W7: Climate Forcing and Marine Ecosystems Workshop

Friday, October 13, 2006

Co-Convenors

- Kerim Aydin (U.S.A.)
- Jacquelynne King (Canada)
- Akihiko Yatsu (Japan)

Workshop Objectives

Afternoon session

- methods of classifying ecosystems
- approaches for comparing ecosystem responses
- discussion on future ecosystem comparison work for CFAME
  - building on the overviews and conceptual models identified today
  - overall theme and focus
  - suggest topics for inter-sessional meetings
- in order to complete the “Scenarios” portion of the workplan and future CFAME/POC collaboration:
  - identify climate variables required from POC modelling work

- W7 workshop report and assignment of tasks

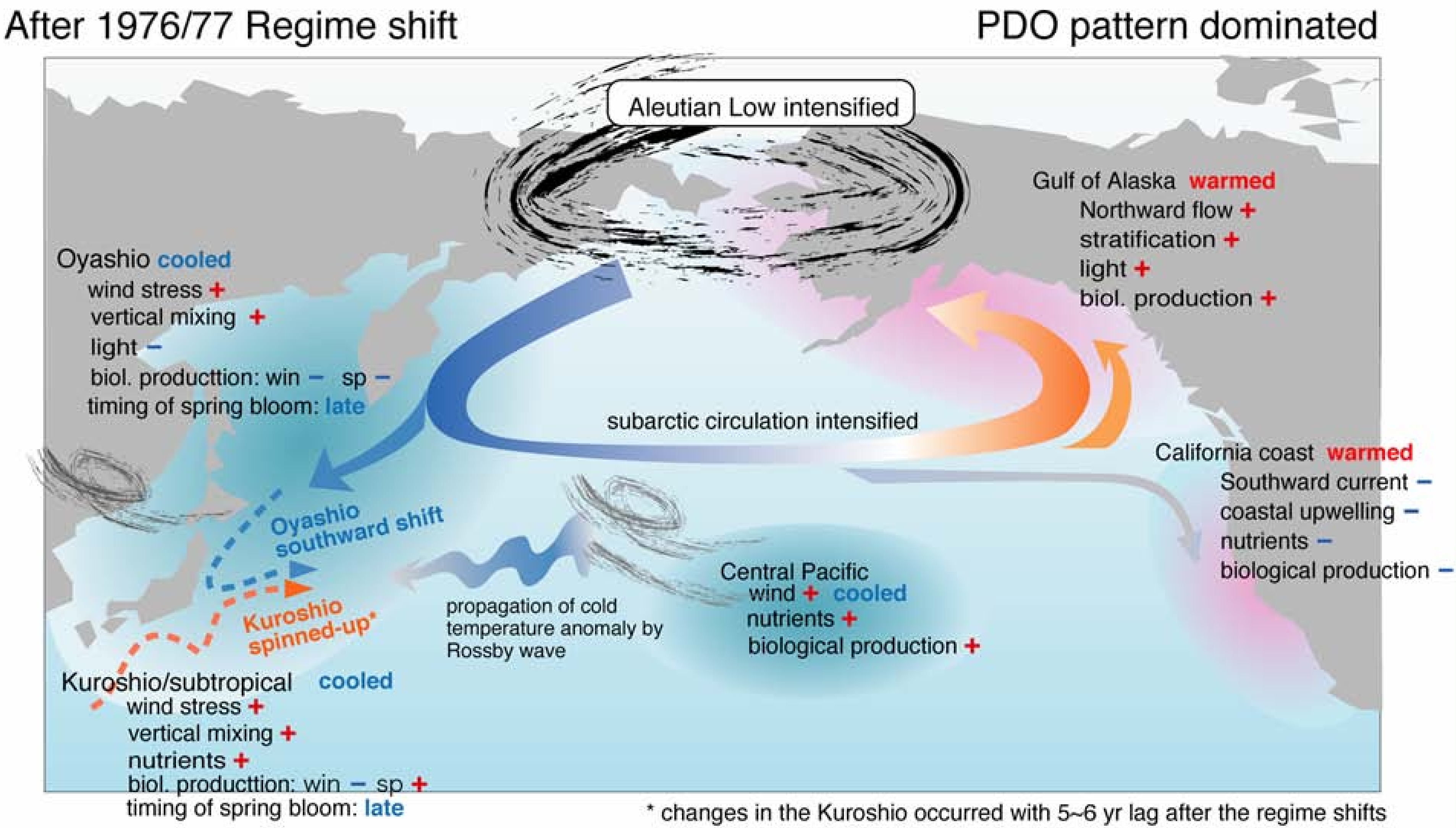
Workshop discussion

- methods of classifying ecosystems
- approaches to comparing ecosystem responses

- Indicators from climate to top-predators
- Mechanisms: data-based (conceptual) and model-based (e.g. Ecosim)

Conceptual model of 1976/77 RS effects on lower production

Wintertime climate and winter-spring production



Drawing by Dr Sanae Chiba

Mechanisms

- Climate to zooplankton: mainly bottom-up
- Fish recruitment: optimum window for survival
  - Spawning time and locations - match/mismatch to subsequent food, predator and habitat conditions
  - Temperature, salinity, transport/retention
- Density dependence (Ricker, BH, etc.)
- Predation: top-down, NB: switching
- Indirect species interactions

Deterministic vs stochastic processes

Ecosystem Indicators

(Cury and Christensen, 2005 ICES JMS)

- Environmental indicators
  - Climate: global and local
  - Human impact: habitat degradation, fishing, etc
- Ecological indicators: characterize functioning and dynamics of ecosystems
  - Species composition
  - Size distribution
  - Trophodhynamics

Ecosystem Indicators continued

(Cury and Christensen, 2005 ICES JMS)

- Environmental and low-trophic-level indicators: bottom-up effects
- Top predators or high-trophic-level indicators: top-down effects, related to exploitation
- Trophodynamics indicators: strength of interactions, ecosystem structure, NB: sensitive to choice of trophic level
- Size-based indicators: promising for characterizing fish community dynamics

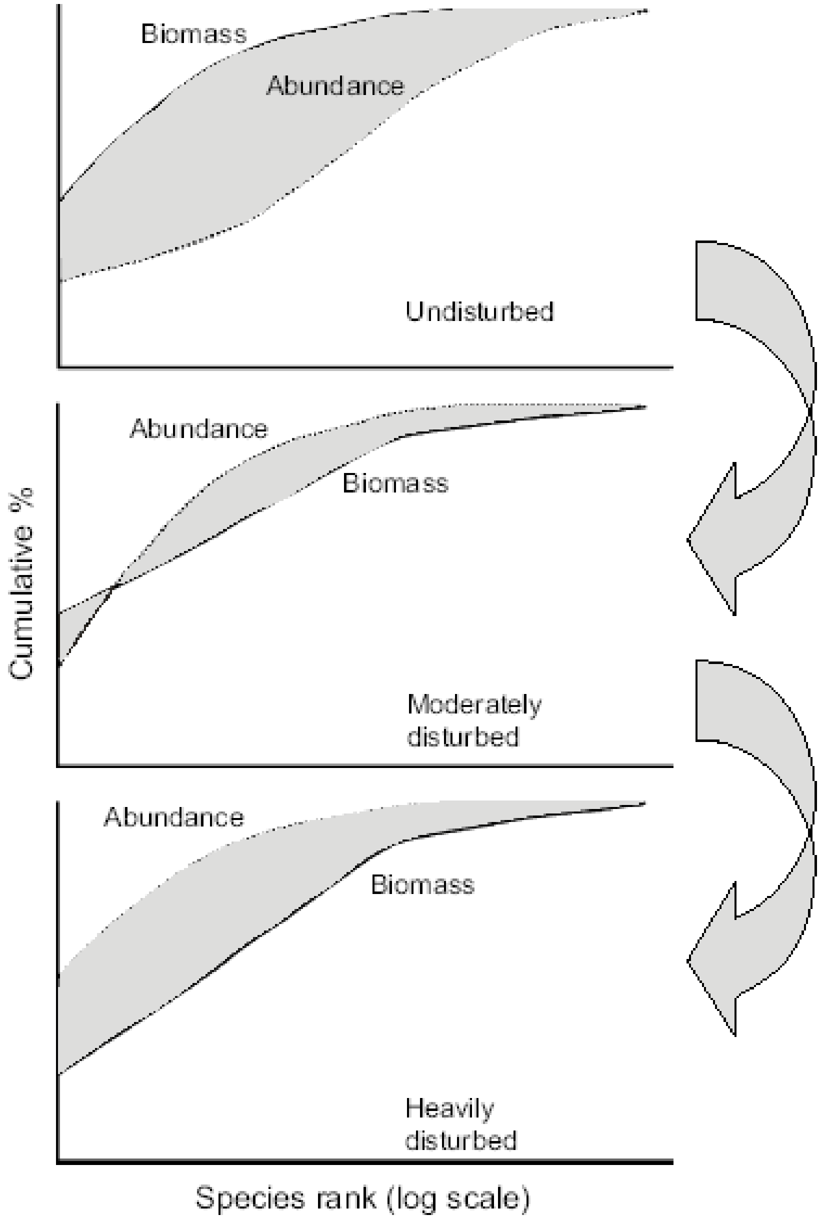


Figure 1. Theoretical ABC curves showing the pattern in the abundance and biomass of undisturbed, moderately disturbed, and heavily disturbed assemblages (modified from Clarke and Warwick, 1994).

Abundance Biomass Comparison (ABC) curves

(Yemane et al., ICES JMS)

Theoretical background: classical K-selection (slow-growing, large, late maturing) species will dominate in undisturbed ecosystems than r-selection species

Needs time series for each ecosystem

Size-based indicators (Shin et al., ICES JMS)

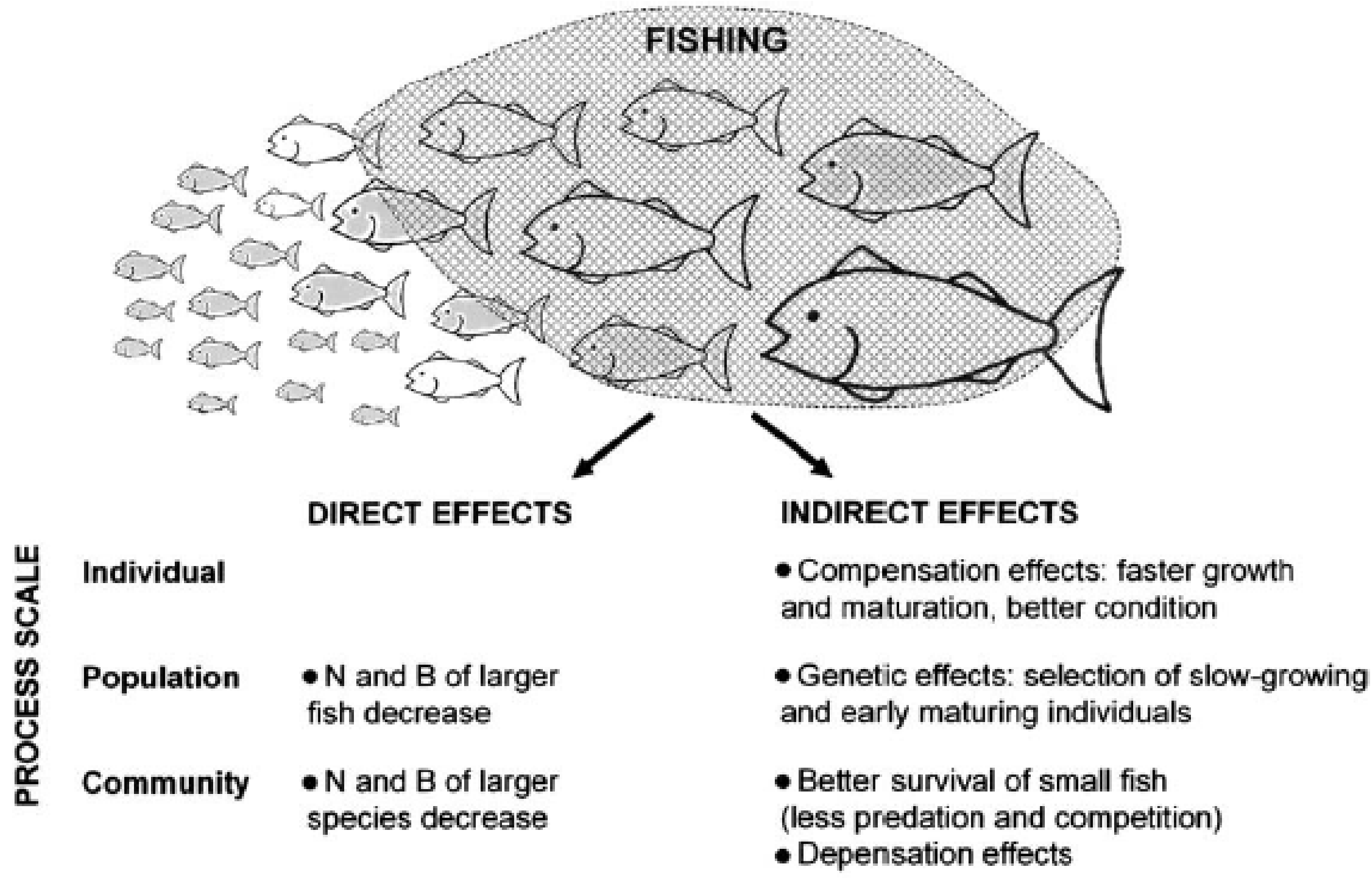
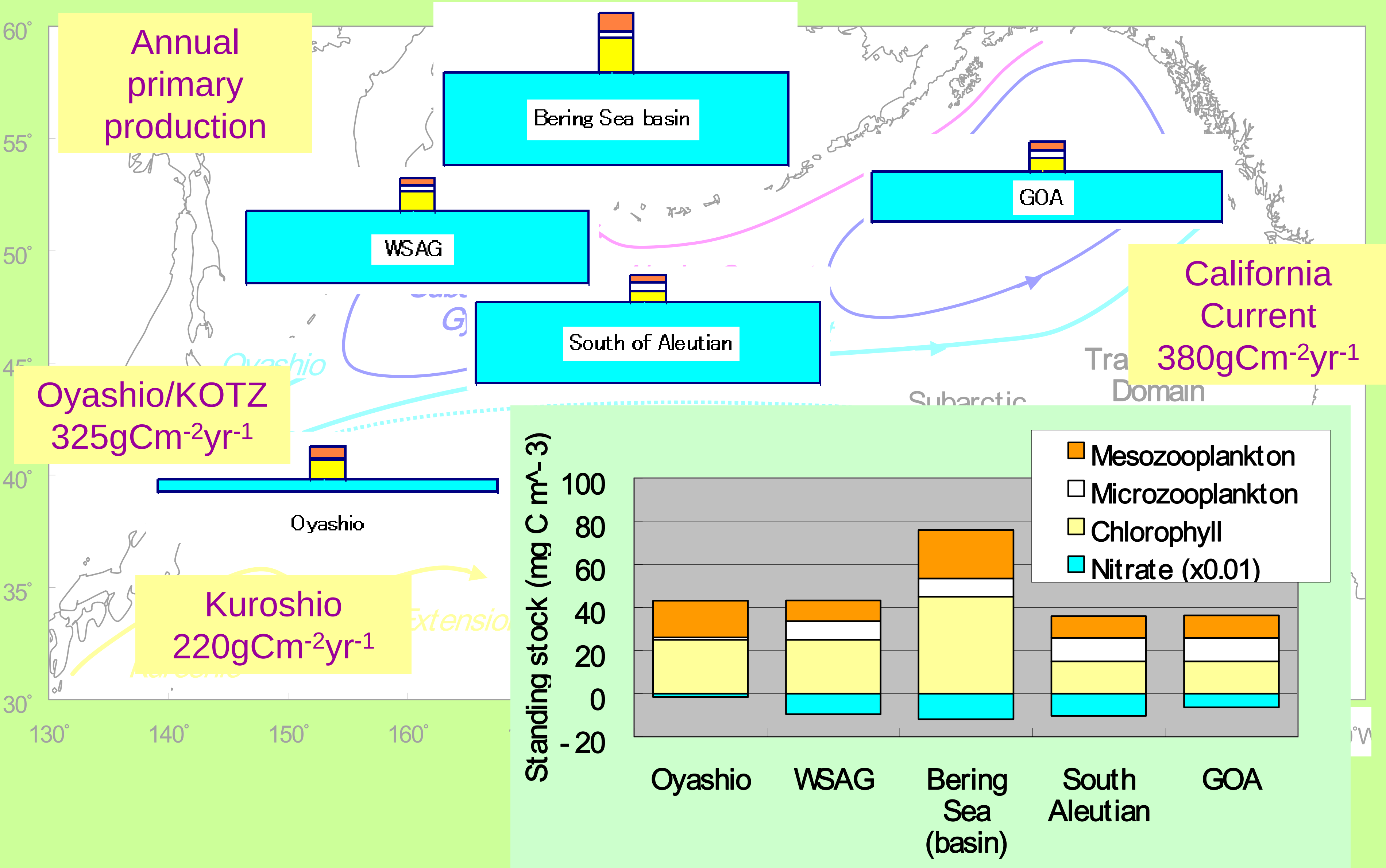


Figure 1. Theoretical direct and indirect effects of fishing on fish populations and communities (N: abundance, B: biomass).

Using abundance indices and mean and maximum length

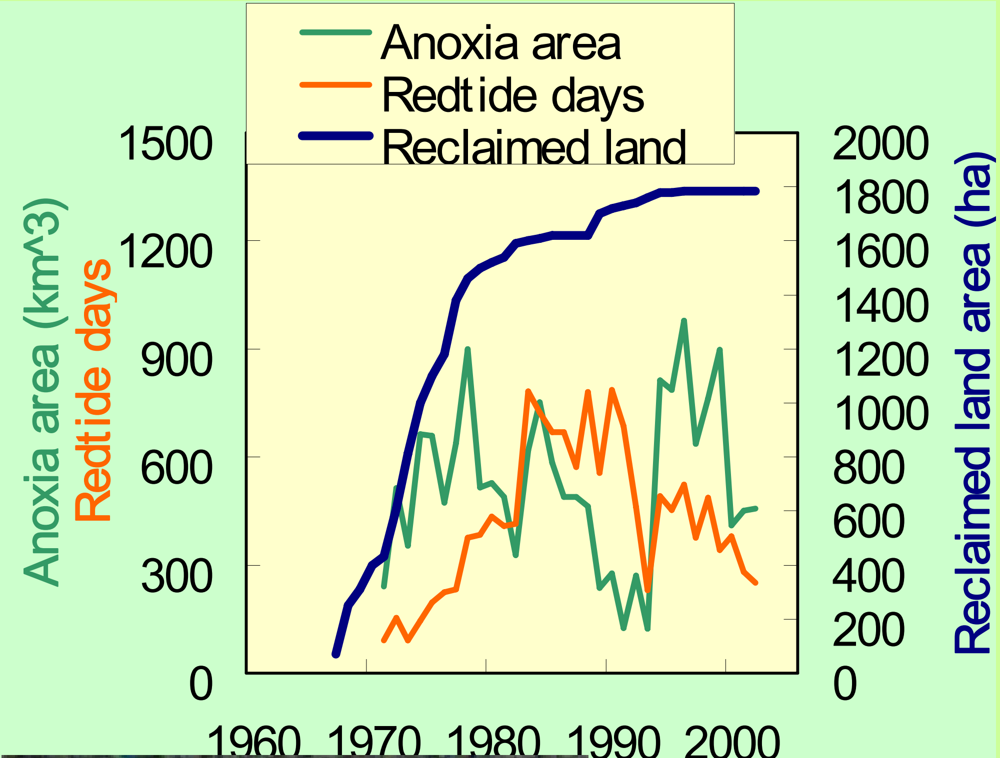
Needs time series for each ecosystem

Structural differences in lower trophic ecosystems - standing stock in summer (modified from Taniguchi (1999PiO))

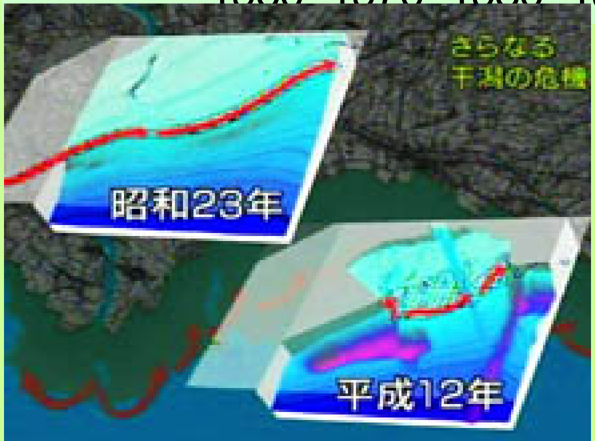


Not only fishing - reclamation effects on the ecosystem of the Mikawa Bay, central Japan

(Funakoshi, 2006; http://www.nhk.or.jp/zero/dsp127.html)



Reclaimed area Tidal flat



Anoxia is created by basins that was formed by removal of sand/mud for reclamation

Size-based indicators (Shin et al., ICES JMS)

	Trends observed in SBI	Possible causes	Complementary indicators
POPULATION	$\overline{L}_i$ ↘	Abundance of large fish ↘ Recruitment ↗ Environmental effects (e.g. food ↘)	$L_{max,i}$ ↘ Abundance index ↗ $\overline{L}_{i,a}$ ↘ K_i ↘
COMMUNITY	$\overline{L}$ ↘	For dominant species, abundance of large fish ↘ Recruitment ↗ Abundance of small species ↗ Abundance of large species ↘	Some $L_{max,i}$ ↘ Abundance index ↗ $\overline{L}_{max}$ ↘ $\overline{L}_{max}$ ↘

Figure 2. Possible causes leading to a decrease in mean length of population i ($\overline{L}_i$), and in mean length of the community ($\overline{L}$), as confirmed by complementary indicators (see text).

Size-based indicators (Shin et al., ICES JMS)

Indicators	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
$\overline{L}_i$	↗	↗	↗	↘	↘	↘
$L_{max,i}$	↗	↗	↘	↗	↘	↘
N index (cpue)	↗	↘	↘	↗	↗	↘

Figure 3. Six cases showing different reference directions for mean length ($\overline{L}_i$), maximum length ($L_{max,i}$), and an index of abundance of population i leading to different interpretations of population state (white, state improving; light grey, state uncertain; dark grey, state deteriorating; see also text).

Workshop discussion

- recommended future ecosystem comparison work for CFAME
  - overall theme and focus
  - topics for interim meetings
- CFAME-POC collaboration
  - suggested climate variables required from POC modeling work
- workshop report and assignment of tasks

Selection of target ecosystems

California current: BC/UW

Gulf of Alaska: BC TD

Eastern Bering Sea: TM-ice? MO

Okhotsk Sea: ice?

Western SA Gyre: BC

Kuroshio/Oyashio: BC MO?

Tsushima Curr / Liman Curr*: BC MO?

Yellow Sea / East China Sea: TM

Transition Zone: PG

* Лиман течения

Classification

by physical structure

Upwelling

Boundary current

Pelagic

Ice-dominated

Freshwater-driven

Solae/crowd

Classification

by dynamics

Bottom-up

Top-down (top-heavy)

Middle-out (wasp-waist, Beer-berry)

Others?

PICES Ecosystem Status Report - regional chapters

	Yellow Sea, ECS	Tsushima / Liman C	Okhotsk Sea	Oyahshio / Kuroshio C	Western subarctic gyre	Bering Sea	Gulf of Alaska	California Current	Gulf of California	Transition Zone
Climate			+							+
Hydrography	+	+	+	+	+	+	+	+	+	+
Chemistry	+	+	+				+	+		+
Plankton	+	+	+	+	+	+	+	+	+	+
Benthos	+									
Fish and inverterbates	+	+	+	+	+	+	+	+	+	+
Marine birds and mammals	+	+	+	+	+	+	+	+	+	+
Contributors	K Ch J	J R K Ca US	R J	J	J	US R Ca	US UK	US Ca M	M	US J

North Pacific Ecosystem Status Report – Integration

“Big Picture” Summary

- North Pacific is dominated by variability at seasonal, interannual, and decadal scales – is in contrast to the Tropics
- Major climate influences on the North Pacific in recent 5 years have been:
  - switch in the atmospheric and oceanographic patterns that are indexed by the PDO
  - Strong La Niña in 1999 and modest El Niño in 2002
- Plankton productivity in the western Pacific has declined over past 30 years, but increased in the eastern Pacific, in part due to a shoaling of the upper mixed layer in the eastern Pacific. Occurrences of HABs are increasing around the North Pacific.
- Demersal fish species have declined significantly throughout the North Pacific over the past 30 years. Pelagic species have undergone high variability, with species replacements common. Sardine collapsed in western Pacific, but began to increase in eastern Pacific, about 1990
- Stellar sea lion populations around the North Pacific have declined significantly over the past 30 years. Some populations show recovery.
- Major direct-human forcing on the North Pacific as a whole is fishing.