

Using habitat suitability models to assess the impact of shrimp trawling on the distributions of benthic species

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Introduction

- The West Greenland fishery for northern shrimp, *Pandalus borealis*, is undergoing an evaluation by the Marine Stewardship Council to gain the MSC certification of sustainability.
- This process includes an independent assessment of the impact of the fishing activities on benthic habitats found in the area.
- Hundreds of benthic invertebrate specimens and more than 1,000 photographs of the sea bed of the West Greenland shelf have been collected.
- This represents sampling of only a fraction of 1% of the benthic habitat of the area, so more cost effective methods are required to provide information on benthic habitats across large scale regions.
- Habitat suitability modelling is one such method suitable to predict habitat extent of important coral species across the West Greenland shelf ⁽¹⁾.



Figure 1. Benthic photographic image displaying *Duva* sp. from *Nephtheidae* family.



Figure 2. Dropping the camera off the M/T Paamiut to sample benthic habitats.

Methods



Figure 3. *Paragorgia* bycatch from the M/T Paamiut.

Environmental Data

- Environmental layers were obtained from online data bases ⁽²⁾ and then up-scaled from a resolution of 12km² to 3.5km² through a “Cookie Cutter” Up-scaling process⁽³⁾.
- The environmental layers selected were factors likely to influence conditions on the sea floor. The layers modelled were depth, slope, ruggedness, temperature, salinity and current speed.

Occurrence Data

- Point data was used to identify environmental factors at each location.
- Initial models have been run to predict the suitable habitat of the soft coral family *Nephtheidae* and the branching coral family *Paragorgiidae*.

Habitat Suitability Modelling

- The programme Maxent was used to model the habitat suitability⁽⁴⁾.
- Separate models were run with and without the inclusion of fishing pressure to determine whether fishing impact is a significant predictor of coral distribution.

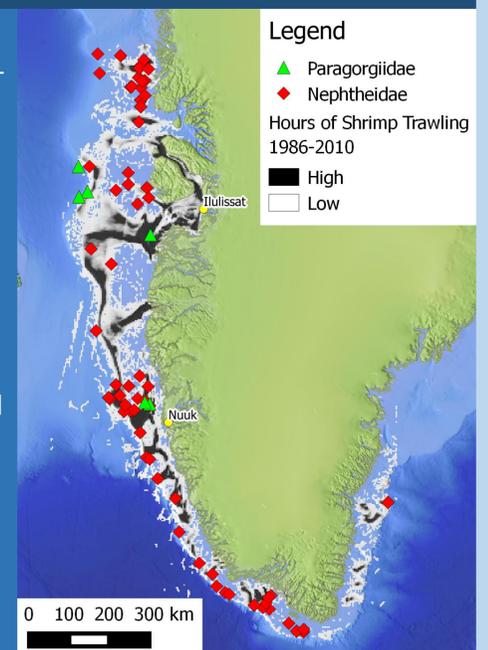


Figure 4. Shrimp trawling activity across Greenland, (provided by Greenland Institute of Natural Resources) and occurrence data of *Nephtheidae* and *Paragorgiidae*.

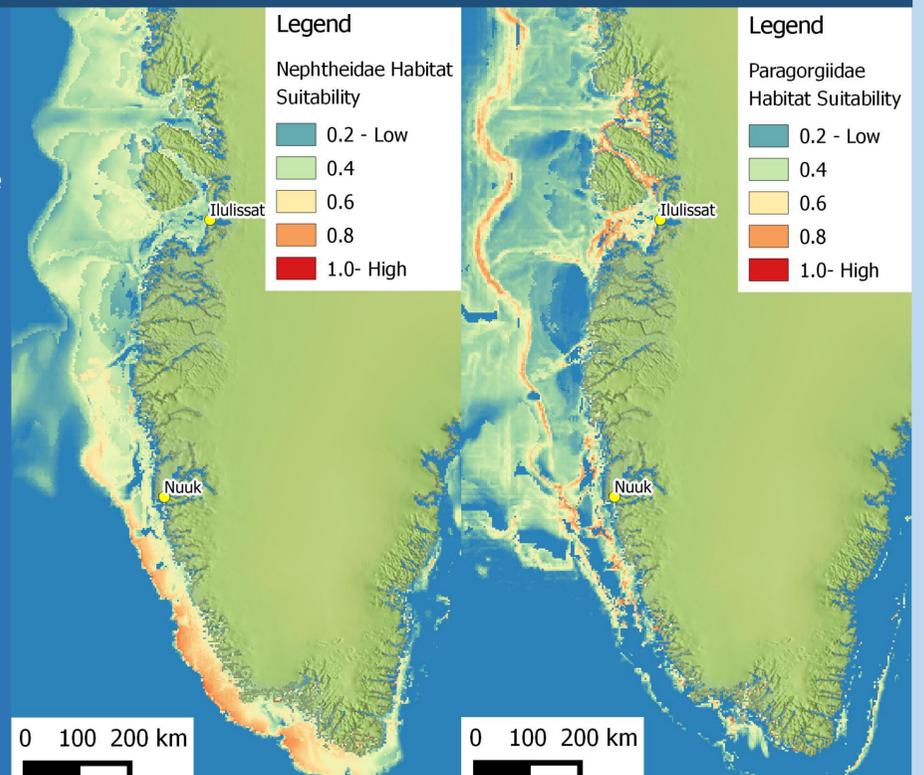
Outcomes

Model Results

- The key factors affecting the likelihood of coral presence were:
 - *Nephtheidae* habitat suitability is influenced strongly by depth and temperature, and is related to fishing impact ($r^2=0.2$, $p<0.01$), which may represent a positive response to fishing, although this response tails off at very high fishing impact.
 - *Paragorgiidae* habitat suitability is determined most strongly by terrain ruggedness, followed by current speed. It displays a much weaker correlation to fishing impact; surprisingly there is no evidence of a negative response to fishing pressure.

Practical Use

- The project will contribute to the assessment carried out by the Institute of Zoology for the Marine Stewardship Council.
- The production of the first habitat distribution maps of the West Greenland shelf will allow key habitat areas for important coral species to be identified.
- The models will highlight areas that appear to be negatively impacted by fishing effort, or those potentially at risk. This can inform decisions on fishing practices and provide evidence to support mitigation efforts.



Figures 5 & 6. Habitat suitability models of the West Greenland Shelf for the coral families *Nephtheidae* and *Paragorgiidae* respectively.

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References

1. Yesson, C., Taylor, M. L., Tittensor, D. P., Davies, A. J., Guinotte, J., Baco, A. & Rogers, A. D. (2012). Global habitat suitability of cold-water octocorals. *J. Biogeogr* 39, 1278-1292.
2. <http://www.myocean.eu/>
3. Davies, A. J., & Guinotte, J. M. (2011). Global habitat suitability for framework-forming cold-water corals. *PLoS One*, 6(4), e18483.
4. Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3), 231-259.