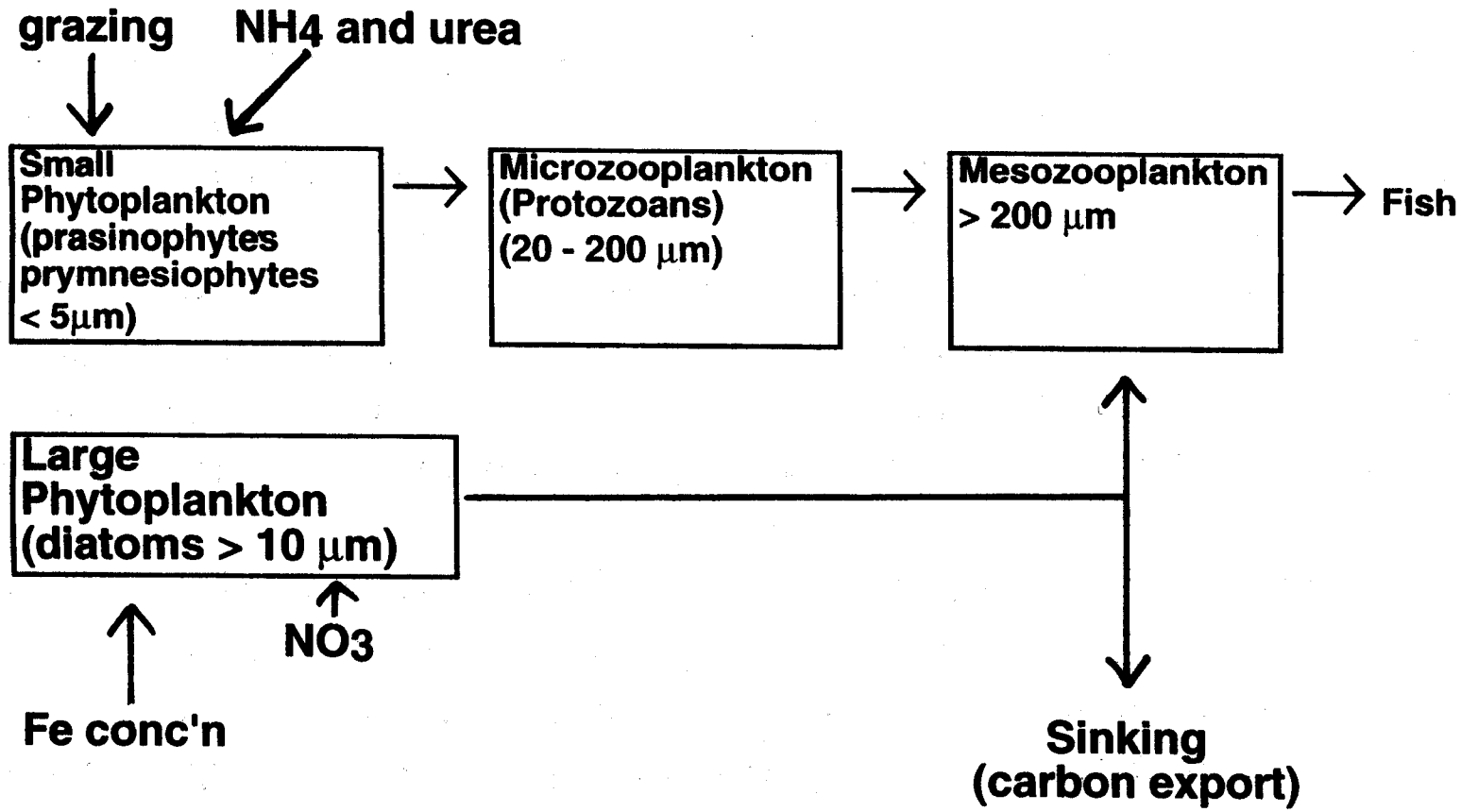
Source: Parsons and Lalli. 1988. *Oceanogr. Mar. Biol. Ann. Rev.* 26:317-359

Historical views of the natural history / science of the North Pacific:

20 years later, in the 1990's, the view of the North Pacific changed again, with a different understanding of:

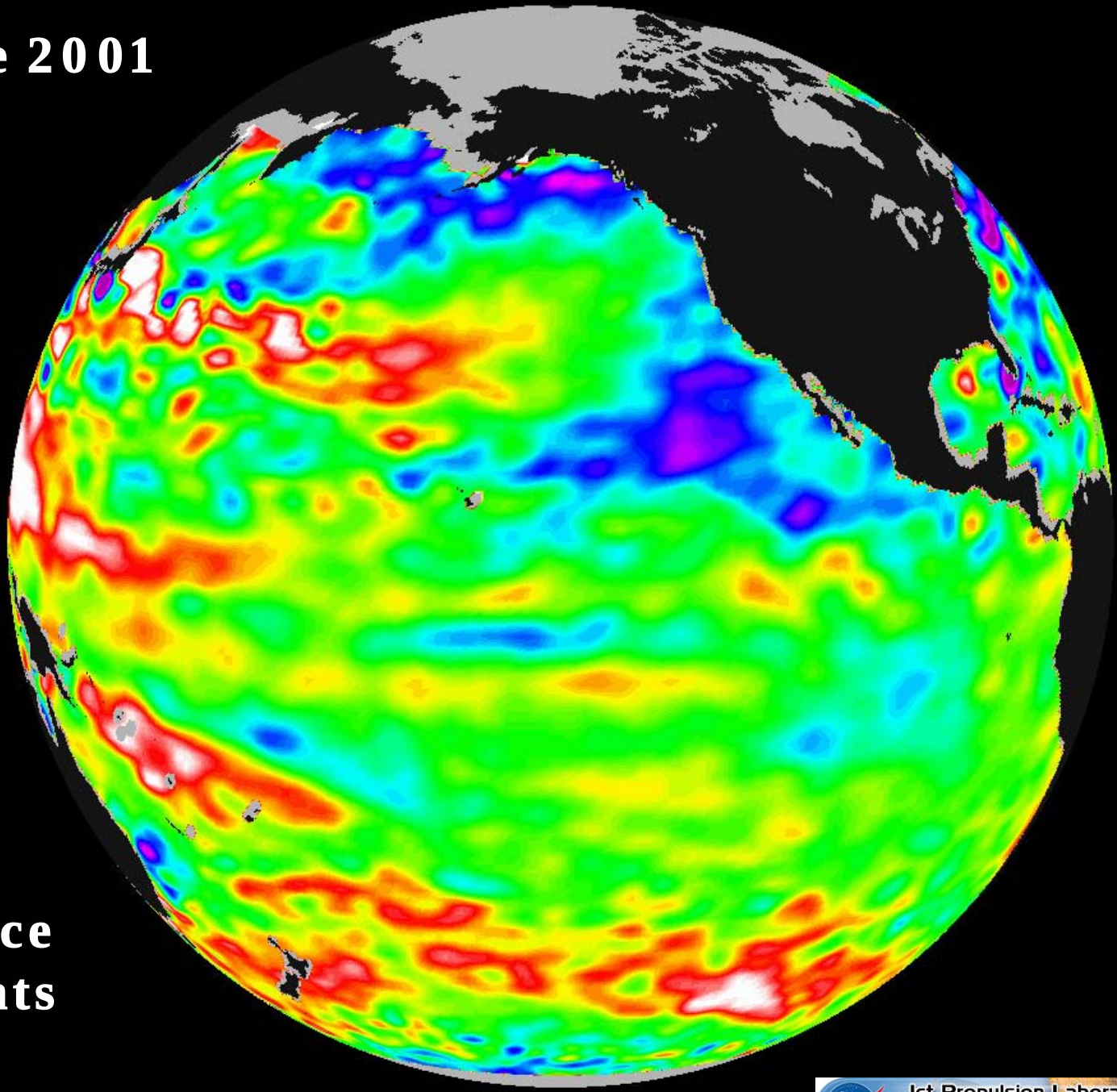
1) **why the North Pacific is a High Nutrient - Low Chlorophyll region**
2) **the extent of connections across basins and with the atmosphere**
3) **the connections between environmental changes and marine populations**

Simple food web at Station P, showing bottom up control of large phytoplankton by Iron (Fe), and top down control of small phytoplankton by microzooplankton grazing



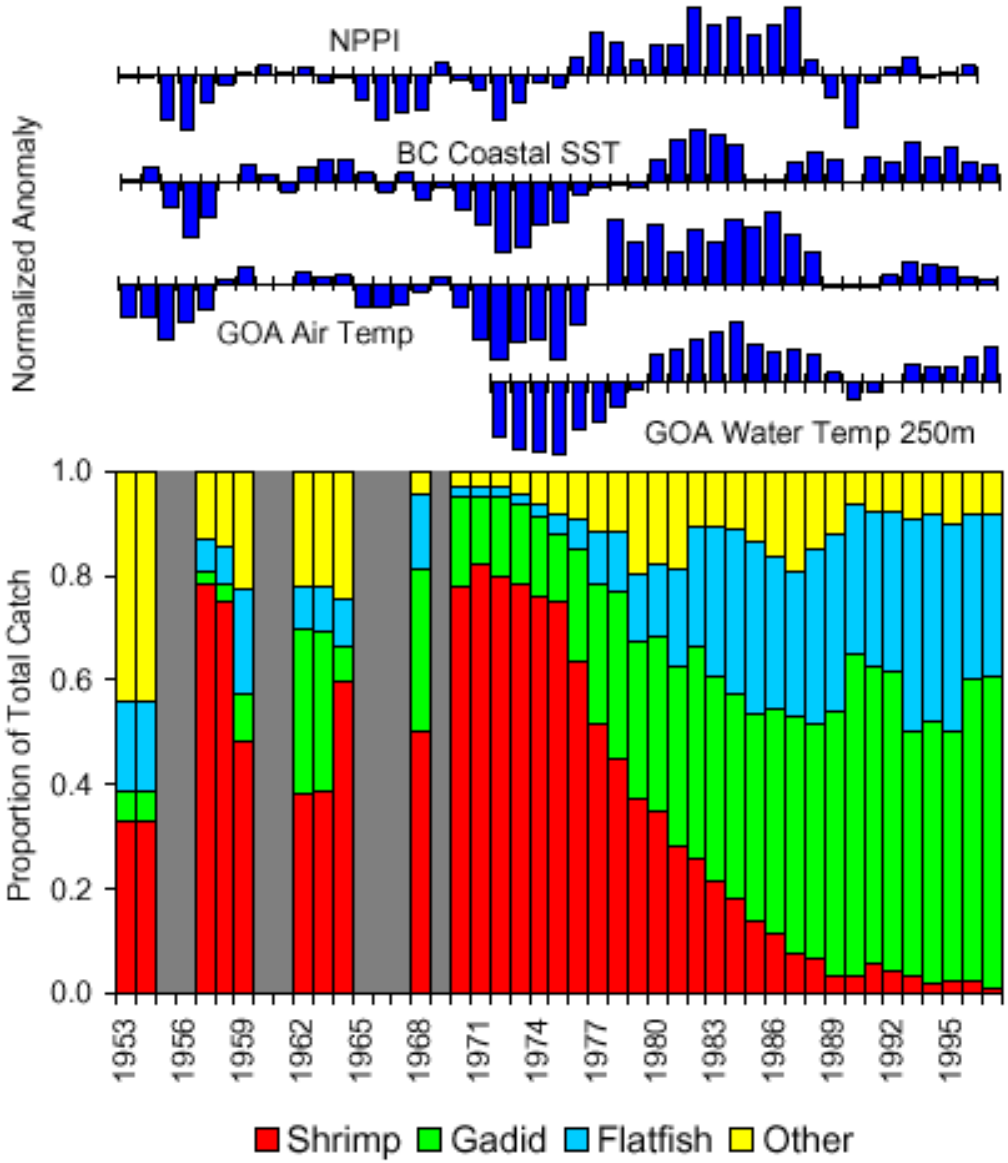
Source: Harrison *et al*. 1999. *Progr. Oceanography* 43: 205-234.

7 June 2001



Sea Surface Heights

Jet Propulsion Laboratory
California Institute of Technology



Connections of living marine resources with large-scale climate indices:

Changes in large-scale environmental indices and species composition from Alaskan small-mesh trawl surveys

Source: Anderson and Piatt. 1999. *Mar. Ecol. Progr. Ser.* 189: 117-123.

Major Question:

How has the PICES Climate Change and Carrying Capacity Program (CCCC) contributed to this recent view of the ecosystems of the North Pacific?

PICES Climate Change and Carrying Capacity (CCCC) Program:

- **Governing Council approved development of a CCCC Program at the 2nd Annual PICES Meeting (1993)**
  - **Scientific program would include *(Annual Rept. 3rd Meeting):***
    1) **a strategy for determing the carrying capacity for High Trophic Level carnivores in the subarctic Pacific**
    2) **a plan for a cooperative study of how changes in ocean conditions affect the productivity of key fish species in the subarctic Pacific and the coastal zones of the Pacific Rim**

PICES Climate Change and Carrying Capacity (CCCC) Program:

- **Science Plan (1994); Implementation Plan (1995)**
- **Ultimate goal:**

  "to forecast the consequences of climate variability on the ecosystems of the subarctic Pacific" (*Implementation Plan*)

General Question:

"How do interannual and decadal variations in ocean conditions affect the species dominance, biomass, and productivity of the key zooplankton and fish species in the ecosystems of the PICES area?" (*Implementation Plan*)

In 1997 , the Terms of Reference for the CCCC Program were revised to:

1) integrate and stimulate national activities on the effects of climate variations on marine ecosystems of the subarctic North Pacific

2) determine how the PICES Scientific Committees and Working Groups can support the program;

3) identify national / international research programs with which CCCC could coordinate

4) provide scientific direction

3 Task Teams (established 1995):

MODEL	**advance the development of conceptual / theoretical and modelling studies**
BASS	**develop the basin scale component of CCCC**
REX	**develop intercomparisons among regional (National) studies**

MONITOR Task Team (established 1997)

1) review and suggest improvements to monitoring by PICES Nations

2) consult on designing the PICES monitoring system (calibrations, standardisation, etc.)

3) assist with development of a coordinated monitoring program to detect and describe events that strongly affect the subarctic Pacific

4) report to CCCC on the montoring needs in the subarctic Pacific to be implemented in GOOS (Global Ocean Observing System)

Major Accomplishments MODEL

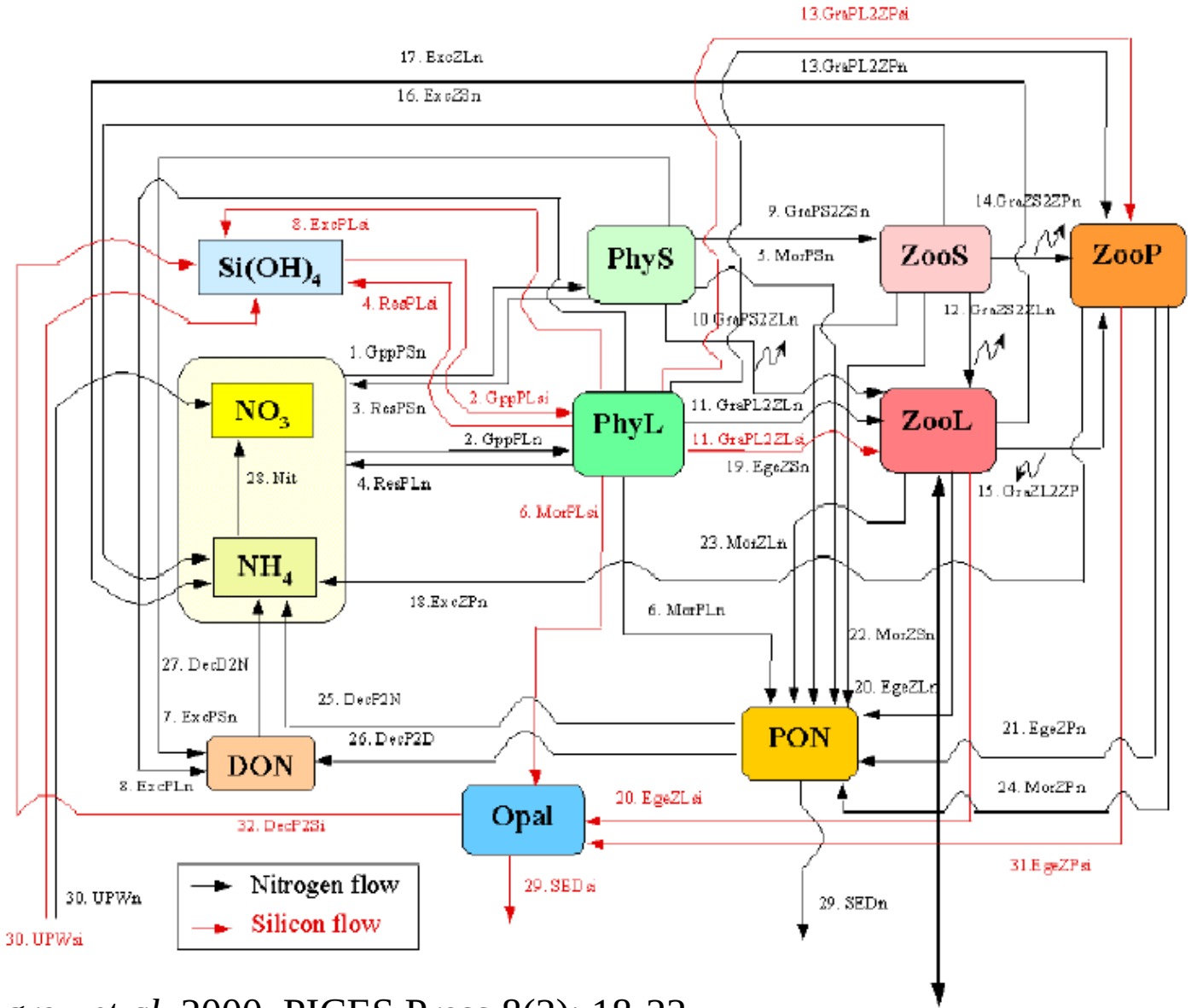
1) identification of modelling needs of the CCCC scientific community:

   - development of Lower Trophic Levels models, and coupling them with physical models and Higher Trophic Level models, lagged behind development of physical models

2) development of the Lower Trophic Level NEMURO model

   - refinements and testing of NEMURO
   - work with BASS to couple NEMURO model to High Trophic Level models (ECOPATH / ECOSIM)
   - work with REX to couple NEMURO model with pelagic fish (e.g. herring) dynamics

NEMURO "North Pacific Ecosystem Model for Understanding Regional Oceanography"



Source: Megrey *et al.* 2000. PICES Press 8(2): 18-22.

Major Accomplishments **BASS**

1) Science Board symposium on "Comparing Eastern and Western Gyres of the Subarctic Pacific"

2) Advisory Panel on an Iron Fertilisation Experiment (IFEP) in the subarctic Pacific

3) BASS - MODEL workshop on Lower Trophic Level / Upper Trophic Level model coupling

Major Accomplishments **BASS**

1) Science Board symposium on “Comparing Eastern and Western Gyres of the Subarctic Pacific”

2) Advisory Panel on an Iron Fertilisation Experiment (IFEP) in the subarctic Pacific

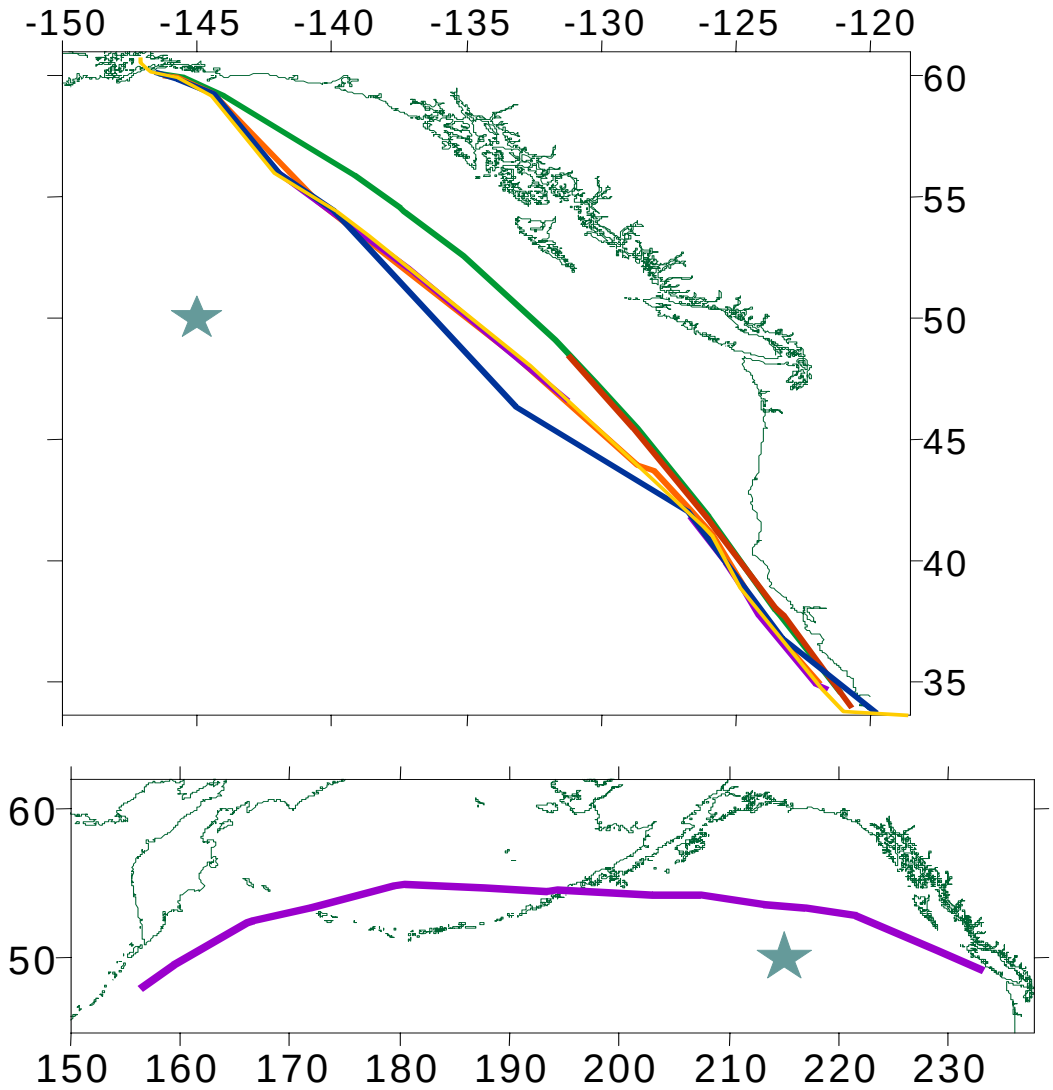
3) BASS - MODEL workshops on Lower Trophic Level / Upper Trophic Level model coupling

Major Accomplishments **MONITOR**

1) Science Board symposium on "The Nature and Impacts of North Pacific Climate Regime Shifts" (published in *Progress in Oceanography*)

2) GOOS workshop, and role as a contact with GOOS in the Pacific

3) Advisory Panel on the Continuous Plankton Recorder (CPR) program, and establishment of a pilot project



North Pacific CPR Routes (pilot project), 2000

Figure 2. The positions of the transects operated in 2000.
(a) Monthly N-S and (b) E-W in June. Key to colours: March (Green), April (Red), May (Brown), June (Violet), July (Blue), August (Orange). Station Papa is shown for reference (Star).

Major Accomplishments REX

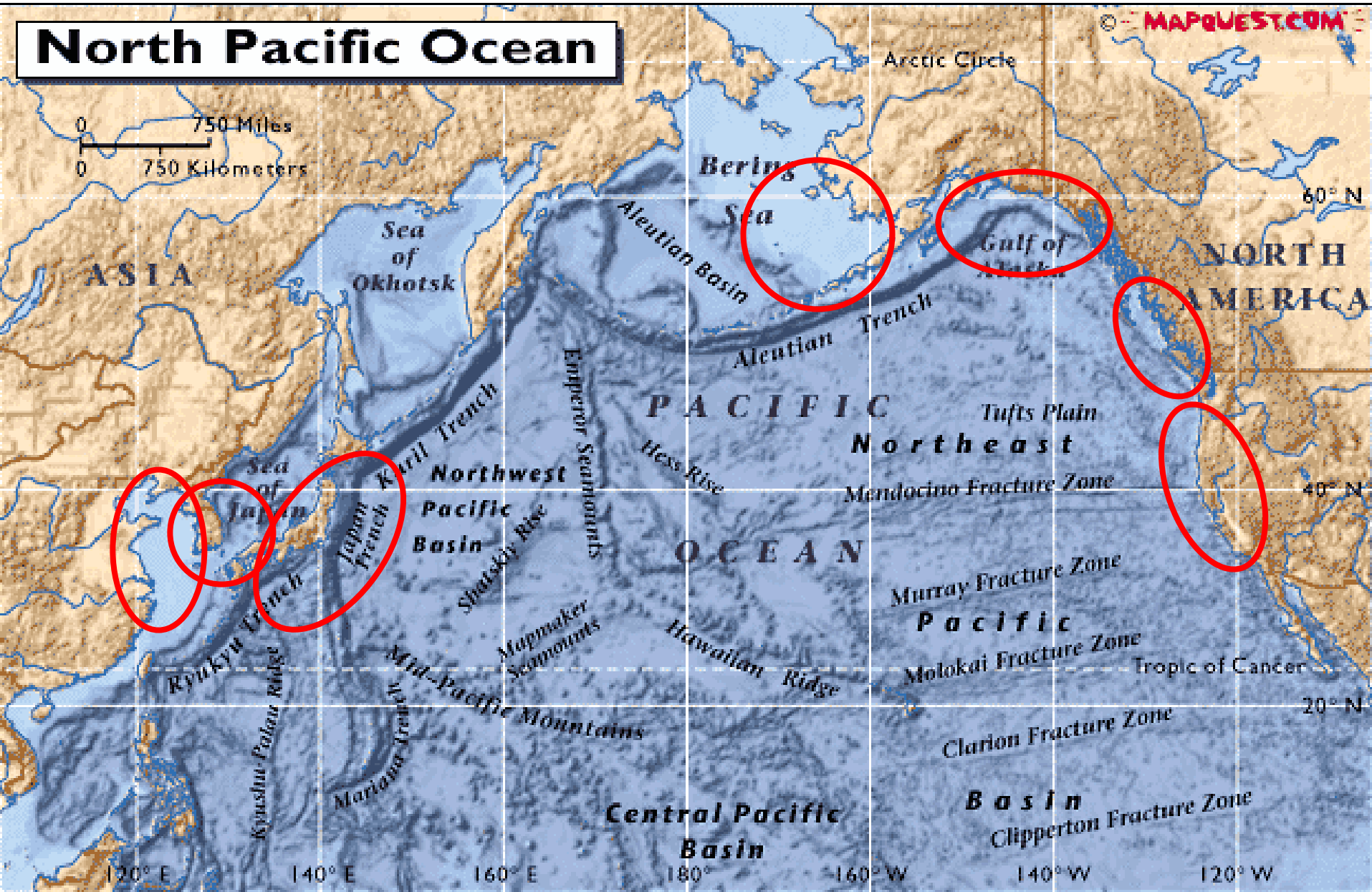
- initially expected to develop “regional experiments” among the 10 identified regions of the Pacific continental margins

1) very active initially as a forum for discussion and information exchange on the needs and developments of National programs

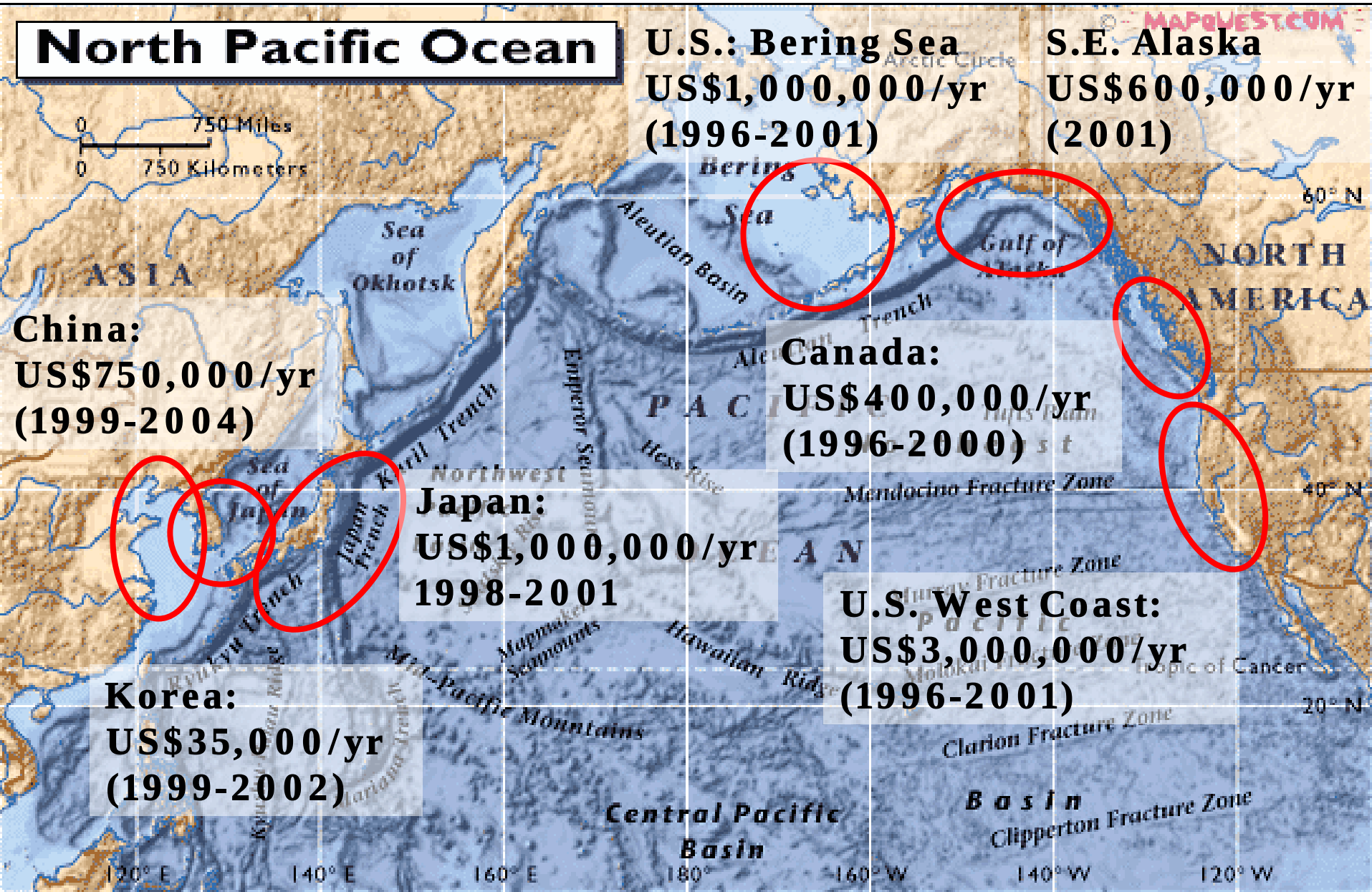
2) recently developed a workshop series on small pelagics - especially herring, and has been assembling data on life history patterns across the Pacific basin

    - 2001 symposium: “Temporal variations in size-at-age for fish species in coastal areas around the Pacific rim”

Locations of Regional (National) CCCC-related Programs of PICES Member Nations



Funding of Regional (National) CCCC-related Programs of PICES Member Nations



PROBLEMS:

1) Heavy administrative structure:

	Number of Members
CCCC EC/IP	≥ 10
CCCC IP	27
BASS	12
IFEP Panel	16
MODEL	16
MONITOR	17
CPR Panel	14
REX	13
Total "Positions" (not people, as some people have >1 position)	≥ 125

Problems:

1) Heavy administrative structure

2) Lack of direct funding to the PICES CCCC Program

- Program elements are funded separately by each Nation, which set their own priorities
- Result: CCCC program identifies an overall structure, but each element is assembled from the Nationally-funded programs
    - This leaves gaps and missing pieces
- BUT: the CCCC Program has encouraged a tremendous infusion of new resources to be devoted to Science in the North Pacific Ocean

How has the CCCC program contributed to the 1990's changed view of the North Pacific?

- Further understanding of what drives Lower Trophic Level productivity and its consequences
  - NEMURO model, connections with Upper Trophic Level models; IFEP project
- Much improved understanding of similarities, differences, and connections among East and West subarctic Pacific, and with atmospheric forcing
  - BASS symposium and publication; Regional programs
- Understanding of the large (basin) scale synchrony of marine populations, and how they are connected to atmospheric and oceanographic processes
  - MONITOR symposium and publication; CPR Program; REX workshops

Has the CCCC program been a success or a failure?

Answer depends on what is believed as its principal objective:

- **to stimulate and integrate programs on climate variations and marine ecosystems in the North Pacific?**
  - **Answer must be** **Outstandingly Successful**

- **to initiate a cooperative study with its own observational program of how changes in ocean conditions affect lower & upper trophic levels?**
  - **Answer is** **Less Successful**

Program gets poor marks on

- **integrating with other PICES Committees**
- **coordinating data management issues in CCCC**

FUTURE DIRECTIONS:

- **revise Adminstrative structure:**
  - **disband Implementation Panel; combine REX & BASS**

- **improve synthesis and coordination, with perhaps re-focusing of the Objectives**
  - **use the Ecosystem Status Report project as a means to summarise what we know, and identify key unknowns that need study**
  - **integration with GOOS**

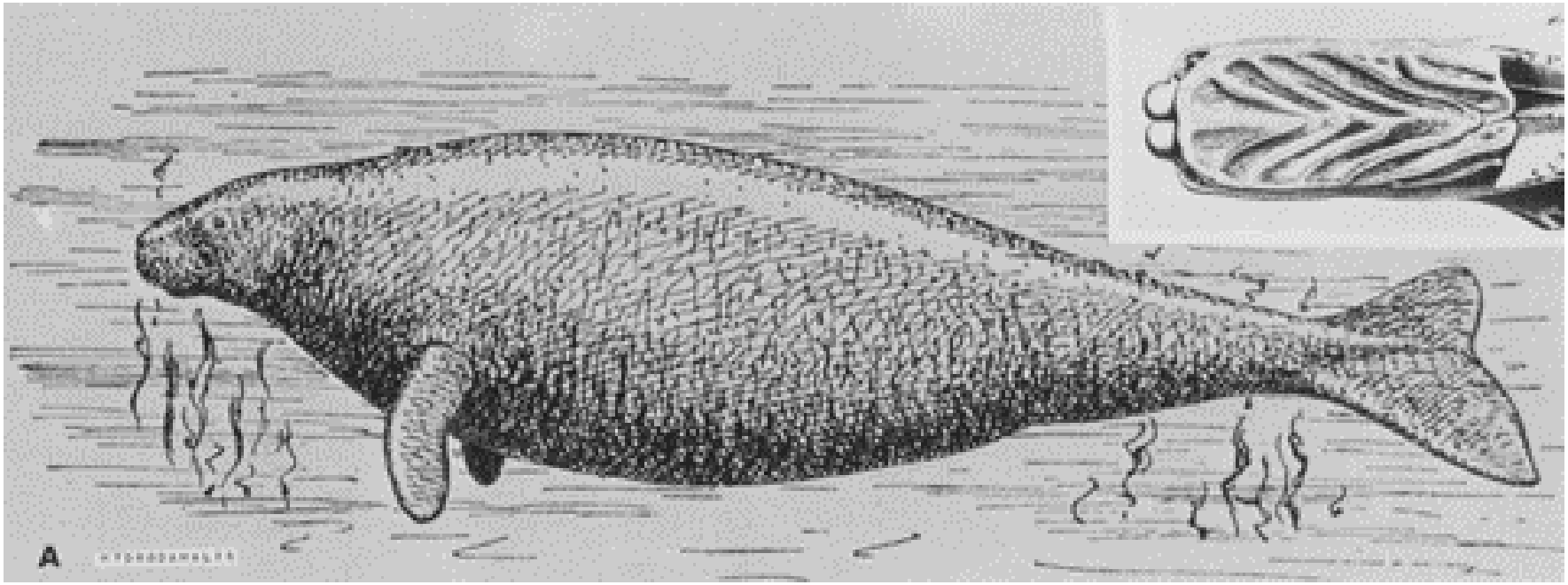
- **terminate program and start something new?**

FUTURE DIRECTIONS (CONT.)

- **PICES should serve as a source of scientific information on issues related to the North Pacific**
  - **model is Intergovernmental Panel on Climate Change (IPCC)**
  - **CCCC could be the start of this for climate impacts, and our ability to distinguish these from more direct human forcing**

Historical views of the natural history / science of the North Pacific:

- **at the time of European contact (mid-1500's in Japan; mid/late 1700's in North America), the peoples of the North Pacific were highly maritime-adapted societies**



Steller's sea cow *(Hydrodamalis gigas):* Photo from *Extinct and Vanishing Mammals of the Western Hemisphere*, Glover M. Allen.; inset: steller's sea cow's palate, from *Symbolae Sirenologicae*, drawing by J.F. Brandt.

Extra Slide

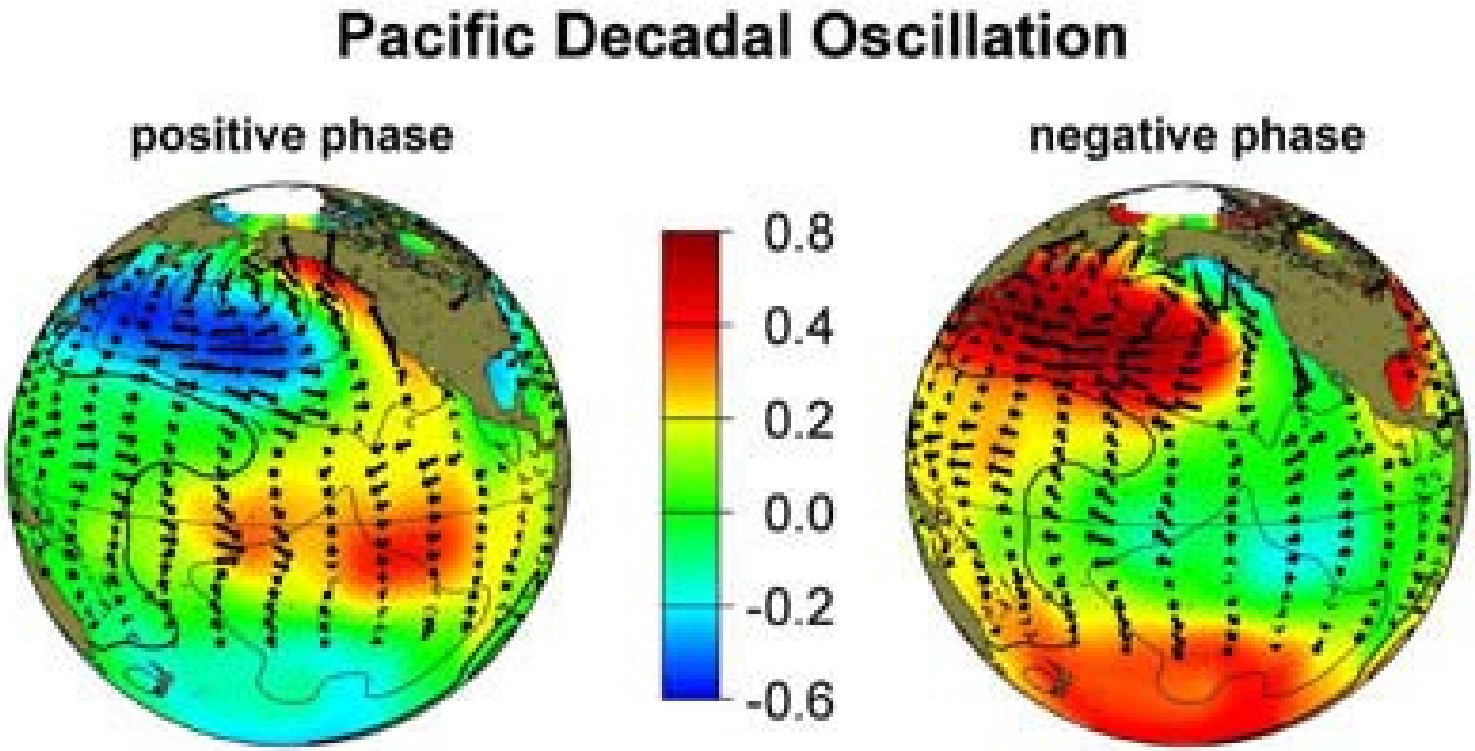


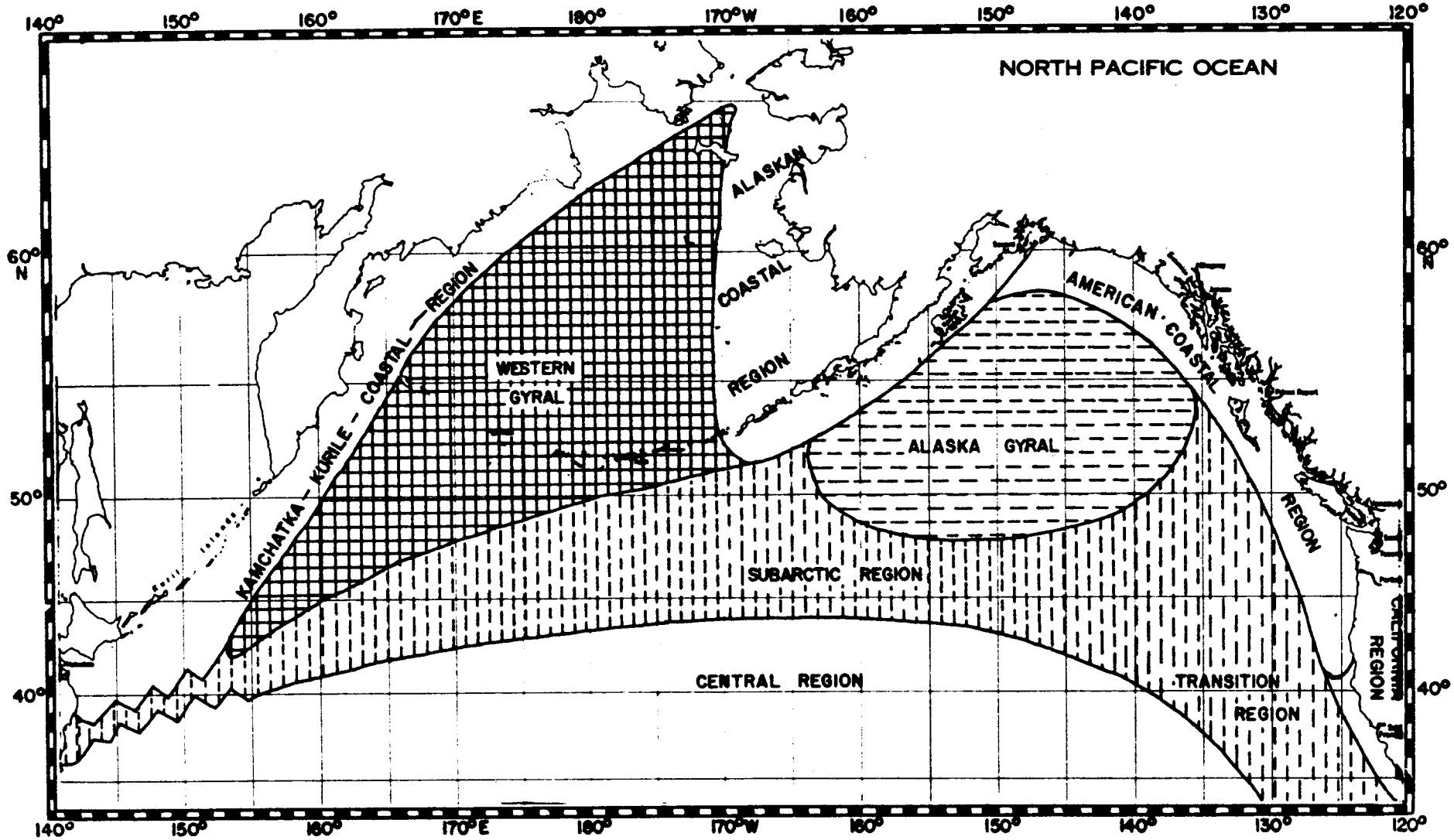
Image courtesy of Stepen Hare and Nathan Mantua, University of Washington, units are degrees Celsius, via JPL website

"The Strike", Bill Holm (1995); with permission of Canadian Museum of Civilisation

Source: “Sea Hunters”, Gordon Miller (1993); by permission Canadian Museum of Civilisation

Historical views of the natural history / science of the North Pacific:

- **200 years later, in the 1960's and 1970's, the view of the North Pacific had changed**



Source: Dodimead, Favorite, Hirano. 1963. INPFC Bull 13

Volume 47 Numbers 2–4 2000

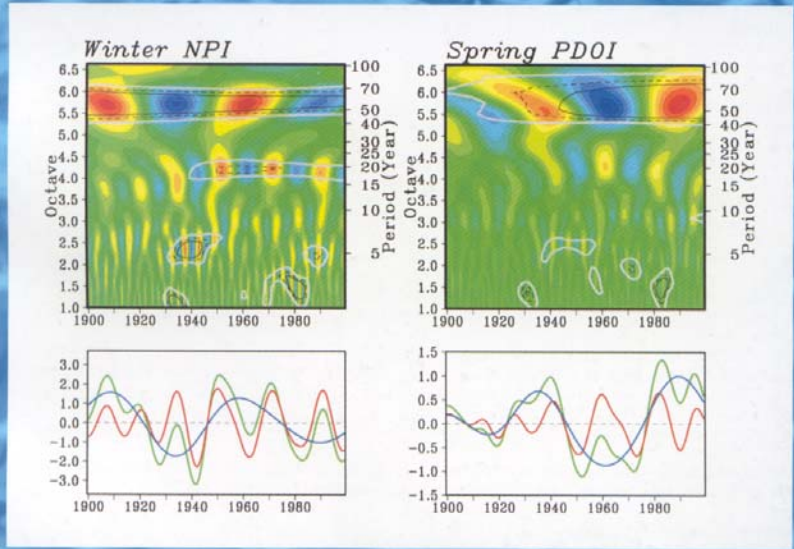
ISSN 0079-6611

Progress in Oceanography

Editors • **Martin V Angel and Robert L Smith**

Special Issue

NORTH PACIFIC CLIMATE
REGIME SHIFTS
Guest Editors
STEVEN R. HARE, SHOSHIRO MINOBE
and WARREN S. WOOSTER



PERGAMON
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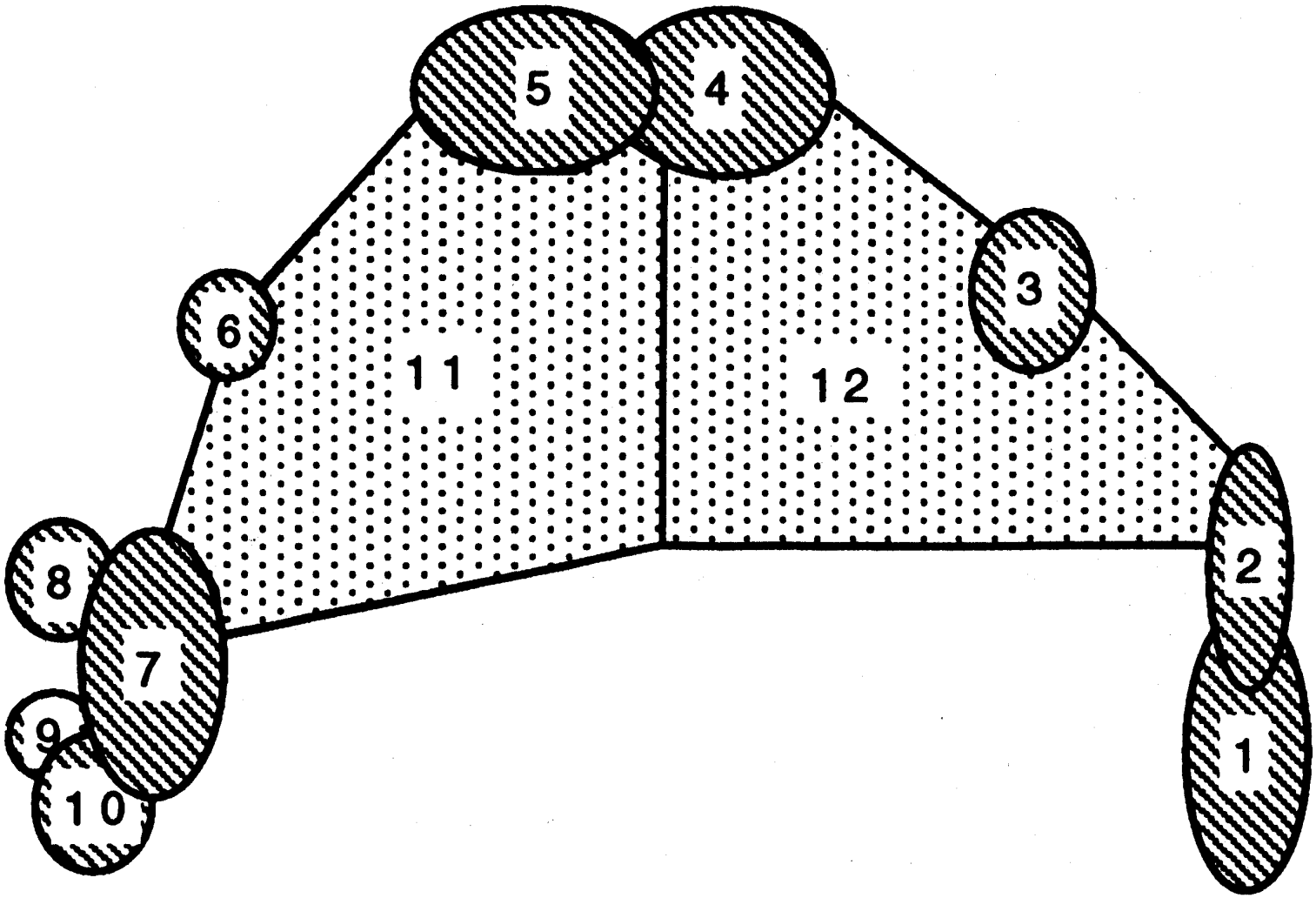
http://www.elsevier.com/locate/pocean

Original view of CCCC Regions for GLOBEC experiments



Regional Programs - China

"Ecosystem Dynamics and Sustainable Utilization of Living Resources in the East China Sea and Yellow Sea"

Program goals:

- **identify key processes of ecosystem dynamics, and improve predictive and modelling capabilities in the East China Sea and the Yellow Sea;**
- **provide scientific underpinnings for sustainable utilization of marine ecosystems and the rational management of fisheries and other marine life**

12 projects

$4.5 million over the period 1999-2004

Regional Programs - Korea

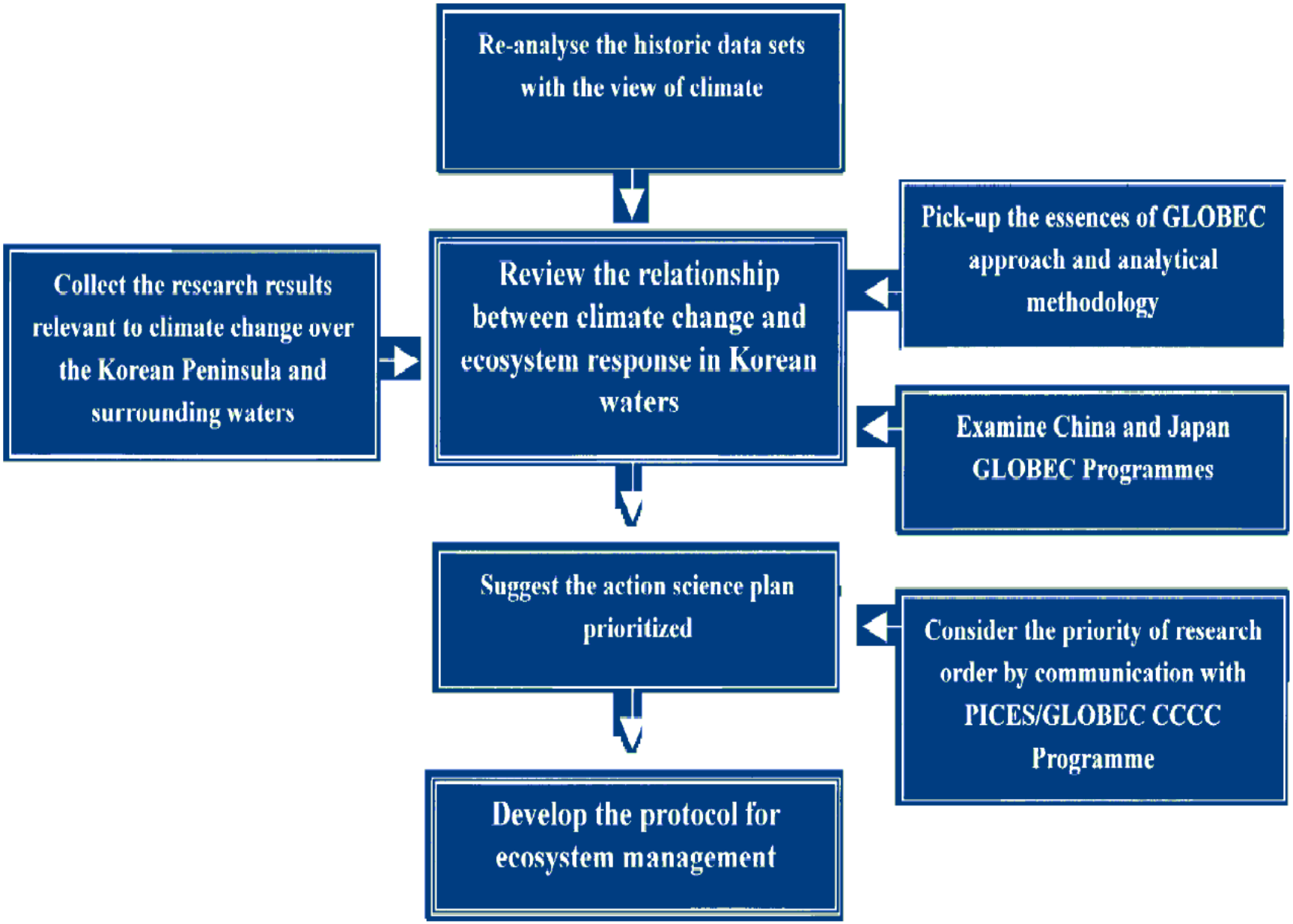
Overall Program goal:

"to provide a long-term science and strategic plan for Korean waters to establish effective and resonable conservation and sustainable measures for fisheries and ecosystem management"

US$100,000 for period 1999 - 2002

Several Task Teams formed to review: Retrospective data; scientific program development; capacity building; and fisheries & ecosystem management approaches

Organisation of Korea GLOBEC program



Regional Programs - Japan

Please insert a few comments here along the lines of previous Regional Program slides

Please try to keep to 1-2 pages max

Regional Programs - United States

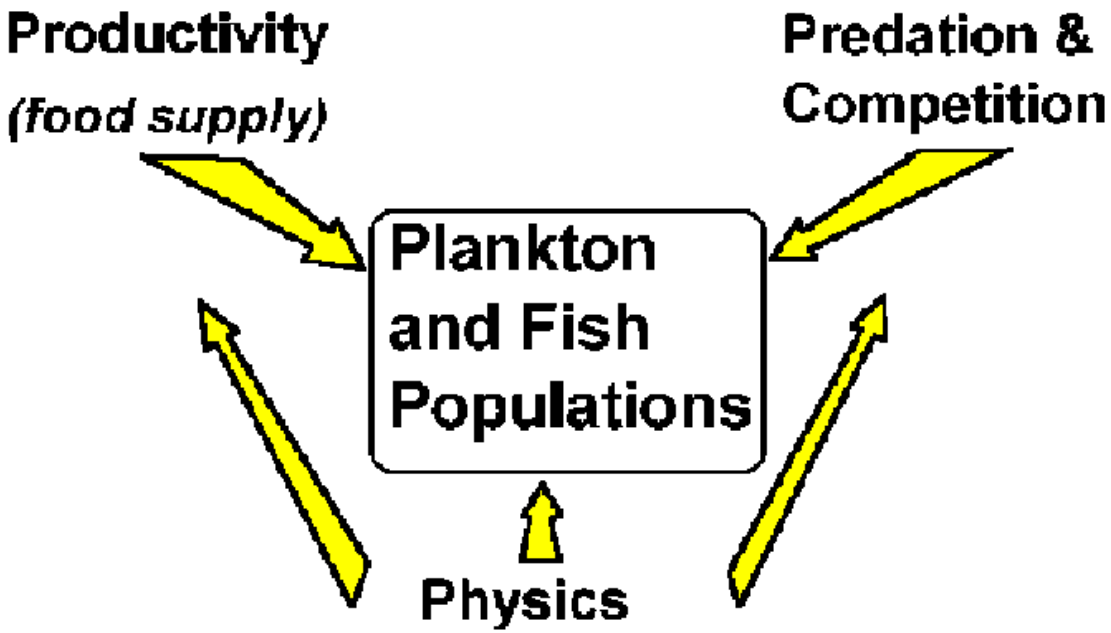
Please insert a few comments here along the lines of previous Regional Program slides

Please try to keep to 1-2 pages max

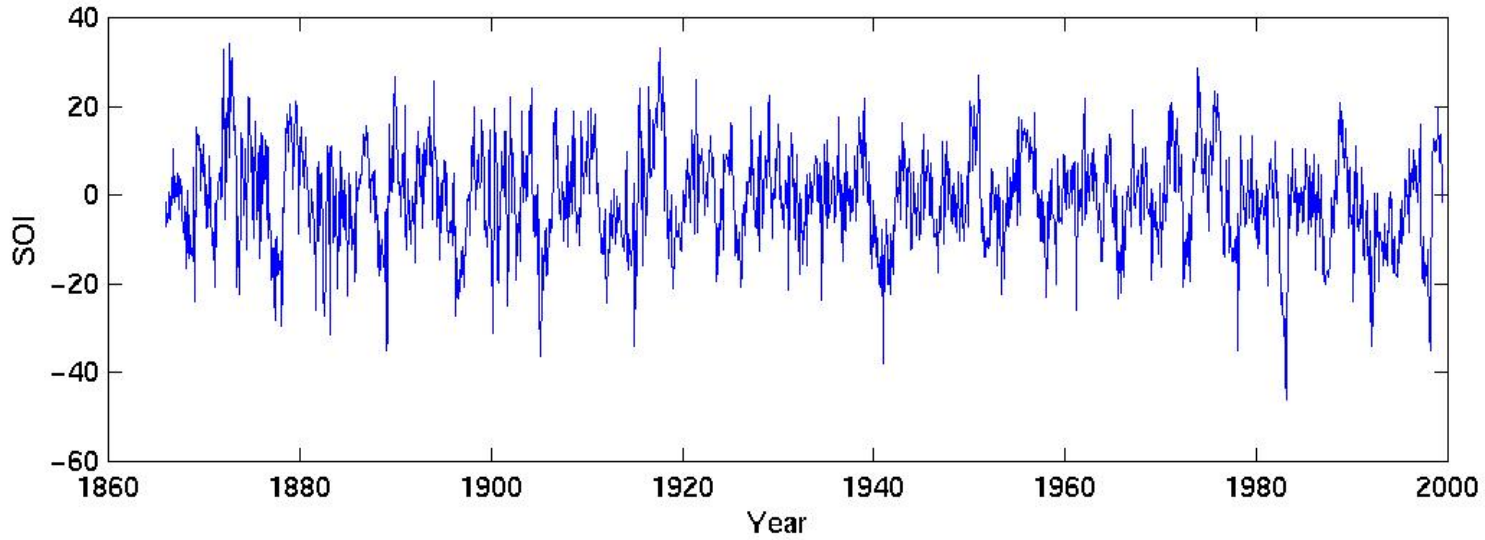
Regional Programs - Canada

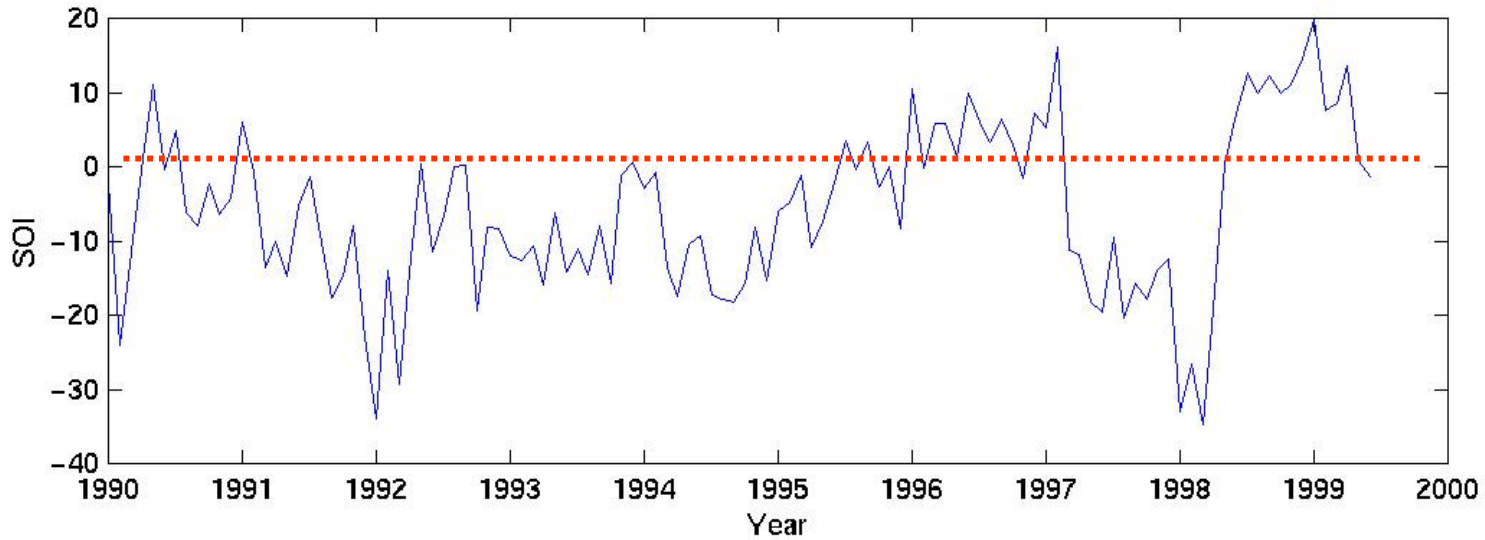
Key Issues:

- **seasonality and timing matches between physics and biology**
- **freshwater inputs, and effects on mixing and transport**
- **advective coupling among continental shelf, margin and deep ocean**
- **interaction between zooplankton and fish populations**



About Cdn$600,000 over the period 1996-2000





SOI=10*(Pdiff – Pdiffave)/SD(Pdiff)

Pdiff=Tahiti SLP–Darwin SLP; Pdiffave=long-term mean diff; SD(Pdiff)=long-term SD

PICES Study Group on Future Integrative Scientific Program

SG tasks are to:

- Solicit ideas for a new integrative program
- Review and assess potential themes of broad interest
- Solicit feedback from the PICES community
- Provide recommendations to GC

SGFISP – Future Directions in Establishing a New Program

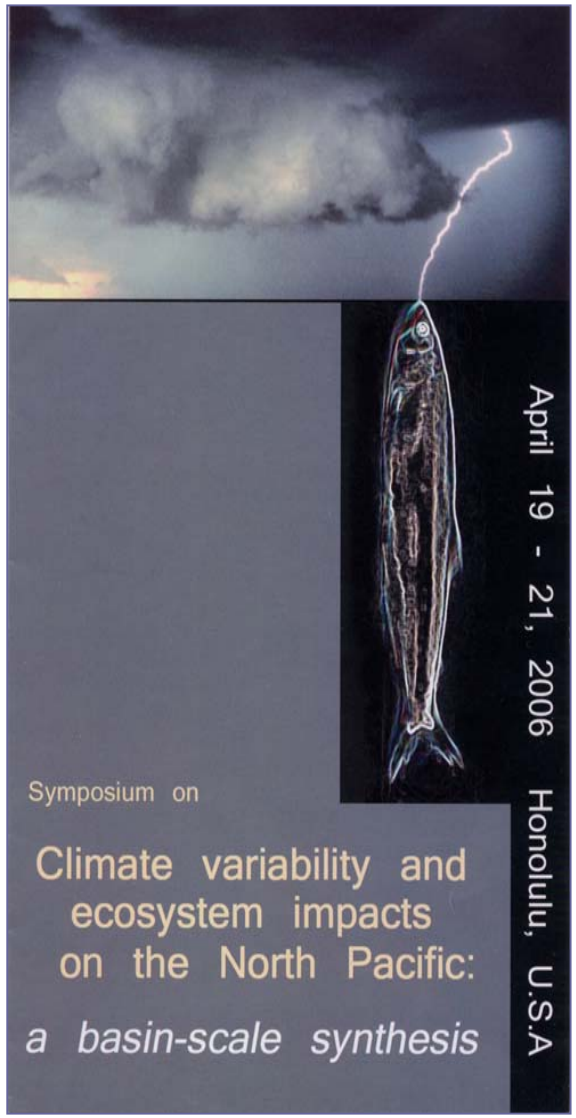
- Build upon the successful CCCC program
- Move from climate variability to global change
- Bring climate into management models
- Key Elements – Forecasts, human dimension, mechanisms, scenarios

SGFISP – A Possible Name?

- FUTURE
  - **F**orecasting and
  - **U**nderstanding
  - **T**rends,
  - **U**ncertainty and
  - **R**esponses of
  - **E**cosystems

Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis

- Three Main Themes
  - Regime Shifts
  - Ecosystem Productivity and Structural Responses to Physical Forcing
  - Pan-Pacific Comparisons



MODEL

- LTL models and coupling to physical models and HTL models
- NEMURO – North Pacific Ecosystem Model for Understanding Regional Oceanography (also from workshop held in Nemuro, JP)
  - 11 state variables, incl. Fluxes of both N and Si
- Collaborations with BASS to couple NEMURO to HTL (ECOPATH; ECOSIM)

BASS

- Develop CCCC activities in the deep basins
- Comparison of WSG and ESG
  - Science board symposium (1997)
- Advisory Panel on Iron Fert. Expt (IFEP; 1999)
  - Coordinate an Fe fert. Expt and examine LTL responses (species composition; export flux rates)
- Develop LTL-HTL linkages with MODEL

REX

- REX played an integral role in information exchange in the early development of national GLOBEC-CCCC programs
- Workshop series on small pelagics, esp. herring (life history data; size-at-age)
- Working with MODEL to develop and add a “Fish” box to NEMURO (January 2002 workshop)

MONITOR

- Both backward and forward looking responsibilities
- Retrospective analysis of existing datasets
- Design of future observational systems
- Nature & Impacts of No Pac Regime Shifts
  - Science Board Symposium (1999)
- Fledgling CPR program (Advisory Panel)
  - 5 north-south transects per year (Mar-Aug)
  - 1 east-west transect per year (June-July)

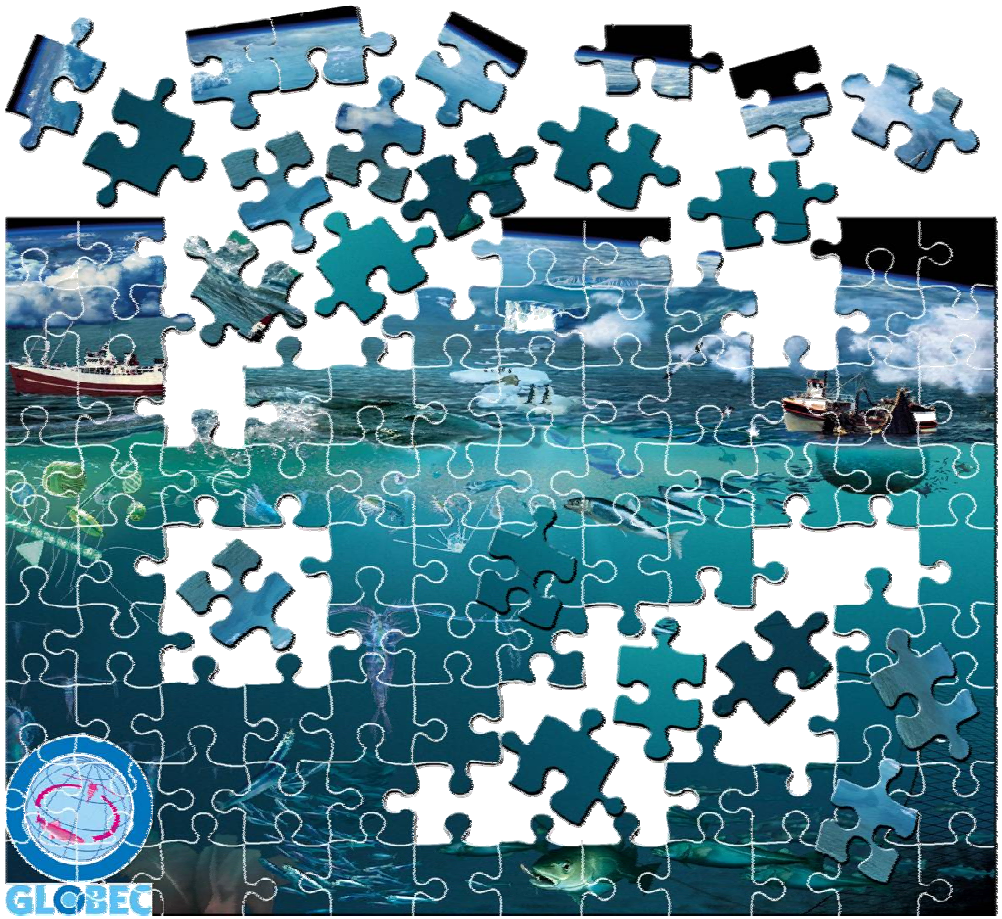
CFAME

- Promote, coordinate, integrate and synthesize research activities related to the CCCC Program through meetings, periodic scientific symposia or workshops;
- Hypothesis testing of model experiments, by providing a forum for interaction between data-gathering and distribution programs (MONITOR) and theoretical experimentation and development (MODEL) groups;
- Test ecosystem-level hypotheses, through review and examination in a collaborative environment, of (i) comparisons between regional and/or basin ecosystems, (ii) linkages in time, space, or seasonality between climate and ecosystems, and (iii) responses of regional ecosystems to basin-scale forcing;

CFAME (2004-)

Integration. The act or process of making whole or entire. The process by which the manifold is compacted into the relatively simple and permanent.

Synthesis. The art or process of making a compound by putting the ingredients together, as contrasted with analysis; thus, water is made by synthesis from hydrogen and oxygen.

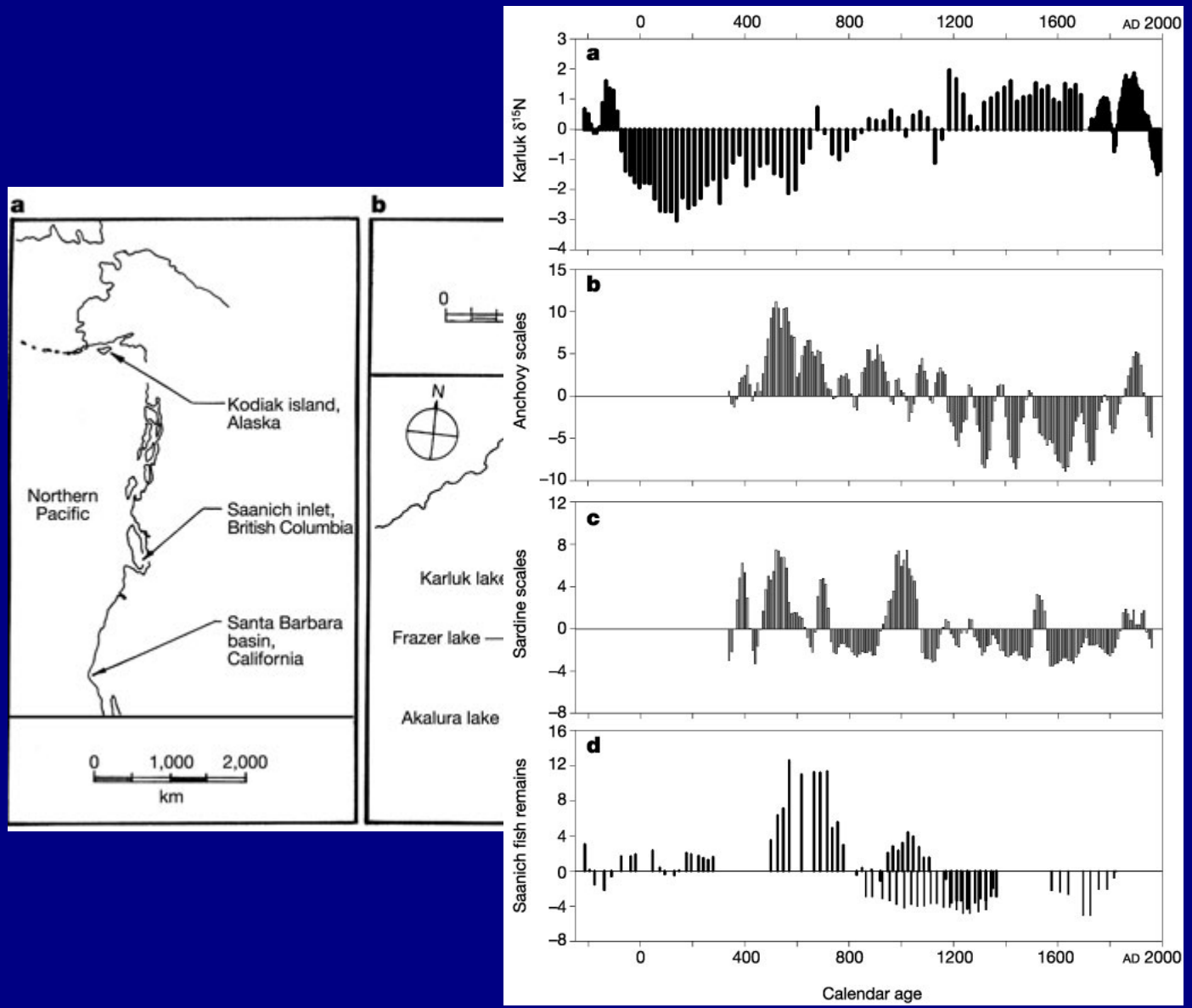


GLOBEC
Integration and Synthesis plans

Cisco Werner
Manuel Barange

Presented to US GLOBEC
Washington, DC, Dec. 2005

GLOBEC
GLOBAL OCEAN ECOSYSTEM DYNAMICS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PICES

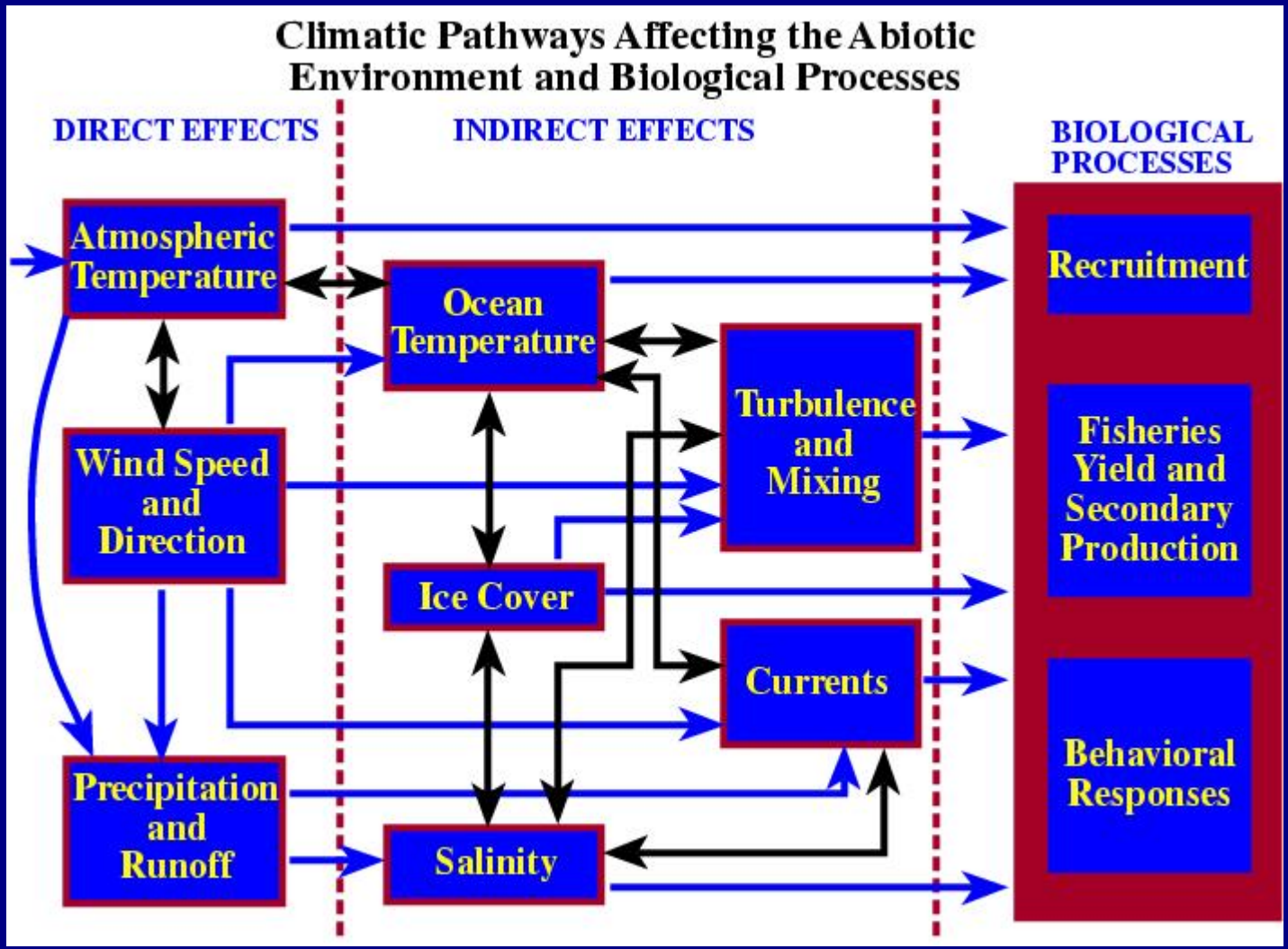
North Pacific Marine Science Organization

An intergovernmental scientific organization that was established and held its first meetings in 1992. Its present members are Canada, People's Republic of China, Japan, Republic of Korea, Russian Federation, and the United States of America.

- Promote and coordinate marine research in the northern North Pacific and adjacent seas especially northward of 30 degrees North

- Advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities

- Promote the collection and rapid exchange of scientific information on these issues


Climatic Pathways Affecting the Abiotic Environment and Biological Processes
DIRECT EFFECTS
INDIRECT EFFECTS
BIOLOGICAL PROCESSES
Atmospheric Temperature
Wind Speed and Direction
Precipitation and Runoff
Ocean Temperature
Ice Cover
Salinity
Turbulence and Mixing
Currents
Recruitment
Fisheries Yield and Secondary Production
Behavioral Responses