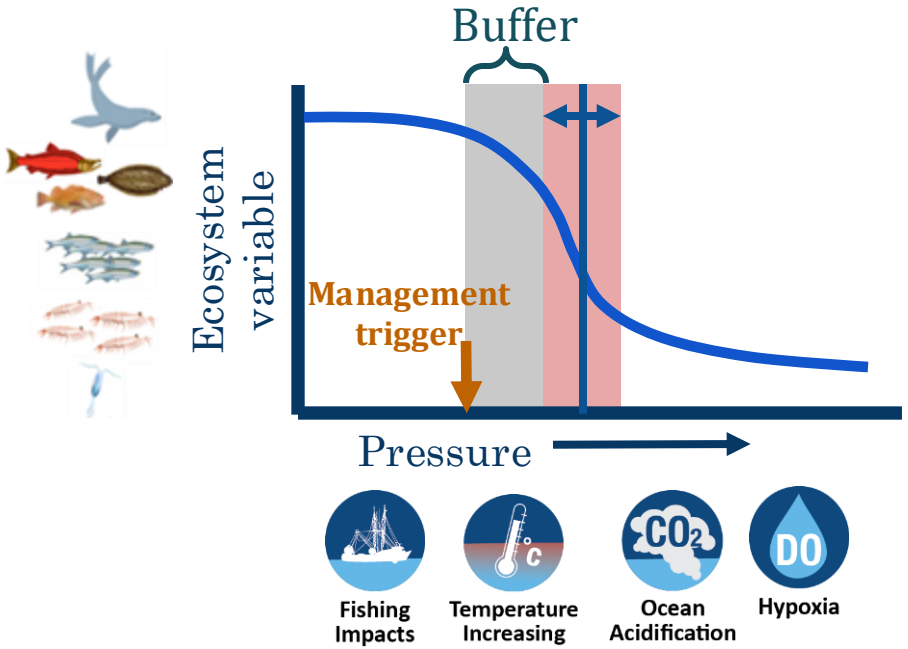
Common Ecosystem Reference Points

WG 36 members: Robert Blasiak (Japan), Jennifer Boldt (Canada), Elliott Hazen (USA), Mary Hunsicker (USA), Vladimir Kulik (Russia), Jongseong Ryu (Korea), Xiujuan Shan (China), Shion Takemura (Japan), Kazumi Wakita (Japan)

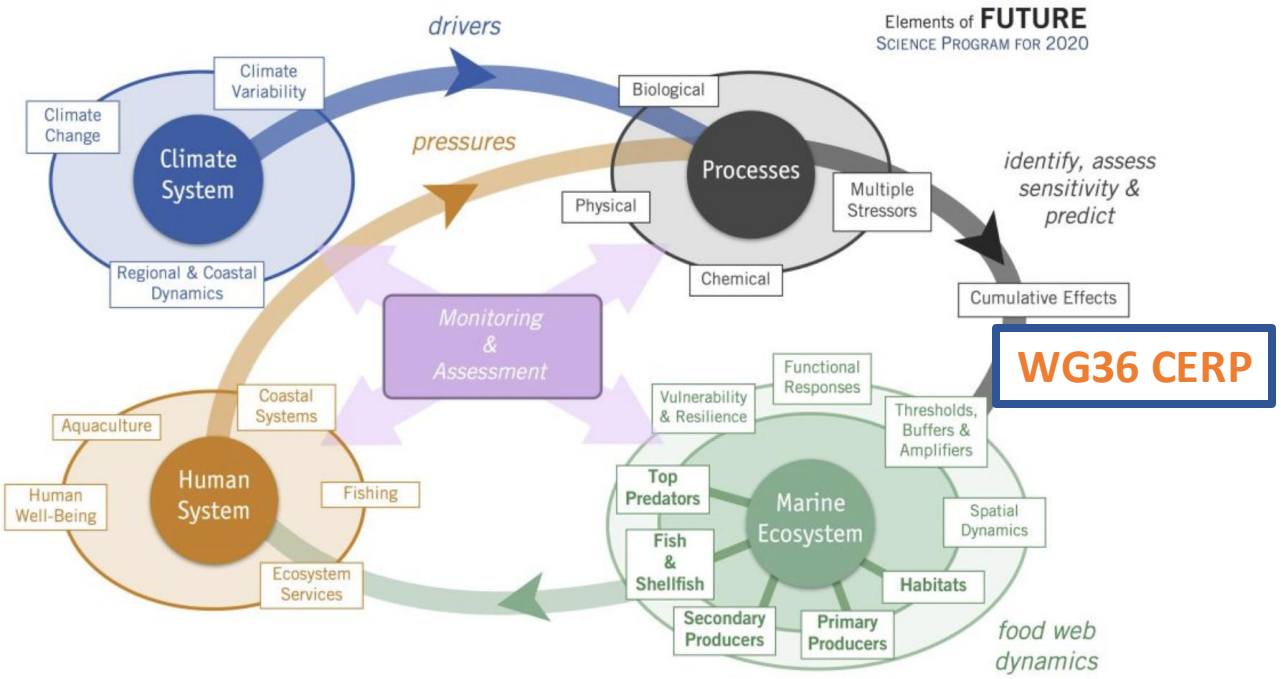
PICES Annual Meeting – FUTURE Symposium
October 28, 2024

Common Ecosystem Reference Points



Thresholds can help inform reference points

Common Ecosystem Reference Points



Terms of Reference (TOR)

1. Review status of ecosystem reference points across PICES member nations

2. Determine a subset of ecosystems and indicators that are the focus of working group activities

3. Provide an overview / select methods for identifying thresholds in pressure - ecosystem response relationships

4. Determine shapes of pressure - response relationships and quantify ecosystem thresholds

5. Identify potential leading indicators of loss of resilience and ecosystem change

6. Develop “heuristic models” to examine drivers and ecosystem response based on ecosystem reference points

Terms of Reference (TOR)

1. Review status of ecosystem reference points across PICES member nations

FUTURE's research theme questions:

1. What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?

- What thresholds associated with maintaining ecosystem resilience?

5. Identify potential leading indicators of loss of resilience and ecosystem change

6. Develop "heuristic models" to examine drivers and ecosystem response based on ecosystem reference points

Terms of Reference (TOR)

1. Review status of ecosystem reference points across PICES member nations

FUTURE's research theme questions:

2. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?

- How do these forcings affect the processes underlying ecosystem structure and function?

6. Develop "heuristic models" to examine drivers and ecosystem response based on ecosystem reference points

TOR 2: Selection of Indicators

Member nations	Environmental pressures	Human pressures	Ecosystem responses
Canada	PDO, NPGO, SST, ENSO, spring transition, upwelling	Tot landings, catches of different groups, Pel:Demersal catch	Copepod biomass, sea lion, abundance, Biomass of several fish groups, TL, mean lengths
China	SST, salinity, nutrients	Tot landings by taxa, TL, habitat	Stock biomass, mean TL, key/dominant species
Japan	SST, current velocity and direction	Catches of different groups,	Stock abundance
Korea	PDO, MEI, SST, Salinity, Nutrients	Tot landings, landings of different species	Copepods, euphausiids, zooplankton biomass
Russia		Catches of different groups	TL, Mean trophic index
USA	PDO, NPGO, ONI, SST, upwelling, nitrate flux	Total landings; coastal pelagics and groundfish landings	Seabird reproductive success; sea lion pup growth, production, juvenile fish, larval fish, copepod abundance

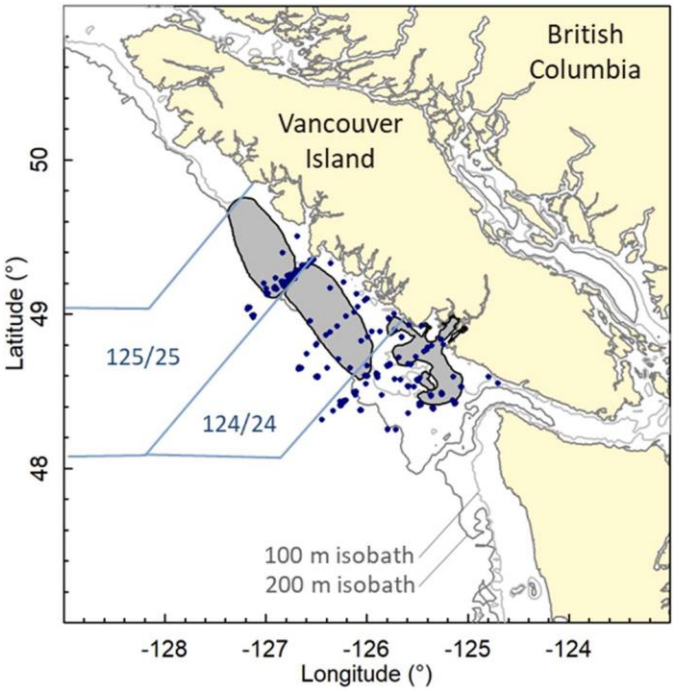
Build upon indicators identified via WG-28, WG-35, and the HD committee

TOR 3: Selection of methods

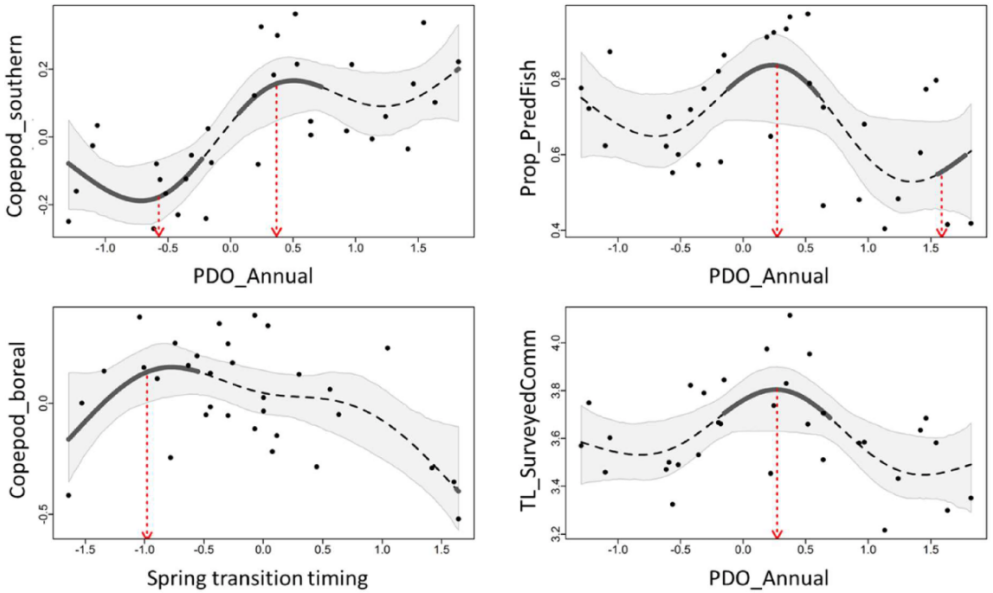
- Identify nonlinear relationships and quantify management relevant thresholds:
  - Generalized Additive Models (2 regions)
  - Gradient Forest Analysis (2 regions)

- Assess status/trends of indicators, evaluate relative changes over time:
  - Dynamic Factor Analysis (4 regions)

TOR 4: Generalized Additive Models (WCVI)



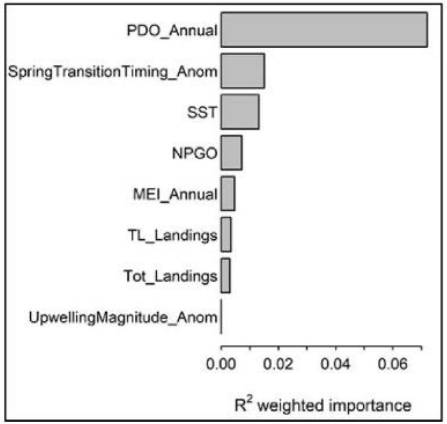
4 relationships (6% of total) were identified as nonlinear



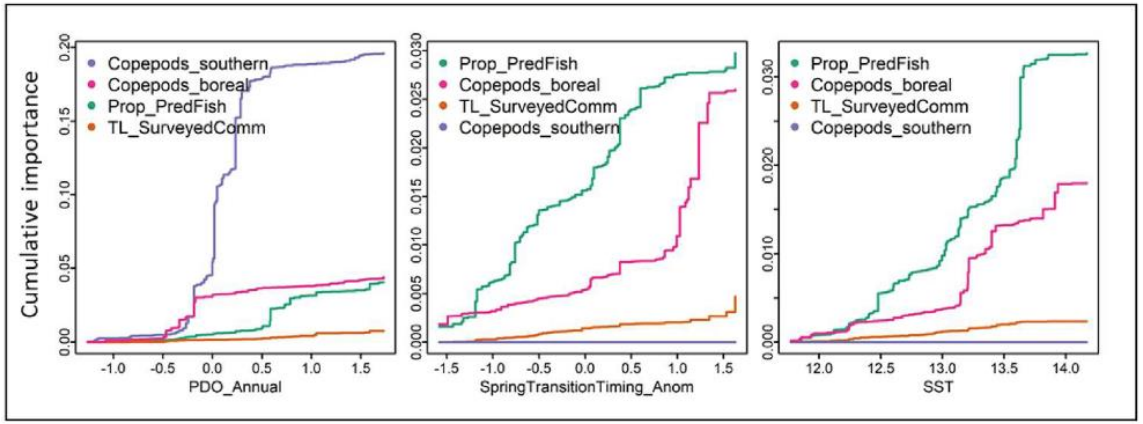
Boldt et al. 2021 Ecological Indicators

TOR 4: Gradient Forest Analysis (WCVI)

Cumulative ecosystem responses



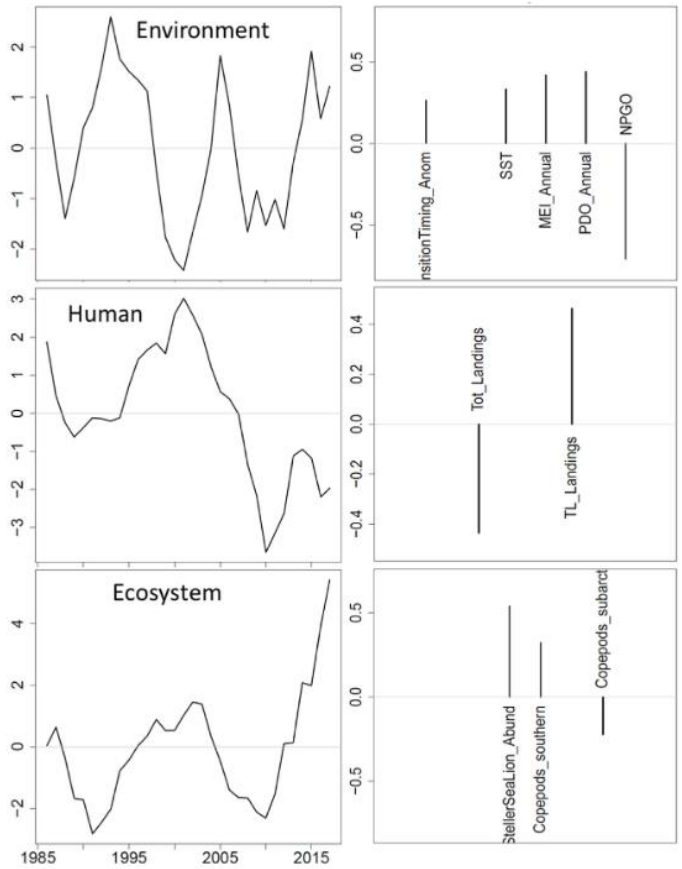
7 relationships (12% of total) were identified as nonlinear



Results from GAM and Gradient Forest were largely in agreement

Boldt et al. 2021 Ecological Indicators

TOR 4: Dynamic Factor Analysis (WCVI)



DFAs were applied to time series to:

1) identify common trends in indicators

2) assess their status and trends, and

3) discuss implications of trends

Boldt et al. 2021 Ecological Indicators
Hunsicker et al. 2022 PLOS Climate

Some key challenges to identifying CERP

- Differences in the types and availability of time series
- Differences in expertise and experience with methods
- Inconsistency in methods applied across ecosystems
- Small number of thresholds identified

Some key accomplishments by WG36 CERP

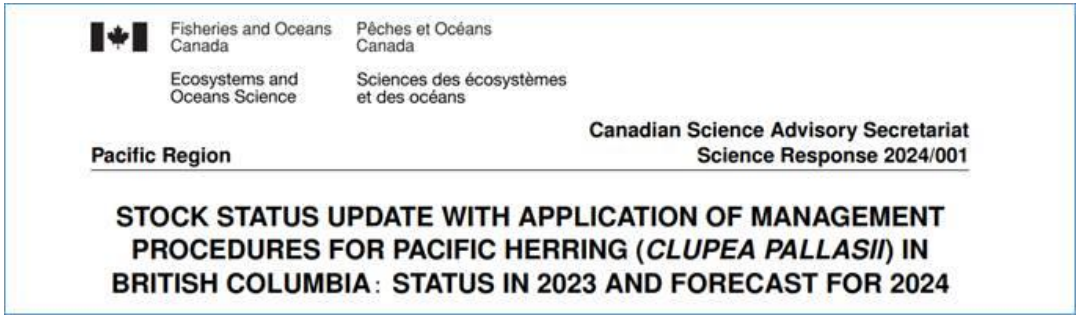
We persevered through the COVID-19 pandemic!

Some key accomplishments by WG36 CERP

- Inclusive of all member nations, increased international collaboration
- Multiple topic sessions, workshops, two manuscripts
- Capacity building via exchange of knowledge and skills
  - GitHub repository – open source R code
- Skills and tools brought back to member countries and applied

Some key accomplishments by WG36 CERP

- Advancing EAFM for Pacific herring



Fisheries and Oceans Canada | Pêches et Océans Canada

Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Pacific Region

Canadian Science Advisory Secretariat
Science Response 2024/001

STOCK STATUS UPDATE WITH APPLICATION OF MANAGEMENT PROCEDURES FOR PACIFIC HERRING (*CLUPEA PALLASII*) IN BRITISH COLUMBIA: STATUS IN 2023 AND FORECAST FOR 2024

Tools were used to develop science advice to fisheries managers through DFO's Canadian Science Advisory Secretariat process

Some key accomplishments by WG36 CERP

- Supporting movement toward EAFM/EBFM on U.S. west coast

NOAA FISHERIES
Headquarters

NOAA Fisheries Ecosystem Based Fishery Management Road Map

deReynier, Harvey, Link, Morrison et al. 2024

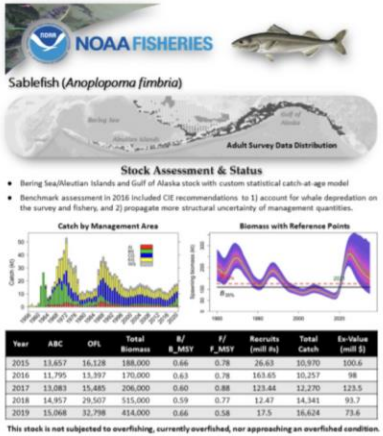
PERSPECTIVE

Ecosystem-level reference points: Moving toward ecosystem-based fisheries management

Wendy E. Morrison[1] | Stephanie A. Oakes[2] | Melissa A. Karp[2] | Max H. Appelman[1] | Jason S. Link[3]

Marine and Coastal Fisheries (2024)

Ecosystem and Socioeconomic Profile (ESP)



Risk Tables

	Ecosystem/ Environmental conditions	Assessment data inputs	Assessment model fits and structural uncertainty
Level 1: favorable			
Level 2: neutral			
Level 3: unfavorable			

A risk table to address concerns external to stock assessments when developing fisheries harvest recommendations

Martin W. Dorn and Stephani G. Zador

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