Recent steps towards incorporating assessment of impacts to vulnerable and discarded bycatch species into ecosystem-based management of fisheries in the NPFC Convention Area and pathways for future improvement

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Fisheries in NPFC Convention Area

Gears

Bottom trawl
Bottom gillnet
Bottom longline
Trap

Pelagic/midwater trawl
Purse seine
Stick held dip-net
Lift net
Jig

Priority species

Pacific saury
Chub mackerel
Japanese sardine
Blue mackerel

Neon flying squid
Japanese flying squid

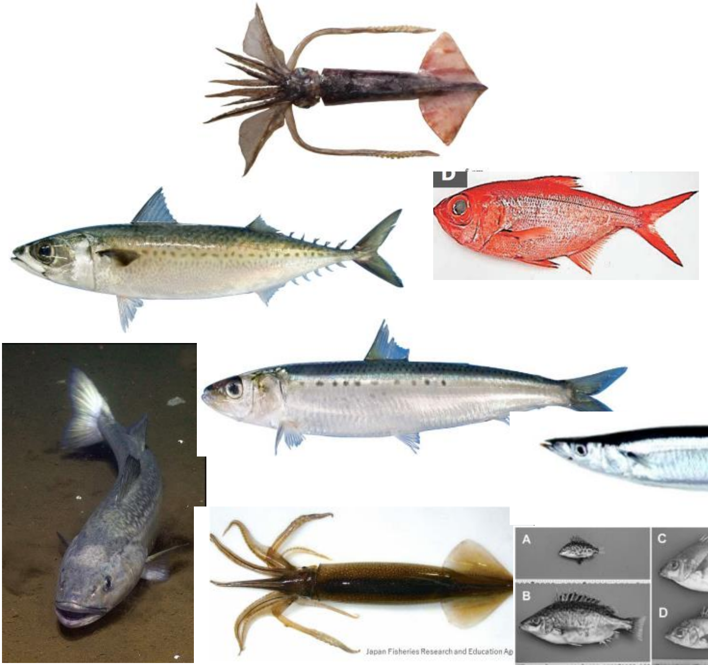
Sablefish
Skilfish
North Pacific Armorhead
Splendid Alfonsino

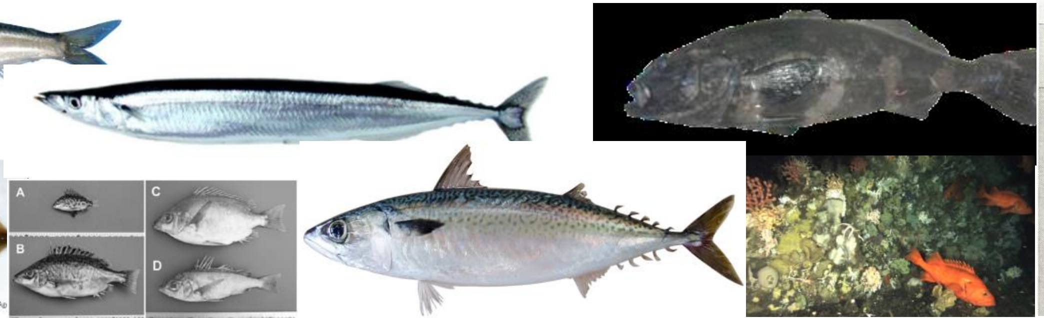
Other species

Rougheye/blackspotted rockfish
Oreo

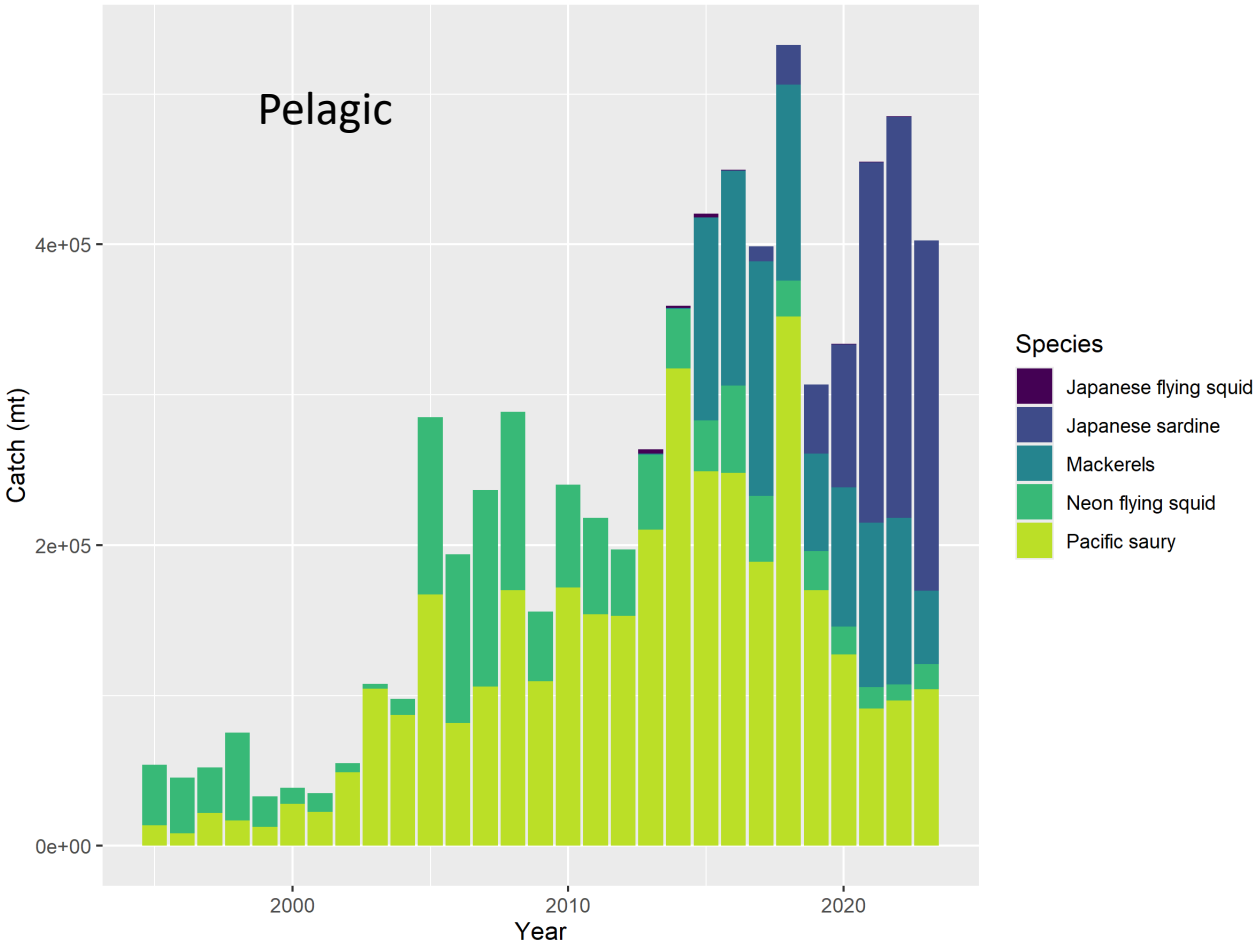
Members

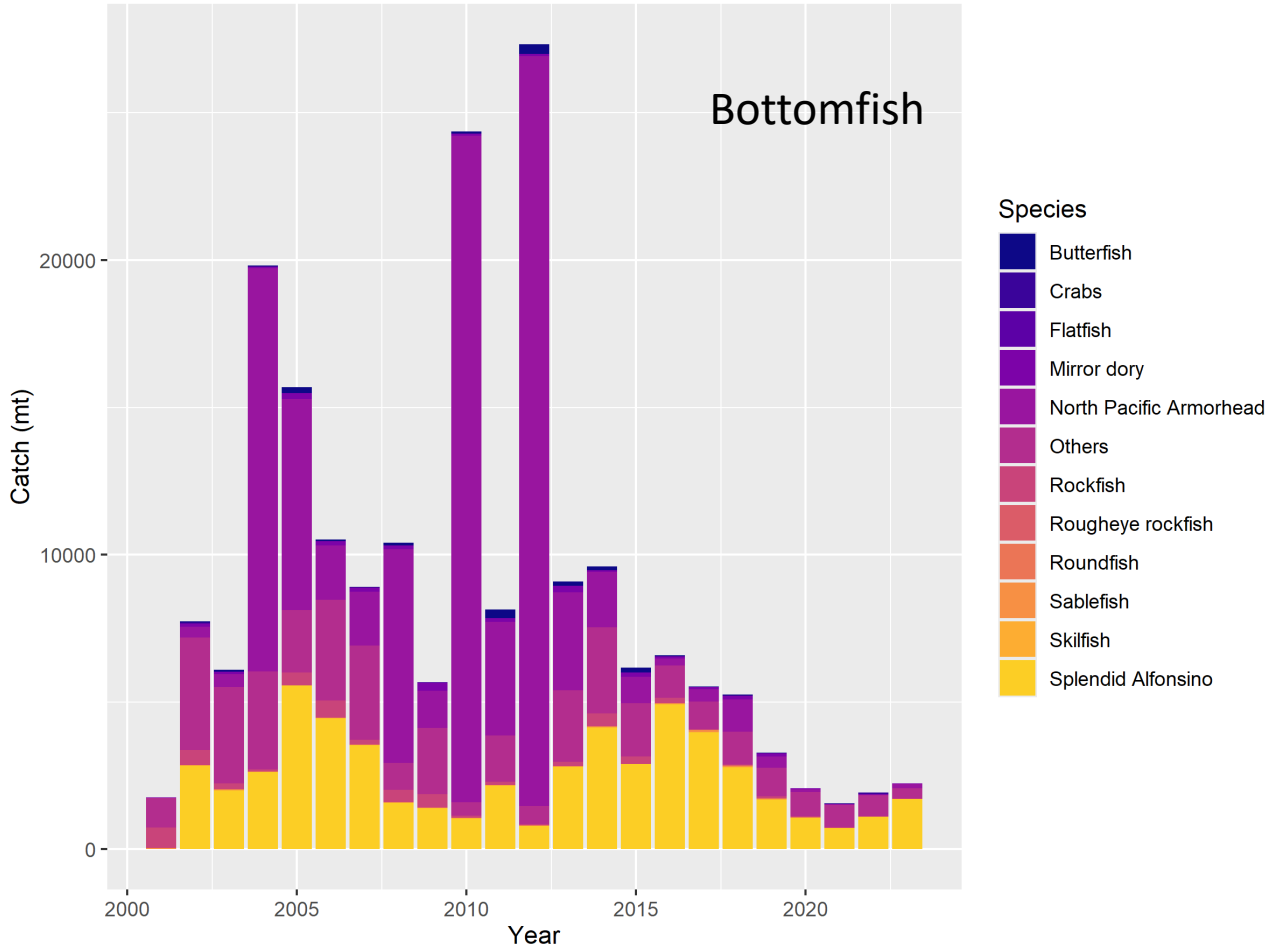
Canada
China
European Union
Japan
Korea
Russia
Chinese Taipei
USA (non-fishing)
Vanuatu



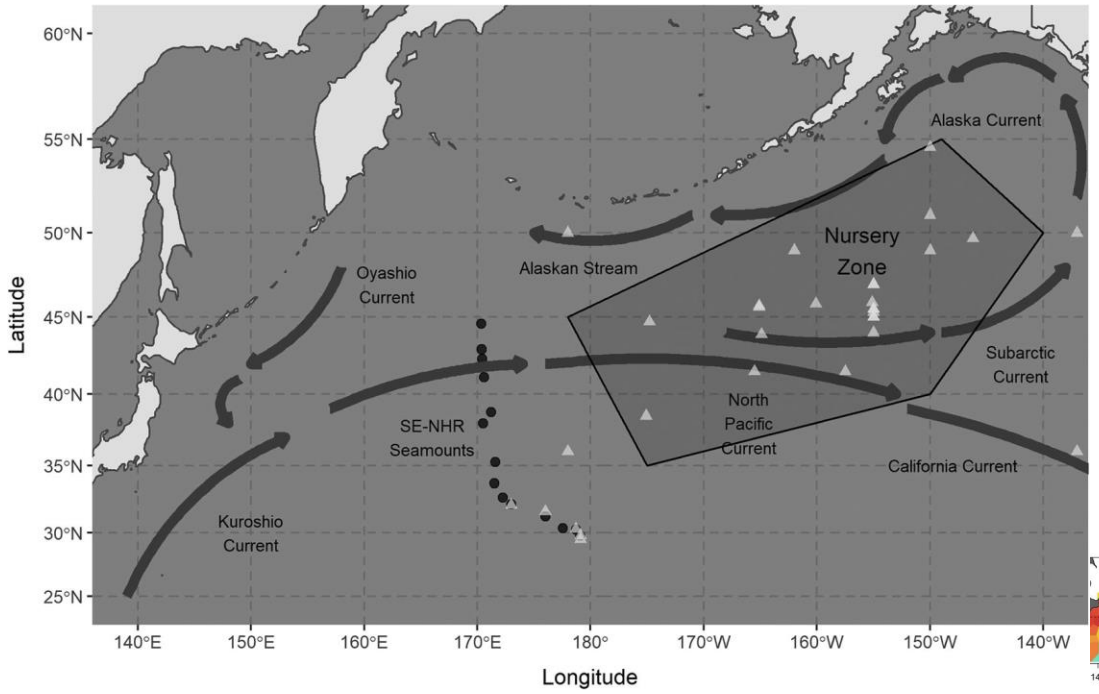


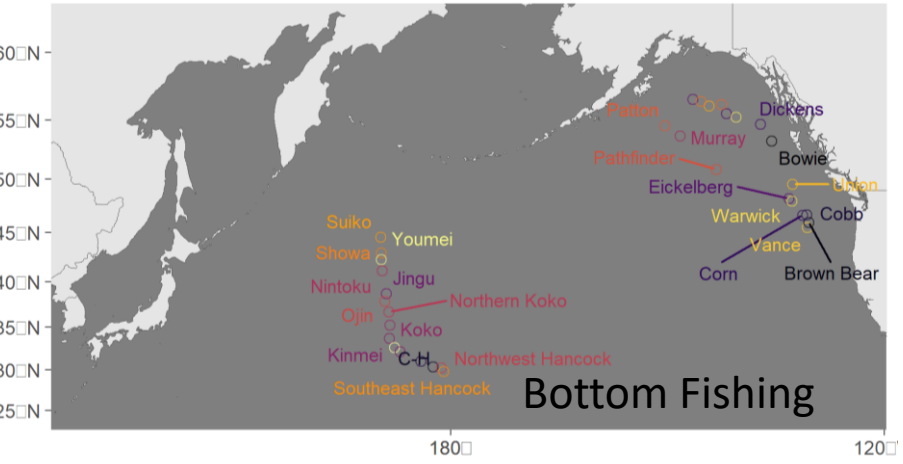
Catches

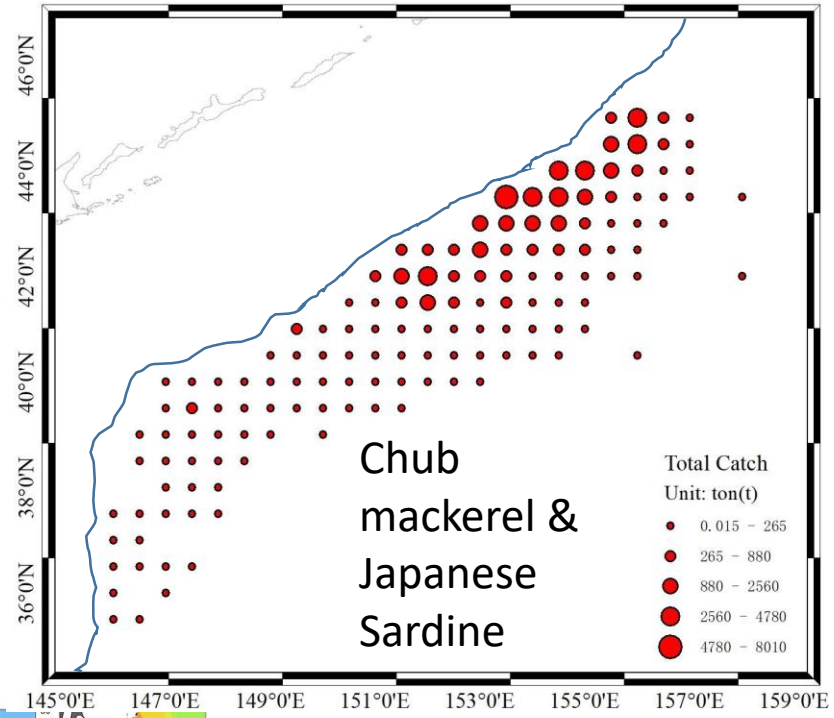

Pelagic
Catch (mt)
4e+05
2e+05
0e+00
2000
2010
2020
Year
Species
Japanese flying squid
Japanese sardine
Mackerels
Neon flying squid
Pacific saury

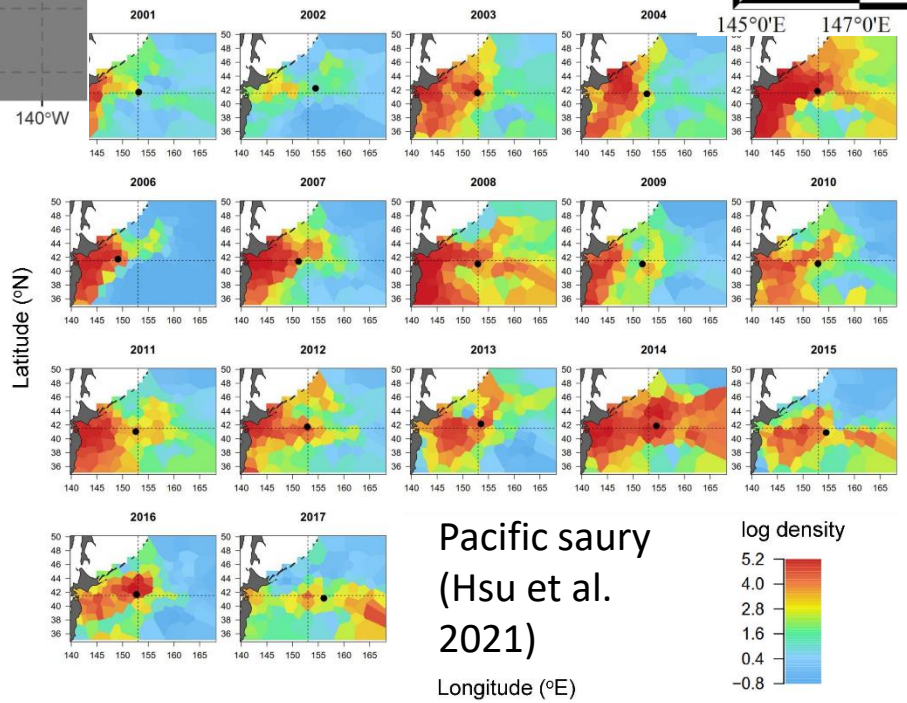

Bottomfish
Catch (mt)
20000
10000
0
2000
2005
2010
2015
2020
Year
Species
Butterfish
Crabs
Flatfish
Mirror dory
North Pacific Armorhead
Others
Rockfish
Rougheye rockfish
Roundfish
Sablefish
Skilfish
Splendid Alfonsino

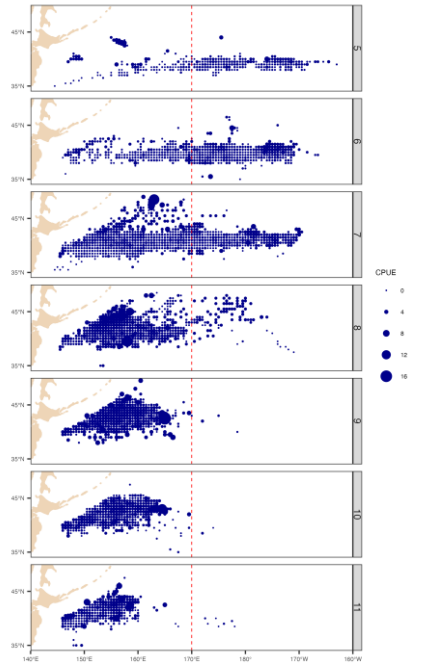
Maps of fishing activity





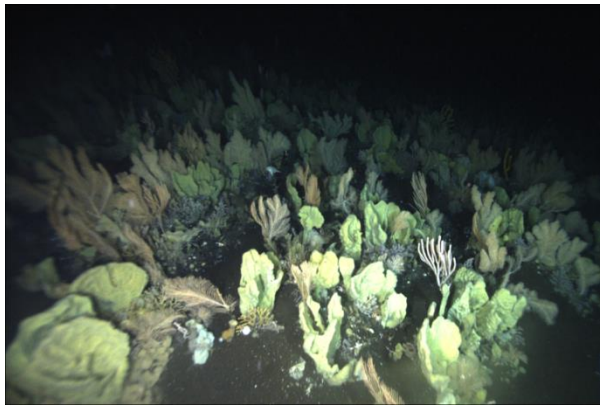






NPFC Ecosystem management – VME Discards and Bycatch

- Currently – Two CMMs on Bottom Fisheries and Protection of VME
  - Much ongoing activity to summarize



NPFC Ecosystem management – Fish Discards and Bycatch

- Currently – No CMMs directly relating to EAFM
- Small steps in 2022-2024
  - Science
  - Regulatory

NPFC Ecosystem management – Future steps?

NPFC Performance Review - 2022

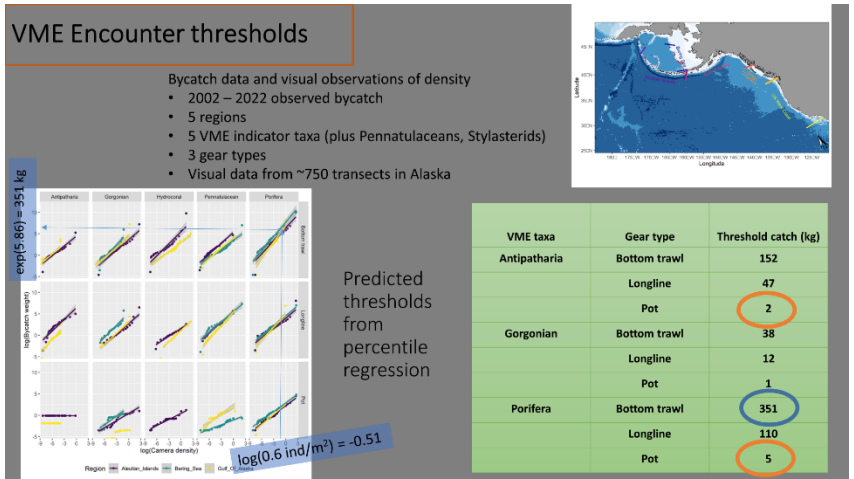
- Recommendation 4.2.1. That the Commission increase efforts to characterise NPFC fisheries by expanding and harmonizing **data collection formats for all species encounters, including bycatch, discards** and species belonging to the same ecosystem or dependent upon or associated with the target stocks.
- Recommendation 4.2.4. That the Commission **dedicate effort and resources** to the collection of data relating to bycatch and species taken incidentally in all NPFC fisheries.
- Recommendation 4.5.1. The implementation of the CMMs relating to bottom fishing and the protection of VMEs should be strengthened by requesting the:
  - SC to undertake a review of the scientific aspects of the 50kg VME encounter threshold (including practices in other RFMOs) for possible revision;
  - SC to re-visit the recommendations of SC03 and SSC VME03 and provide a transparent assessment of the value of including sponges and hydrocorals as VME indicator taxa in conjunction with supporting an initiative to develop a quantitative method for the identification of VMEs; and
  - TCC to develop compliance-related reporting provisions for the Scientific Observer Program related to VME encounters, accompanied by a mechanism to deter non-compliance.4. Include climate change as a standing agenda item of meetings of the Commission, SC, and TCC.
- Recommendation 4.5.2. That the Commission and the SC develop **strategies that address the lack of information needed to take ecosystem considerations into account for NPFC pelagic fisheries in the Convention Area**, and include these in the SC's Research Plan, data collection procedures and obligations to better take into account ecosystem-related interactions, and how they might compare with compatible initiatives in areas under national jurisdiction.
- Recommendation 4.5.3. That the Commission, at an early opportunity, develop and adopt CMMs addressing lost and discarded fishing gear, marine pollution and waste from fishing vessels, **interactions with marine mammals, seabirds or sharks** (particularly a prohibition on shark finning), and a prohibition on fishing with long driftnets in the NPFC Convention Area.
- Recommendation 4.5.4. That the Commission recognize the importance of taking into account the known and anticipated impacts of **climate change** on the North Pacific Ocean ecosystem, including with respect to changes in the geographic and temporal distribution of stocks, notably Pacific saury.
- Recommendation 4.5.5. That the SC make appropriate provision in its current Research Plan to address current deficiencies associated with addressing the impacts of **climate change** on NPFC ocean ecosystems and associated fisheries.

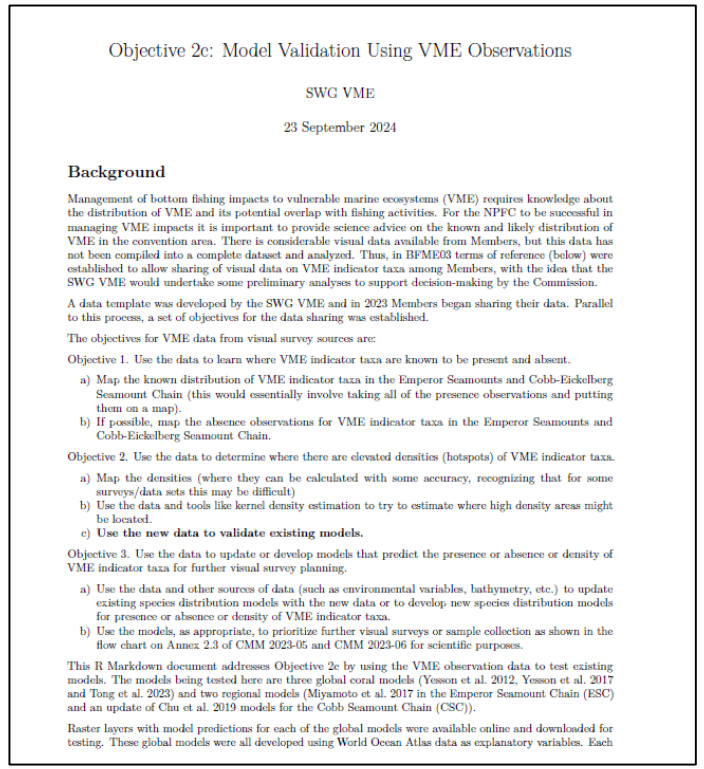
Resolution on Climate Change - 2023

- NPFC resolves to:
- 1. Consider where appropriate the potential impacts of climate change on NPFC fisheries resources and related ecosystems in the Convention Area, related fishing activities, as well as any related socio-economic impacts.
- 2. Take into account in relevant deliberations, including in the development of conservation and management measures to the extent possible, the best available scientific information and advice, particularly from the Scientific Committee (SC), on the potential impacts of climate change on target stocks, **non-target species, and species belonging to the same ecosystem or dependent on or associated with target stocks**, with a view to adapting to changing conditions and improving the resilience of these stocks, species, related ecosystems, and fisheries.
- 3. Task the SC to identify relevant data availability and needs and integrate analyses of climate change relevant to NPFC fisheries into its work plan. The SC will consider to the extent possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and **species belonging to the same ecosystem or dependent upon or associated with target stocks**, including the impacts on overfished stocks and vulnerable marine ecosystems. The SC will discuss how best to incorporate existing climate change data and analyses in its work as well as other information that may be needed to assess the impact of climate change on the fisheries managed by NPFC.
- 4. Include climate change as a standing agenda item of meetings of the Commission, SC, and TCC.

VME management, protection and tools

- Similar path to other RFMOs
- Main areas of work
  - VME (and VME indicator taxa) definition (Rowden method, Japan method)
  - Encounter thresholds (data based weights)
  - Compilation of existing data (look for areas of risk, test models, build models)
  - SAI?
- Spatial closures
- Why not use models?
  - Validation of existing models





Objective 2c: Model Validation Using VME Observations

SWG VME

23 September 2024

Background

Management of bottom fishing impacts to vulnerable marine ecosystems (VME) requires knowledge about the distribution of VME and its potential overlap with fishing activities. For the NPFC to be successful in managing VME impacts it is important to provide science advice on the known and likely distribution of VME in the convention area. There is considerable visual data available from Members, but this data has not been compiled into a complete dataset and analyzed. Thus, in BFME03 terms of reference (below) were established to allow sharing of visual data on VME indicator taxa among Members, with the idea that the SWG VME would undertake some preliminary analyses to support decision-making by the Commission.

A data template was developed by the SWG VME and in 2023 Members began sharing their data. Parallel to this process, a set of objectives for the data sharing was established.

The objectives for VME data from visual survey sources are:

Objective 1. Use the data to learn where VME indicator taxa are known to be present and absent.

a) Map the known distribution of VME indicator taxa in the Emperor Seamounts and Cobb-Eickelberg Seamount Chain (this would essentially involve taking all of the presence observations and putting them on a map).
b) If possible, map the absence observations for VME indicator taxa in the Emperor Seamounts and Cobb-Eickelberg Seamount Chain.

Objective 2. Use the data to determine where there are elevated densities (hotspots) of VME indicator taxa.

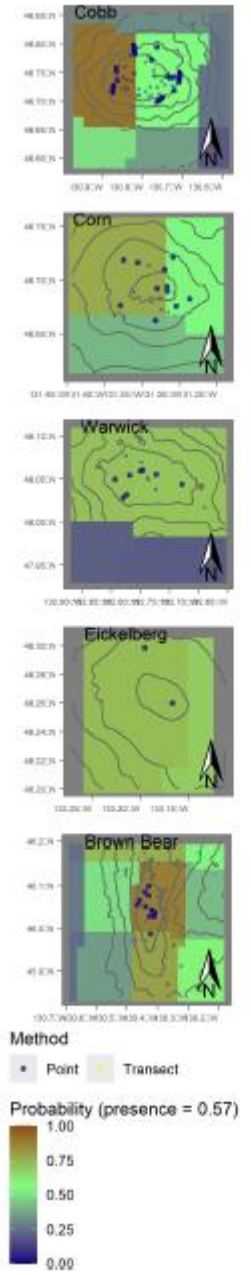
a) Map the densities (where they can be calculated with some accuracy, recognizing that for some surveys/data sets this may be difficult)
b) Use the data and tools like kernel density estimation to try to estimate where high density areas might be located.
c) **Use the new data to validate existing models.**

Objective 3. Use the data to update or develop models that predict the presence or absence or density of VME indicator taxa for further visual survey planning.

a) Use the data and other sources of data (such as environmental variables, bathymetry, etc.) to update existing species distribution models with the new data or to develop new species distribution models for presence or absence or density of VME indicator taxa.
b) Use the models, as appropriate, to prioritize further visual surveys or sample collection as shown in the flow chart on Annex 2.3 of CMM 2023-05 and CMM 2023-06 for scientific purposes.

This R Markdown document addresses Objective 2c by using the VME observation data to test existing models. The models being tested here are three global coral models (Yesson et al. 2012, Yesson et al. 2017 and Tong et al. 2023) and two regional models (Miyamoto et al. 2017 in the Emperor Seamount Chain (ESC) and an update of Chu et al. 2019 models for the Cobb Seamount Chain (CSC)).

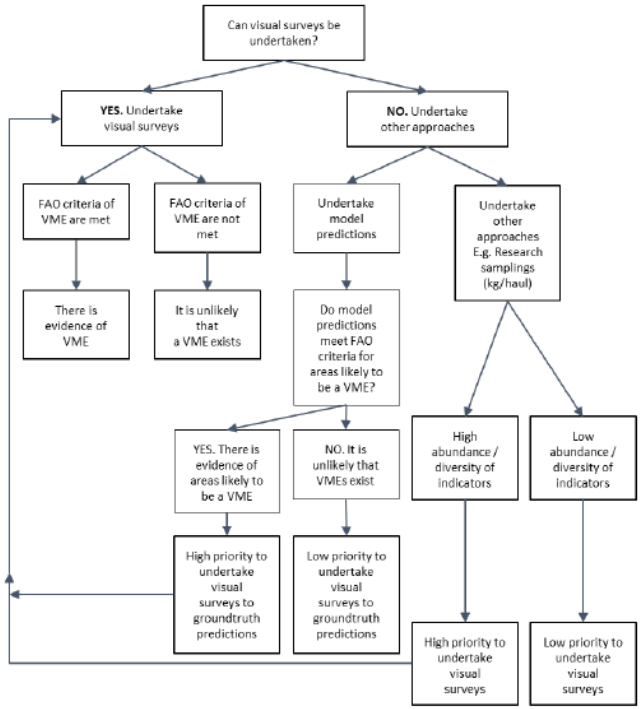
Raster layers with model predictions for each of the global models were available online and downloaded for testing. These global models were all developed using World Ocean Atlas data as explanatory variables. Each

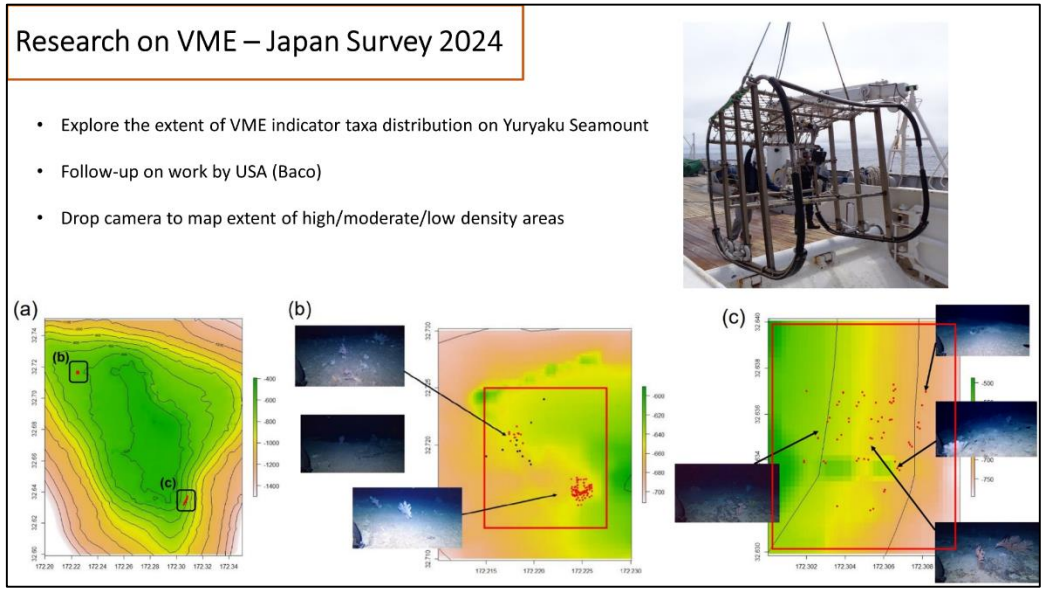


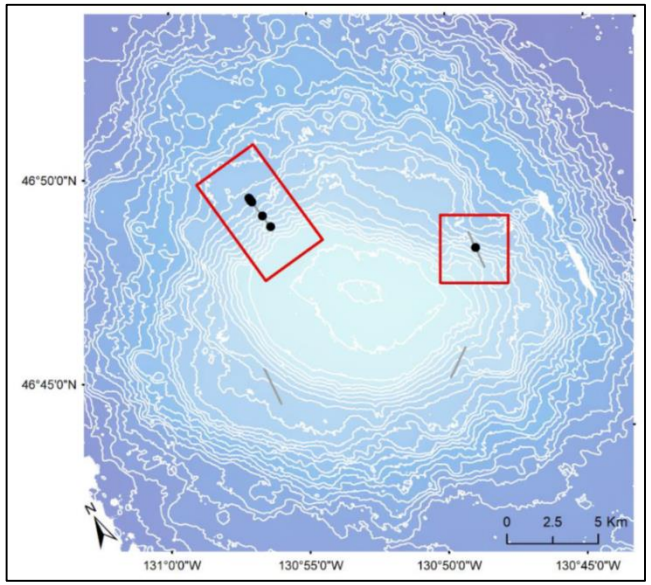
Vulnerable Marine Ecosystems

- Identification and protection – visual surveys only
  - 6 sites in ESC
  - 2 sites in CSC (38.4 km^2)

Flow chart to identify data that can be used to identify VMEs in the NPFC Convention Area

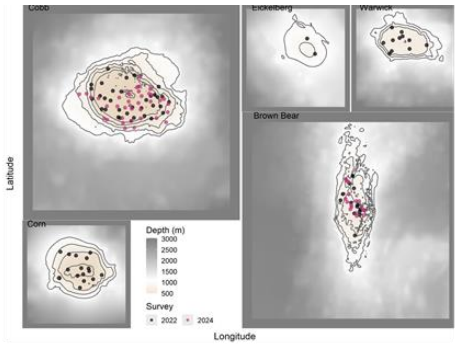


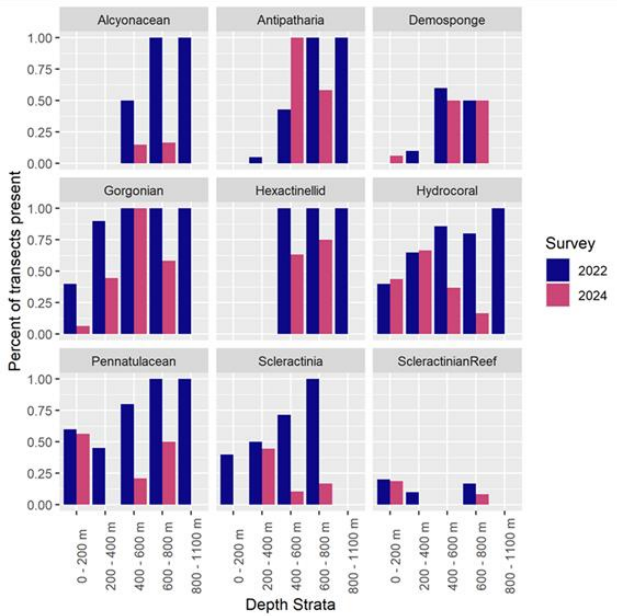




Future plans – Risk assessment updates 2025-2026

- Survey data 2022-2024

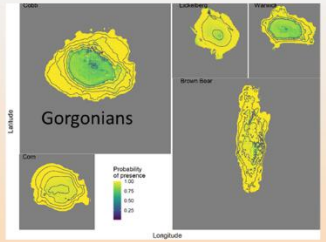


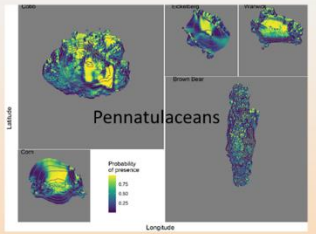


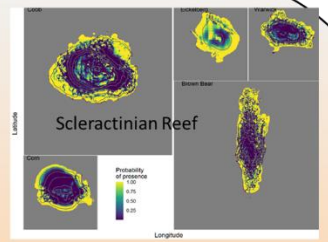
Distribution modeling

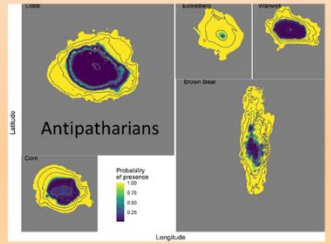
Presence/absence

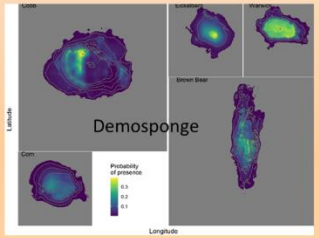
- 135 transects (presence/density)
- 1,286 height measurements

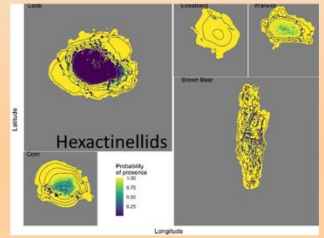




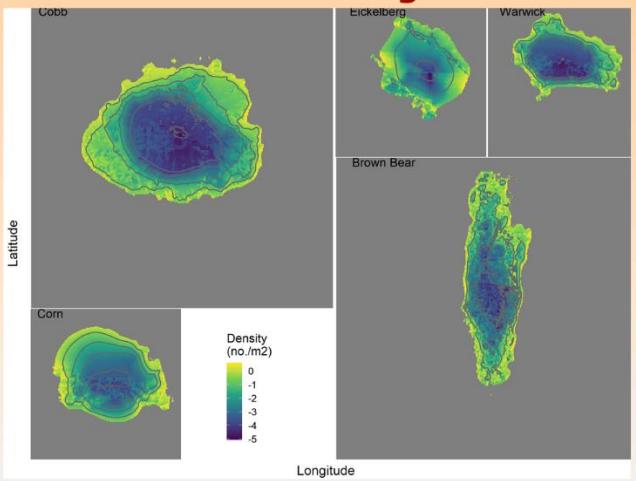




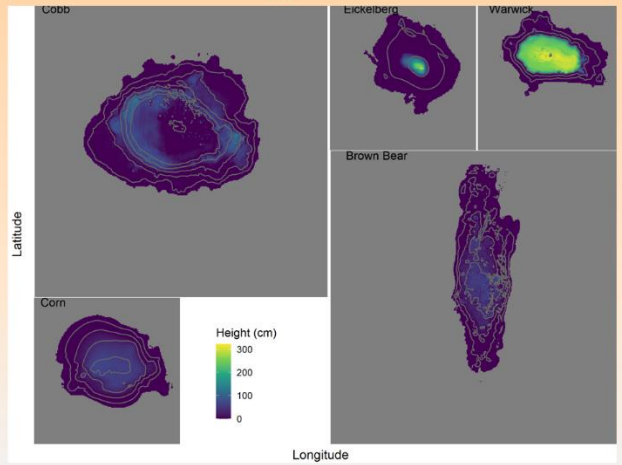




Density



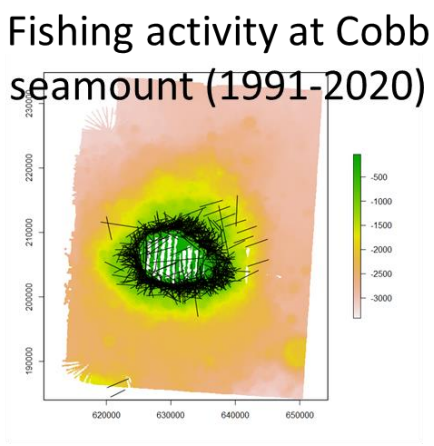
Height

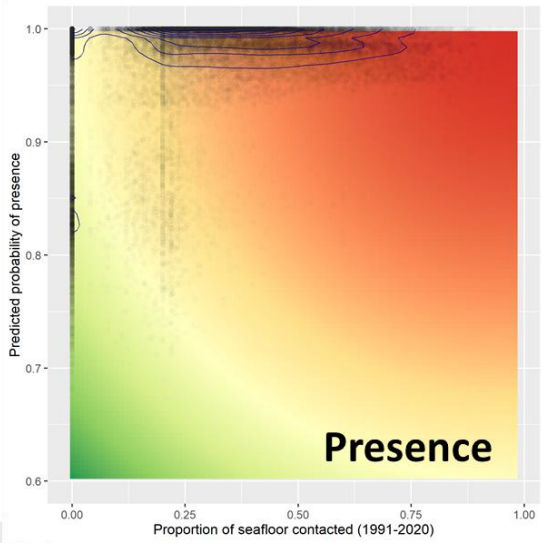


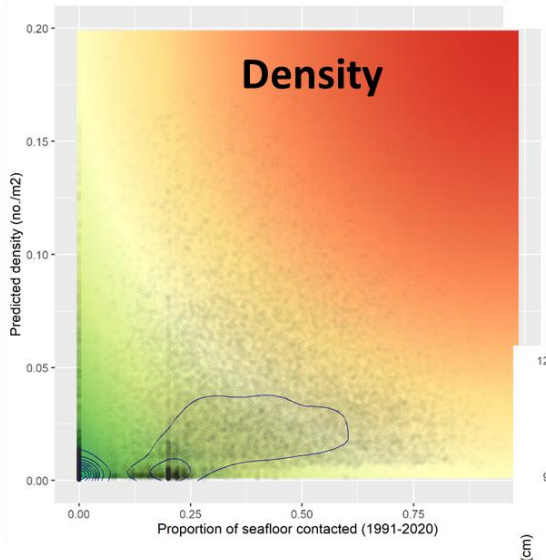
Future plans – Risk assessment updates 2025-2026

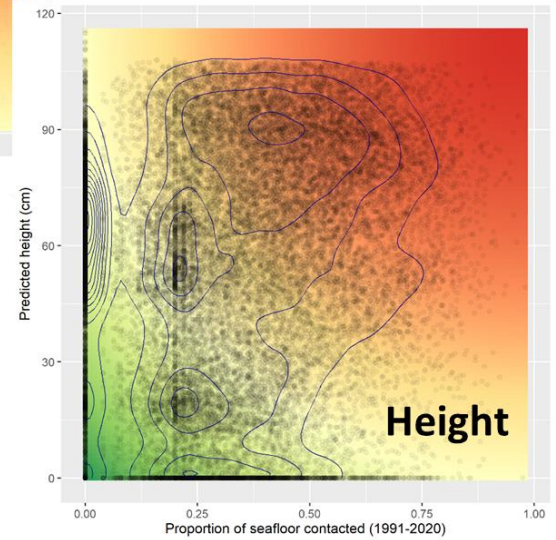
Sidebar: ICES WKPHM & WKPHM2

- Standards for species distribution models
- Integrate data, models, scales, etc.
- Framework for bringing in multiple layers of information









NPFC Ecosystem management – VME Discards and Bycatch

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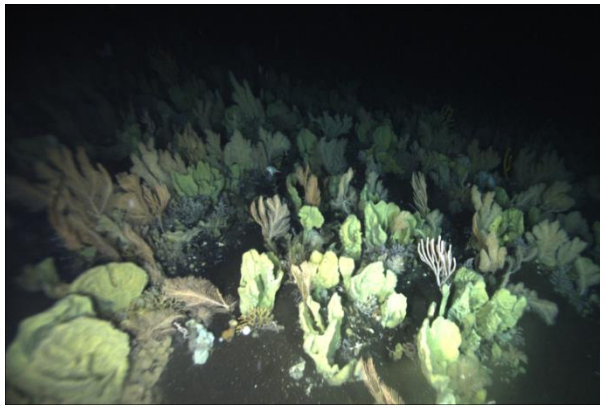

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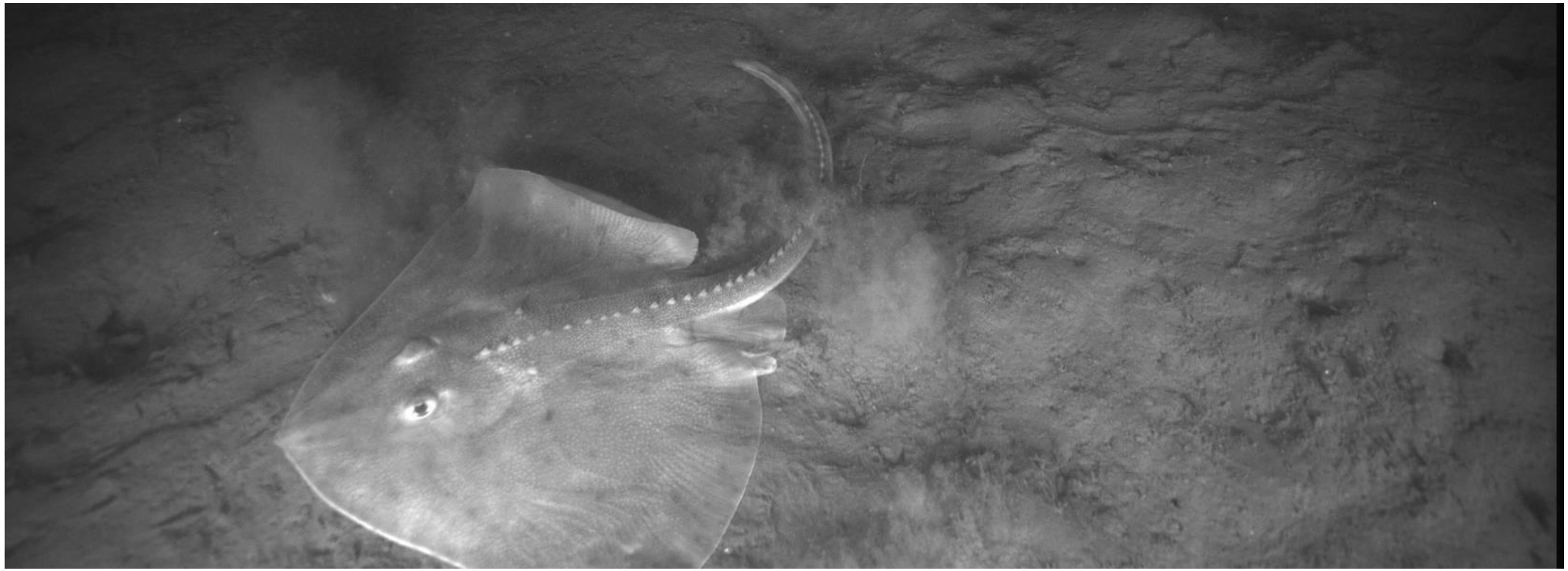
- Small steps in 2022-2024
  - Science
  - Regulatory

NPFC Ecosystem management – Future steps?

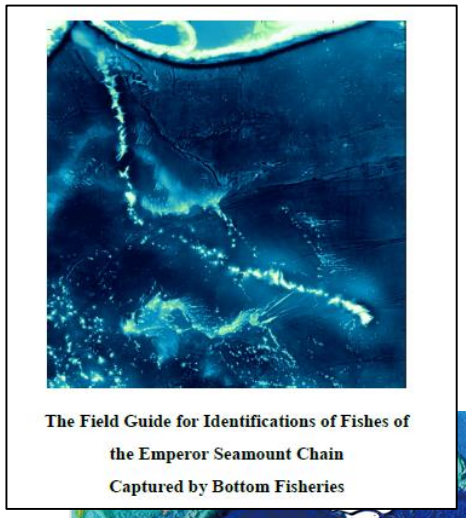
Bycatch/discards in fisheries - management and tools

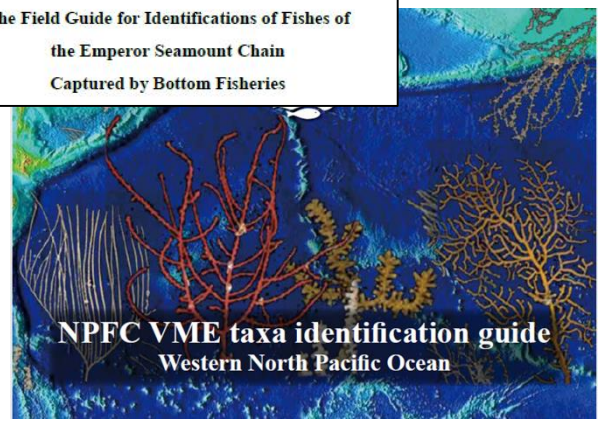
- Data
  - Bottom fish – 100% observer coverage or EM with port sampling
  - Pelagic fish – sporadic observer coverage
  - Pelagic fish – logbook data, port sampling, transshipment observers in 2025?

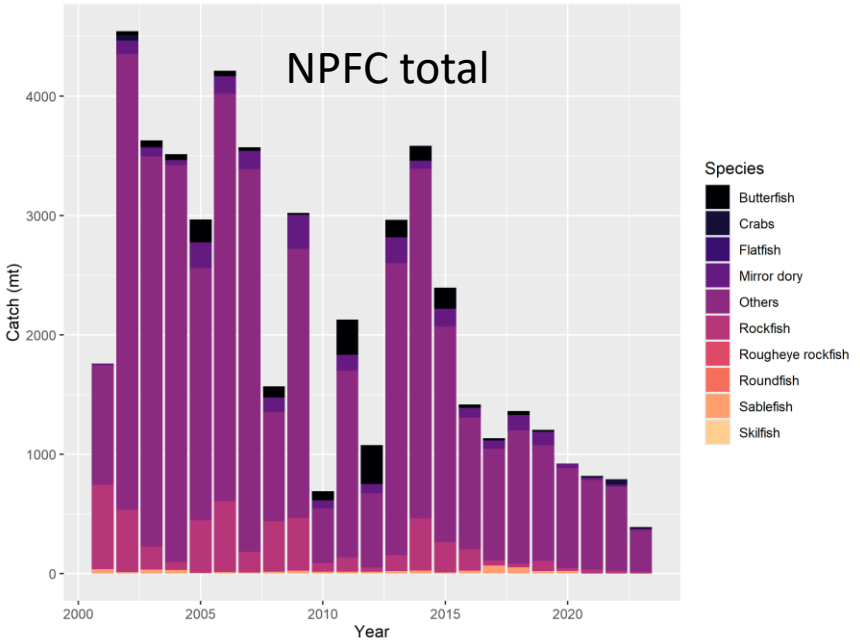


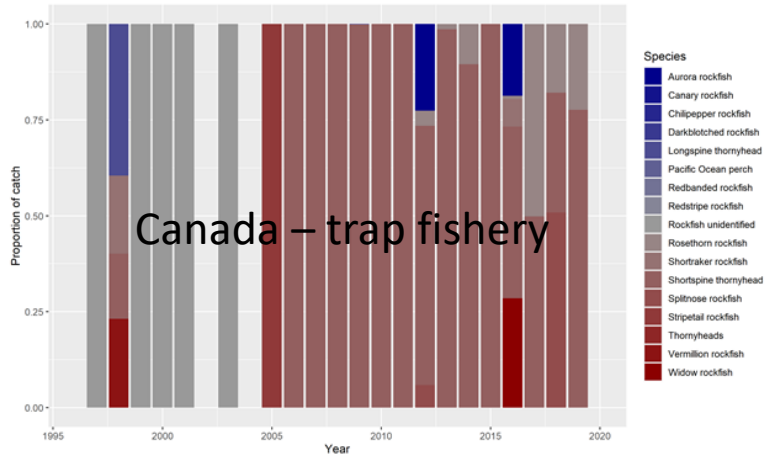
Bycatch/discards in fisheries - management and tools

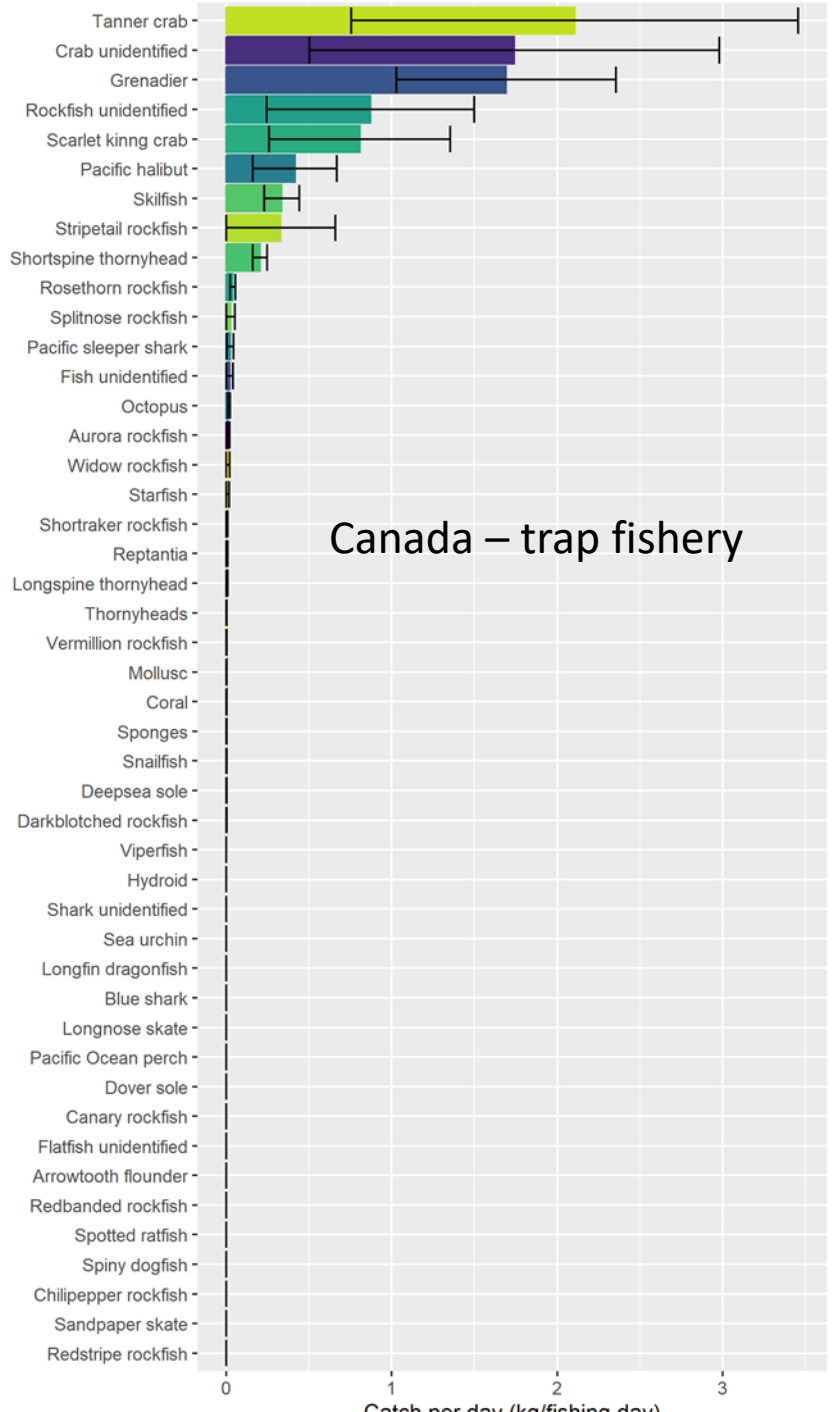
- Bottom fish
  - ID Guides
  - Primary species











Bycatch/discards in fisheries - management and tools

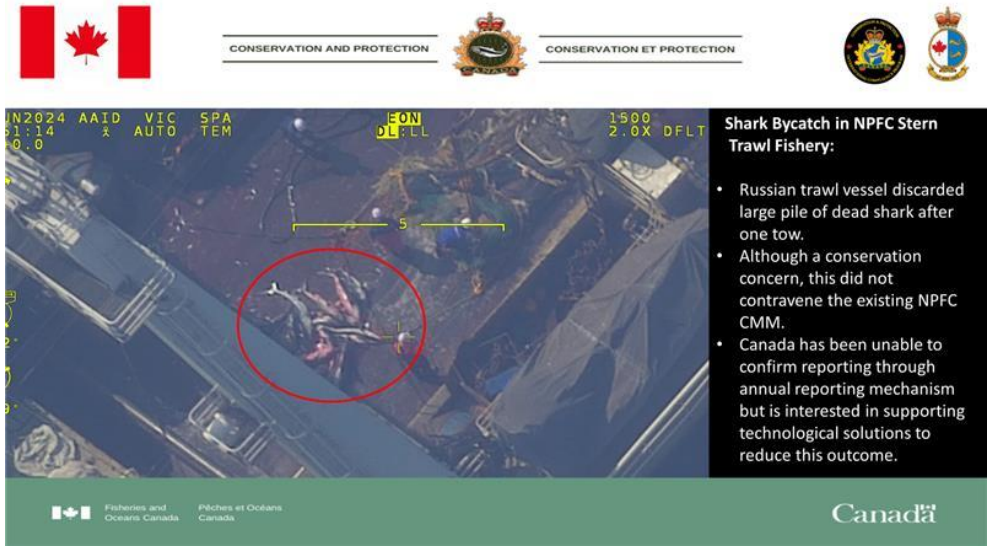
- Pelagic data – reported in 2024
  - Typically not required to be reported (except other priority species)
  - Reported bycatch in stick-held dipnet fishery < 1% of catch weight
  - Reported bycatch in other fisheries < 10% of catch weight

- Primary species

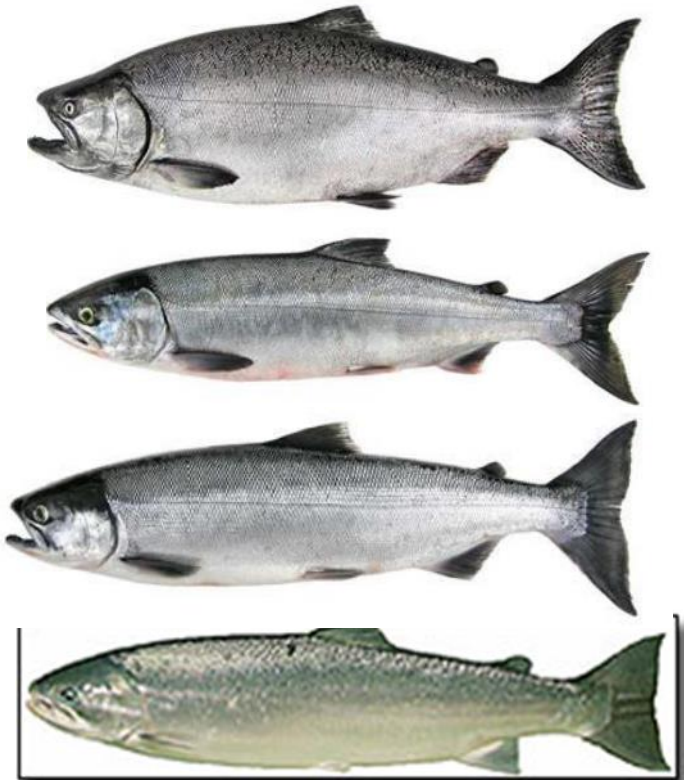
Regulatory - Prohibited species measures

Members annual reports and past enforcement patrols indicate salmon and shark bycatch

2023 – Shark finning prohibited
Targeting shark prohibited



2024 – Salmon retention prohibited



In 2025 or 2026 – Canada hopes to implement shark, mammal and turtle excluder device on trawls

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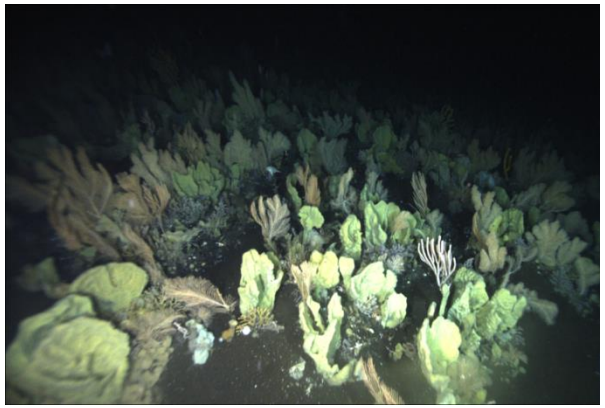

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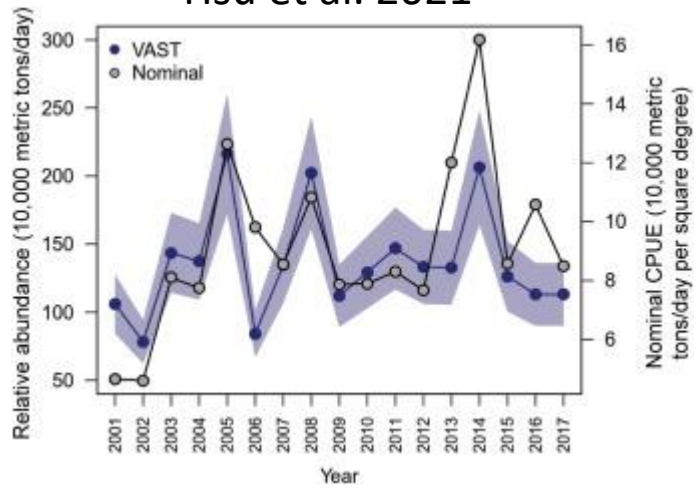
NPFC Ecosystem management – Future steps?

What else are we working on?

- Index standardization using environmental variables
  - Assessments highly dependent on CPUE
  - SST and other variables are helpful
- Process error exploration with environmental correlates
- Incorporating ecosystem into assessment/MSE

Hsu et al. 2021



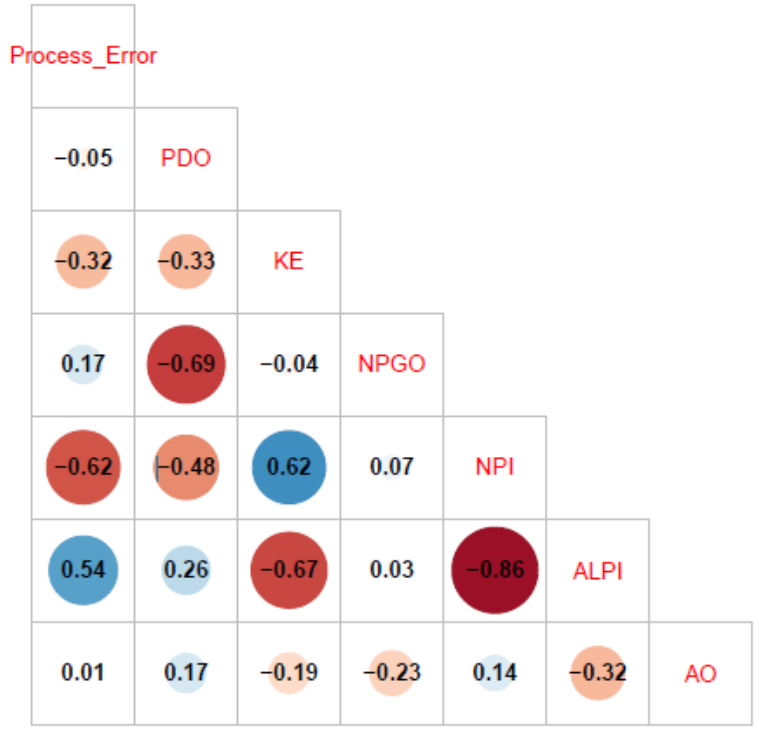
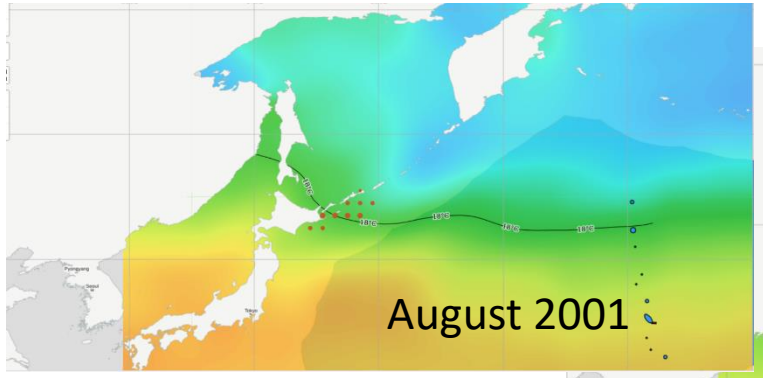
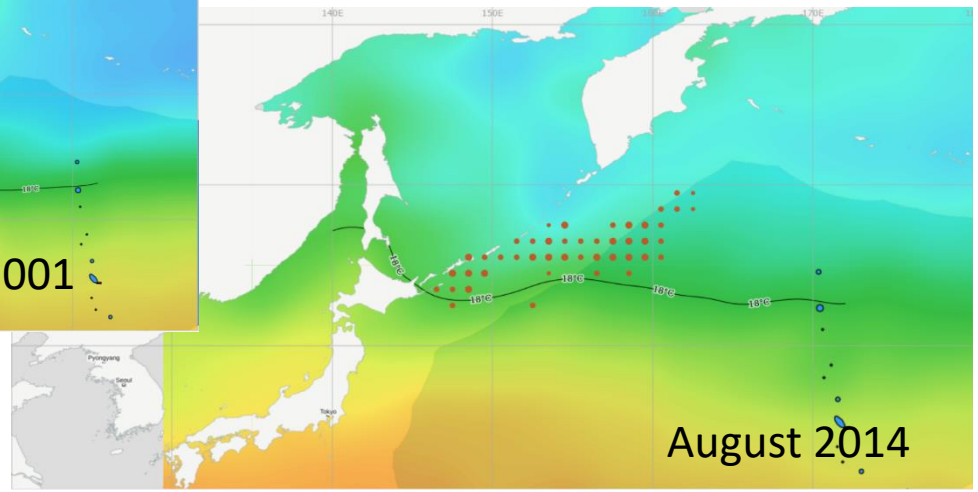


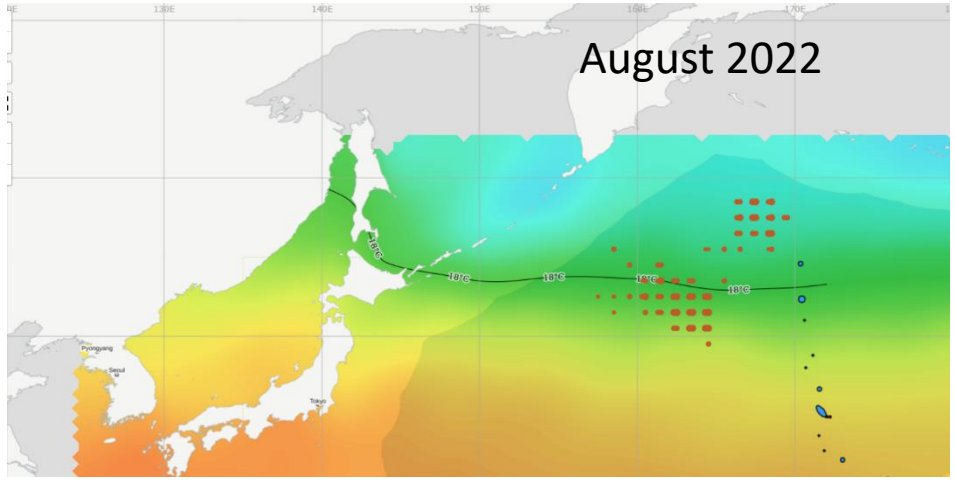
Figure 8: Correlation between environmental indices and process error from BSSPM Base Case 1.

New Regime? Trends in Effort/Catch – Pacific Saury

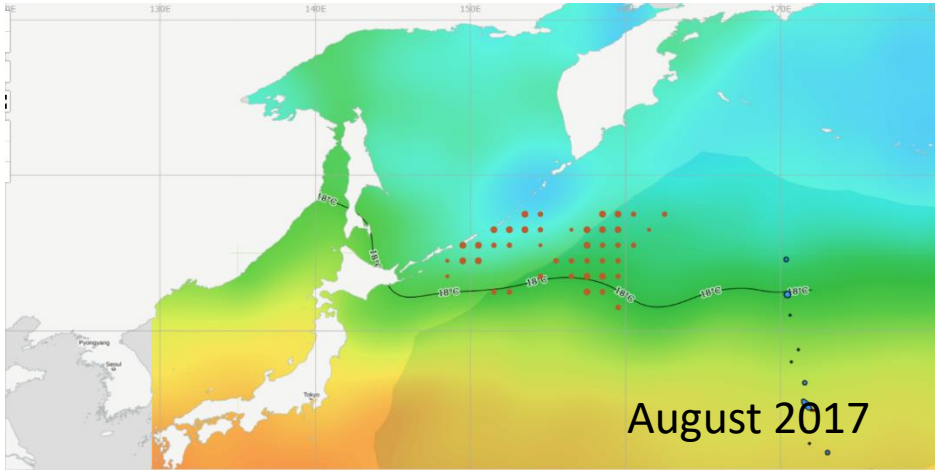
- Moving Northeast into Convention Area
- Similar to other species (Japanese sardine, chub mackerel)

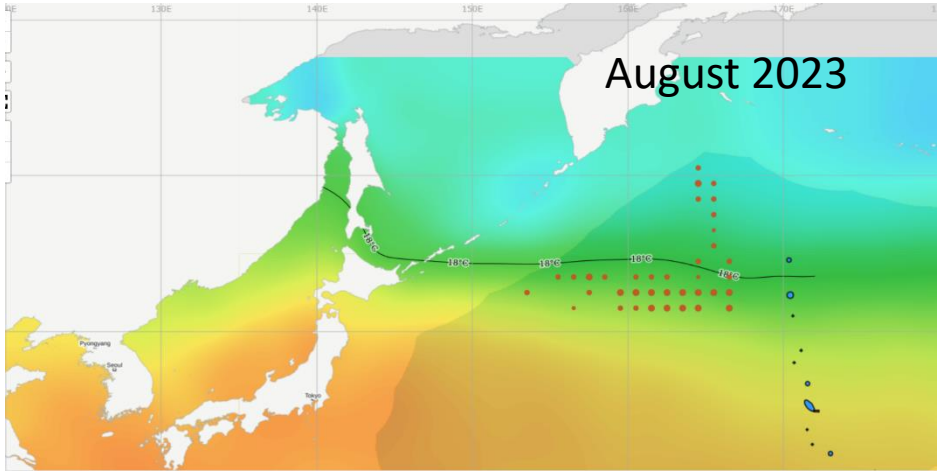






Chub mackerel growth rates
Maturity changes

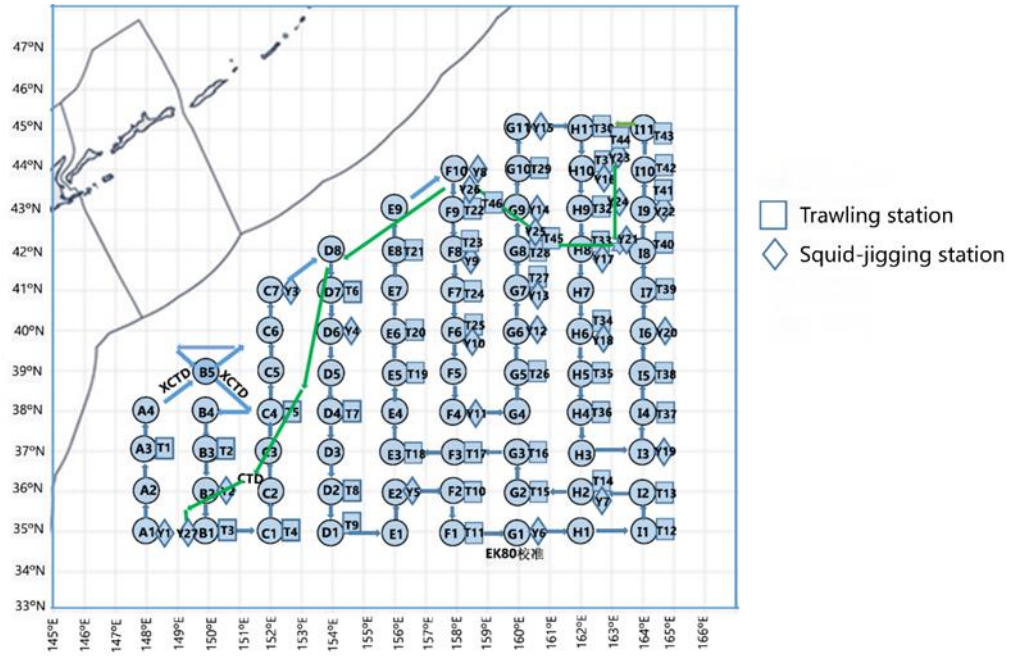




What is needed?

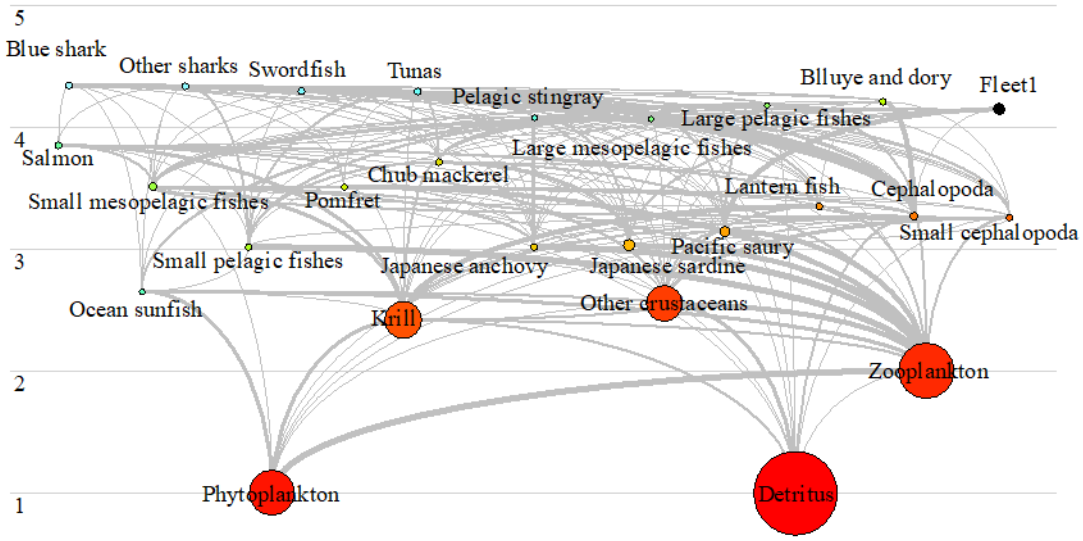
- Food web models – can link fisheries to other ecosystem components
- Multispecies stock assessment
- Joint species distribution models
- More ecosystem surveys & indicators of ecosystem health

Sampling grid of RV Song Hang (China 2024)



Courtesy of Dr. Quiyun Ma

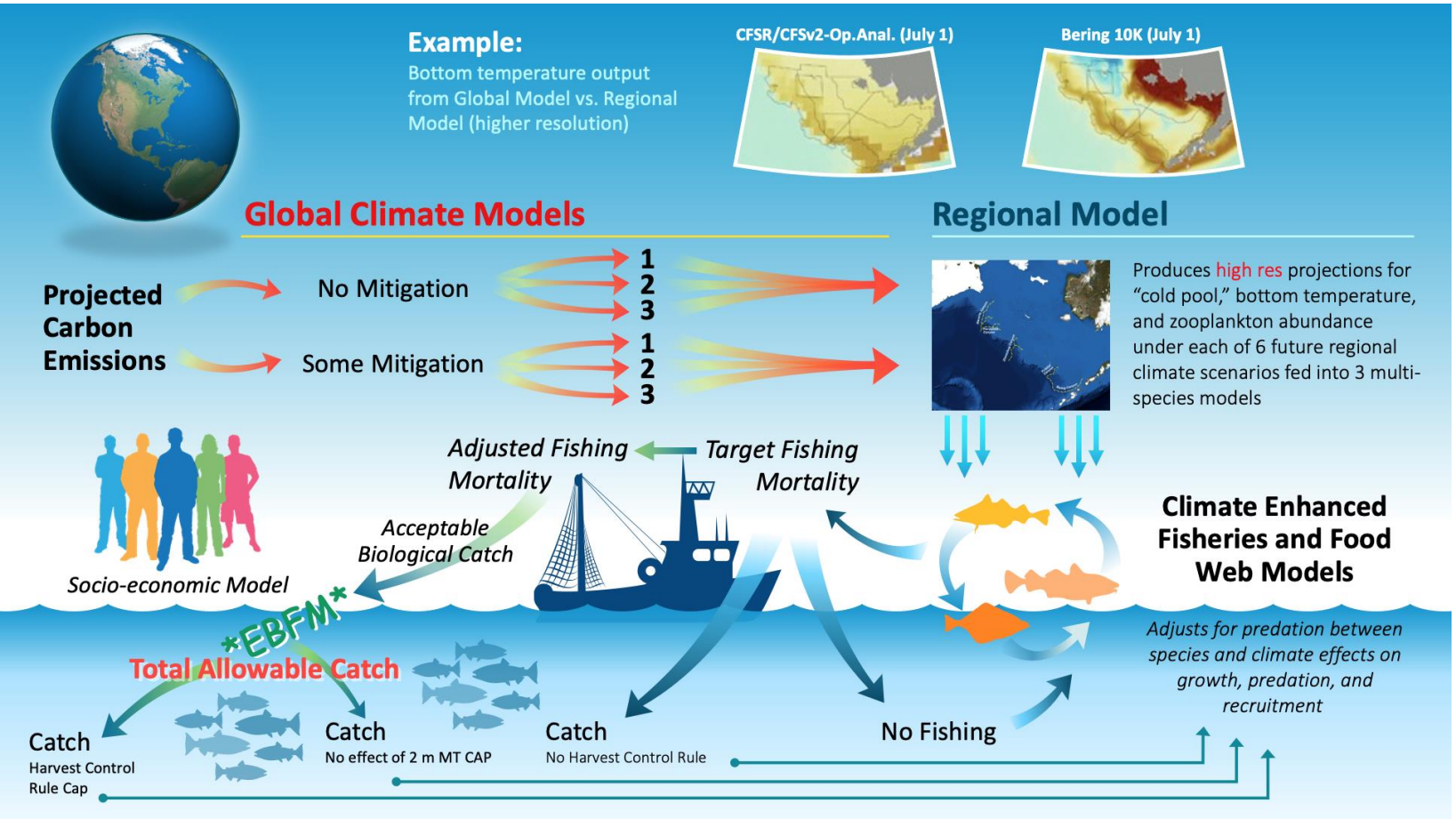
Food web of Kuroshio-Oyashio extension area (Chen et al. 2024)



Chen G, Ma Q, Wang S, Tian S, Liu B, Han D 2024. Study in the ecosystem structure and trophodynamics in the Kuroshio-Oyashio Extension area. NPFC-2024-SC09-WP22

What is needed?

AClim – Alaska Fisheries Science Center (Holsman et al.)



Received: 19 September 2023 | Revised: 6 February 2024 | Accepted: 8 February 2024
DOI: 10.1002/mcf2.10285

PERSPECTIVE

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

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Abstract

Objective: To support the movement in marine fisheries management toward ecosystem-based fisheries management by exploring ecosystem-level reference points (ELRPs) as an option for managing fisheries at the ecosystem level. An ELRP is an ecosystem harvest level or indicator with one or more associated benchmarks or thresholds (i.e., targets, limits) to identify, monitor, or maintain desirable ecosystem conditions and functions.

Methods: This paper explores the development and implementation of ELRPs in fisheries management to support ecosystem and fisheries sustainability, help identify when ecosystem changes that impact fisheries resources occur, and foster discussions of trade-offs in management decisions.

Result: We organize existing and potential ELRPs into five categories (statistical analysis of nonlinear dynamics and tipping points, ecosystem productivity, ecosystem trophic information, biodiversity, and human dimensions), provide an overview of analytical methods that can estimate ELRP benchmarks, provide examples of where ELRP benchmarks are being used today, and evaluate pros and cons of the different ELRP categories. We also attempt to identify potential next steps for fisheries scientists and managers to further the science, development,

- What is consequence of removal of huge biomass of forage species
- Ecosystem reference points
  - Can enhance performance under climate change
  - Example 2 m MT cap in EBS

Initial steps

- Data reporting – on all catch
- Database at Secretariat (in progress?)
- Automated reports generated
- Tracking of indicators of discards, bycatch over time
- Links to science organizations – PICES, BECI

Chub Mackerel Catch in Canada (updated for 2024)

Chris Rooper, Jackie King, Amy Tabata, Jennifer Boldt

2024-08-19

Commercial catches

There are n = 7607 records of Chub mackerel bycatch in commercial fishing gear (Figur
records are from bottom trawl, midwater trawl, and the hook and line halibut fisheries. There
of records of catches of Pacific mackerel which were not included in this report.

Research catches

The catch per unit of effort (CPUE) of Chub mackerel in survey catches (bottom trawl, m
surface trawls) is zero in most years (Figure 2). In 1983, 1998, 2003 and 2004 there were a total
trawl survey tows capturing Chub mackerel. There have been 53 catches of Chub mackerel in
with a maximum catch of 8650 individuals.

The Chub mackerel were mostly captured on the outer coast surveys (Figure 4). Howev
reflect the areas where the surveys are conducted (on the shelf and continental slope exclusively)
representing the distribution of Chub mackerel in the area.

It should be noted that historical survey catches focussed primarily on Salmonids and at times
species (including Chub mackerel) were not entered in the databases. There is currently an effo
to include bycatch species, so it is likely that the historical numbers presented in this report will
in future years.

A total of n = 872 Chub mackerel lengths have been collected in surveys in Canada since 198
of observed lengths was ~28 cm.

Other observations

Chub mackerel are often captured as bycatch in both recreational and commercial fisheri
salmon species. Especially off the west coast of Vancouver Island and off of Prince Rupert in nor

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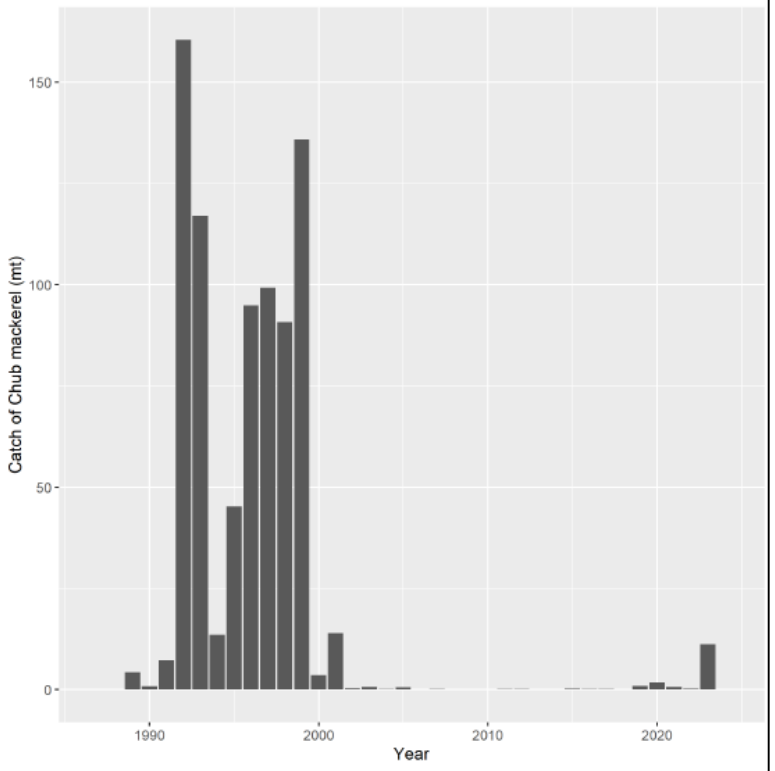


Figure 1: Catch of Chub mackerel in commercial fisheries in British Columbia, Canada combined by year across all fishing gears.

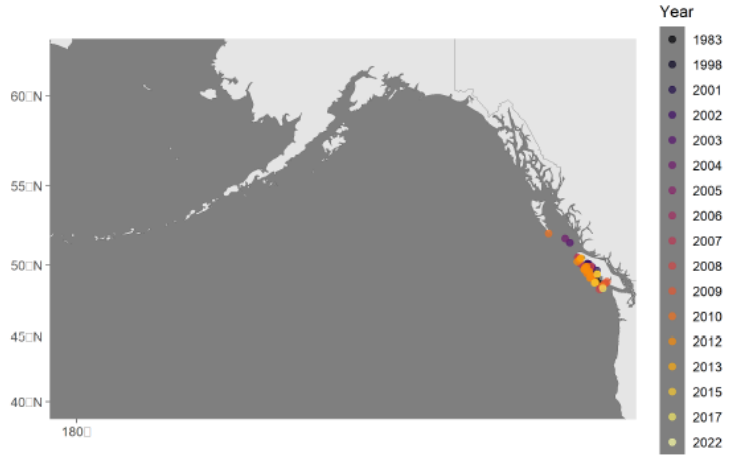
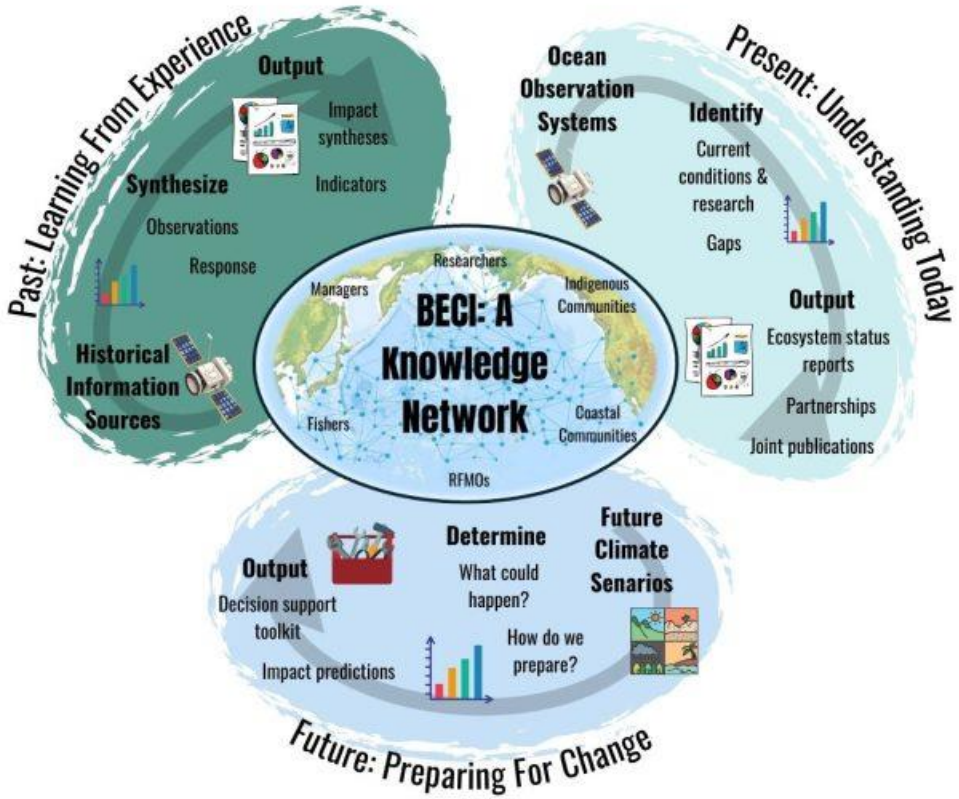
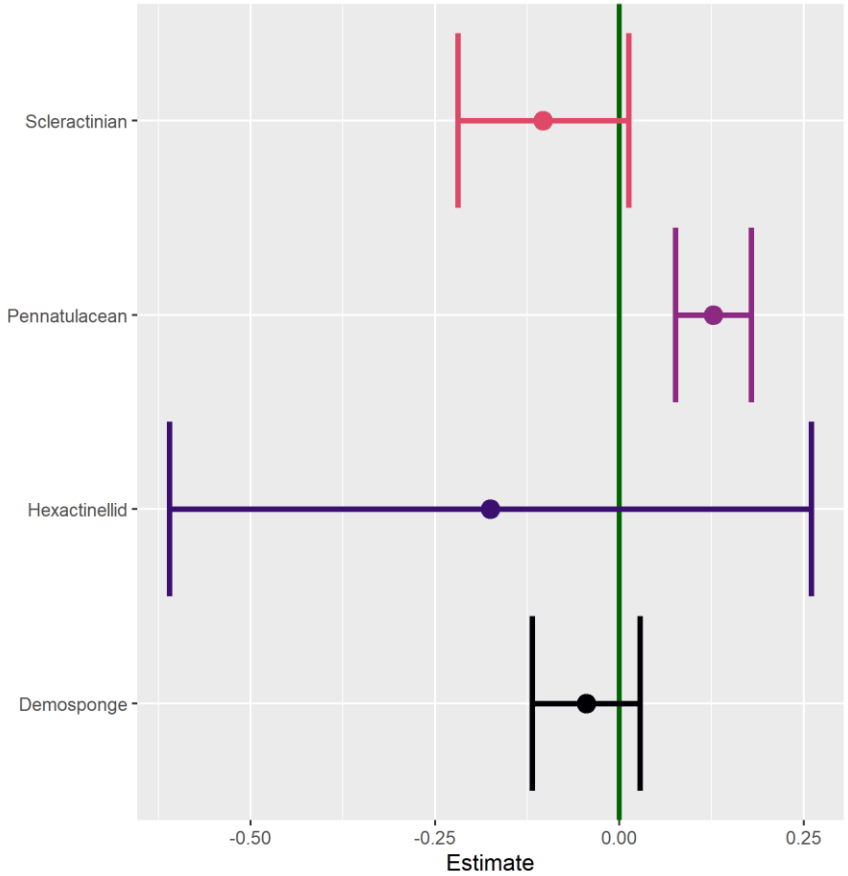


Figure 3: Locations of Chub mackerel catches in historical research surveys in British Columbia.

What is needed?

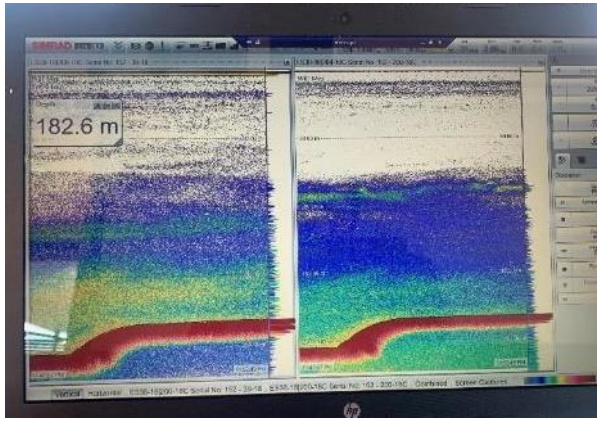
- What are relationships between VME and target species
- BECI (Basin Scale Events and Coastal Impacts)
- PICES

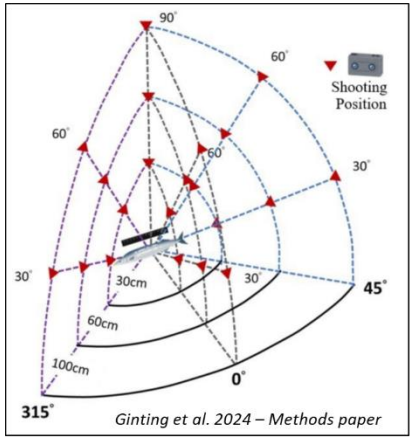




Conclusions and summary

- NPFC has worked primarily on ecosystem impacts on VME from bottom fishing
- Very little is known about wider impacts of pelagic fisheries on the ecosystem
- Data and capacity are the main impediments
  - Need to mandate reporting of all catches to Secretariat
  - Infrastructure to house data (broader issue)
  - Need to link with science organizations that can help with capacity
  - Use advanced technology to improve data availability (e.g. fisheries acoustics from vessels of opportunity, CTD collections, etc.)






Paired images from Vanuatu catch

Acknowledgements

- Qiuyun Ma, Libin Dai – China
- Kota Sawada, Kazuhiro Oshima, – Japan
- Karolina Molla Gazi – EU
- Janelle Curtis, Patricia DeMille, Devon Warawa – Canada
- Mei-chin Juan, Rocky Kaku - Vanuatu
- Kevin Pranata Ginting, Wen-Bin Huang
- Kathryn Berry – BECI/PICES
- Alex Zavolokin – NPFC
- Pam Goddard, Christina Conrath, Lauri Sadorus, Kim Rand, Kresimir Williams, Amy Baco Taylor – NOAA, USA