Using the overlap of predicted cold-water coral habitat and bottom-contact fisheries to identify VMEs in British Columbia, Canada

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Cold-water coral in Pacific Canada

• BC home to a diversity of cold-water coral

• Provide valuable biogenic habitat
Fishing impacts

- Vulnerable to bottom-contact fishing and other human activities
- Low capacity to recover from disturbance
- Canada has committed to protecting coral

(e.g., Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas, UNGA Resolution 61/105)
Constraints to conservation

• Deep-sea research expensive, logistically challenging

• Distribution largely unknown

• Do not know the extent of overlap between coral habitat and bottom fishing activity

• Species distribution modeling can help meet management needs by predicting areas of habitat suitability
Species distribution models

- Relate occurrence data to background environmental variables to determine a species’ niche

- Create maps predicting suitable habitat for coral
Purpose

1) Predict areas of **suitable habitat** for four orders of cold-water coral in BC

2) Evaluate the **overlap** between bottom-contact fishing activity and predicted coral habitat to identify VMEs
Suitable Habitat: Environmental data

- 2450m depth cutoff
- 500 m x 500 m grid
  - Bathymetry
  - Slope
  - Chlorophyll $a$ conc.
  - Tidal velocity
  - Temperature
  - Salinity
  - Current speed

Summer and winter values
Suitable Habitat:
Coral data

• Criteria:
  – Expert identification
  – Spatial resolution

• Four orders of coral:
  – Alcyonacea
  – Antipatharia
  – Pennatulacea
  – Scleractinia

\[ n = 821 \]
Suitable Habitat: Previous studies

- Scleractinia on seamounts
- Compared ENFA to Maximum Entropy (Maxent)
- Maxent performed significantly better
- Other studies have shown Maxent performs substantially better than other models (e.g., Elith et al. 2006; Phillips et al. 2006)
Suitable Habitat: Maxent

- Maximum-likelihood method
- Starts with a uniform distribution
- Iteratively updates the probability of occurrence at known coral locations
- Produces a continuous map of probability of occurrence
Suitable Habitat: Alcyonacea

AUC: 0.908

n = 121
Suitable Habitat: Antipatharia

AUC: 0.940

n = 49
Suitable Habitat: Pennatulacea

AUC: 0.947
n = 84
Suitable Habitat: Scleractinia

AUC: 0.864

$n = 32$
Overlap:
Fishing activity

Data on effort in a 4 km grid, at least 3 vessels/grid cell

Data summed over all years (1996-2004)
Suitable Habitat:
Alcyonacea
Overlap: Fishing overlap

Proportion of habitat fished

Threshold

- **Alcyonacea**
- **Antipatharia**
- **Pennatulacea**
- **Scleractinia**

○ Cumulative
+ Trawl
△ Trap
× Longline
Overlap: Fishing overlap

Alcyonacea

Predicted habitat
Overlap

46.5%

Antipatharia

Predicted habitat
Overlap

30.4%
Overlap:
Fishing overlap

![Map showing fishing overlap with predicted habitat overlap for Pennatulacea and Scleractinia.](image)

Pennatulacea: 46.2%
Scleractinia: 41.9%
Discussion

• Maxent appears to provide robust predictions of **suitable habitat** for cold-water coral in BC

• Estimates of **overlap** between bottom-contact fishing and predicted habitat range from **30.4%** to **46.5%**
Discussion:

Suitable habitat

- Ardron and Jamieson (2006)
- Density analysis on commercial bycatch of coral and sponges
- Used to identify coral and sponge EBSAs in BC
Discussion:

Suitable habitat

- Bryan and Metaxas (2007)

- ENFA predictions for Alcyonacea

Discussion: Overlap

- Vulnerable to bottom-contact fishing and other human activities
- Low capacity to recover from disturbance
Discussion: Overlap

- A taxon is considered vulnerable or threatened if there is a population reduction of ≥ 30%

(IUCN 2001, COSEWIC 2009)
Conclusions

• This study facilitates marine conservation efforts by identifying areas of predicted coral habitat that are vulnerable to fishing activity

• Estimates of overlap are substantial, and the long-term viability of coral populations may be at risk

• A formal assessment of the conservation status of coral in BC should be a priority
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