Methods of predicting species distributions for marine spatial planning: what lies beneath?

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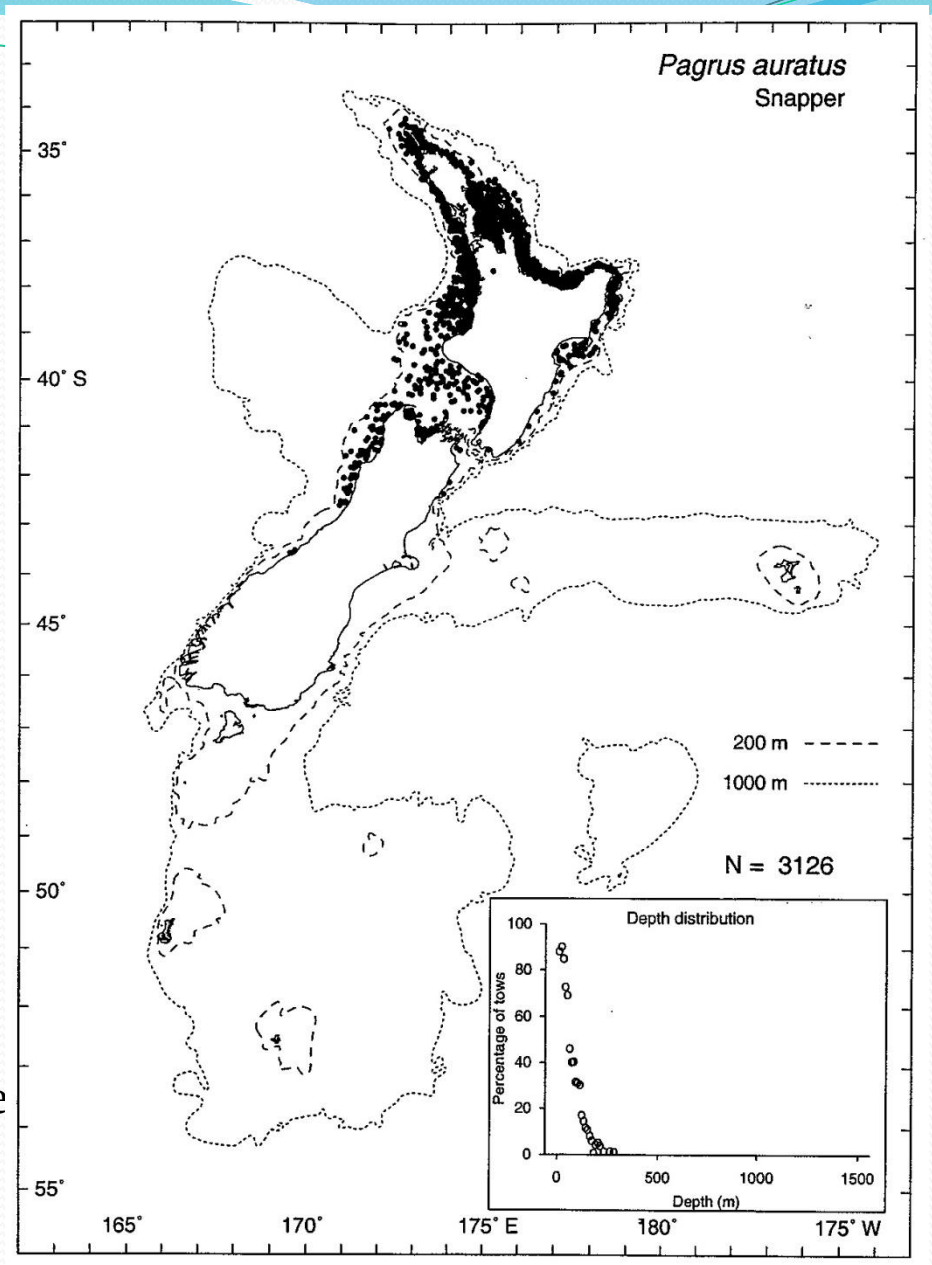
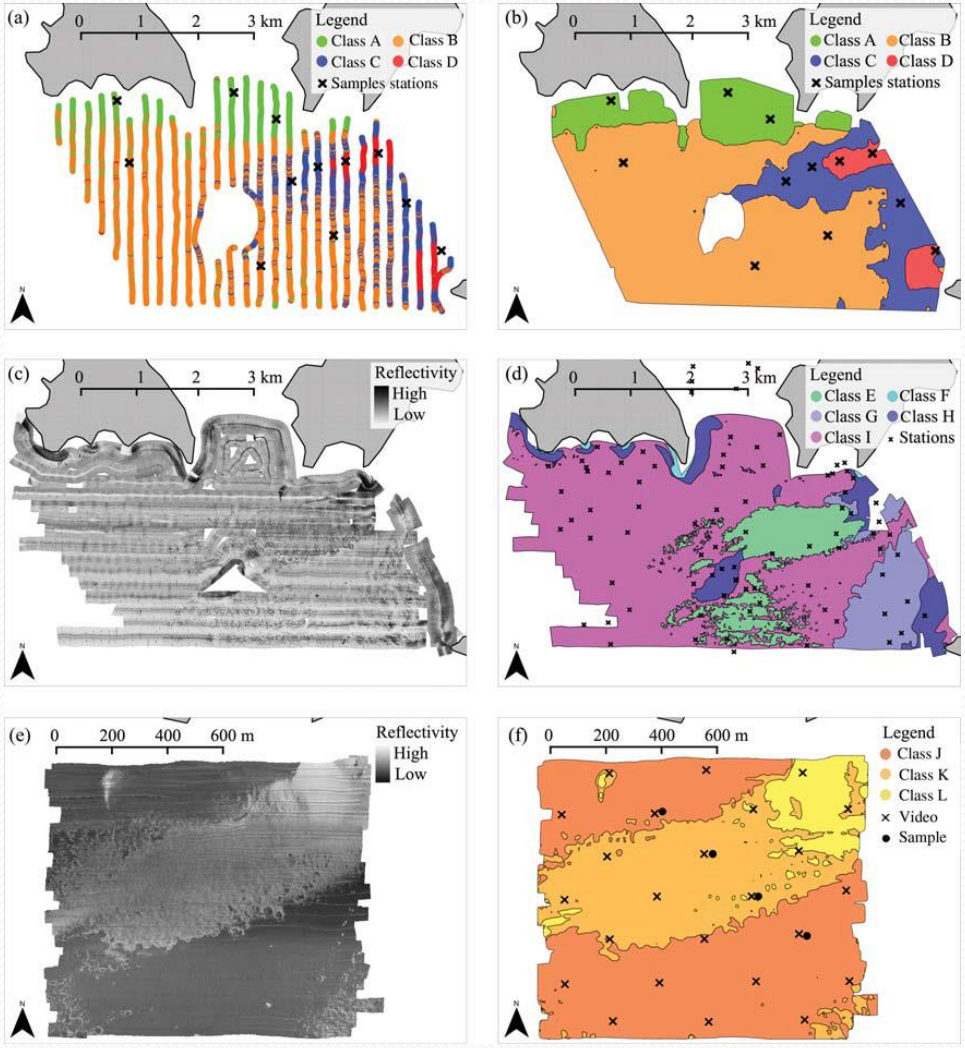
Species distributions (point data):

- Serendipitous observations (presence only)
- Scientific collections (usually presence only)
- Systematic surveys (presence-absence data)
- Fishery data (mixture of presence only and presence-absence data)



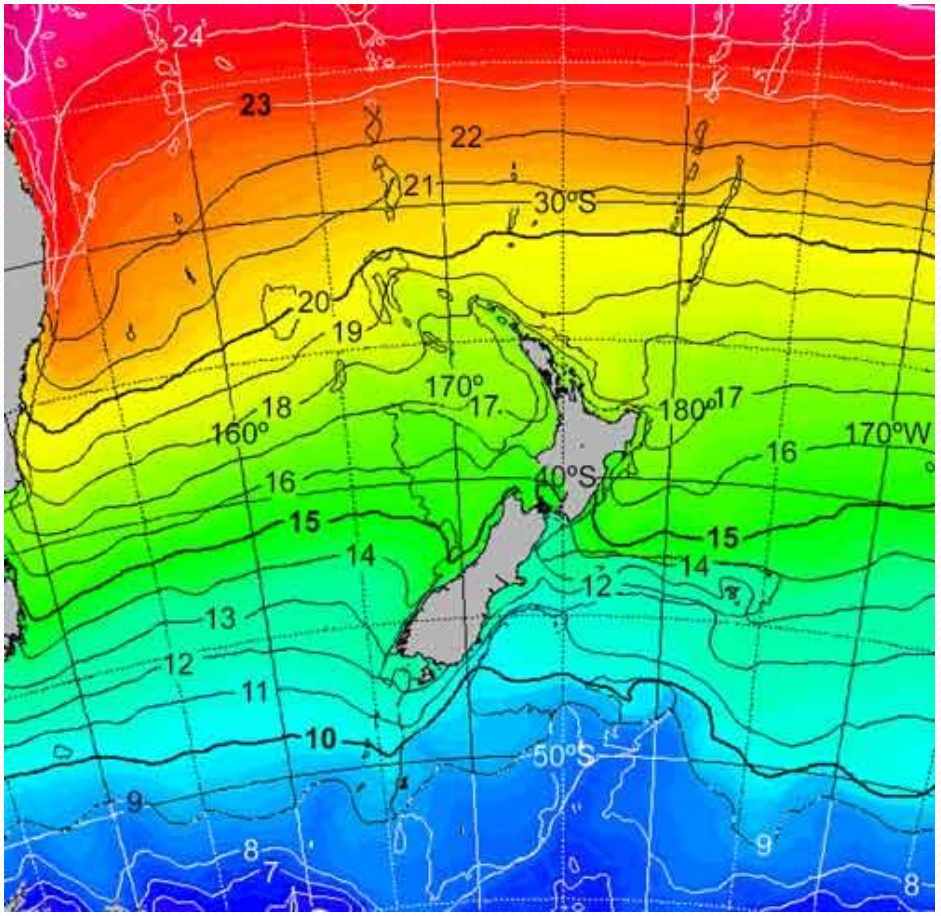
Habitat survey methods:

- Aerial photographs (coastal, < 20 m depth)
- Single beam sonar
- Side-scan sonar
- Multibeam sonar
- Ground-truthing (divers, drop-cameras, camera sleds)



Remote-sensed environmental data:

- Large scale, continuous coverage
- Relatively good spatial resolution
- Short – medium term temporal resolution (length of time series improving)
- Restricted to the sea surface
- May not function well in the nearshore zone
- Raw data needs to be interpreted using appropriate algorithms (e.g. Chla algorithms confounded by suspended sediment)



Marine environment classifications:

These represent attempts to develop classifications of areas based upon prevailing environmental conditions to provide a spatial framework for management of the marine environment:

- New Zealand marine environment classification (MEC) – 2005 (MfE, DOC, MFish)
- Fish tuned MEC – 2006 (DOC, MFish)
- Benthic Optimised MEC (BOMEC) – 2009 (MFish)

Marine environment classifications:

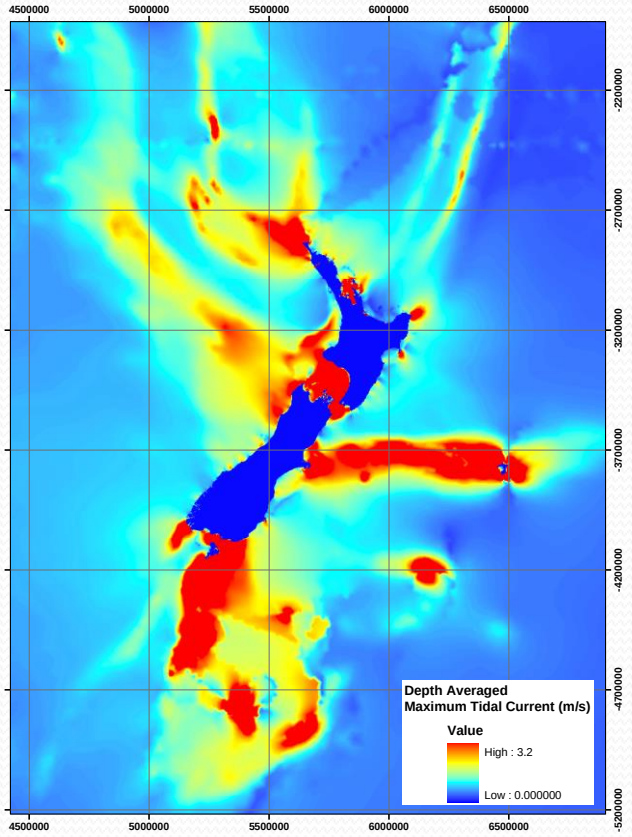
- Statistical procedures are used to determine relationships between environmental and biological (presence and abundance) variables

- Groups of grid cells sharing similar combinations of environmental variables were identified statistically and then mapped - 1km^2 at EEZ scale; 250 m^2 at regional (Hauraki Gulf) scale

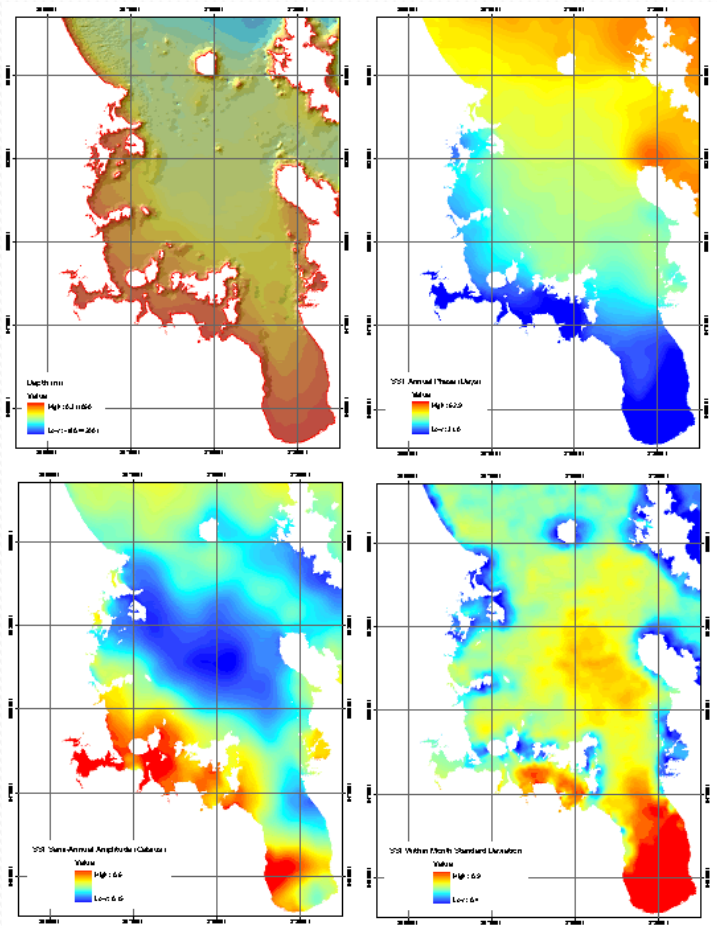
Environmental variables

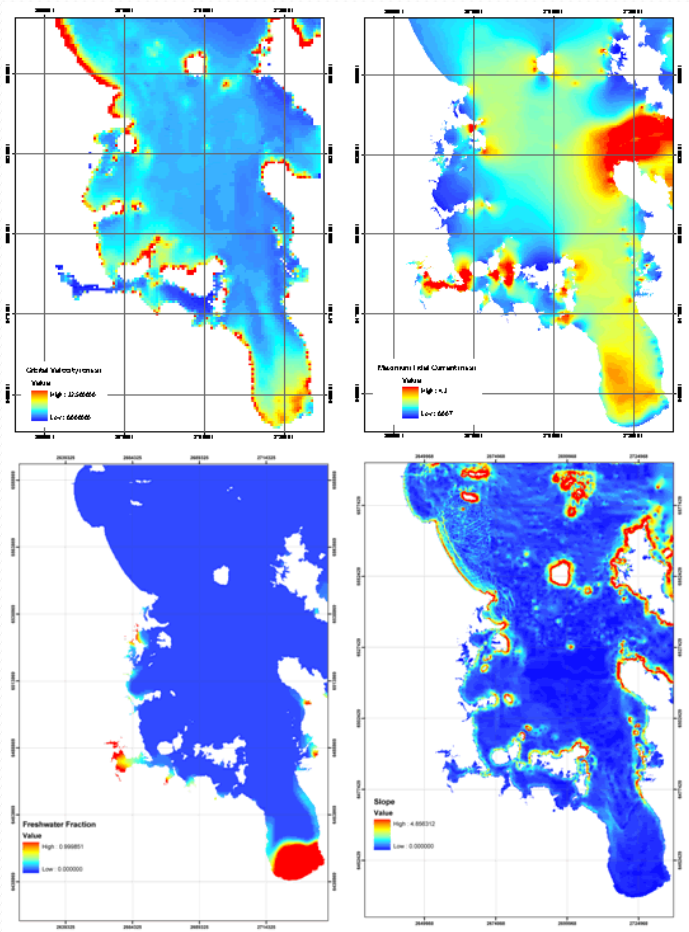
Candidate environmental variables tested were those considered likely to structure marine ecosystems:

- Light
- Stratification and mixing
- Water mass
- Fronts
- Upwelling and eddies
- Tidal currents
- Freshwater inputs
- Depth
- Wave climatology (bed stress)
- Seabed shape and slope
- Sediment type

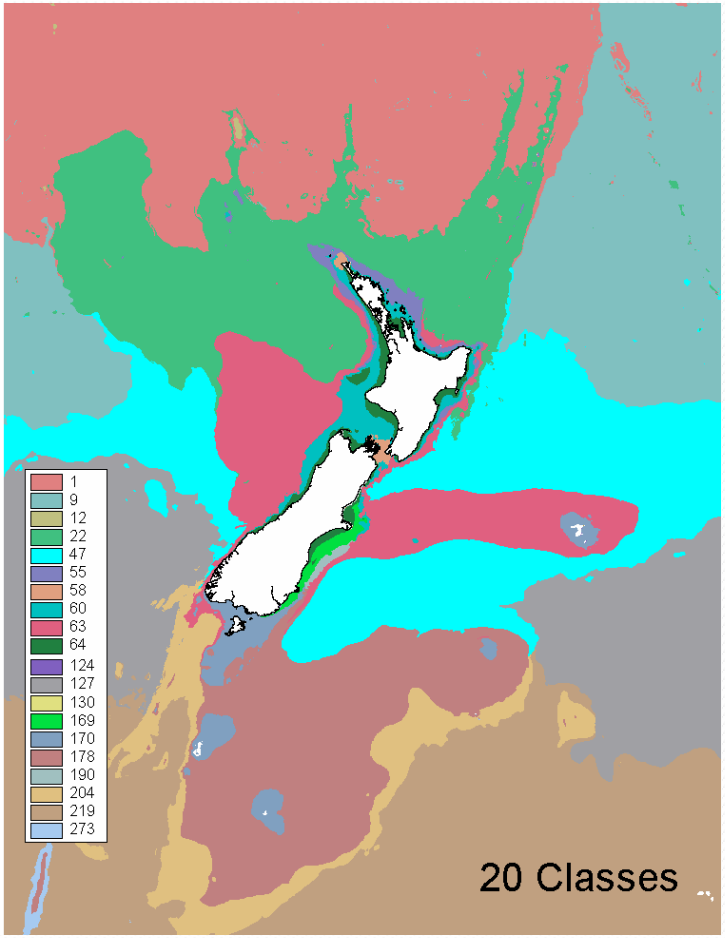


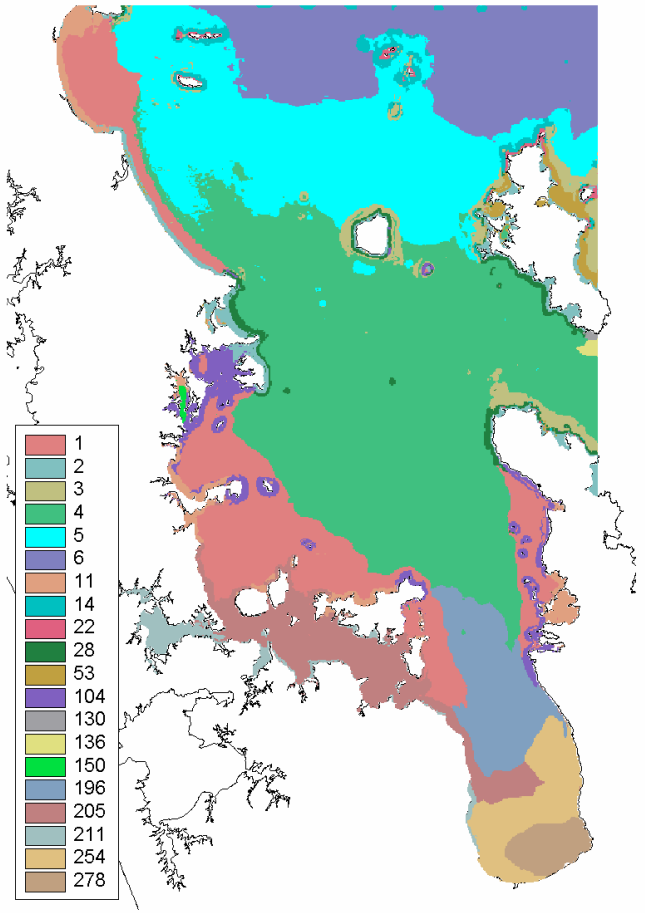
Examples of maps of the environmental variables derived for the Hauraki Gulf classification (Depth, SST annual phase, SST semi-annual amplitude, SST monthly standard deviation, Mean orbital velocity, Tidal currents, Freshwater fraction, Slope)





EEZ and Hauraki Gulf marine environmental classifications (MEC) at the 20 class level

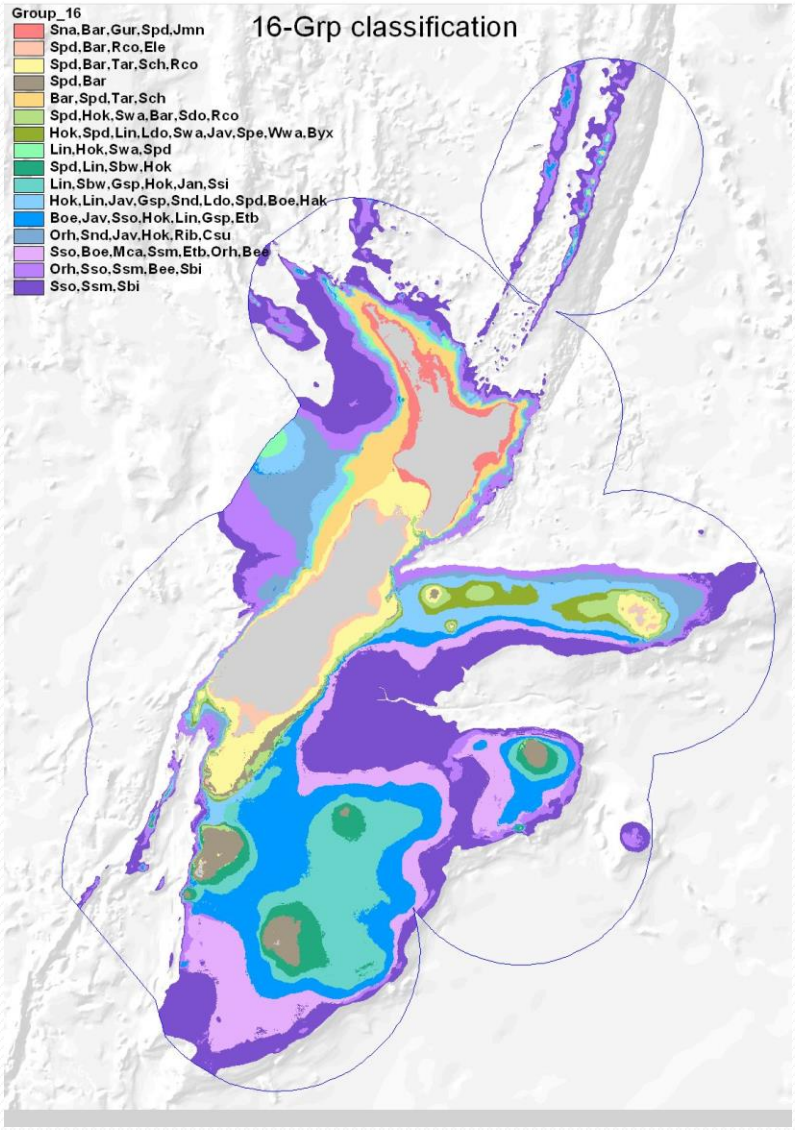


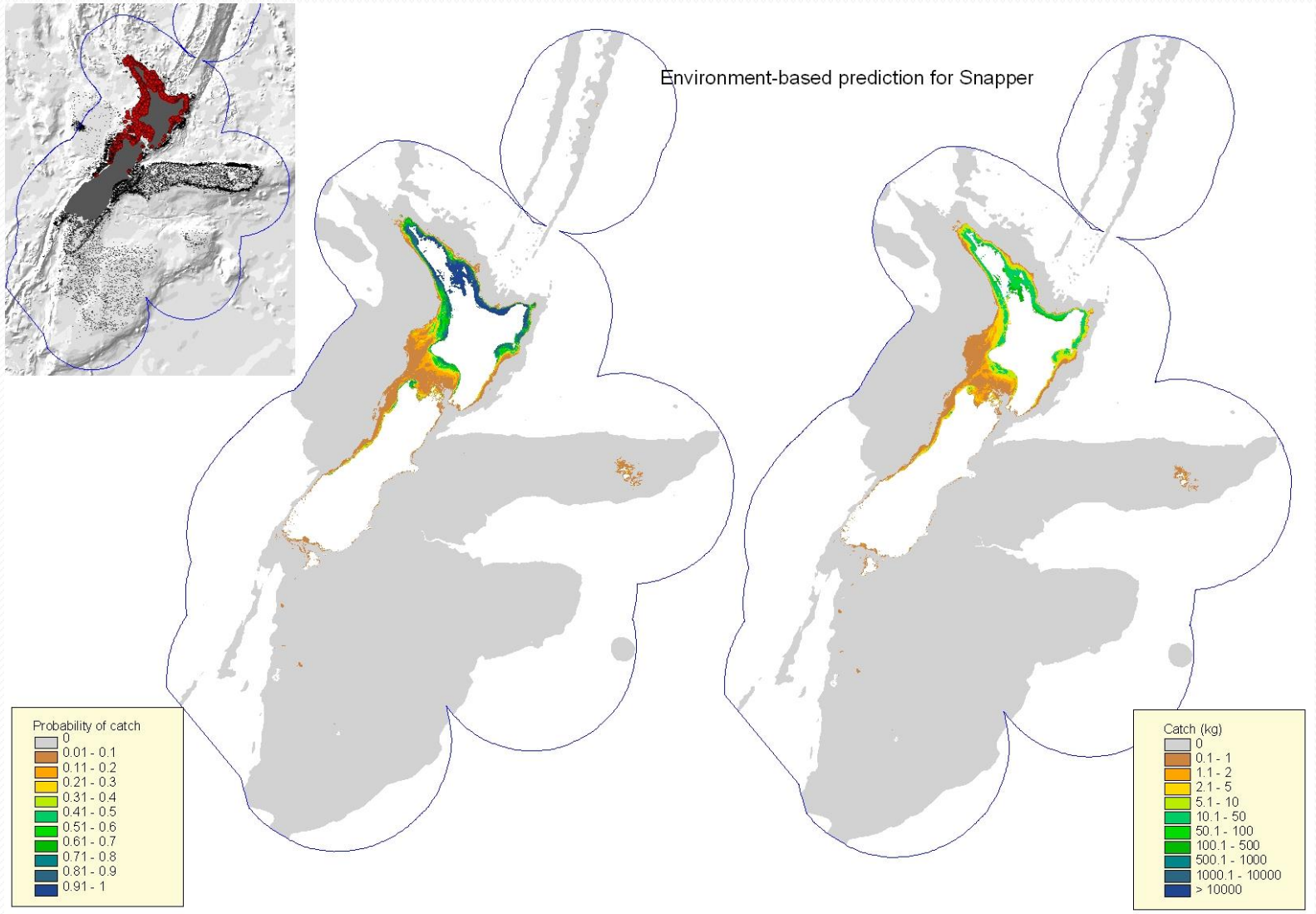


Habitat suitability modelling

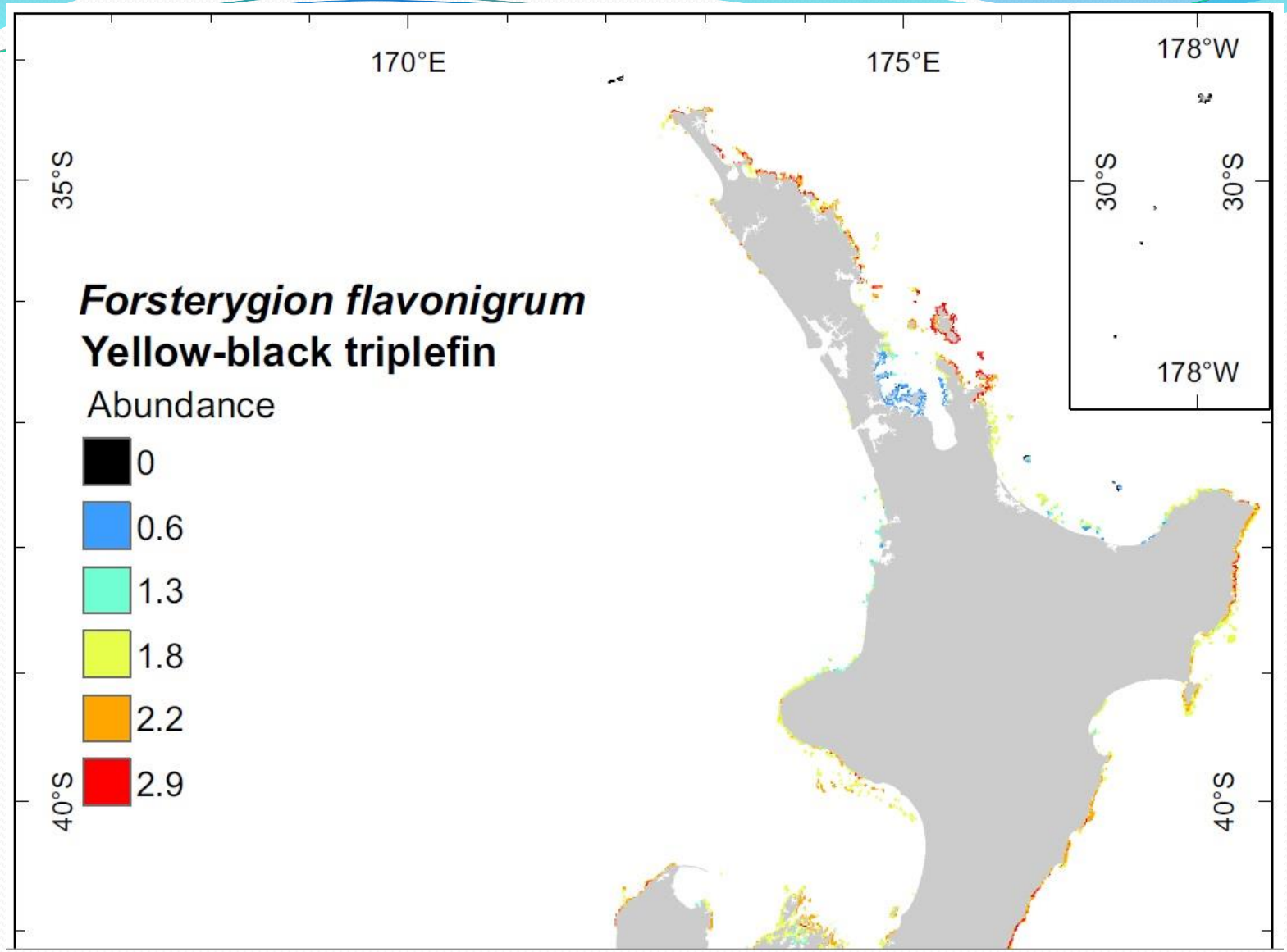
- Testing of the MEC showed it was not a good predictor of biological pattern, particularly near shore

- A demersal fish community classification based upon habitat suitability models (predicted distributions) of 122 species had much better predictive power





Habitat suitability model for snapper derived from trawl survey data



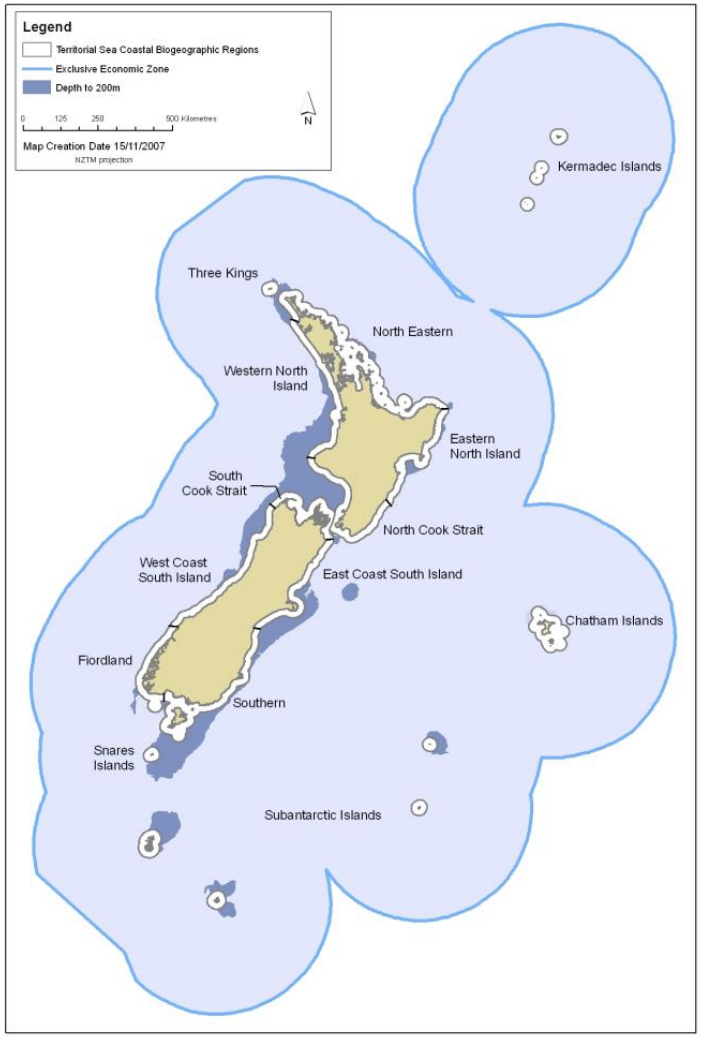
Habitat suitability model for a common rocky reef fish based upon diver observations

MPA Policy: Coastal Marine Classification

The Marine Protected Areas (MPA) Policy uses a combination of biogeographic and habitat classifications to provide a spatial framework for MPA planning.

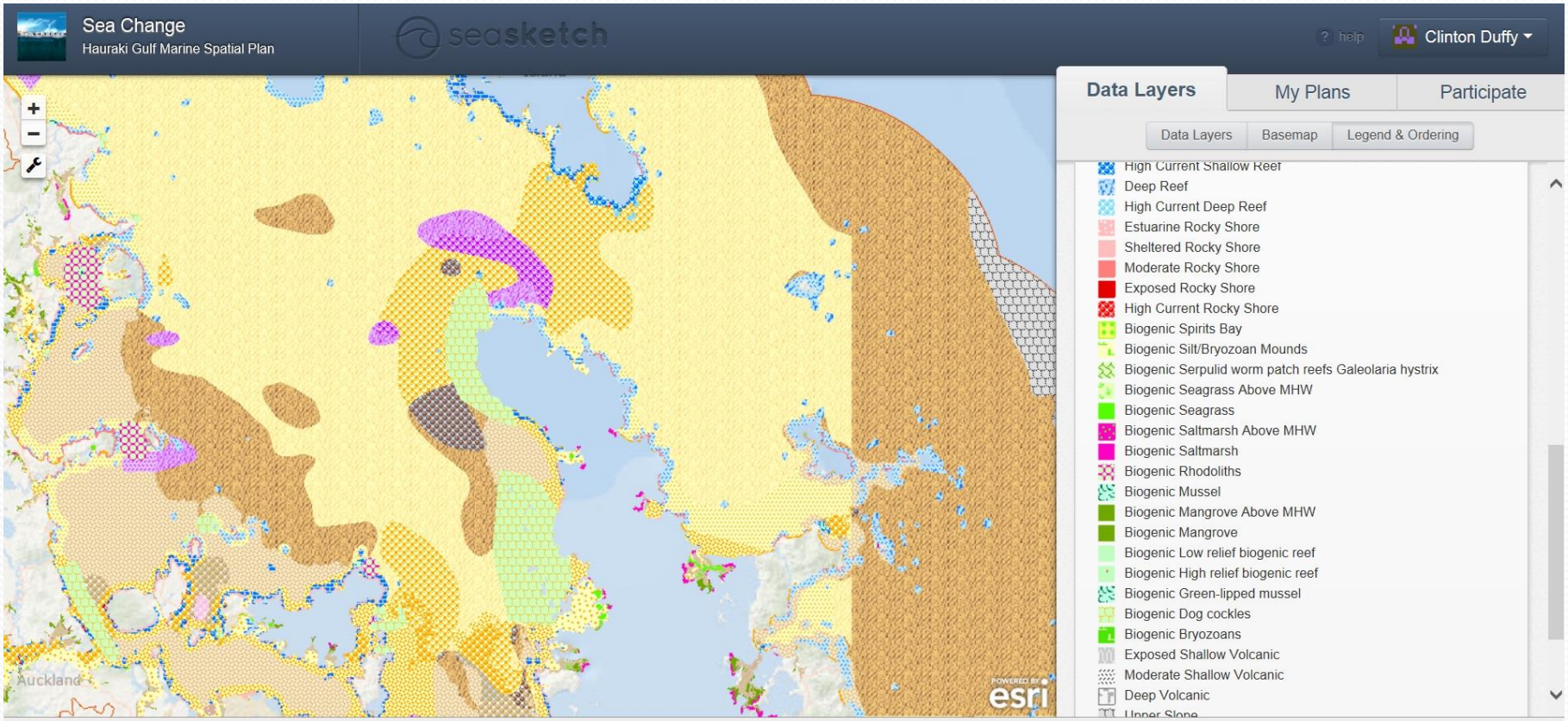
Near shore (Territorial Sea) classification:

- Biogeographic region
- Environment (estuarine versus marine)
- Depth
- Exposure
- Substrate type

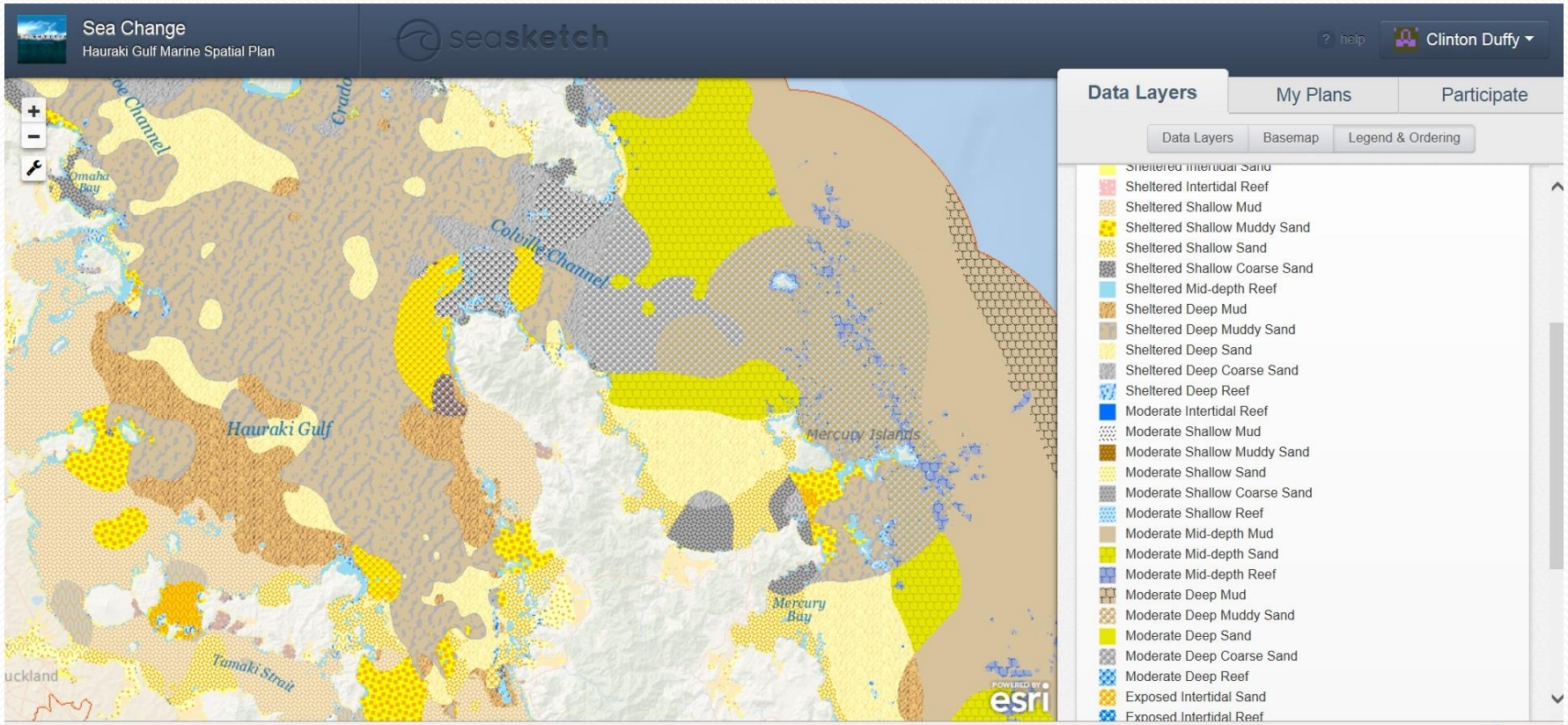


MPA Policy national inventory and gap analysis (2011)

this assessed gaps in MPA coverage against the near shore habitat classification



Hauraki Gulf inshore habitats interpreted using the MPA Policy habitat classification and the revised information on the distribution of rocky reefs and soft sediments developed for the Sea Change Project




The Beginning
Developing an understanding of the distribution of species and the habitats and processes that sustain them is the first step towards ecosystem-based management.