Process for Analyzing Trade-offs between Fishing and Vulnerable Marine Ecosystem Protection

NPFC-2020-SSC BFME01-WP13

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Fisheries and Oceans Canada | Pêches et Océans Canada | Canada

NPFC SSC BF-ME

16-18 November 2020

(from Du Preez et al. 2020)


https://caseagrant.ucsd.edu/seafood-profiles/sablefish-black-cod

Proposed process for trade-off analysis

Systematic conservation planning principles

Modeled after the SPRFMO approach
(see Rowden and Cryer 2018)

9 steps with continuous stakeholder engagement and periodic review

Iterative process

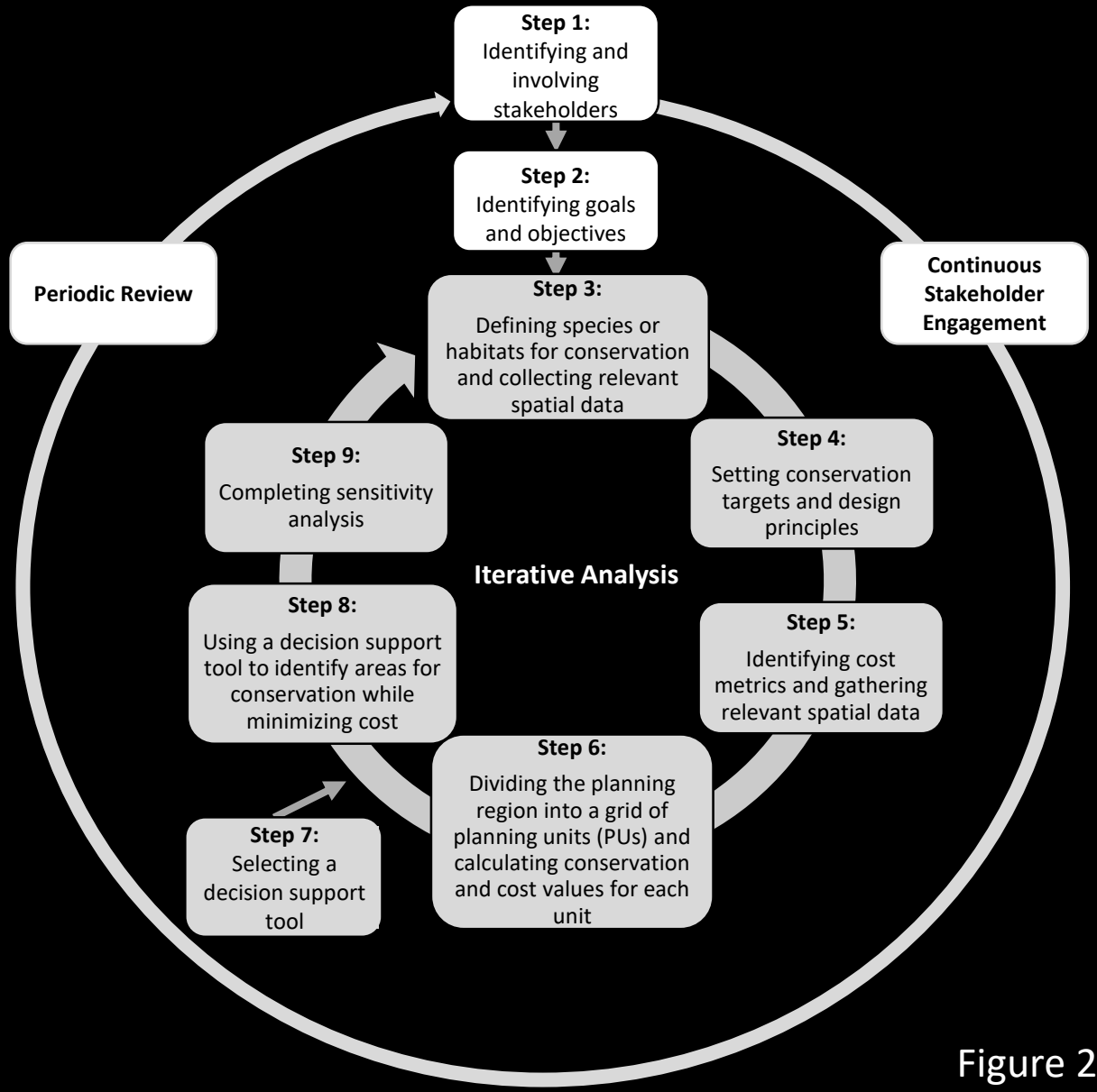
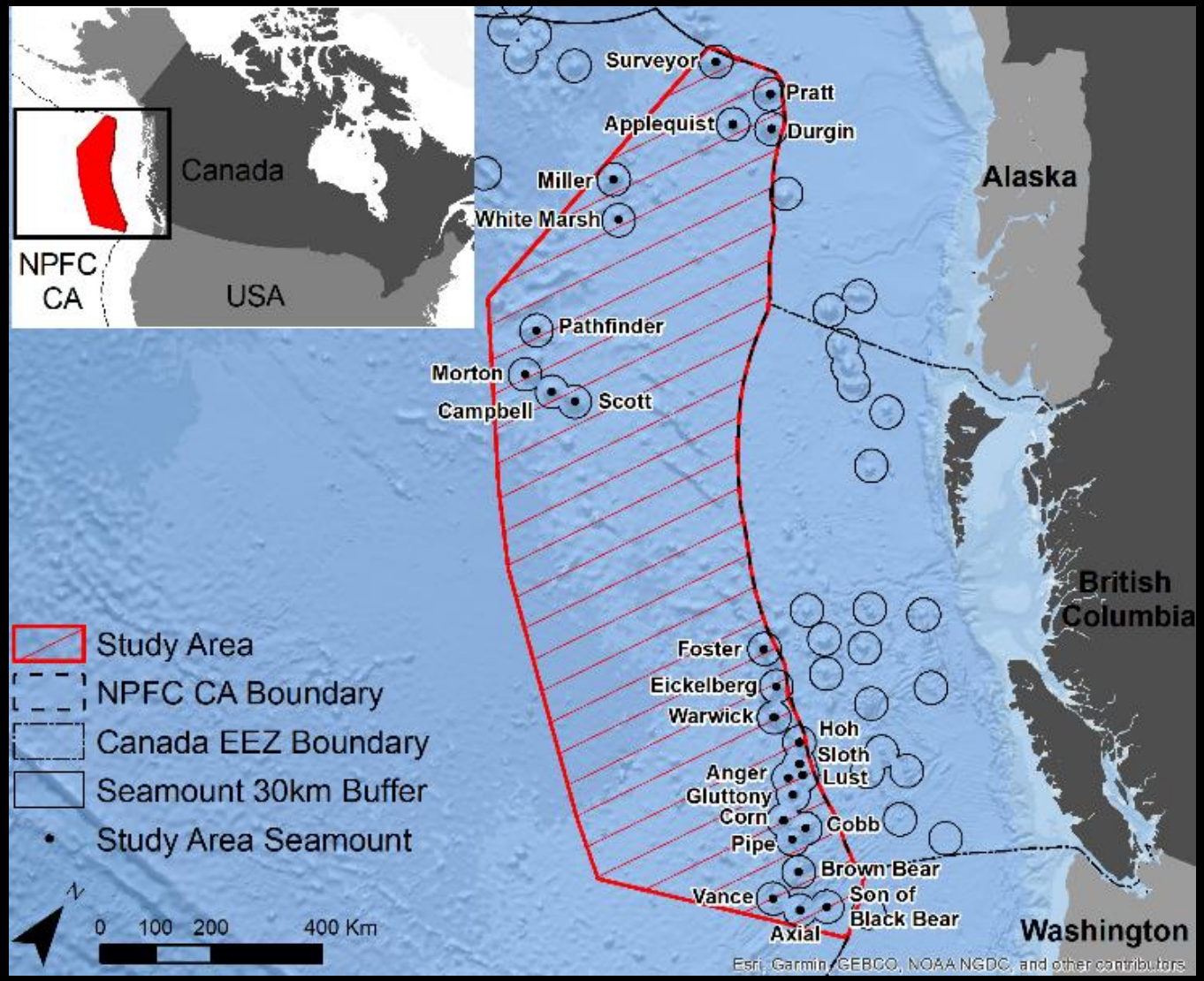


Figure 2 in NPFC-2020-SSC BFME01-WP13

Preliminary Study: Northeast Pacific Ocean



Preliminary Study: Northeast Pacific Ocean

Visual Surveys

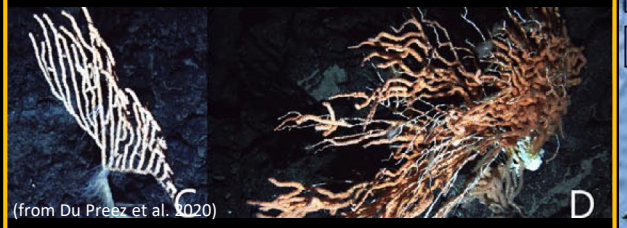
Scleractinia (Stony coral)

Lophelia pertusa specimen (from Curtis et al. 2015)

Antipatharia (Black corals)

(from Du Preez et al. 2020)

Alcyonacea (Soft corals)



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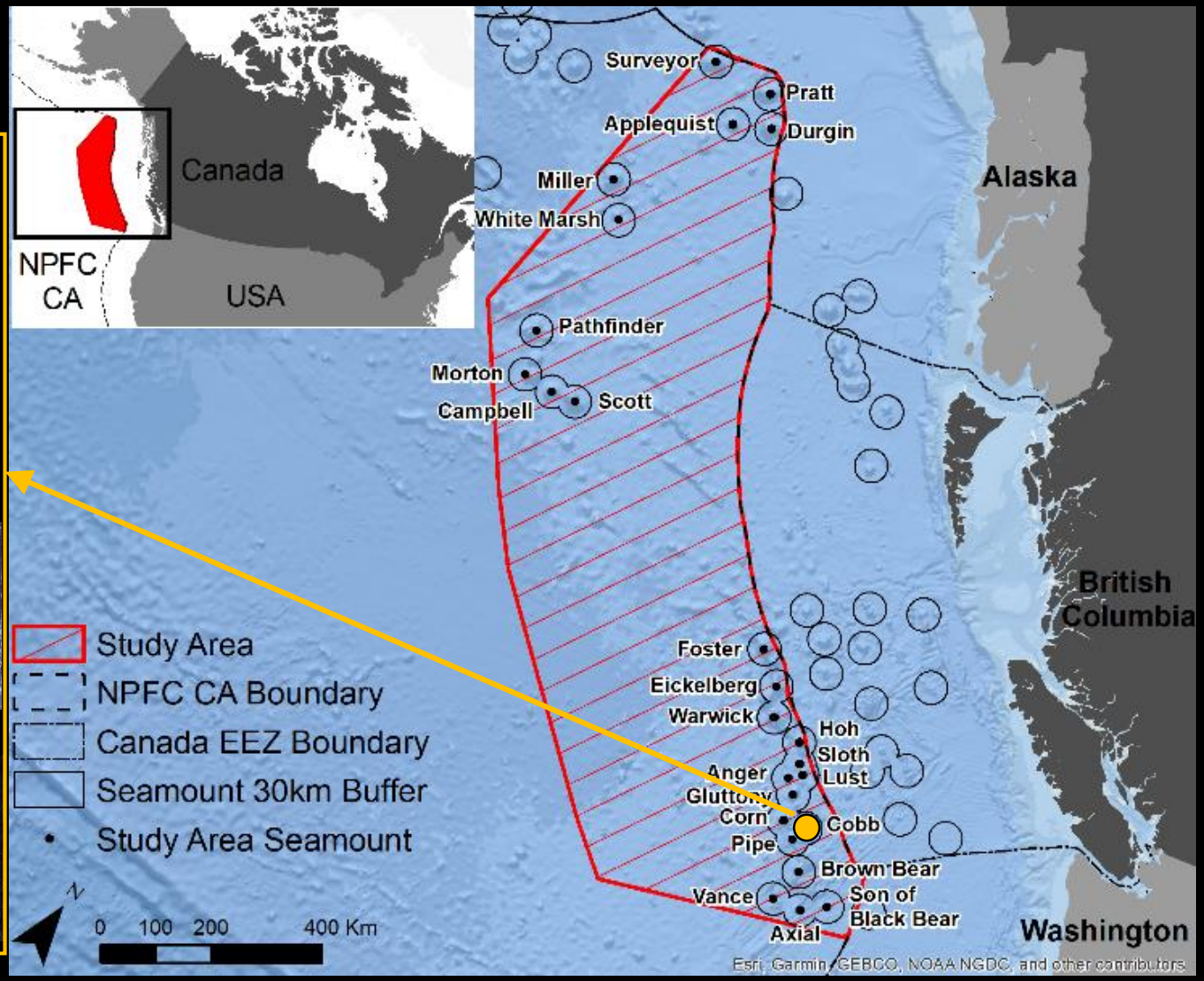

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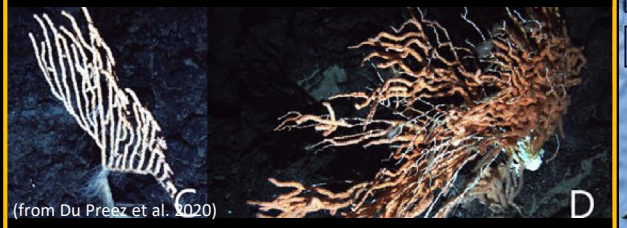

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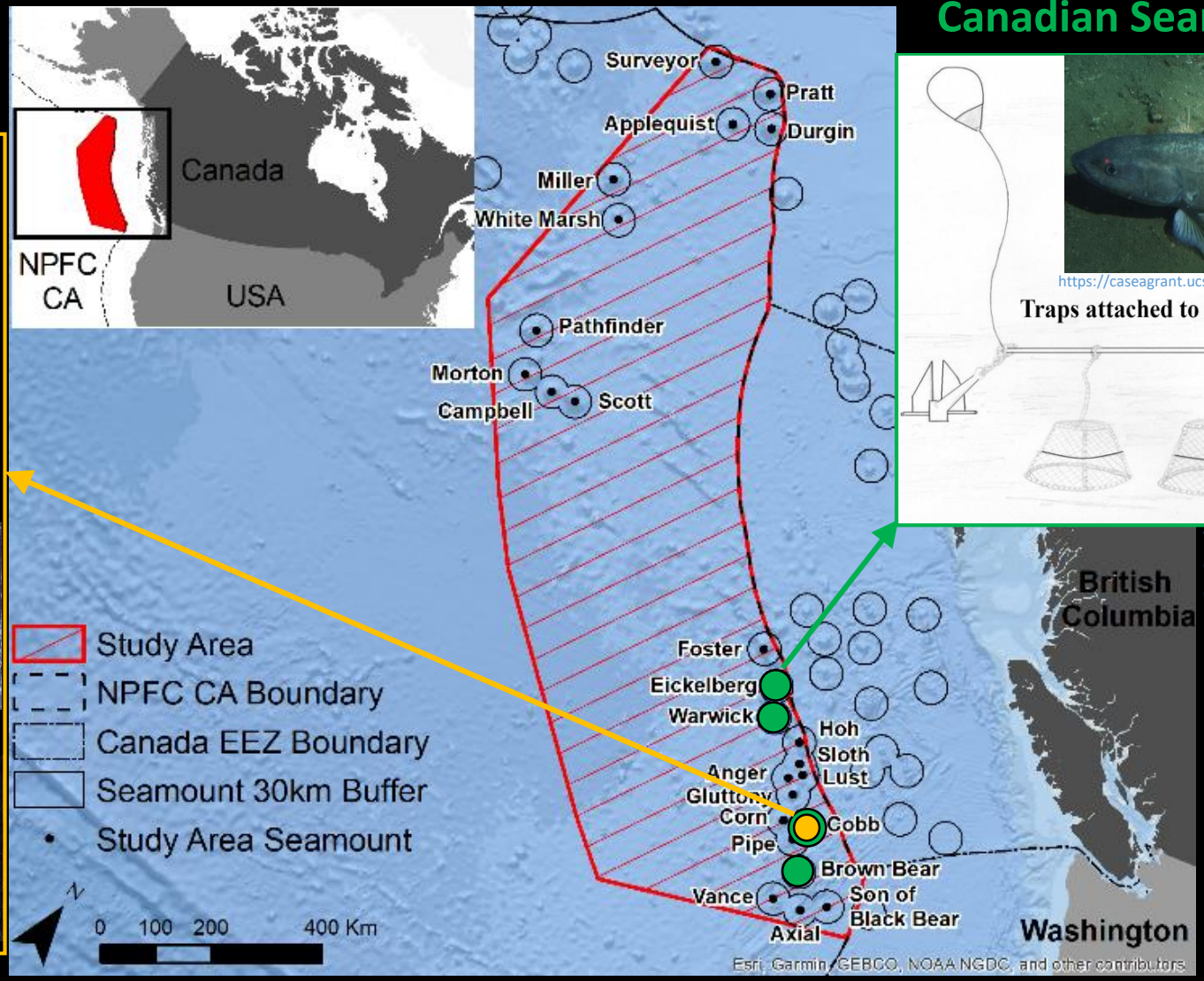


Canadian Seamount Sablefish Fishery

https://caseagrant.ucsd.edu/seafood-profiles/sablefish-black-cod

www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/fixed_gear_guide_final_12.14.11.pdf

Preliminary data and code is available to members at https://collaboration.npfc.int/node/86 or upon request

Step 1: Identifying and involving stakeholders

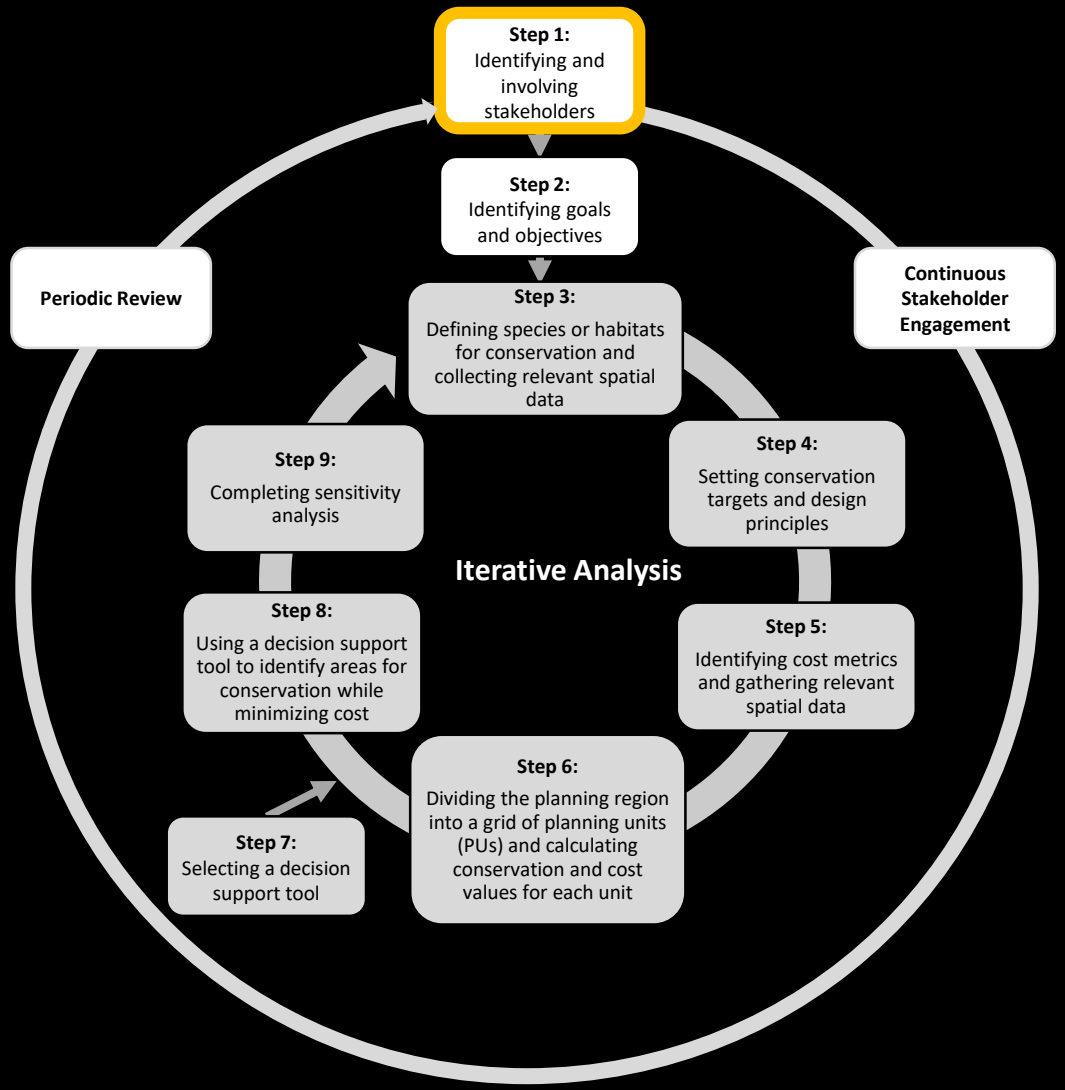
"Individuals, groups or organizations who are, in one way or another, interested, involved or affected (positively or negatively) by a particular project or action toward resource use."

(Pomeroy and Rivera-Guieb 2006)

Canadian Sablefish fishery

First Nations

Environmental non-government organizations (eNGO)



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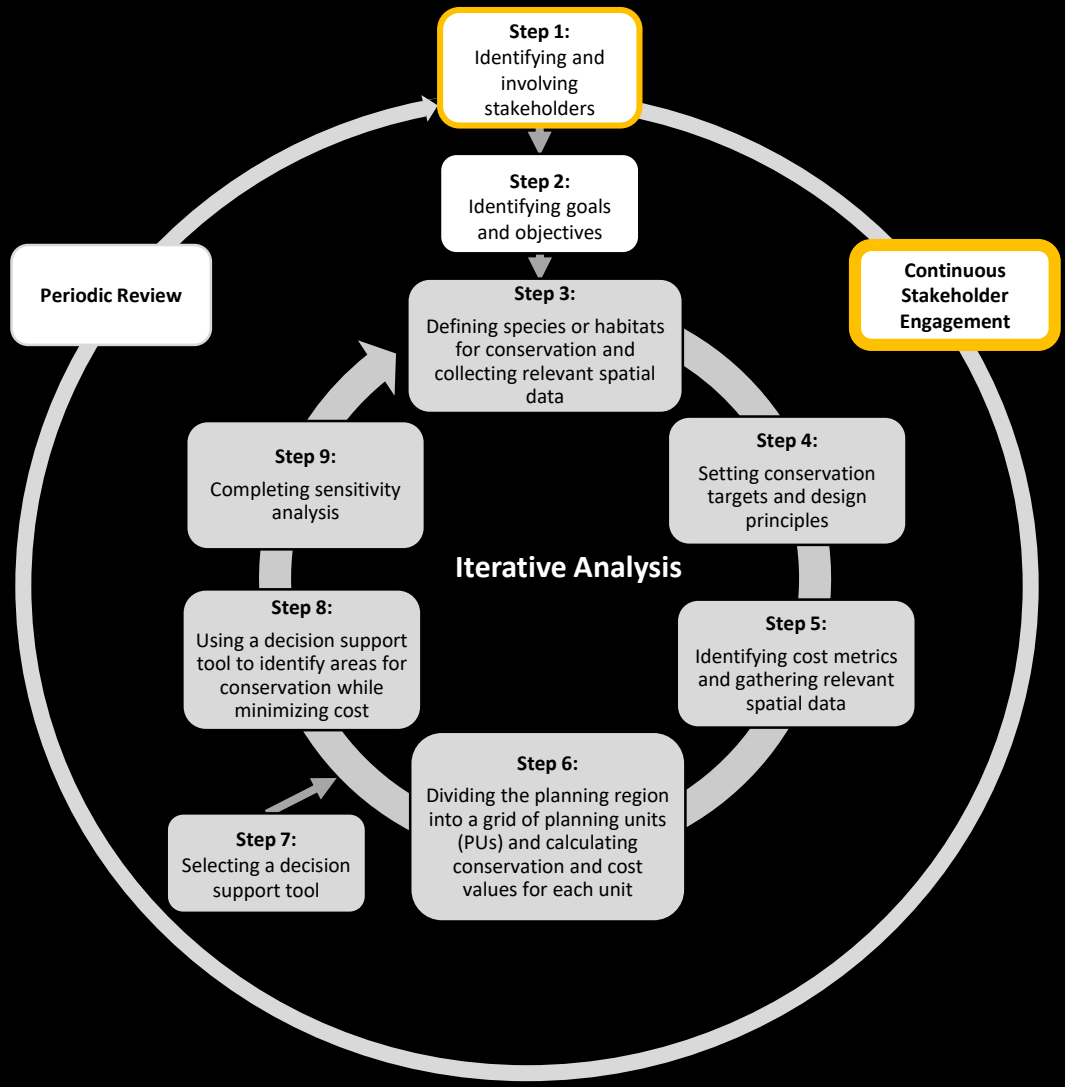
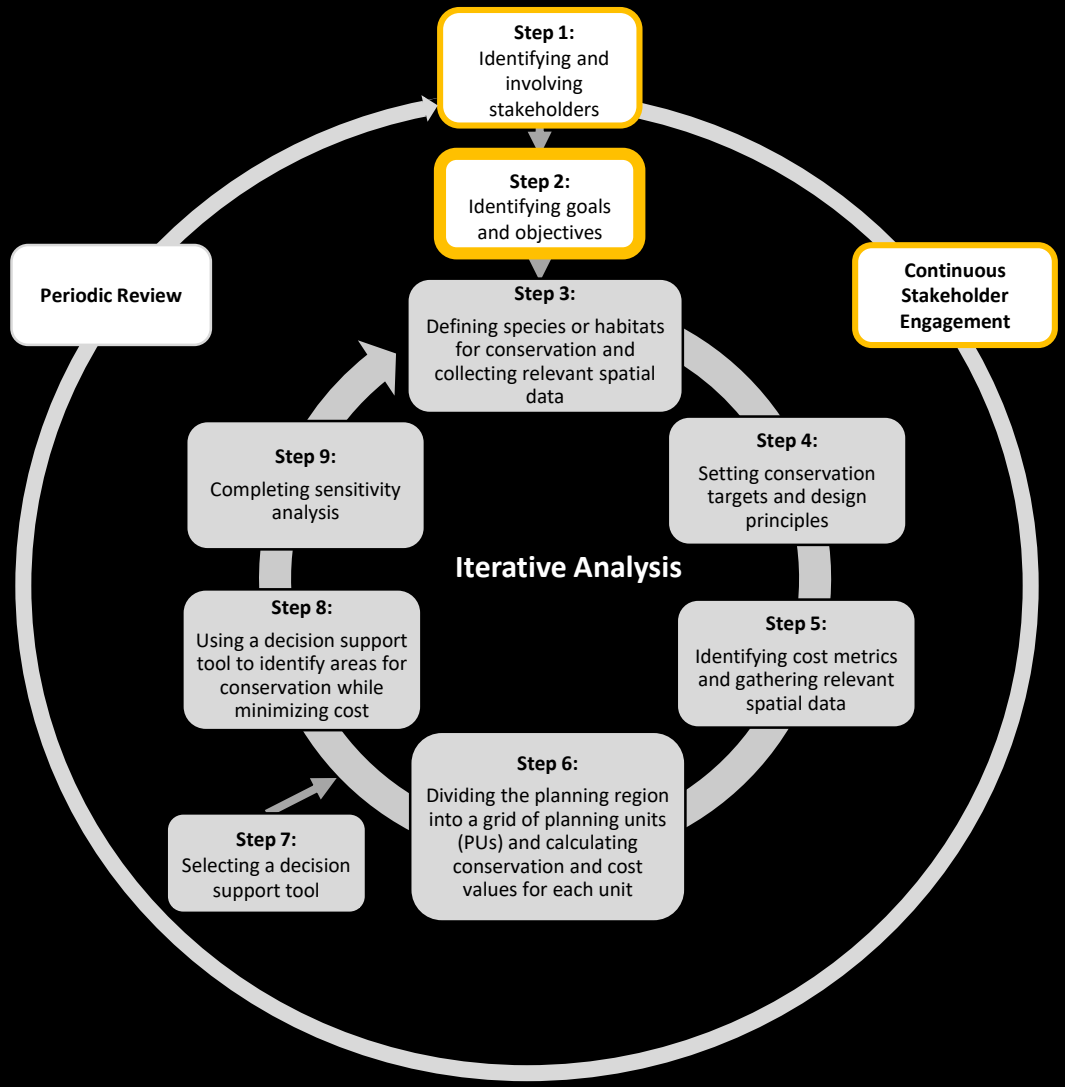


Step 2: Identifying goals and objectives

Comprehensive planning approach supports diverse goals including ecological conservation and social-economic objectives

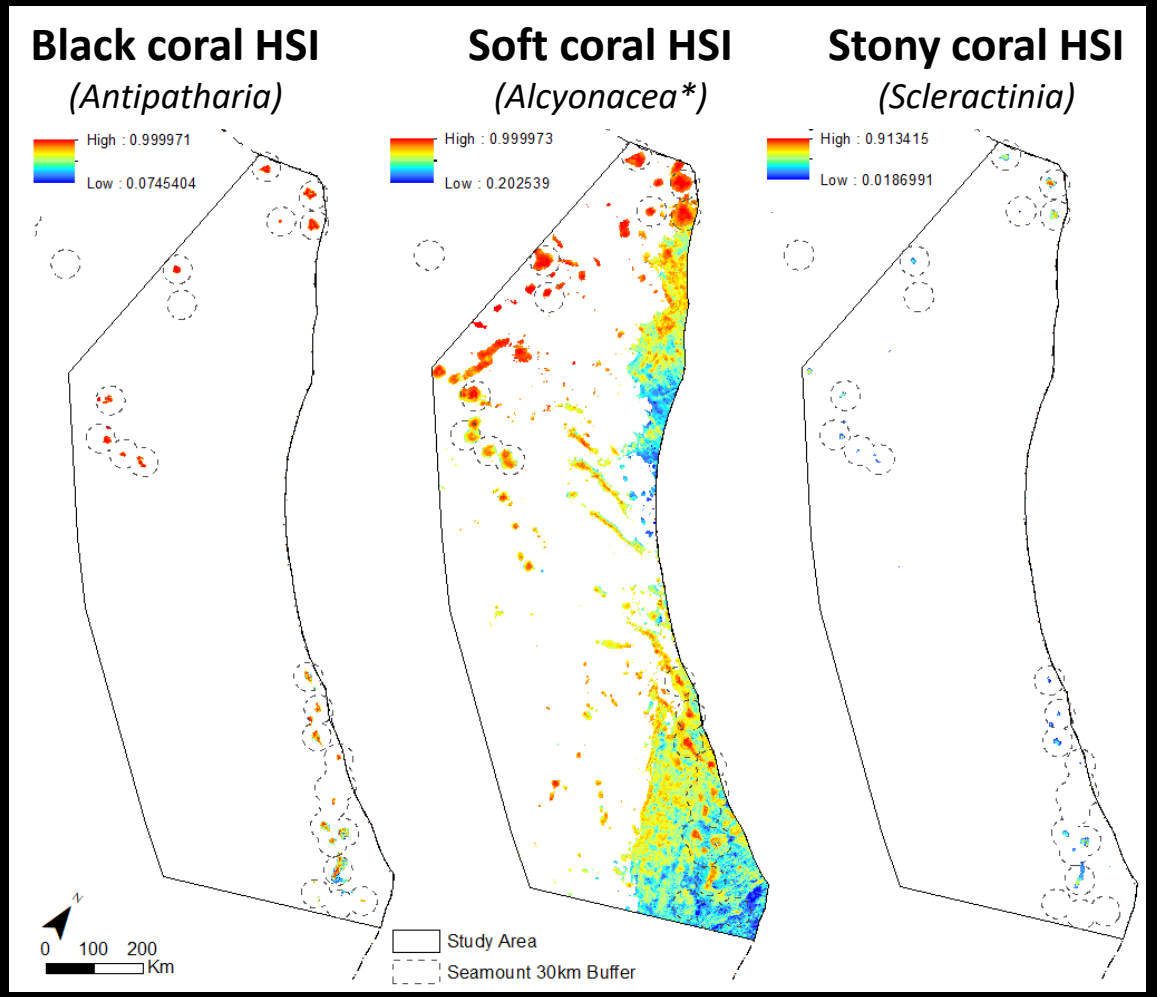
Northeast Pacific preliminary study objective:

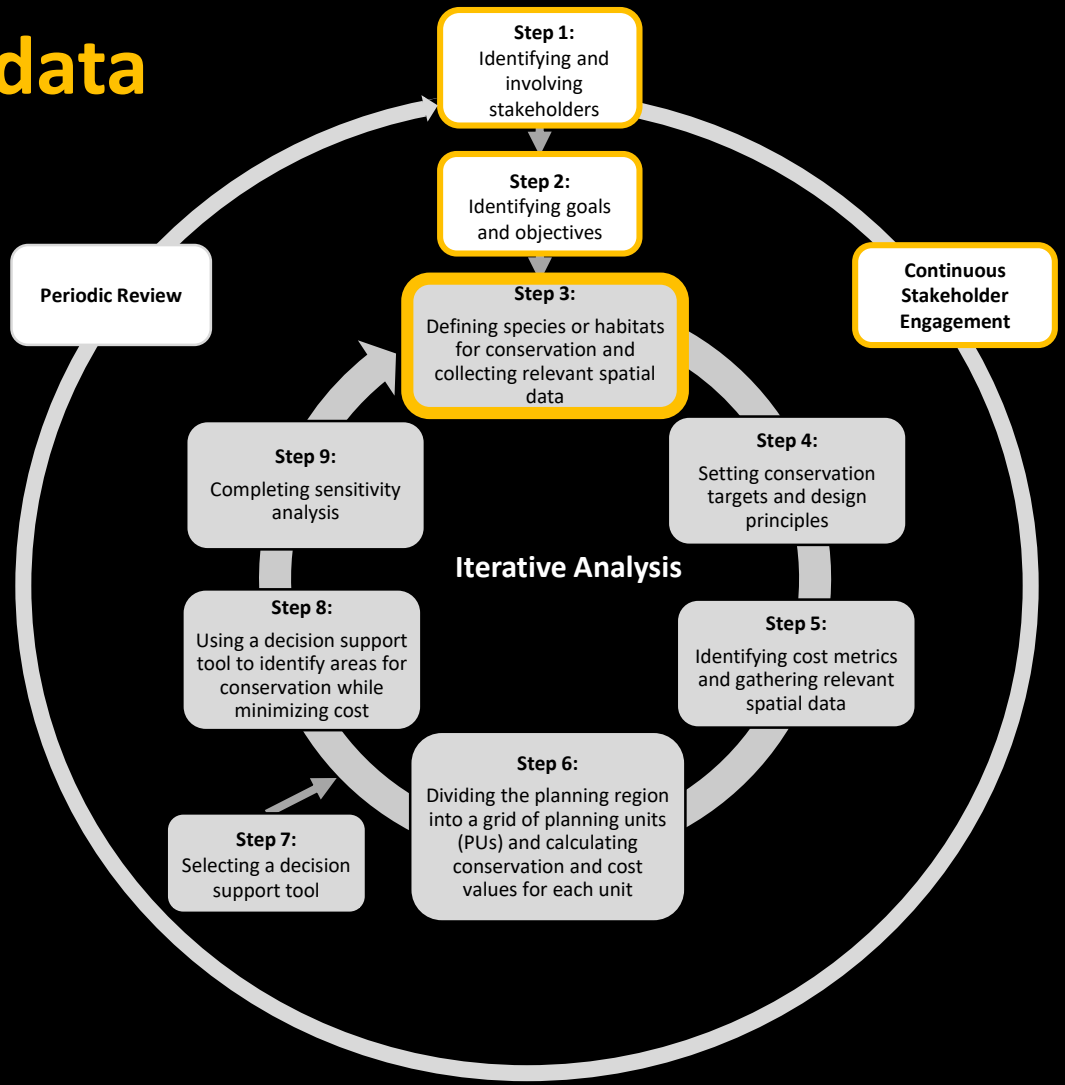
Identify areas in the study area where VMEs can be protected from significant adverse impacts (SAIs) while minimizing the economic impacts to the Sablefish fishery and other stakeholders



Step 3: Defining species or habitats for conservation and collecting relevant spatial data

Species distribution models (SDMs) of NPFC recognized VME indicator taxa





** Gorgonian corals are now part of the order Alcyonacea and are included with soft corals in this analysis*

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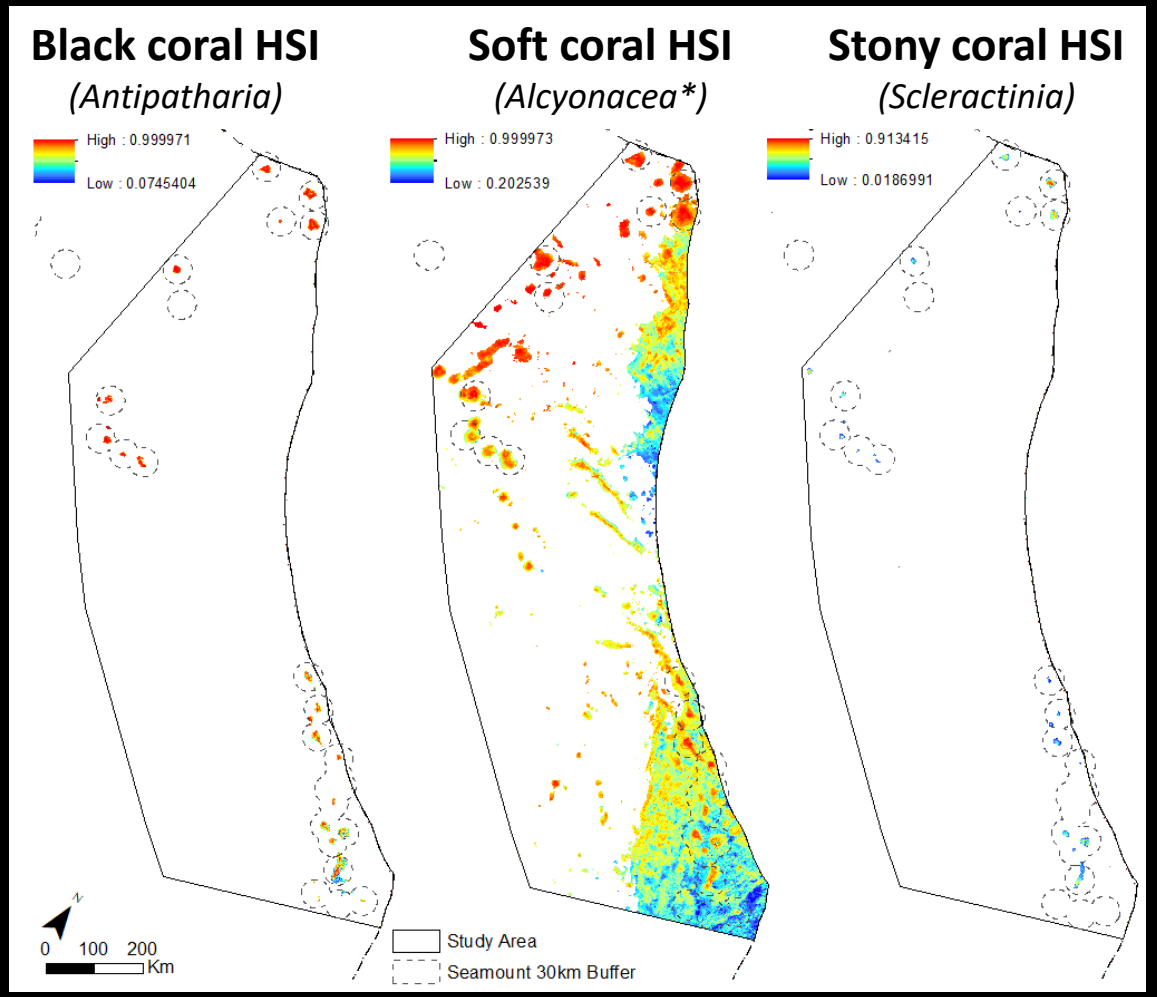


30 environmental data layers

Seafloor characteristics
Nutrients
Carbon chemistry
Terrain metrics
Water column properties

Species occurrence records

Fisheries and Oceans Canada (DFO) research and commercial database
+
Royal British Columbia Museum records

↓

MaxEnt modelling

↓

Habitat Suitability Index (HSI) maps

1 km resolution

Chu JWF, Nephin J, Georgian S, Knudby A, Rooper C, Gale KSP. 2019. Modelling the environmental niche space and distributions of cold-water corals and sponges in the Canadian northeast Pacific Ocean. Deep Res Part I Oceanogr Res Pap. 151(March):103063.

Step 4: Setting conservation targets and design principles

Conservation targets are based on SDM uncertainty, where HSI values with high certainty have higher conservation targets

Standard deviation uncertainty category	Conservation target example*
High certainty HSI	95%
Medium certainty HSI	50%
Low certainty HSI	10%

* More consideration is needed to define appropriate target levels and should include stakeholders and managers

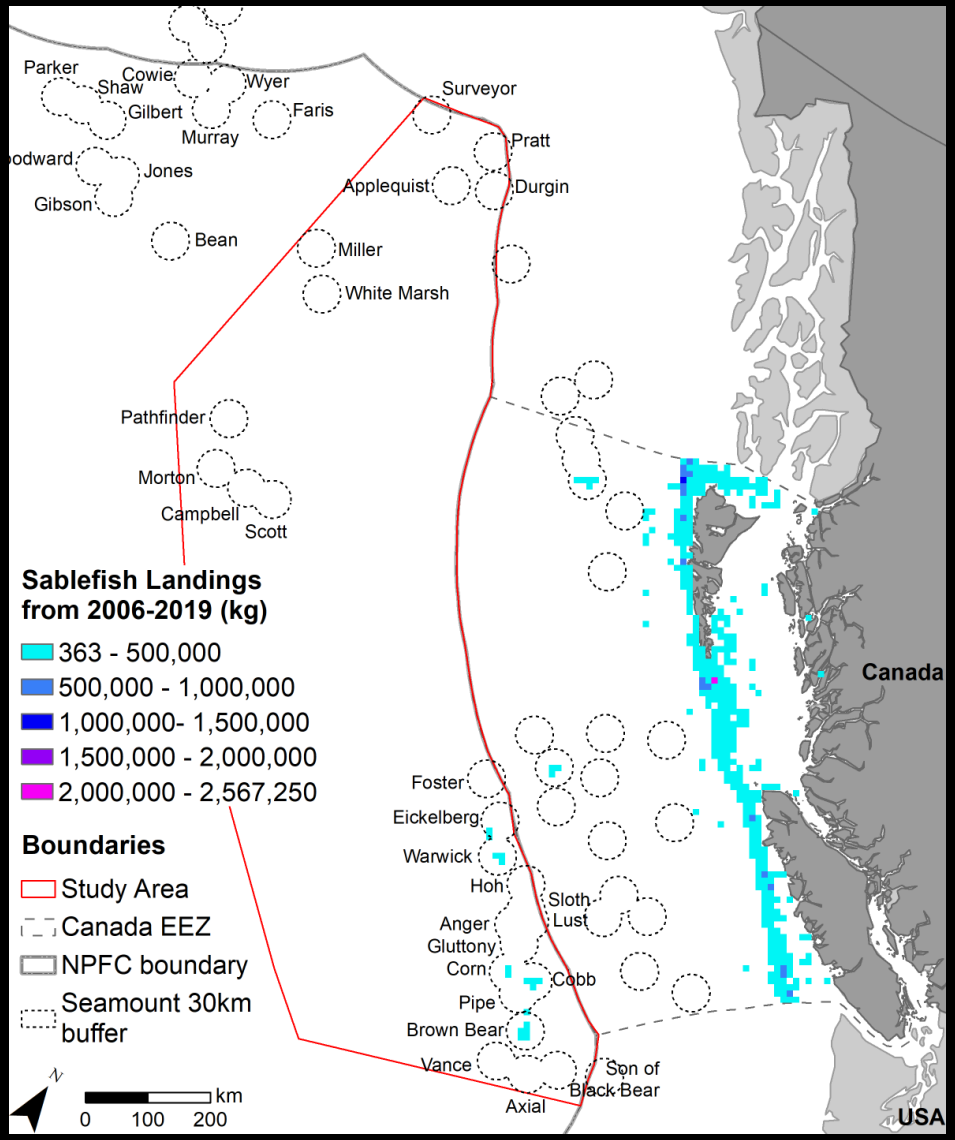
Nine conservation features are used:

Black coral – high certainty
Black coral – medium certainty
Black coral – low certainty
Soft coral – high certainty
Soft coral – medium certainty
Soft coral – low certainty
Stony coral – high certainty
Stony coral – medium certainty
Stony coral – low certainty

Step 5: Identifying cost metrics and gathering relevant spatial data

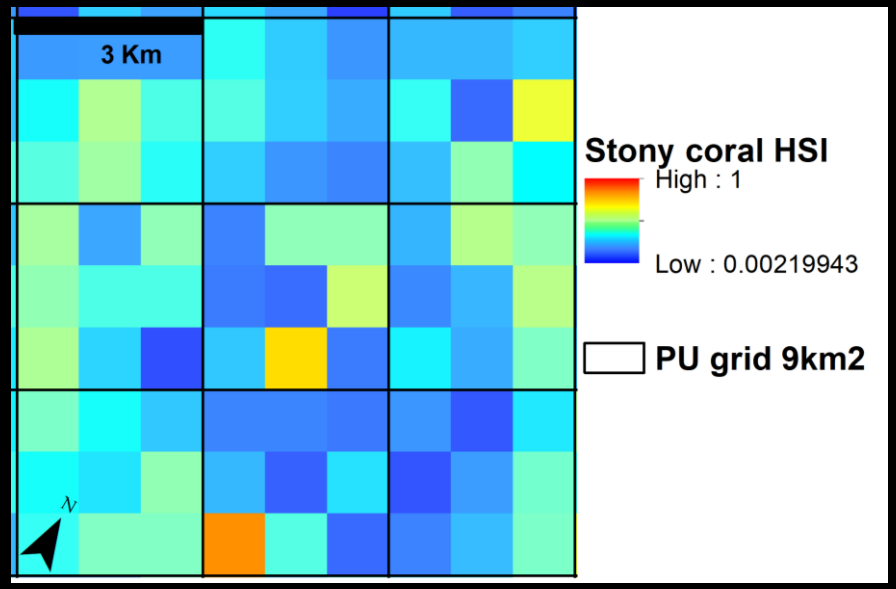
Sablefish landings values from Fisheries and Oceans Canada (DFO) database

Landings focused on four seamounts in the south eastern corner of the study area



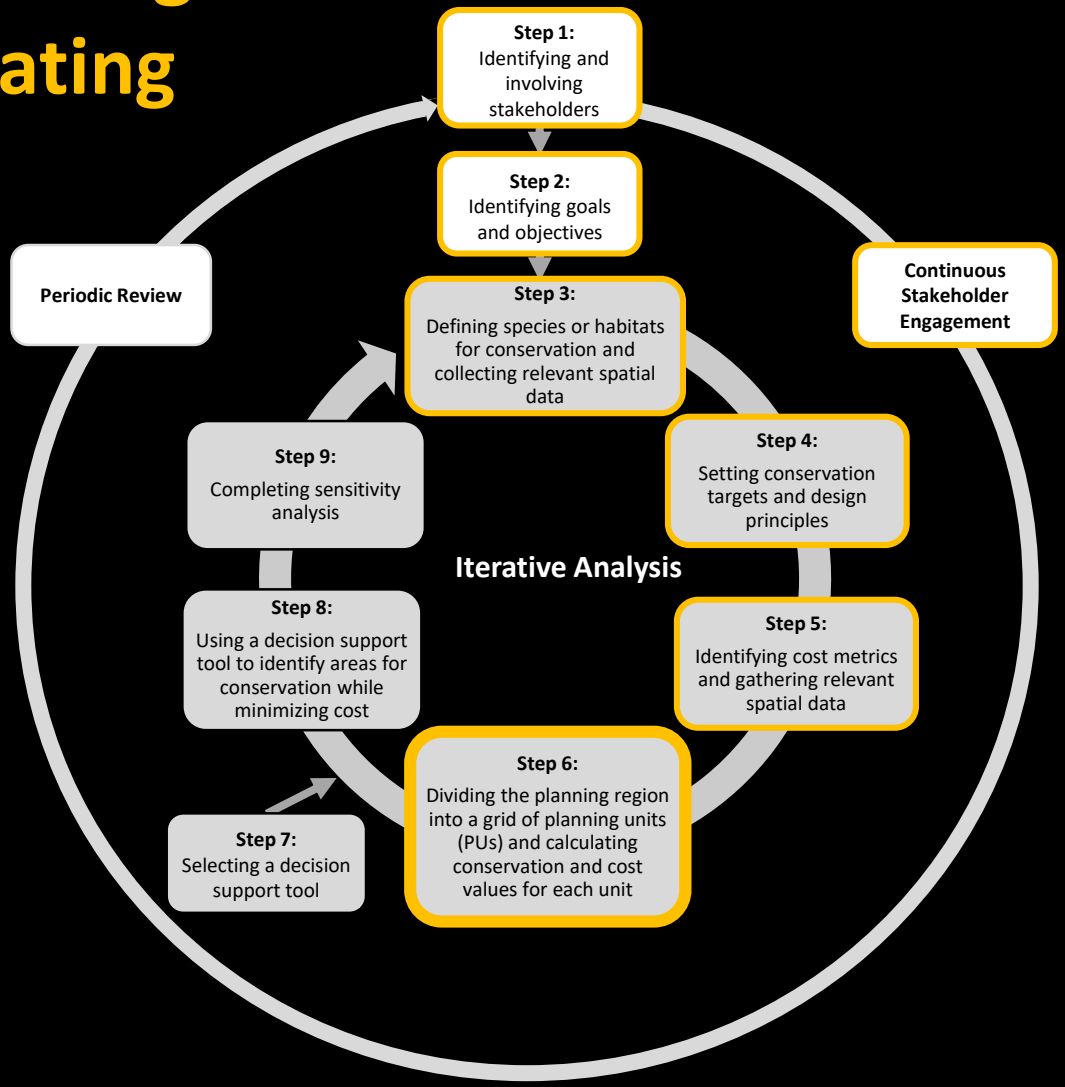
Step 6: Dividing the planning region into a grid of planning units (PUs) and calculating conservation and cost values

Square PU grid with a size of 9 km² and total of 72,119 PUs



Conservation feature value per PU = **Mean HSI**

Cost value per PU = **Sum of landings in kg from the years 2006-2019**

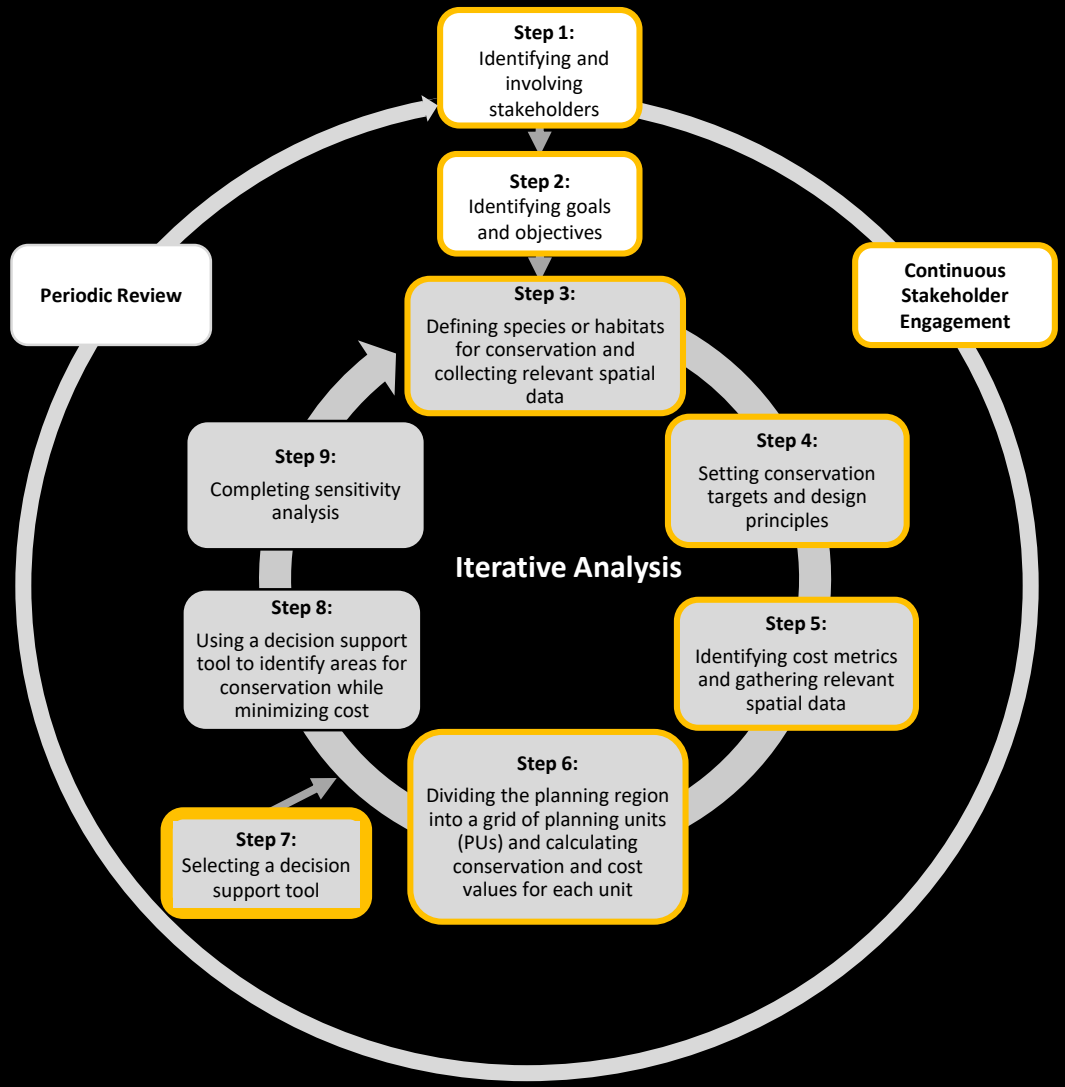


Step 7: Selecting a decision support tool

Prioritizr

A newer tool available as an R package used for solving conservation planning problems

- Superior reproducibility and transparency
- Integer linear programming algorithm
- Faster processing time
- Free to use
- Excellent documentation and support



Other widely used tools include:

Marxan

Zonation

The decision support tool should be chosen based on the project objectives and additional functionality and strengths of the different tools

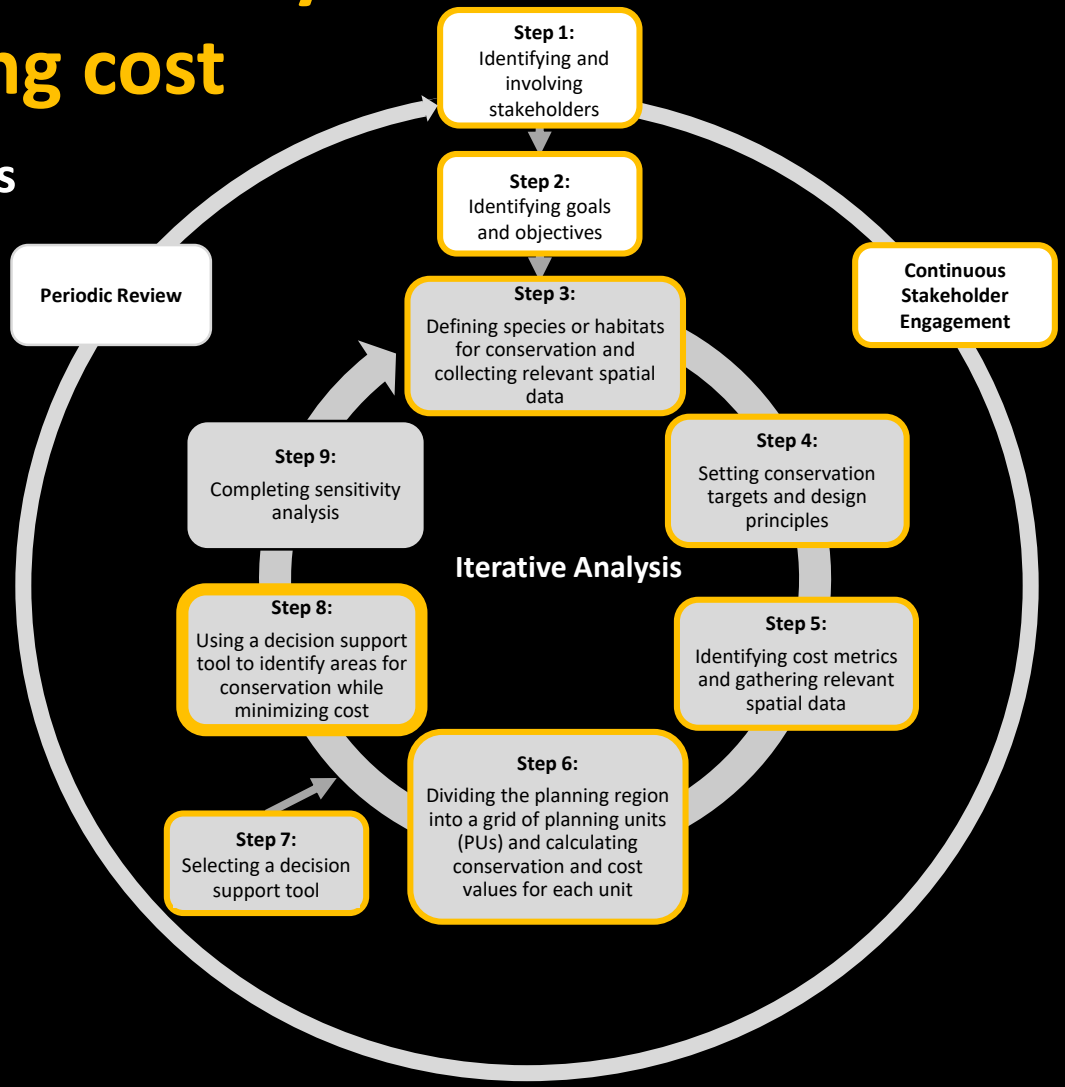
Step 8: Using a decision support tool to identify areas for conservation while minimizing cost

Preliminary study focused on using the main basic functions

Added complexity can easily be added in the future

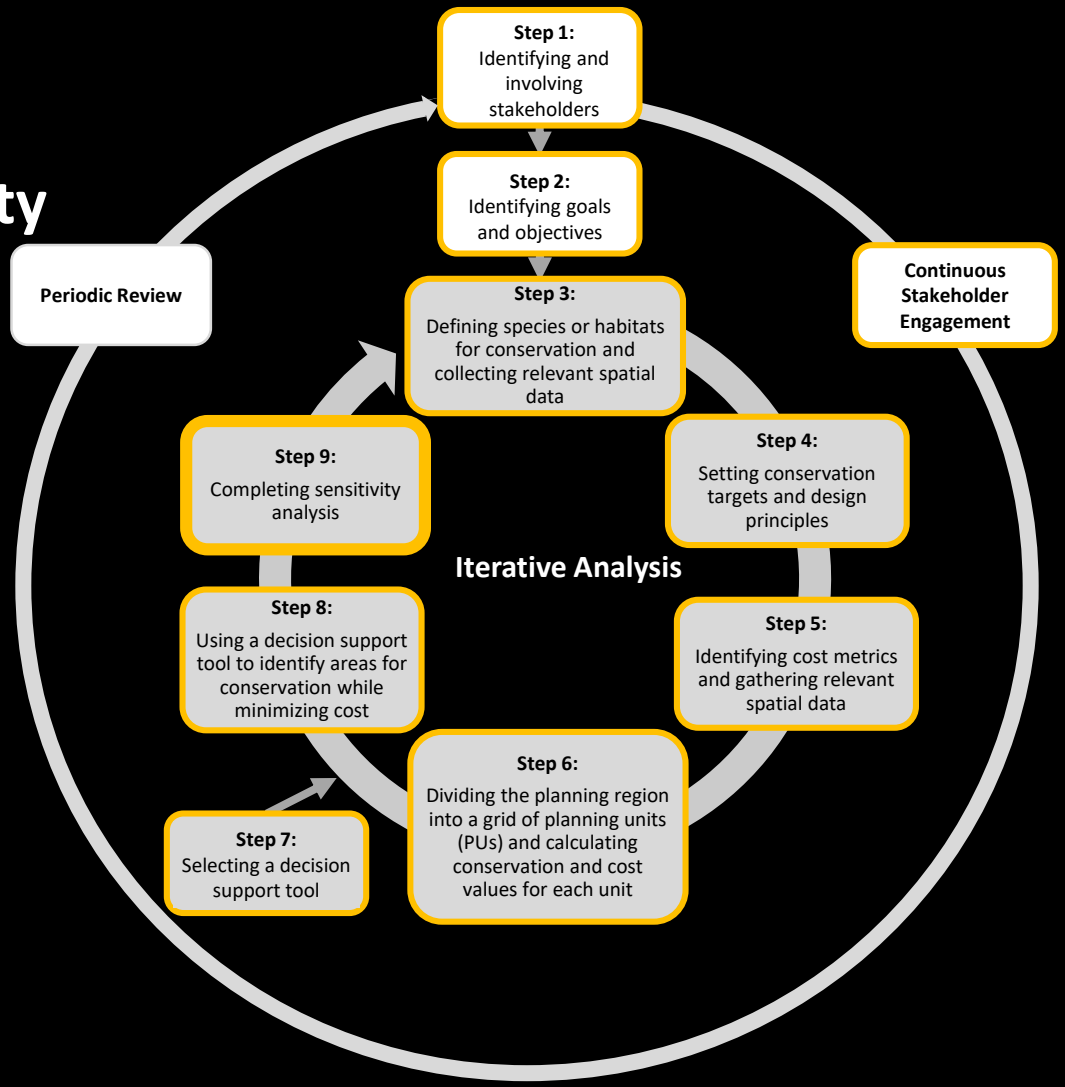
Prioritizr function	Description
Loading data and initializing a problem	There are many different ways to initialize a problem depending on the format of the input data.
Objective	Used to specify the overall goal of the planning problem.
Targets	How much of each feature is desired or required to be conserved.
Constraints	Ensures that solutions exhibit specific properties such as selecting specific PUs for protection.
Penalties	Penalize solutions according to specific metrics.
Decision types	Specify the nature of the decision.
Solver	Specify the optimization software used to solve the problem.

https://prioritizr.net/index.html



Step 9: Completing sensitivity analysis

Ensure the analysis represents the data and addresses the project goals to the best of its ability



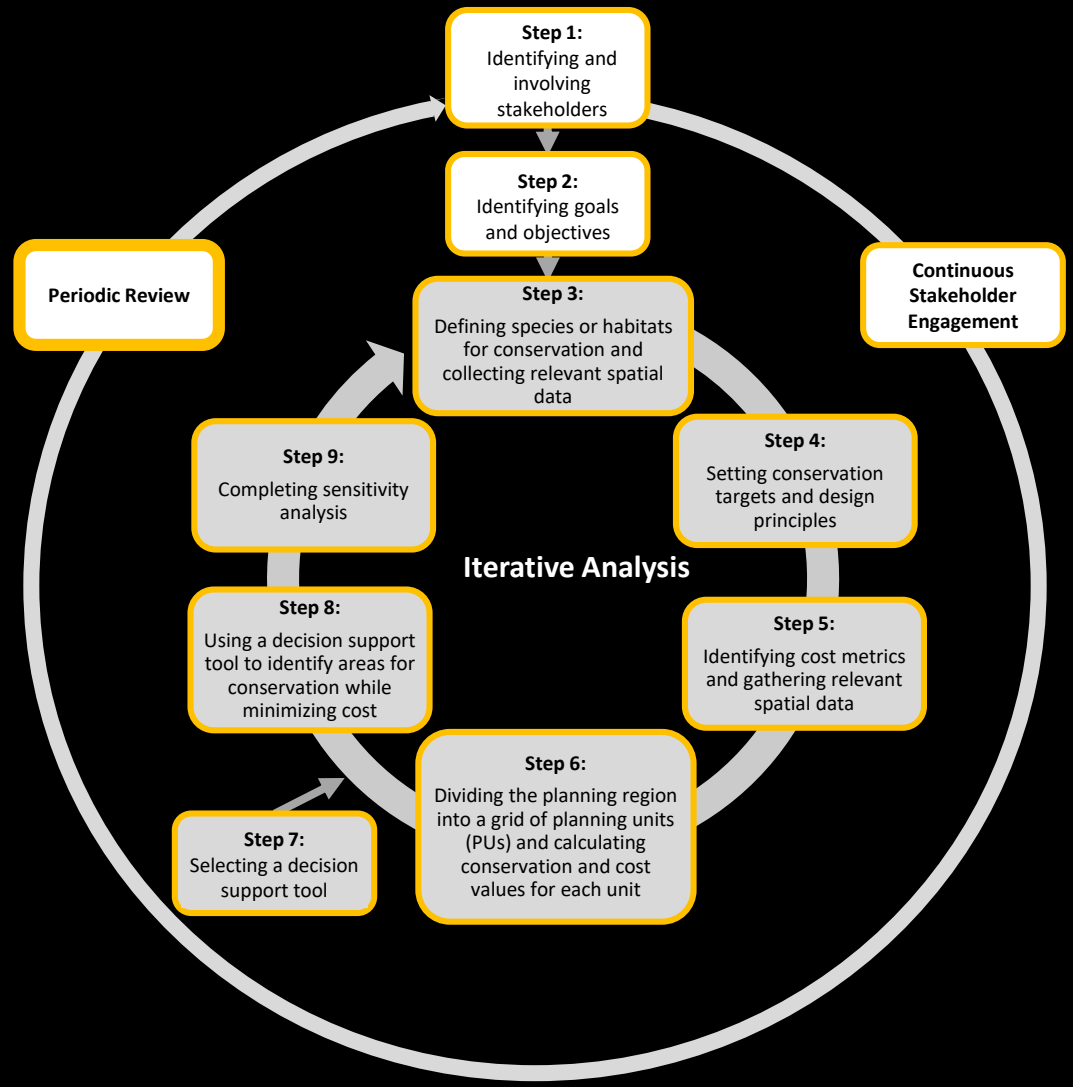
Parameters tested include:

- Sablefish landings values input (mean vs total landings)
- Historical fishing timeframe used long term (2006-2019) versus short term (2014-2019)
- Varying conservation targets (10-95%)
- Penalty factors that control how spatial fragmentation of protected areas

Periodic Review

To ensure the protection measures remain effective in practice after implementation, review and update the analysis in the case of:

- New data available
- Changes in the environment or species distribution
- Objectives evolve



Recommendations

1. NPFC SSC BFME endorses this process for completing trade-off analysis between fishing and Vulnerable Marine Ecosystem protection

2. Canada moves forward with completing a trade-off analysis in the northeast Pacific using this proposed method


(from Curtis et al. 2015)

(from Du Preez et al. 2020)


https://caseagrant.ucsd.edu/seafood-profiles/sablefish-black-cod

(from Du Preez et al. 2020)

Thank you! Questions, comments, or feedback?

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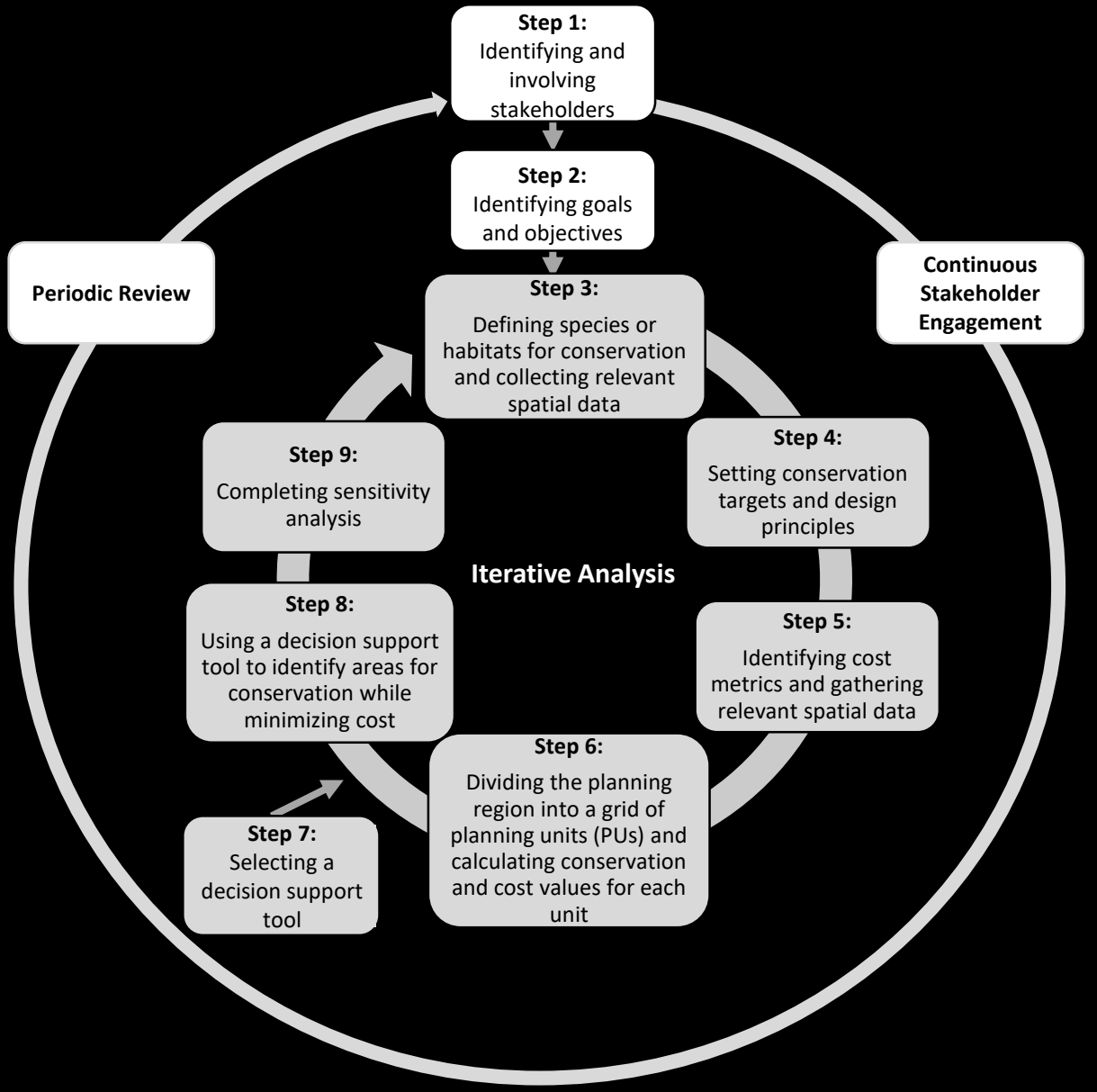


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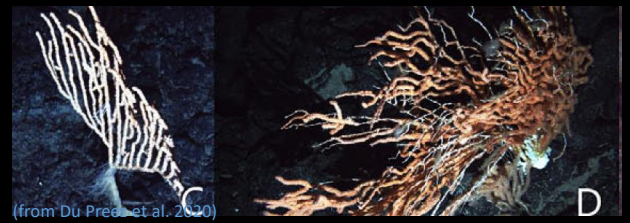

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Pomeroy R, Douvere F. 2008. The engagement of stakeholders in the marine spatial planning process. Mar Policy. 32(5):816–822. doi:10.1016/j.marpol.2008.03.017.

Rowden AA, Cryer M. 2018. Spatial management strategies: The SPRFMO (New Zealand) experience. Protection of VMEs in the North Pacific Fisheries Commission NPFC/FAO Workshop. March 12-15, Yokohama, Japan. (NPFC-2018-WS VME01-WP16).