Using Predictive Habitat Models and Visual Surveys to Identify Vulnerable Marine Ecosystems (VMEs) on Seamounts in the North Pacific Fisheries Commission (NPFC) Convention Area

PICES W1 2022 (NPFC-2021-SSC BFME02-WP05)

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(from Curtis et al. 2015)

(from Du Preez et al. 2020)

Outline

- Project background
- Methods
- Preliminary results
- Comments and questions

Photo by Chu/Leys/Tunnicliffe/CSSF

North Pacific Fisheries Commission

- Regional Fisheries Management Organization
- Conservation and sustainable fisheries
- Protection of marine ecosystems

NPFC

NPFC's VME indicator taxa

- **Black corals**
  (Order: *Antipatharia*)
- **Stony corals**
  (Order: *Scleractinia*)
- **Gorgonian soft corals**
  (Order: *Alcyonacea*)
  Belonging to 10 families
  (see Miyamoto et al. 2017)
- **Non-gorgonian soft corals**
  (Order: *Alcyonacea*)

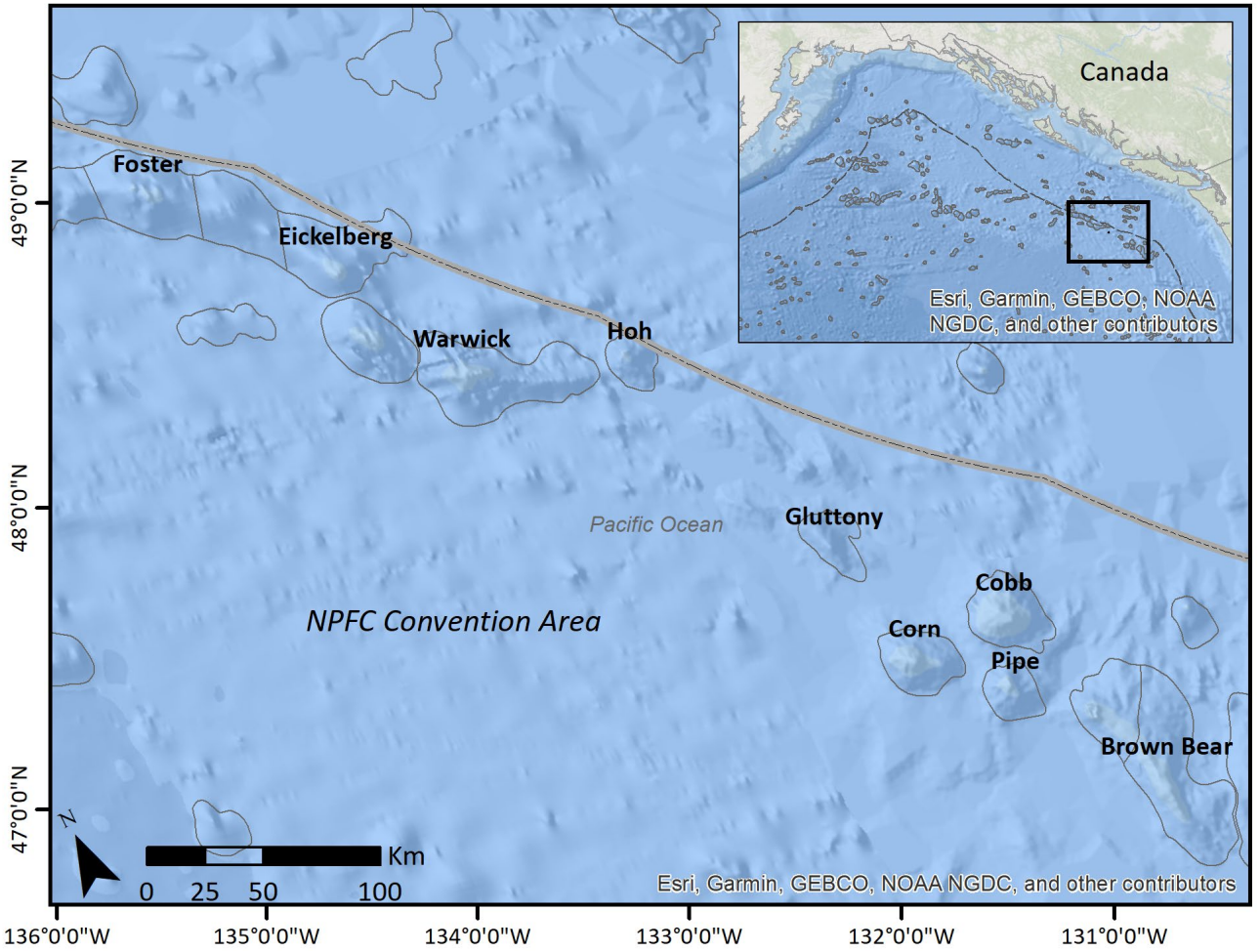
Photos by Chu/Leys/Tunnicliffe/CSSF

Quantitative method to identifying VMEs in the NPFC

- We propose this approach as one way that NPFC can use to quantitatively identify VMEs and areas likely to be VMEs in its Convention Area

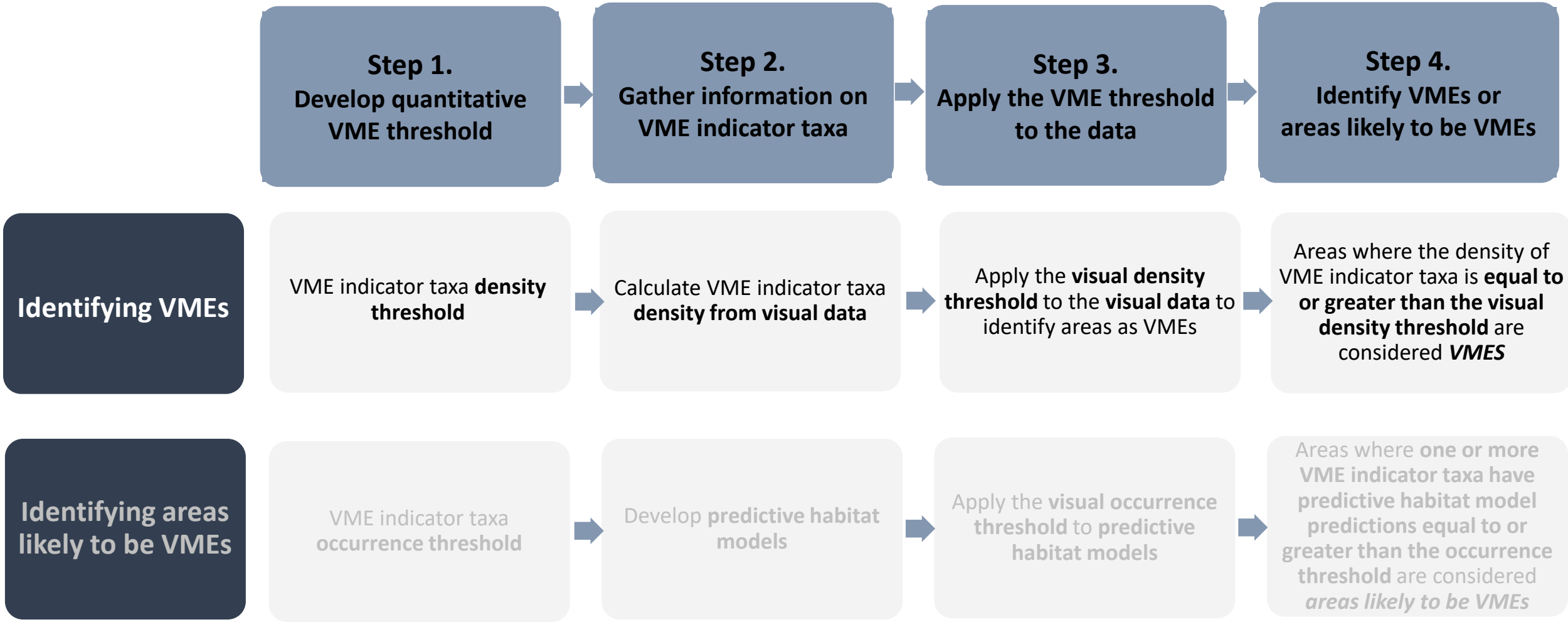
- This approach is applied to the Cobb-Eickelberg Seamount Chain

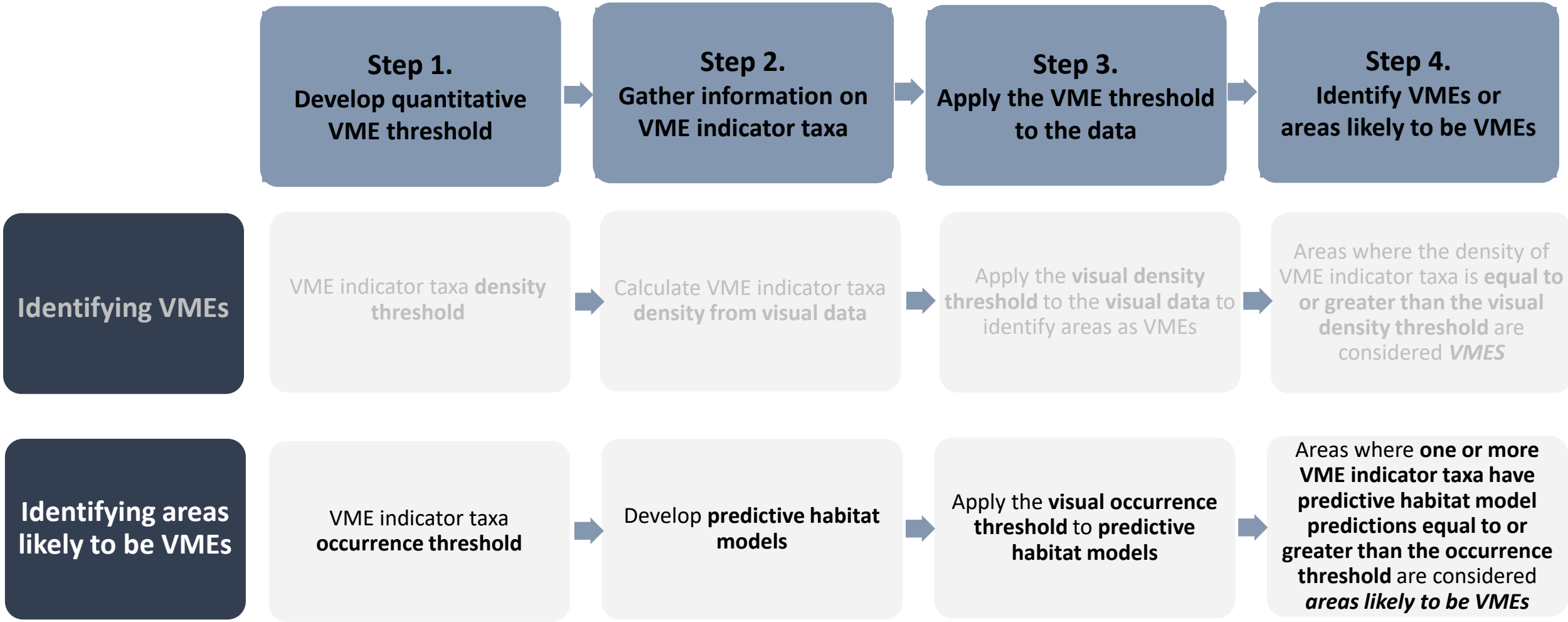
- Our results are preliminary



FAO's five criteria for identifying VMEs

- Uniqueness or rarity
- Functional significance of the habitat
- Fragility
- Life-history traits of component species that make recovery difficult
- ***Structural complexity*** → VME indicator taxa increase ***structural complexity*** which increases diversity of other animals in the area


Step 1.
Develop quantitative VME threshold
Step 2.
Gather information on VME indicator taxa
Step 3.
Apply the VME threshold to the data
Step 4.
Identify VMEs or areas likely to be VMEs
Identifying VMEs
VME indicator taxa density threshold
Calculate VME indicator taxa density from visual data
Apply the visual density threshold to the visual data to identify areas as VMEs
Areas where the density of VME indicator taxa is equal to or greater than the visual density threshold are considered VMES
Identifying areas likely to be VMEs
VME indicator taxa occurrence threshold
Develop predictive habitat models
Apply the visual occurrence threshold to predictive habitat models
Areas where one or more VME indicator taxa have predictive habitat model predictions equal to or greater than the occurrence threshold are considered areas likely to be VMEs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Step 2
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Step 3.
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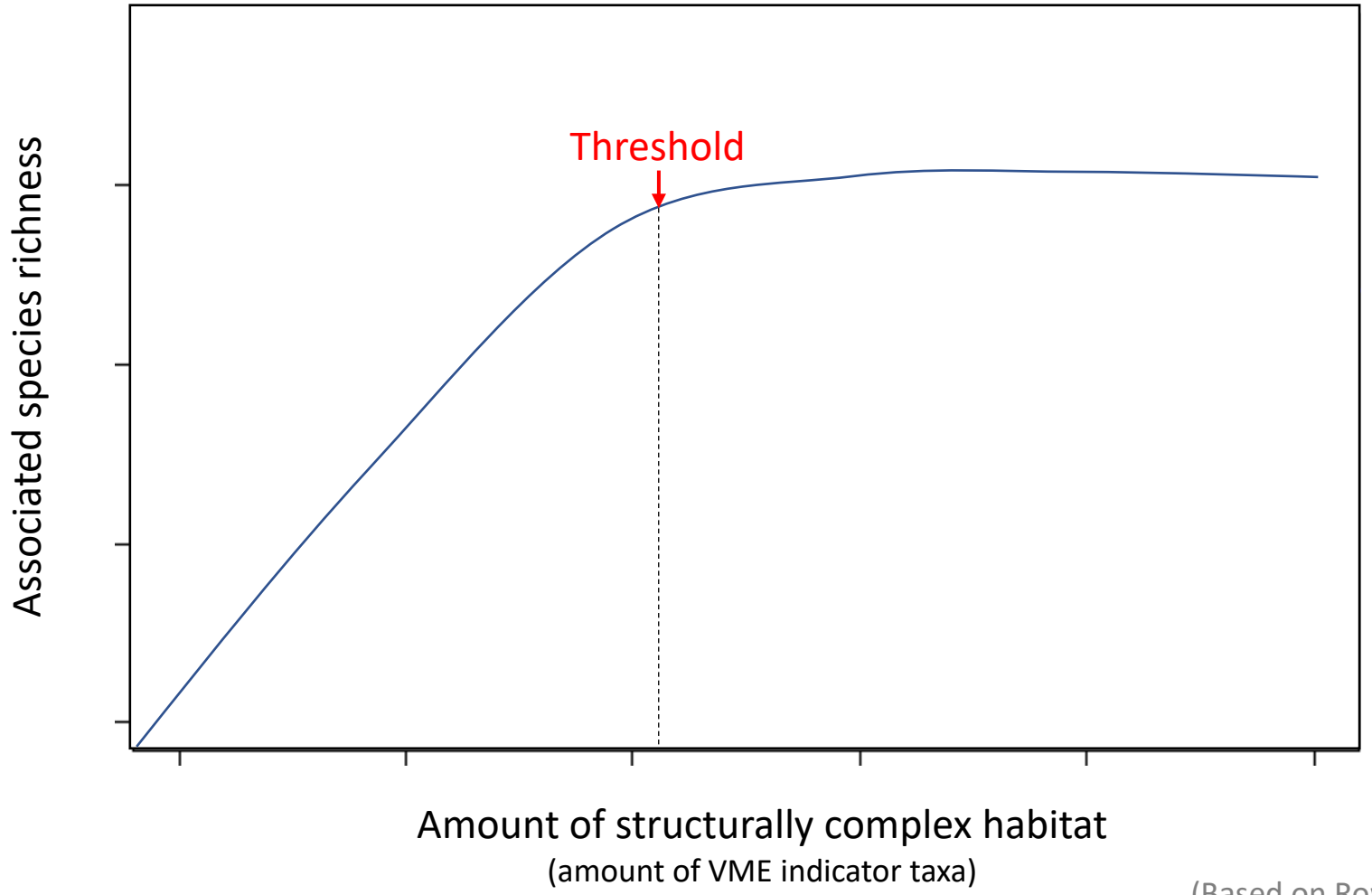
Step 4
Identify VMEs or areas likely to be VMEs

Theoretical relationship



(Based on Rowden et al. 2020)

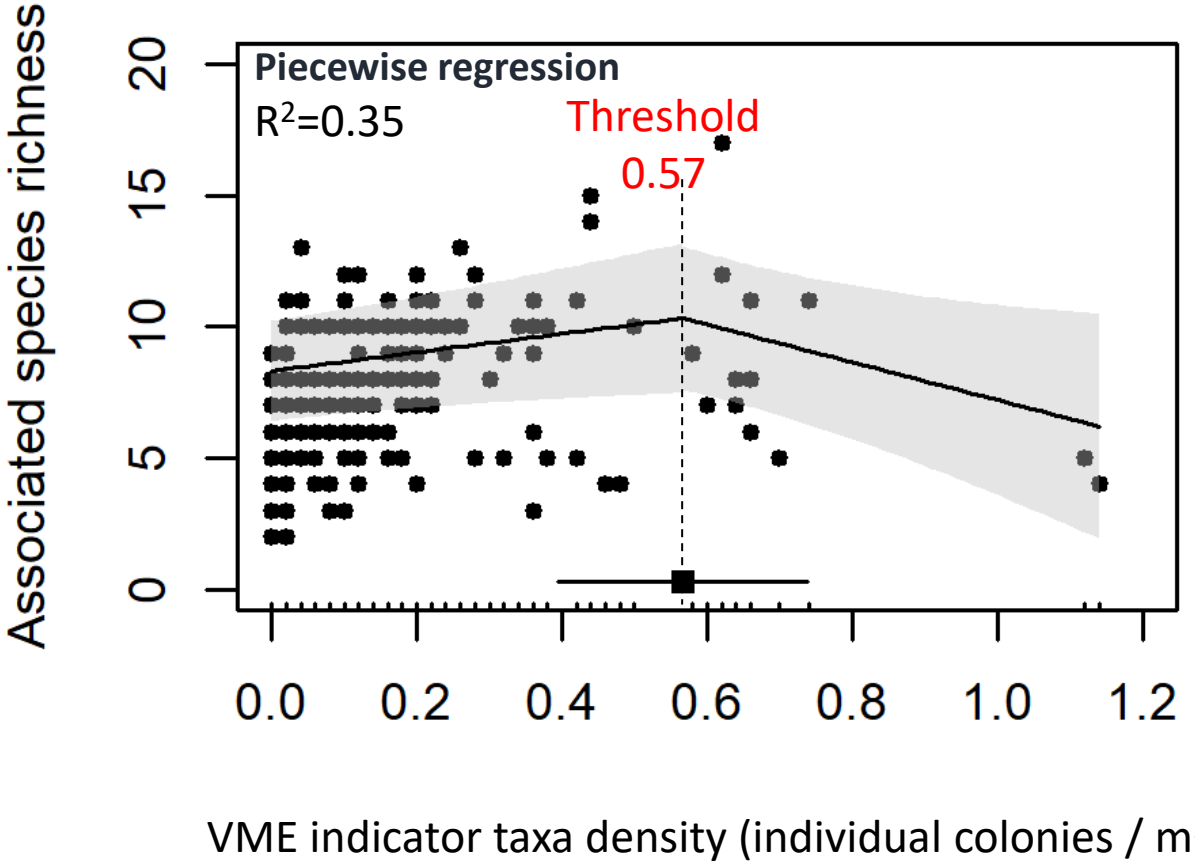
Step 1
Develop quantitative VME threshold

Step 2
Gather information on VME indicator taxa distribution

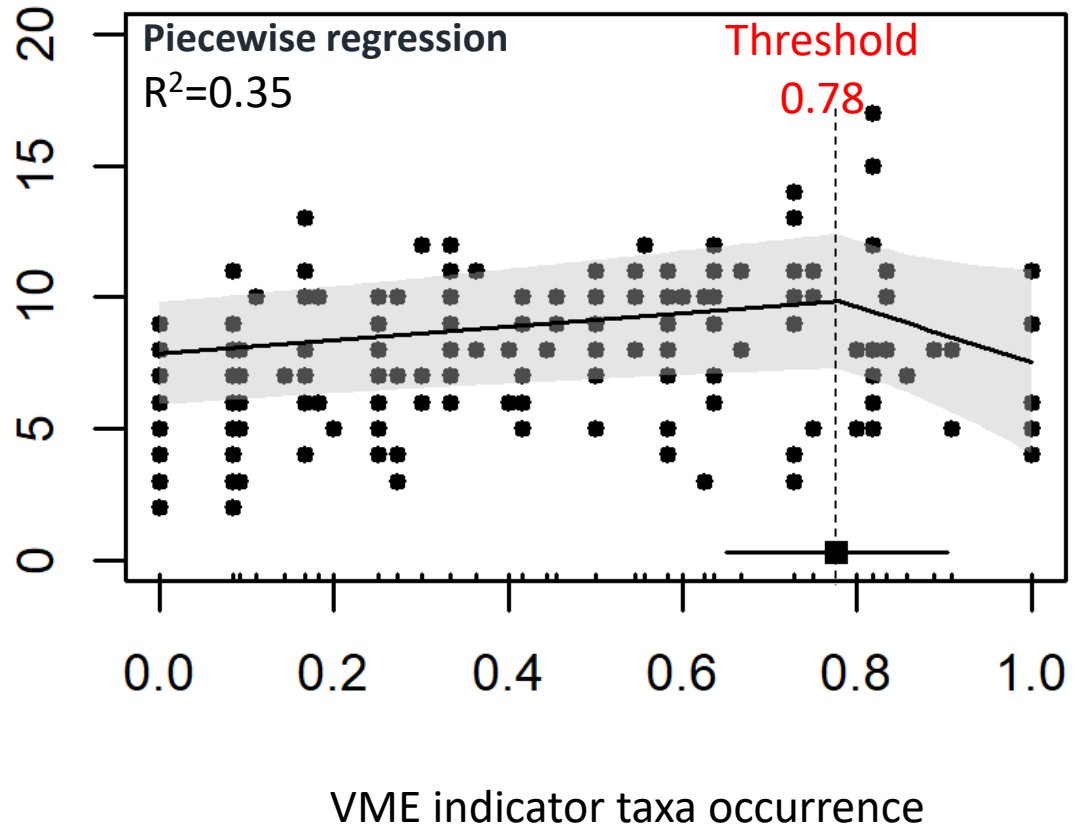
Step 3.
Apply the quantitative VME threshold to the VME indicator taxa distribution

Step 4
Identify VMEs or areas likely to be VMEs

VMEs
VME Density Threshold



Areas likely to be VMEs
VME Occurrence Threshold



VMEs

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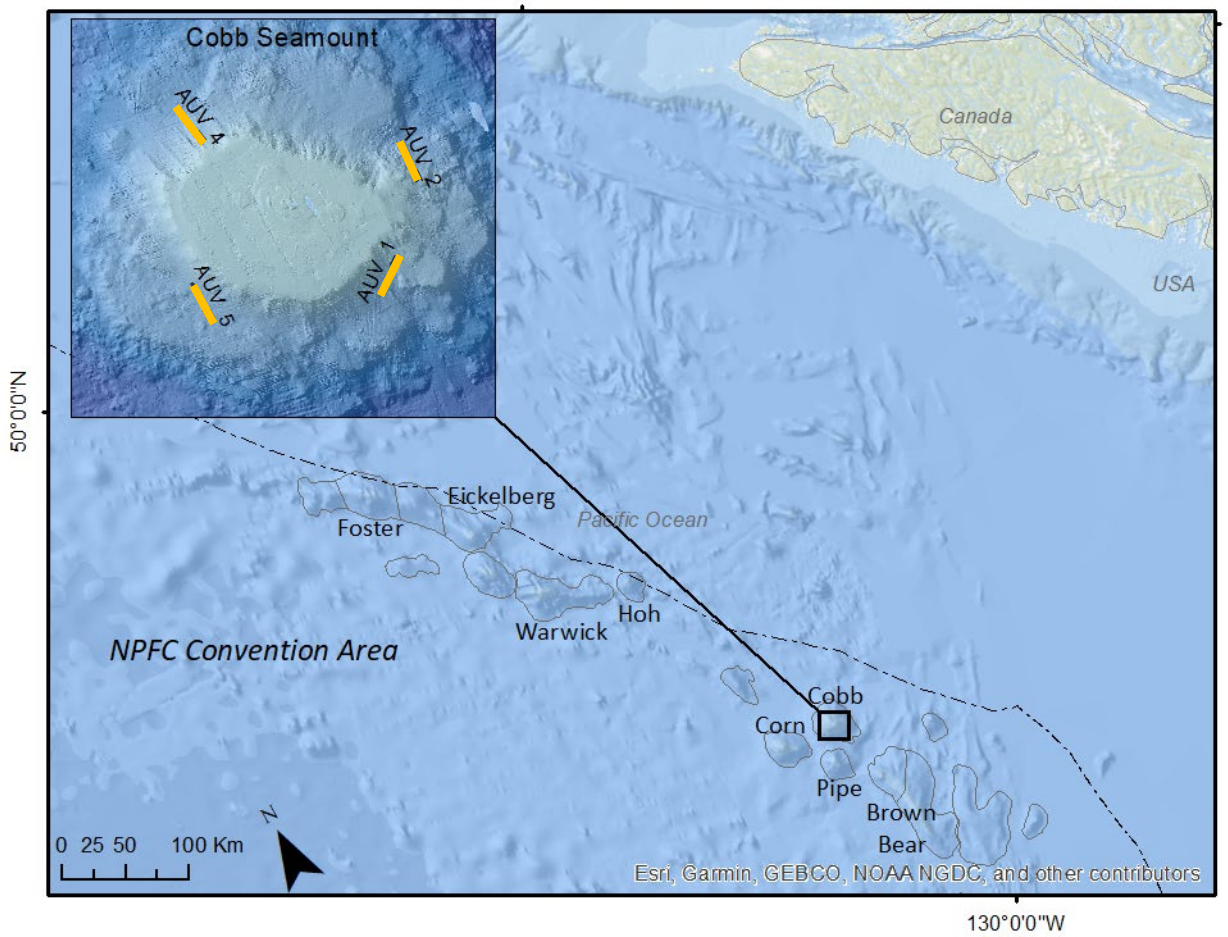
Visual data from Cobb Seamount 2012 Survey

AUV photos:

- 4 transects
- Average transect length 1805 m
- Transect depth range 435 – 1154 m



Curtis et al. (2015) 2012 Expedition to Cobb Seamount: Survey methods, data collections, and species observations. Canadian Technical Report of Fisheries and Aquatic Sciences, 3124

Areas likely to be VMEs

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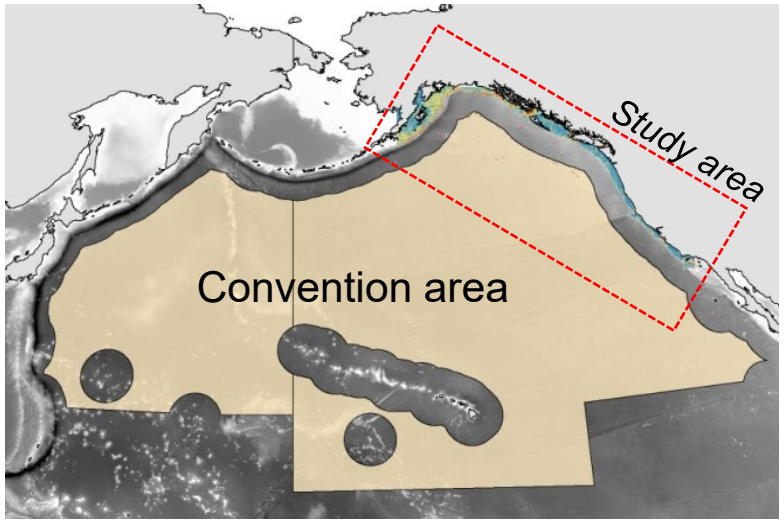
Predictive habitat models of VME indicator taxa

North Pacific environmental data

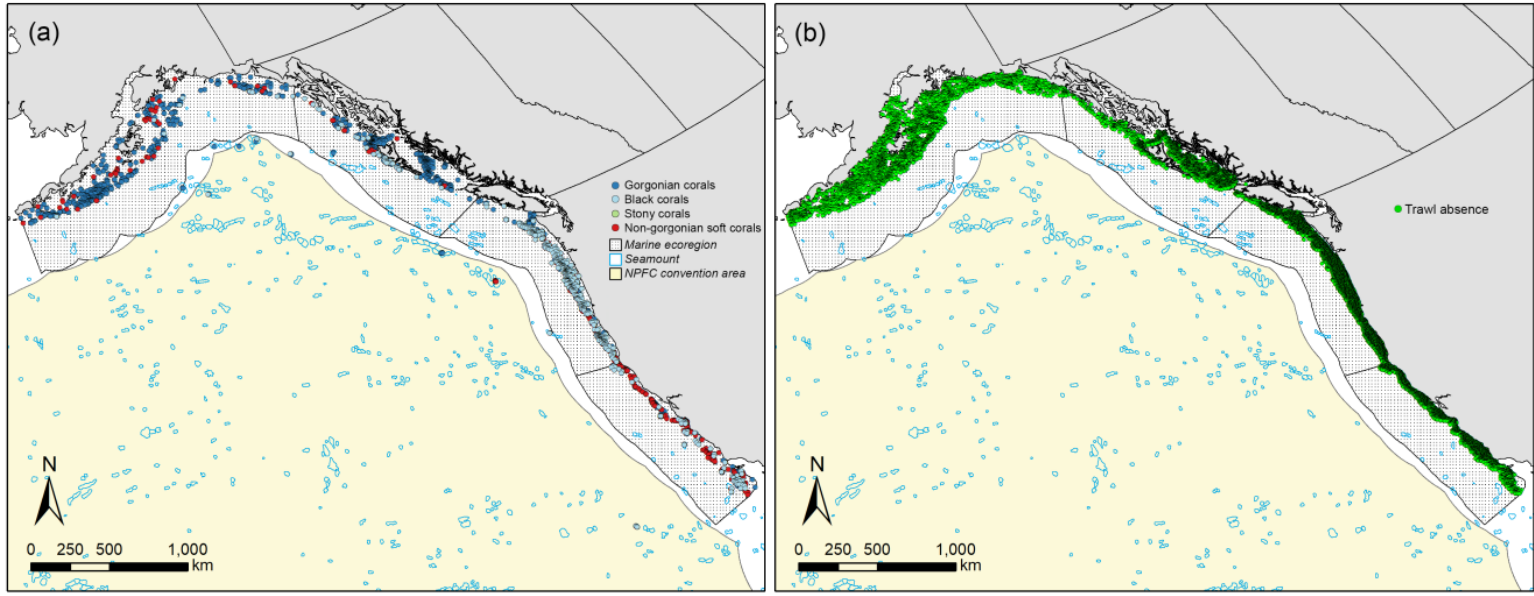
- Output from PICES WG32 on Biogenic Habitats
- 32 variables, 1 km^2 grid resolution
  - Bathymetry & Terrain metrics
  - Oceanographic properties
  - Surface layer characteristics



VME indicator taxa records

Presence records
From NOAA, DFO, and academics

Absence records
From NOAA and DFO trawl surveys



Areas likely to be VMEs

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Predictive habitat models of VME indicator taxa

Ensemble model results (Random forest, Boosted regression, GAM)

Taxa	AUC	Examples of the important environmental predictors
Black	0.898	Dissolved oxygen Photosynthetically active radiation Omega calcite (ΩCALC) Particulate organic carbon
Stony	0.917	SST Roughness Chlorophyl-A Vertical current velocity Regional current velocity
Gorgonian	0.880	Slope Eastness Omega calcite (ΩCALC) Chlorophyl-A
Soft	0.918	Roughness Chlorophyl-A Topographic Position Index

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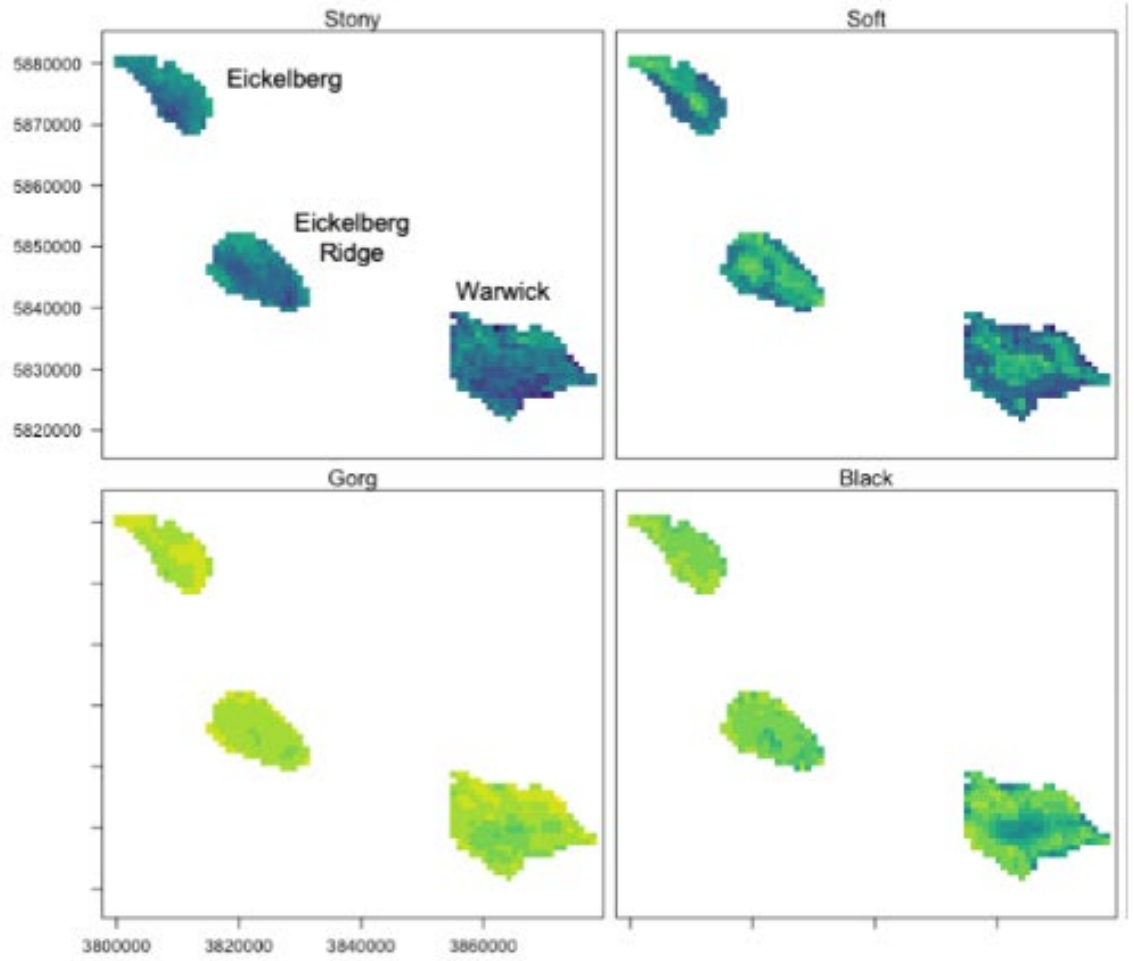

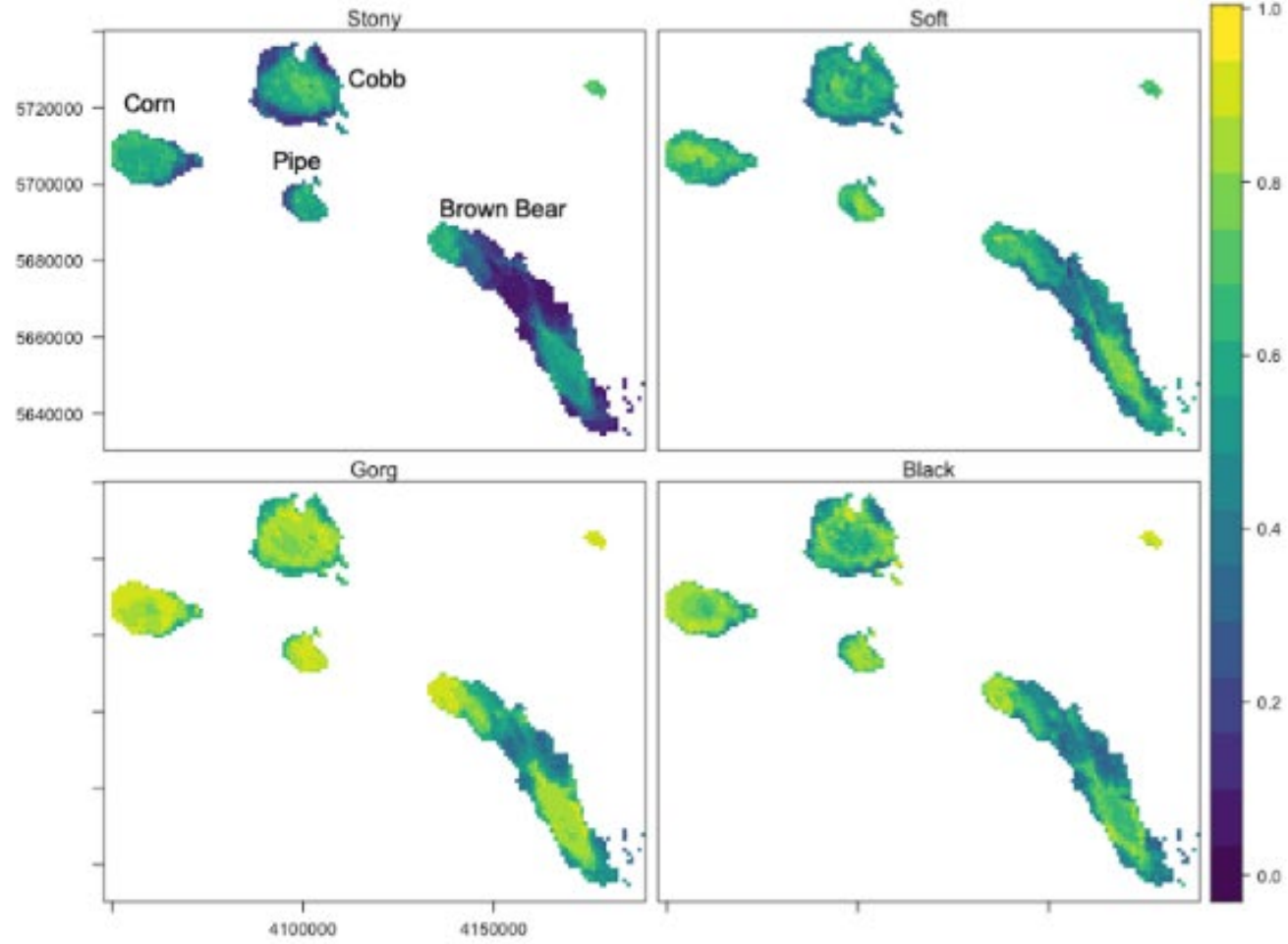

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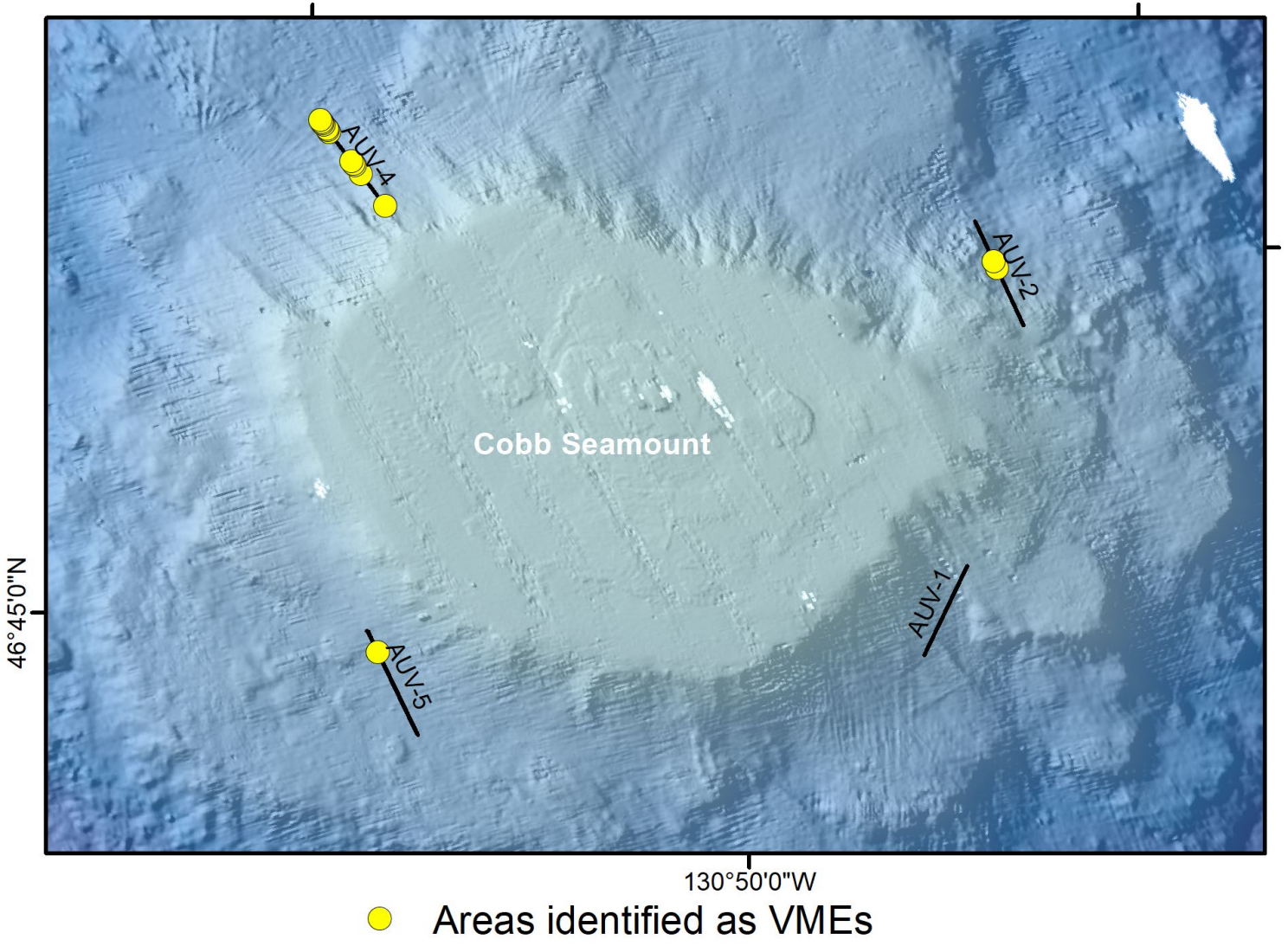
VMEs:

- Areas where visual data show VME indicator taxa in densities equal to or greater than the VME visual density threshold.



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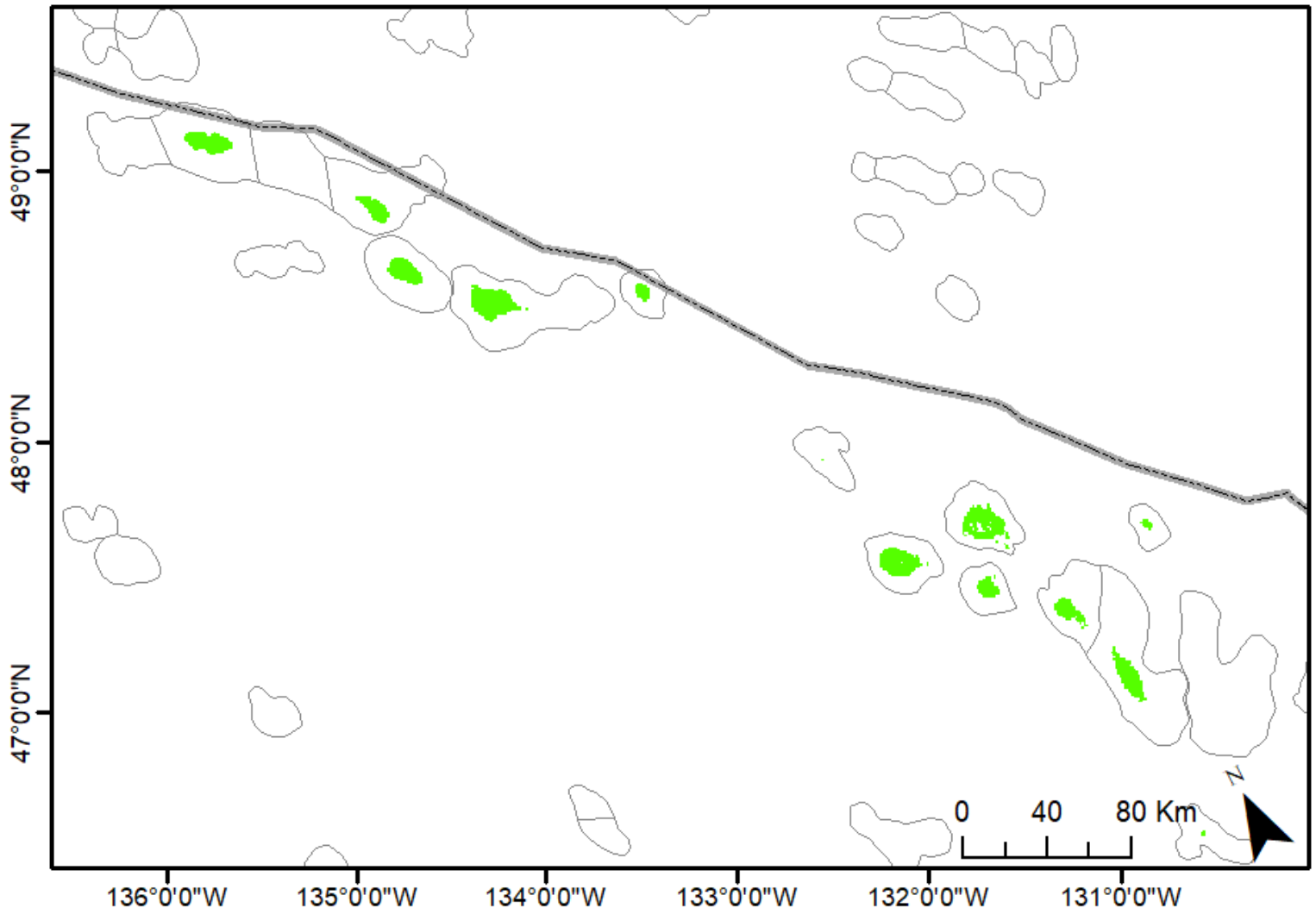
Areas likely to be VMEs:

- at least one of the VME indicator taxa has a predicted habitat suitability ≥ the VME indicator occurrence threshold of 0.78



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VMEs

- Total VME area identified = 700 m^2
- VME areas identified on 3 / 4 transects on Cobb Seamount
- 6% of AUV transects were VMEs

Areas likely to be VMEs

- Total area likely to be VMEs = 1542 km^2
- Areas likely to be VMEs on all seamounts in the Cobb-Eickelberg seamount chain

64% of areas <1600 m depth in the Cobb-Eickelberg seamount chain

Periodic Review

NPFC-2021-SSC BFME02-WP05

Visual survey of Cobb-Eickelberg Seamount Chain (6-20 September)

Comments and questions most welcome – thank you!

Fisheries and Oceans Canada / NOAA Fisheries