PICES Flagship Science Programs: Transition from CCCC to FUTURE

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Today's contents

1. Establishment of PICES
2. Development of CCCC
3. Achievements of CCCC
4. Development of FUTURE
5. FUTURE Phase-I, II, and III

“Looking back to go forward"

by Jackie King (2014)

by looking back to CCCC,
we can understand how we got to where we are
and
how to redirect to go forward with the rest of FUTURE

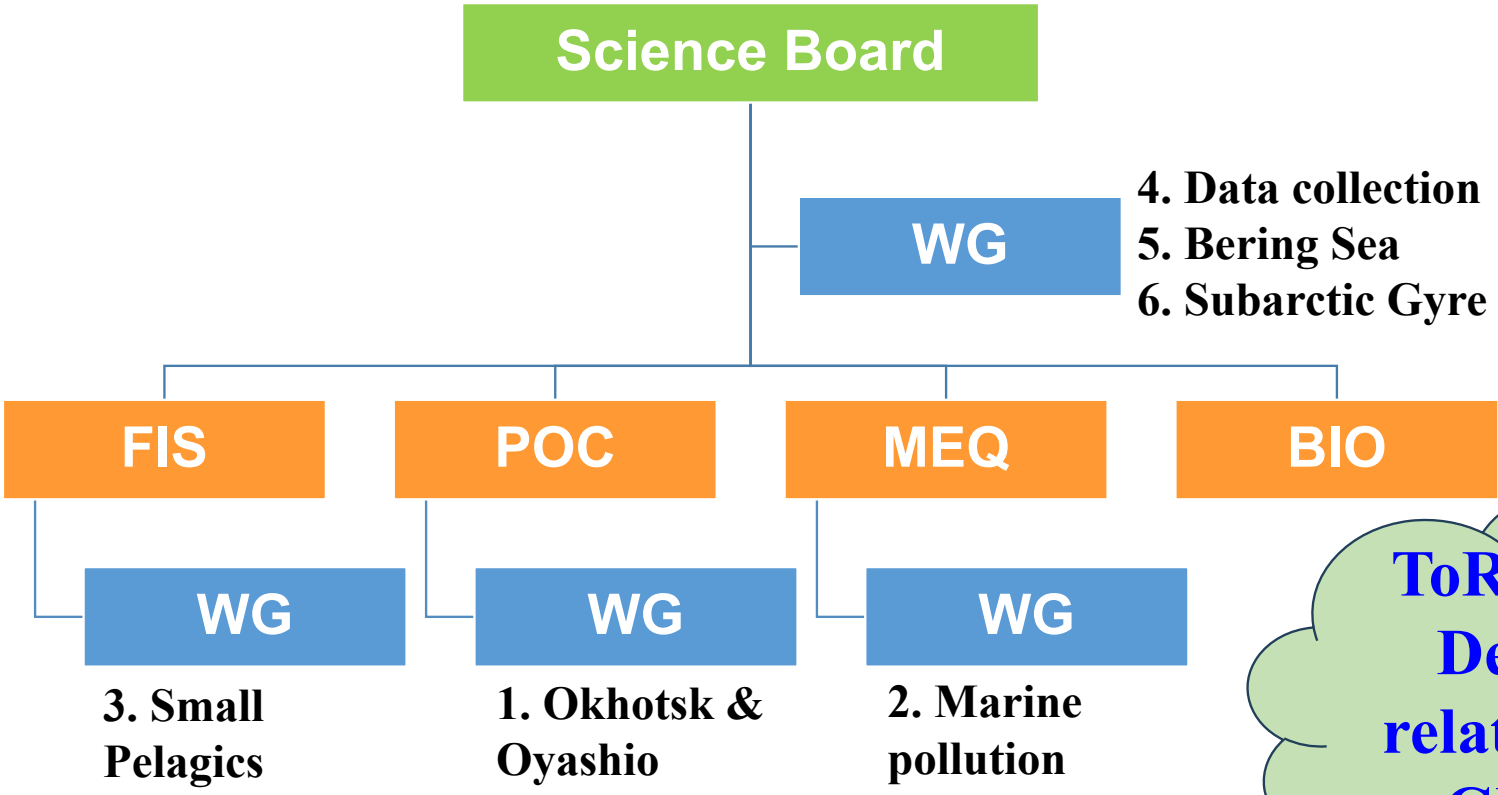
PICES' Overarching question

"What is the nature of the subarctic Pacific ecosystem (or ecosystems), and how is it affected over periods of months to centuries by changes in the physical environment, by interactions among components of the ecosystem, and by human activities? "

Multi-scales
&
Multi-disciplinary

By Warren Wooster
Opening address at 1st Annual Meeting, 1992 (Victoria)
PICES Annual Report 1992

Initial structure of PICES



ToR7 of WG6 Determine relationship to GLOBEC

Global Ocean Ecosystem Dynamics (1995-2009)

GLOBEC was initiated in 1990 by SCOR (Scientific Committee on Oceanic Research) and IOC-UNESCO, and incorporated into IGBP (International Geosphere-Biosphere Program) Core Element structure in 1995.

Good match with PICES

GLOBEC Science Plan in 1997

"To advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change"

GLOBEC Regional Programs

SPACC

Small Pelagic fishes
And Climate Change

ICES-GLOBEC
CCC

Climate change
and cod

PICES-GLOBEC
CCCC

Climate change and
Carrying Capacity

SO-GLOBEC

Southern Ocean

ESSAS

Ecosystem Studies of
Sub-Arctic Seas

CLIOTOP

Climate influence on
oceanic top predators

ICED

Integrating Climate and
Ecosystem Dynamics in the
Southern Ocean

PICES – GLOBEC CCCC
Climate Change and Carrying Capacity

"Why is PICES interested in studying Climate Change and Carrying Capacity?
The reason stems from the remarkable changes that have occurred in the North Pacific and adjacent seas in recent decades, in both the open ocean and coastal margins."

Thanks Makoto to realize the meeting under the damage of a big earthquake.

Makoto Kashiwai

CCCC Science Plan
PICES Scientific Report No.4
PICES-GLOBEC '94 Workshop
at 3rd Annual Meeting, 1994 (NEMURO)

PICES – GLOBEC CCCC

Climate Change and Carrying Capacity

The First PICES' Science Program (1995-2009)

https://www.sciencedirect.com/journal/progress-in-oceanography/vol/77/issue/2

Primary goal:

to examine how climate change and variability affect ecosystem structure, and the productivity of key biological species at multiple trophic levels in both the oceanic and neritic regions of the North Pacific

Ultimate goal:

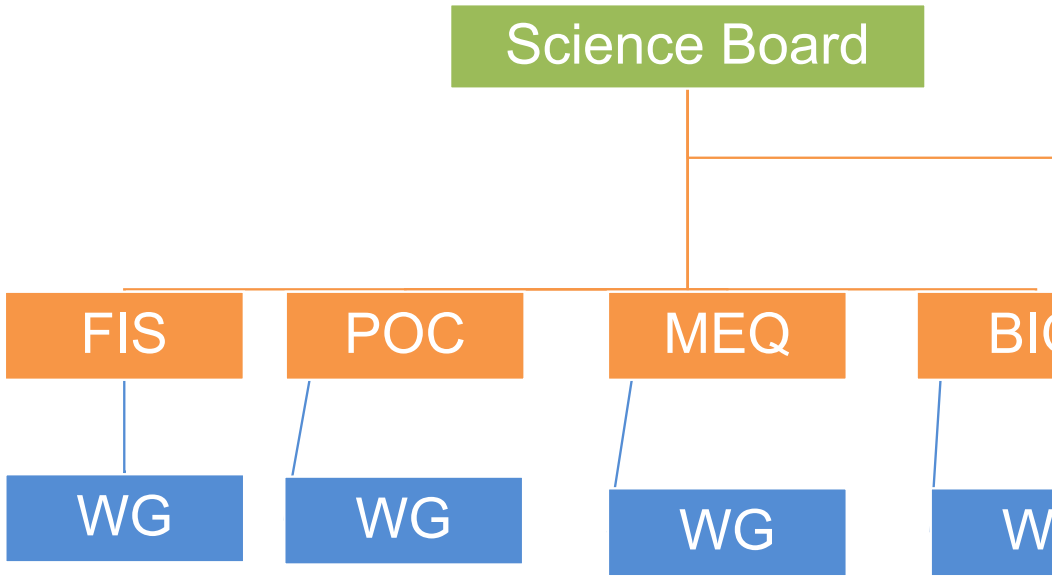
to forecast the consequences of climate variability on the ecosystems of the North Pacific

Batchelder and Kim (2008, Progr. Oceangr.)

PICES – GLOBEC CCCC

Climate Change and Carrying Capacity

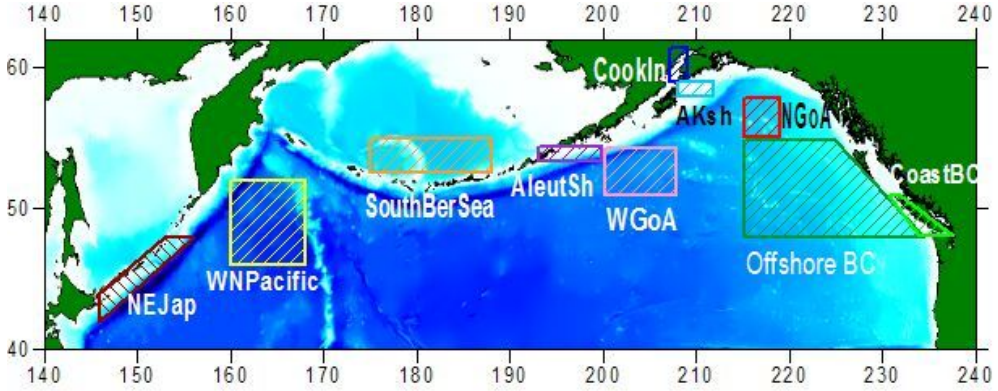
Start with 4 task teams with SSC

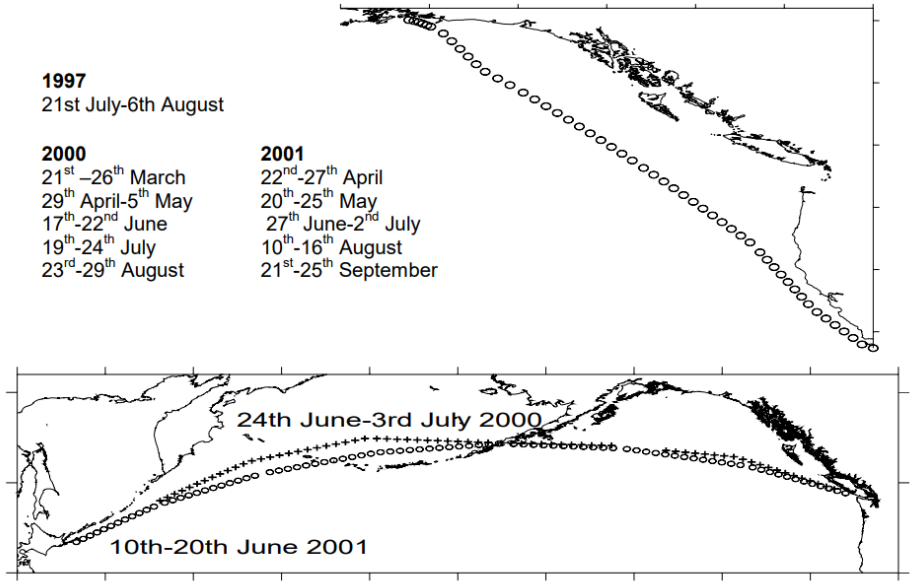


Task Teams

- MODEL — Conceptual/Theoretical and Modeling Studies
- REX — Regional Experiments
- BASS — Basin Studies
- MONITOR — Monitoring
- CFAME — Climate Forcing and Marine Ecosystem Response
- NEXT — NEMURO Experimental Plan Team

Achievements of PICES – GLOBEC CCCC
I. Volunteer Observing Ship Monitoring





Basin-scale monitoring systems were established.
e.g. Continuous Plankton Recorder (CPR)

http://www.pices.int/projects/CPR/index.aspx
Courtesy of Sonia Batten

PICES Scientific Reports No.21
PICES-GLOBEC International Program on Climate Change and Carrying Capacity: Report of the PICES 2002 Volunteer Observing Ship Workshop (Miller, C.B. (Ed.), 2002)

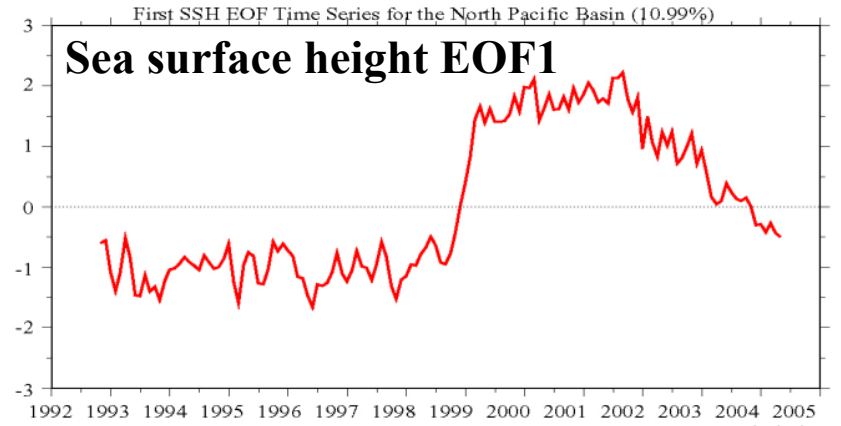
https://meetings.pices.int/publications/scientific-reports/Report21/Rep21.pdf

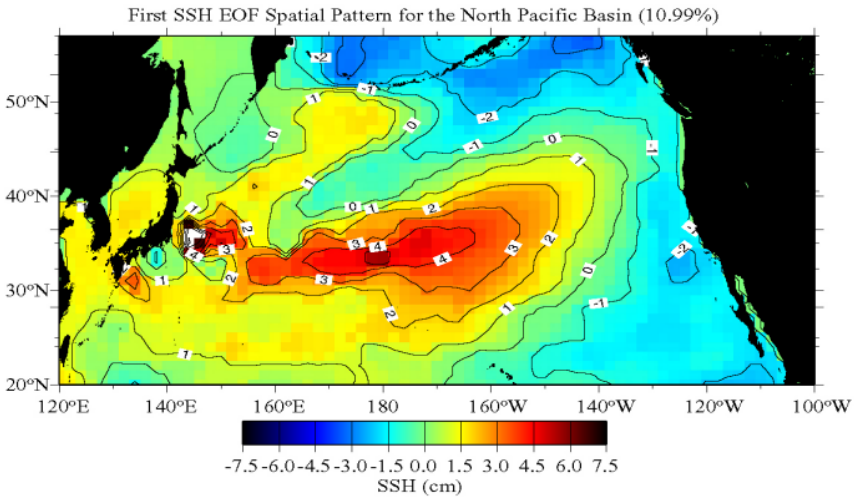
Achievements of PICES – GLOBEC CCCC
II. Consolidating the concept of regime shift

"Since then, PICES symposia have continued to foster exchanges of new ideas about how marine ecosystems respond to environmental variation. Perhaps the most significant concept to emerge from the mid-1990s was that of regime shifts (Hare, Minobe, & Wooster, 2000). These are low frequency, high amplitude changes in community composition, species abundance and trophic structure that occur abruptly and concurrently with changes in the North Pacific climate system. An important role for PICES is in providing a forum for ongoing dialogue among scientists of the Pacific Rim.

S.M McKinnell, R.D Brodeur, K Hanawa, A.B Hollowed, J.J Polovina, C.-I Zhang (2001, Prog. Oceanogr.)

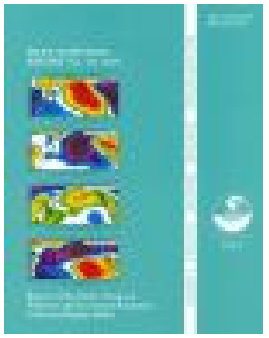
Achievements of PICES – GLOBEC CCCC
II. Consolidating the concept of regime shift





Schwing et al. (2005, PICES Scientific Reports)

Described the 1998 regime shift.

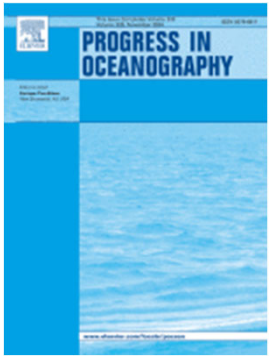


PICES Scientific Reports No.28

1. **Report of the Study Group on the Fisheries and Ecosystem Responses to Recent Regime Shifts (King, J.R. (Ed.), 2005)**

Special Issues

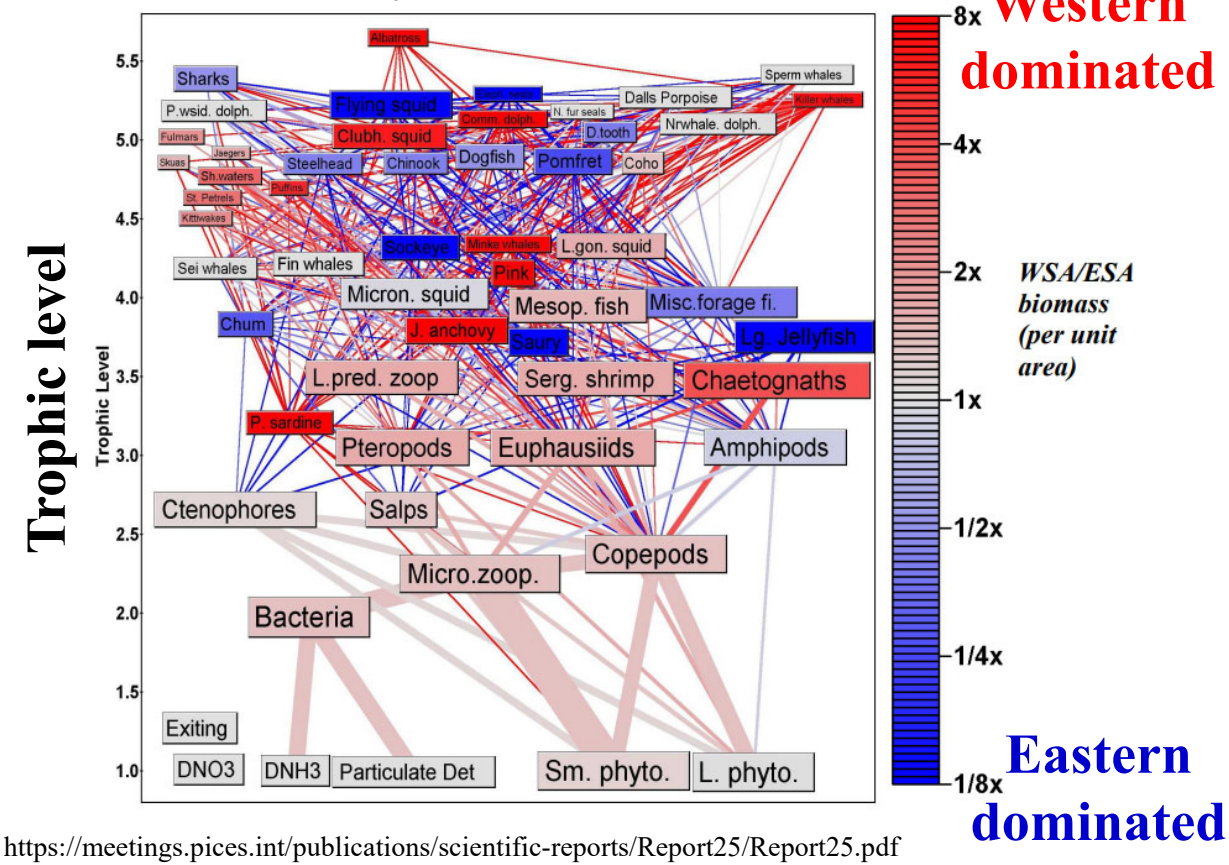
1. **Ecosystem dynamics in the eastern and western gyres of the Subarctic Pacific (Guest Editors: Richard J. Beamish, Suam Kim, Makoto Terazaki and Warren S. Wooster), Prog. Oceanogr. , 1999**
2. **North Pacific climate regime shifts (Guest Editors: Steven R. Hare, Shoshiro Minobe and Warren S. Wooster), Prog. Oceanogr. , 2000**
3. **Pacific climate variability and marine ecosystem impacts (Guest Editors: Stewart M. McKinnell, Richard D. Brodeur, Kimio Hanawa, Anne B. Hollowed, Jeffrey J. Polovina and Chang-Ik Zhang), Prog. Oceanogr., 2001**



https://www.sciencedirect.com/journal/progress-in-oceanography/

Achievements of PICES – GLOBEC CCCC
III. Basin-scale linkages in ecosystem dynamics

Relative biomass in western/eastern subarctic derived by ECOPATH Model

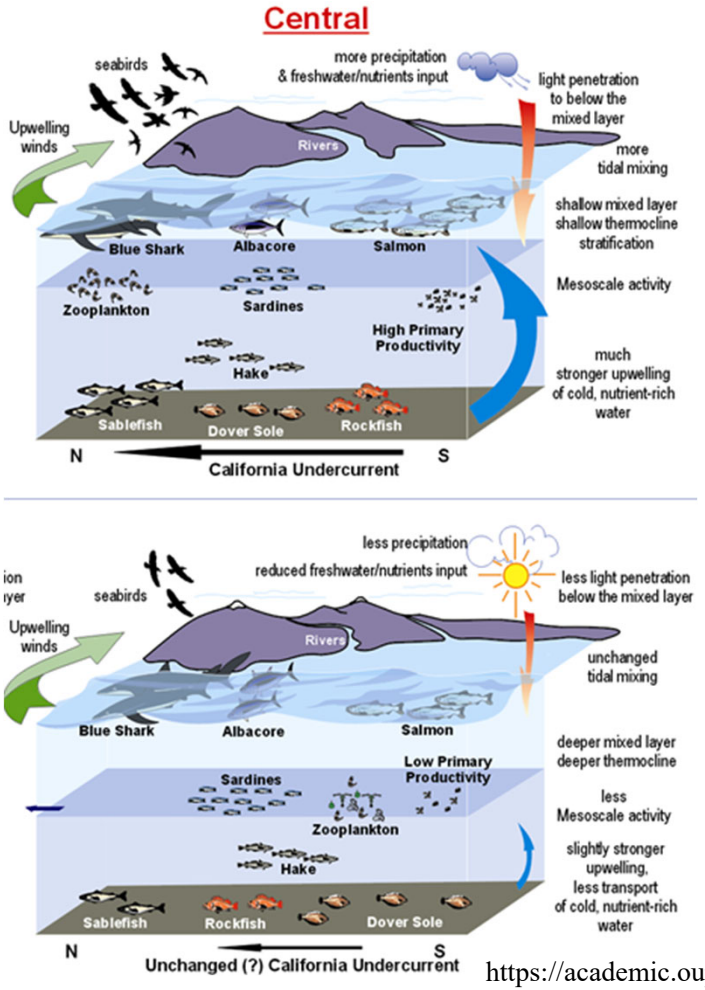


Basin-scale ecosystem structures were clarified. Basin-scale ecosystem dynamics were also elucidated.

PICES Scientific Reports No.25
PICES-GLOBEC International Program on Climate Change and Carrying Capacity: The BASS/MODEL Report on Trophic Models of the Subarctic Pacific Basin Ecosystems (Aydin, K.Y., McFarlane, G.A., King, J.R. and Megrey, B.A. (Ed.), 2003)

https://meetings.pices.int/publications/scientific-reports/Report25/Report25.pdf

Achievements of PICES – GLOBEC CCCC
IV. Linkage of climate forcing and ecosystem response



Current condition

Future condition

King et al. (2011, ICES-JMS)

Developed conceptual mechanisms linking climate to higher trophic levels through physics & scenarios of ecosystem change under global climate chage

King et al. (2011, ICES-JMS) Climate forcing and the California Current ecosystem.
Yatsu et al. (2013, ICES-JMS) Climate forcing and the Kuroshio/Oyashio ecosystem.

https://academic.oup.com/icesjms/article/68/6/1199/698284

Achievements of PICES – GLOBEC CCCC
V. Common model developments

Please see Fig. 1 of Megrey et al. (2007, Ecological Modelling)
https://doi.org/10.1016/j.ecolmodel.2006.08.020

Developed

1. **NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography)**
2. **NEMURO.FISH (NEMURO for including saury and herring)**

Applied it for many regions and global

Special Issues

1. **NEMURO and NEMURO.FISH: Modeling of North Pacific Marine Ecosystems (Guest Editors: Michio Kishi, Bernard A. Megrey, Shin-ichi Ito and Francisco E. Werner), Ecol. Model., 2007**
2. **Combining Modeling and Observations to Better Understand Marine Ecosystem Dynamics (Guest Editors: E.Curchitser, K.Rose, S.Ito, M.Peck and M.Kishi), Prog. Oceanogr. , 2015**

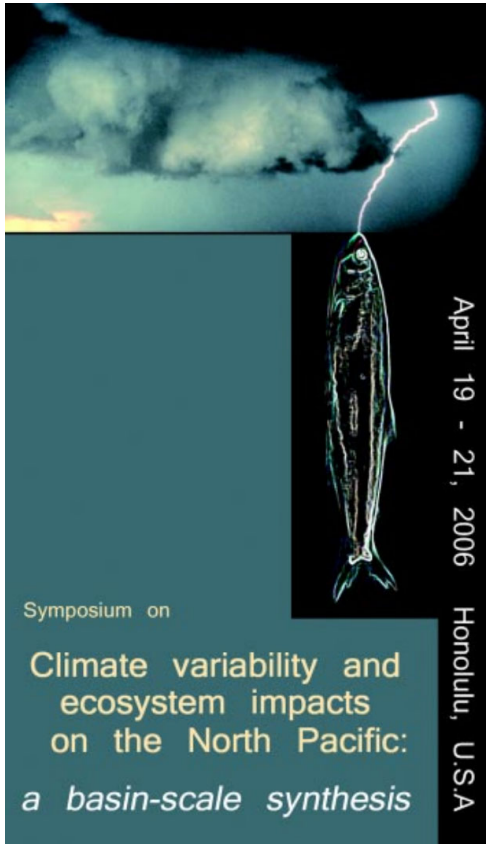
https://meetings.pices.int/publications/pices-press/volume15/issue1/master_rgb.pdf#page=27

Transition to FUTURE

GLOBEC moved to the synthesis phase around 2005 and decided to end in 2009.

CCCC also had to end in 2009.
CCCC also moved to the synthesis phase.

PICES held CCCC symposium "Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis" (2006, Honolulu)



https://pices.int/meetings/international_symposia/Honolulu2006/CCCC_Brochure.pdf

Development of FUTURE

Forecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems (2009-)

Study Group on Future Integrative Scientific Program(s) (2005-2009)

- **FUTURE Science Plan Writing Team (2007-2008)**
- **FURURE Implementation Plan Writing Team (2008-2009)**

Make broader themes

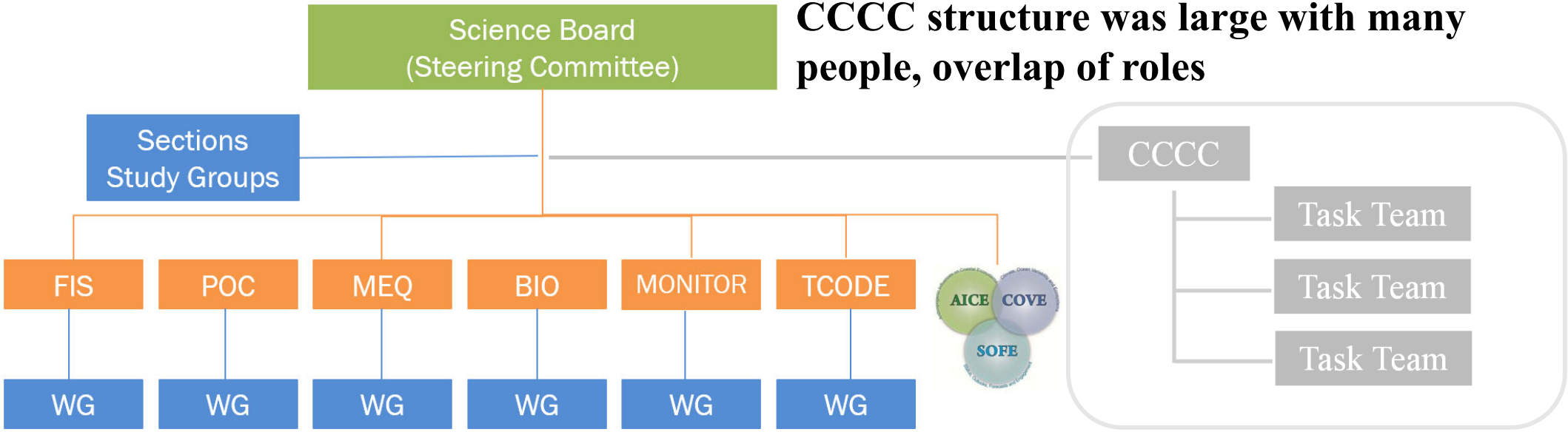
"What is the future of the North Pacific given current and expected pressures?"

1. **What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?**
2. **How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?**
3. **How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?**

"How can forecasts, uncertainty and consequences of ecosystem change be communicated effectively to society?"

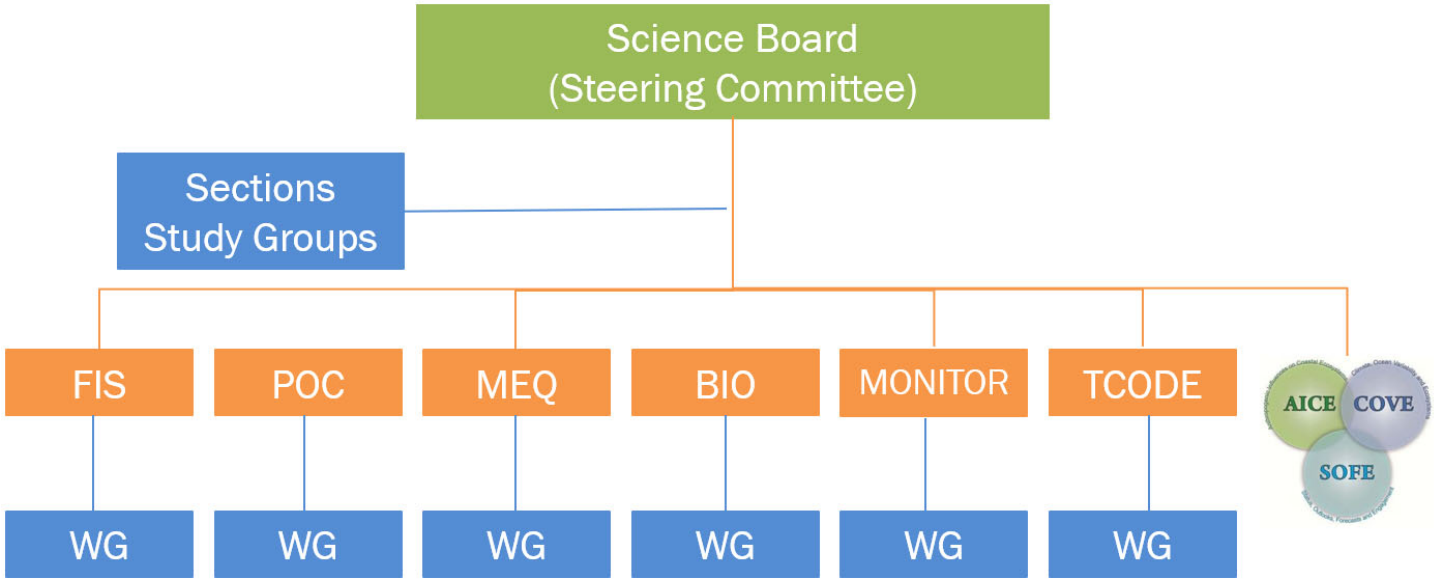
FUTURE Phase-I

CCCC seen as separate and independent
Task Teams seen as self-directing activities
CCCC structure was large with many people, overlap of roles



Science Board is the steering committee of FUTURE.
Formed three advisory panels.
FUTURE related WG directly linked committees.

FUTURE Phase-I



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FUTURE Phase-I

Anthropogenic Influences on Coastal Ecosystems

Climate, Ocean Variability and Ecosystems

Status, Outlooks, Forecasts and Engagement

Science Board is the steering committee of FUTURE.
Advisory Panels only make advise not to study by themselves.

FUTURE Phase-I
Related Expert Groups

Working Groups

- WG 27: North Pacific Climate Variability and Change (2011-15)
- WG 28: Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors (2011-15)
- WG 29: Regional Climate Modeling (2011-15)
- WG-30: Assessment of Marine Environmental Quality of Radiation around the North Pacific (2013-17)
- WG-31: Emerging Topics in Marine Pollution (2014-17)

Sections

- Section on Climate Change Effects on Marine Ecosystems (2011-)
- Section on Human Dimensions of Marine Systems (2011-2016)

Study Group

- SG-SEES: Socio-Ecological-Environmental Systems (2014-15)

COVE

AICE

SOFI

FUTURE Phase-I

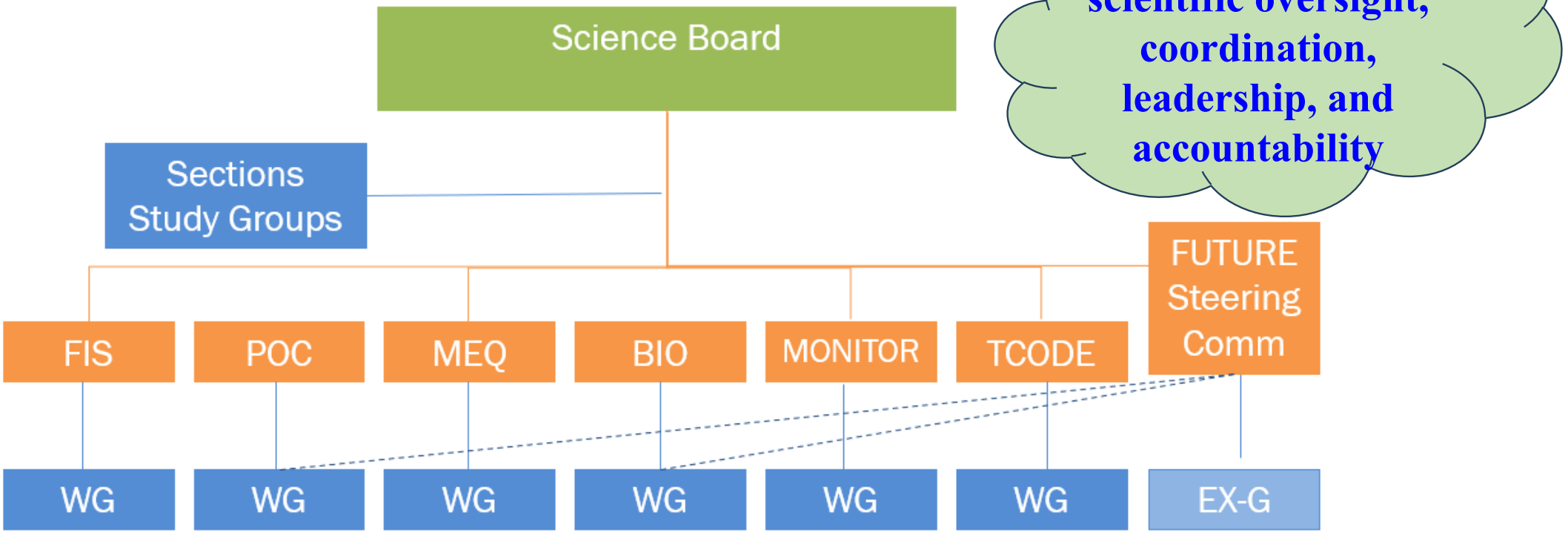
After 5 years
FUTURE Open Science Meeting (Hawaii, April 2014)

FUTURE Evaluation Panel
"basic paradigm that drives FUTURE is being implemented, perhaps slowly, but surely"

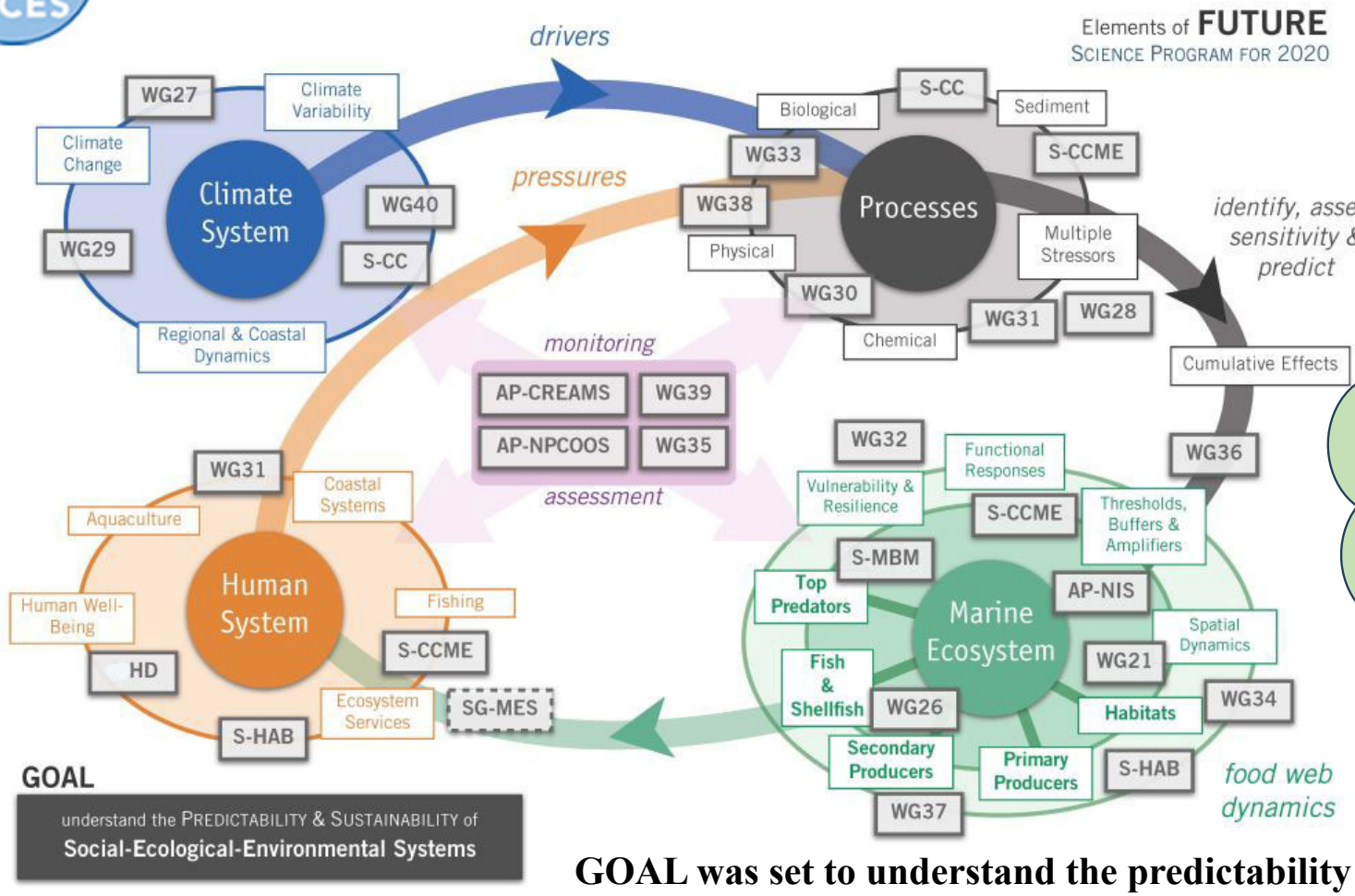
Recommendations

- **a change to the governance structure of FUTURE**
- **Committee (SSC) with a separate Chair supported by two Vice-Chairs.**

FUTURE Phase-II



FUTURE Phase-II



FUTURE entered to Phase-II with strong leadership of FUTURE SSC

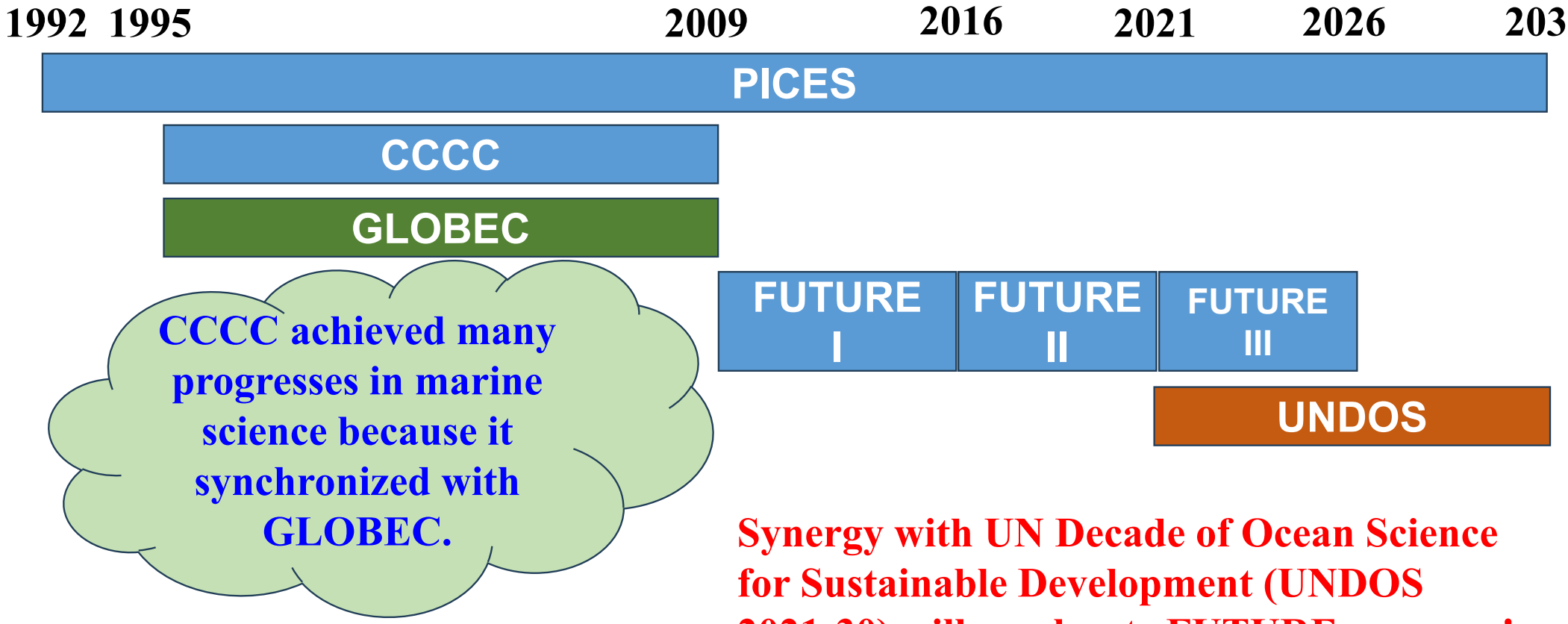
GOAL was set to understand the predictability & sustainability of Social-Ecological Environmental Systems (SEES)

https://meetings.pices.int/Members/Scientific-Programs/FUTURE#materials

FUTURE Phase-I, II, III

- ✓ surely addressing the 3 questions
- ✓ Increased engagement of ECOPs (Early career ocean professionals)
- ✓ stronger collaboration with ICES
- ✓ Continued collaboration with international programs (IMBeR, CLIVAR, SOLAS, etc.)
- ✓ Stronger collaboration with IOC-UNESCO, IPCC, FAO, etc.
- ✓ Good match with UNDOS

FUTURE Phase-III



Synergy with UN Decade of Ocean Science for Sustainable Development (UNDOS 2021-30) will accelerate FUTURE progress!

Thank you for your attention

Thanks for
Jackie King, Steven Bograd, Hanna Na