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Nau mai, welcome

Applications of the New Zealand Seafloor Community Classification

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1:30pm	**Webinar 2.0 | Applications of the New Zealand Seafloor Community Classification**
	Welcome Fabrice Stephenson
2:10pm	**Webinar 2.0 | Q&A and discussion**
	Ashley Rowden, Judi Hewitt, Shane Geange, Greig Funnell, Tom Brough, Fabrice Stephenson

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Webinar 2. Applications of the New Zealand Seafloor Community Classification (SCC)

Fabrice Stephenson (fabrice.stephenson@niwa.co.nz)

Ashley Rowden, Tom Brough, Grady Petersen, Richard Bulmer, John Leathwick, Andrew Lohrer, Joanne Ellis, David Bowden, Shane Geange, Greig Funnell, Debbie Freeman, Karen Tunley, Pierre Tellier , Dana Clark, Carolyn Lundquist, Barry Greenfield, Ian Tuck, Theophile L. Mouton, Kate Neill, Kevin Mackay, Matt Pinkerton, Owen Anderson, Richard Gorman, Sadie Mills, Stephanie Watson, Wendy Nelson, Judi Hewitt

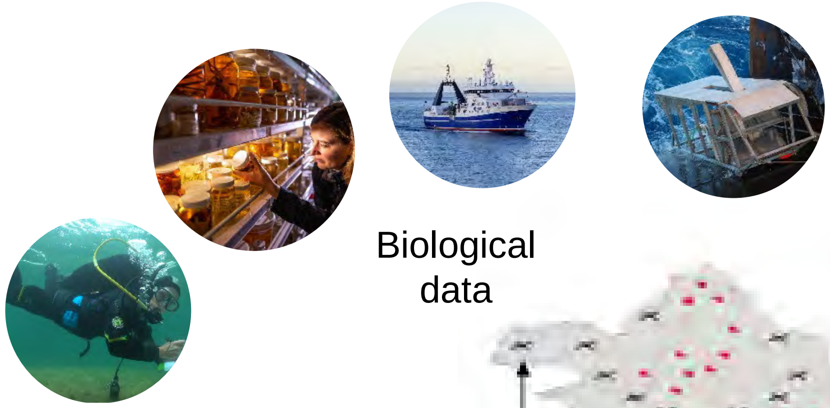
Talk overview

- Recap
- Considerations
- Applications of the New Zealand Seafloor Community Classification

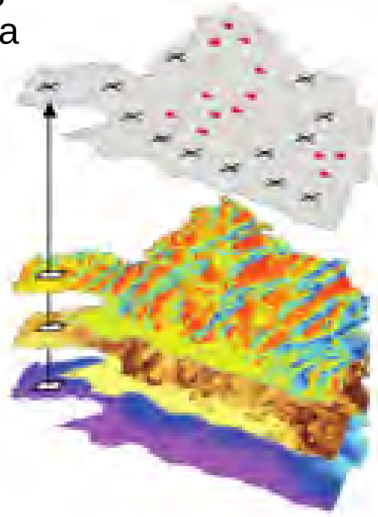
Talk overview

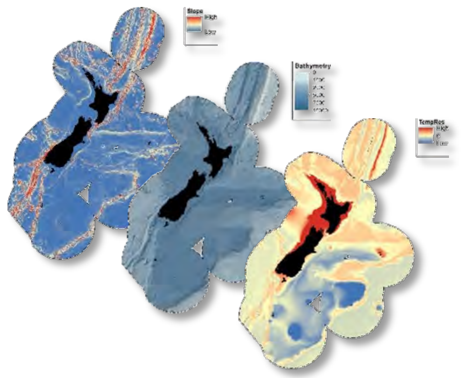
- Recap › How was the New Zealand SCC developed
- Considerations
- Applications of the New Zealand Seafloor Community Classification

How to create a Gradient Forest Model for all of NZ?



Biological data





Environmental data

Biological data

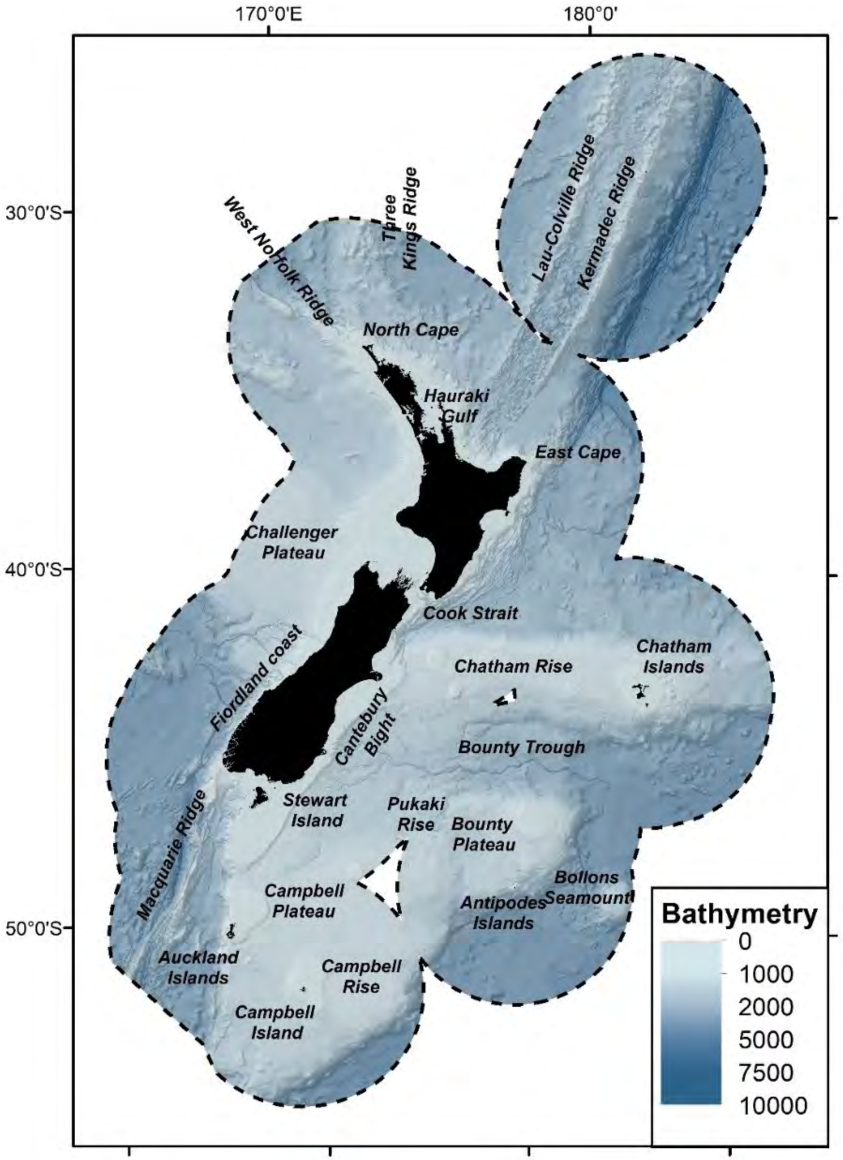
Biological data across 4 biotic groups

Reef Fish

Demersal Fish

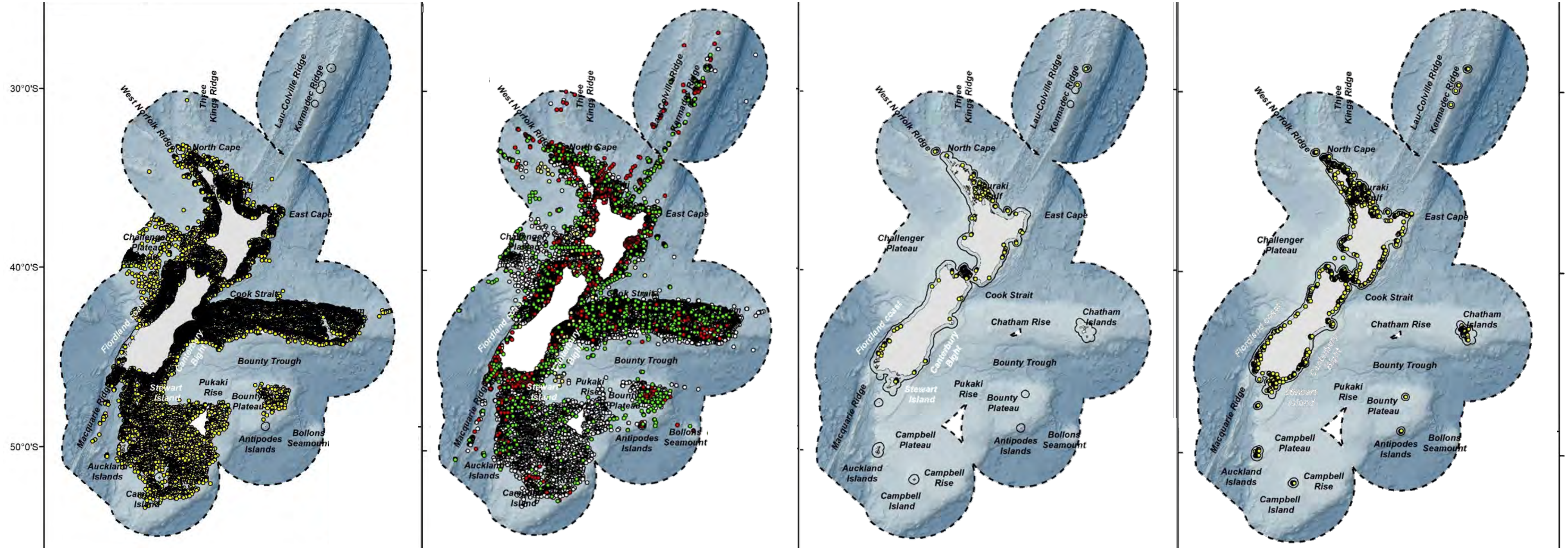
Subtidal benthic invertebrates

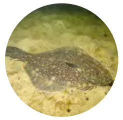
Macroalgae



NZ Exclusive Economic Zone

What does this look like?



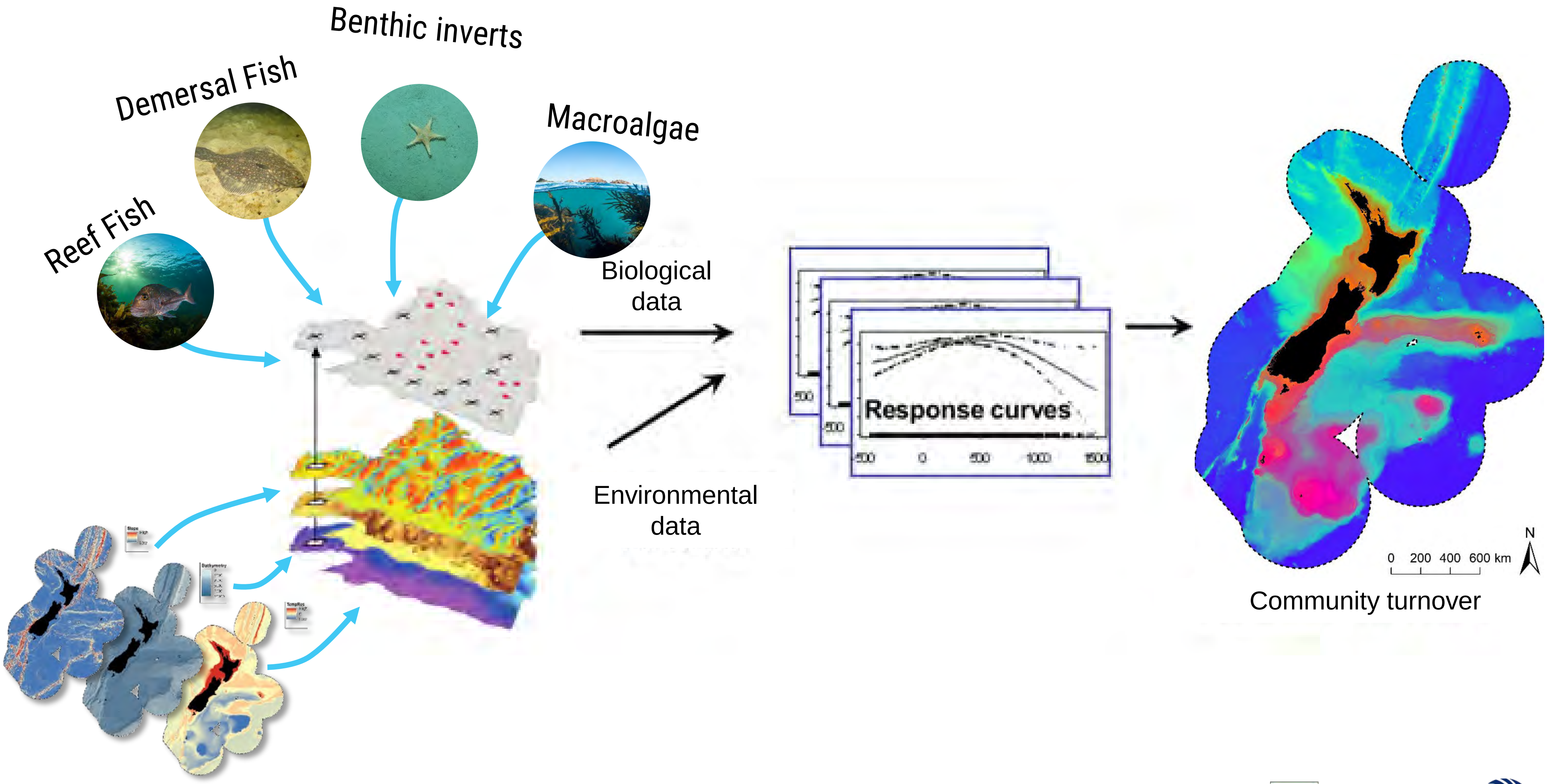


Demersal Fish
317 species
28,599 unique locations
n = 391,198

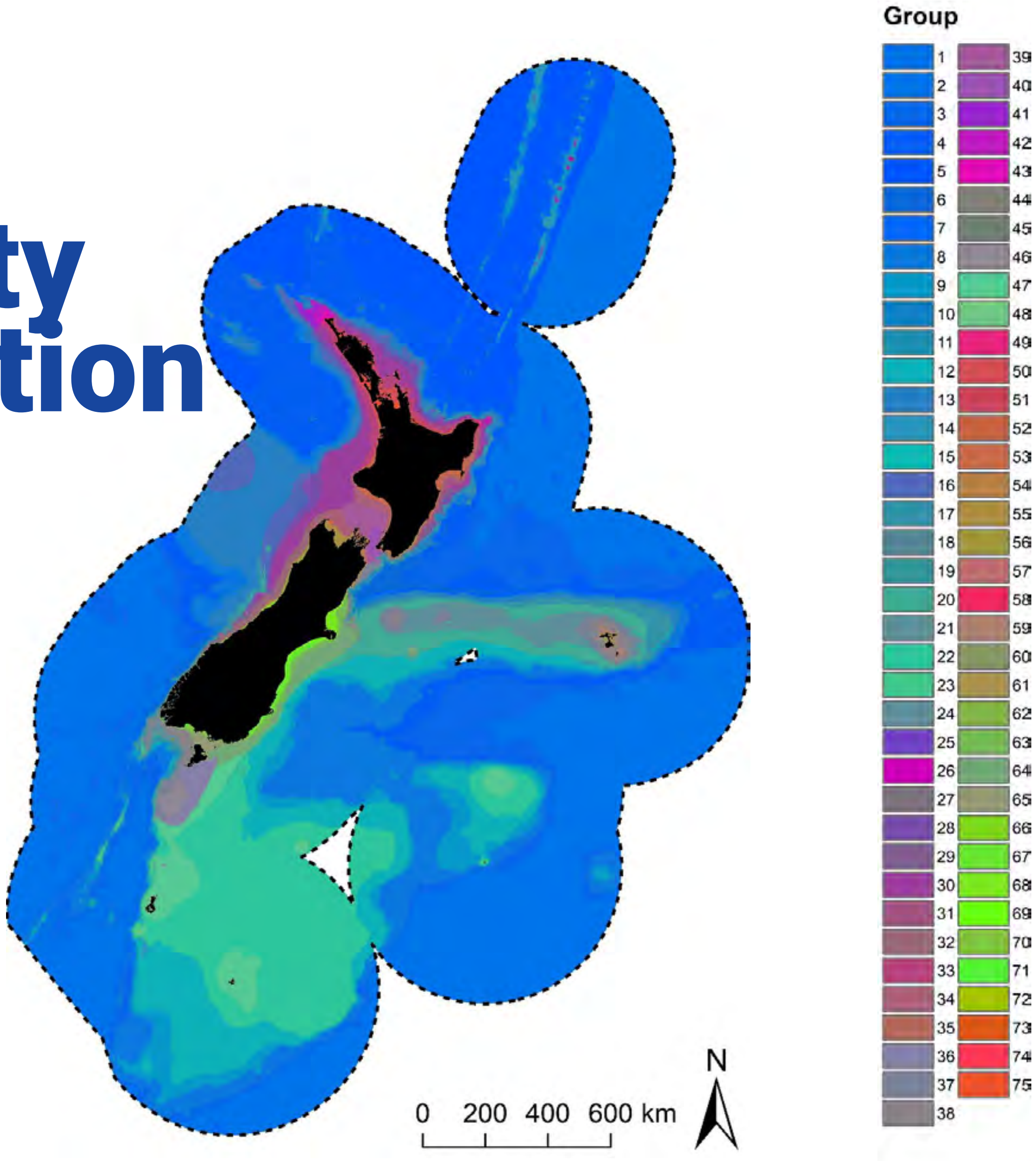
Benthic Inverts
958 genera
27, 247 unique locations
n = 127, 330

Reef Fish
92 species
339 unique locations
n = 467

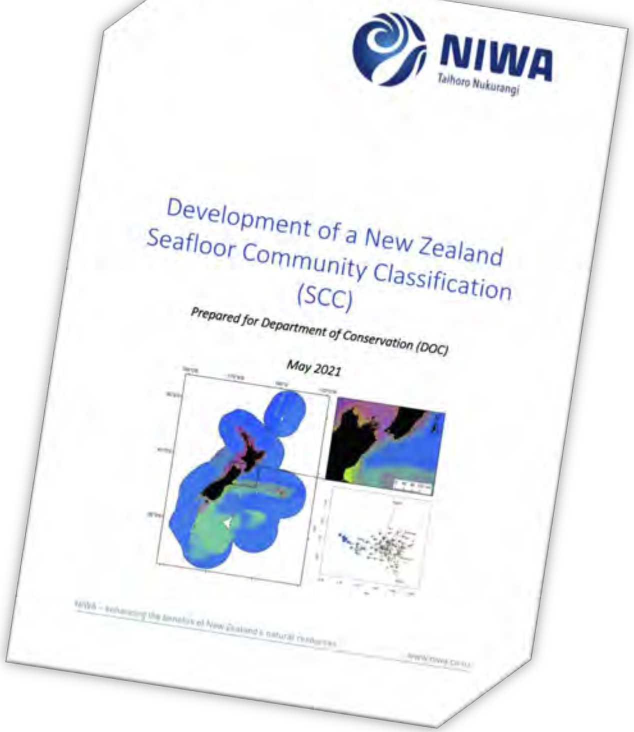
Macroalgae
339 species
3320 unique locations
n = 112,002


Benthic inverts
Demersal Fish
Macroalgae
Reef Fish
Biological data
Environmental data
Response curves
0 200 400 600 km
N
Community turnover

The NZ Seafloor Community Classification



READ MORE HERE



Climate, Freshwater & Ocean Science

All details available in our report:
Stephenson, F., Rowden, A., Brough, T., Leathwick, J., Bulmer, R., Clark, D., Lundquist, C., Greenfield, B., Bowden, D., Tuck, I., Neill, K., Mackay, K., Pinkerton, M., Anderson, O., Gorman, R., Mills, S., Watson, S., Nelson, W. and Hewitt, J. (2021). "**Development of a New Zealand Seafloor Community Classification (SCC)**". NIWA report prepared for Department of Conservation (DOC).

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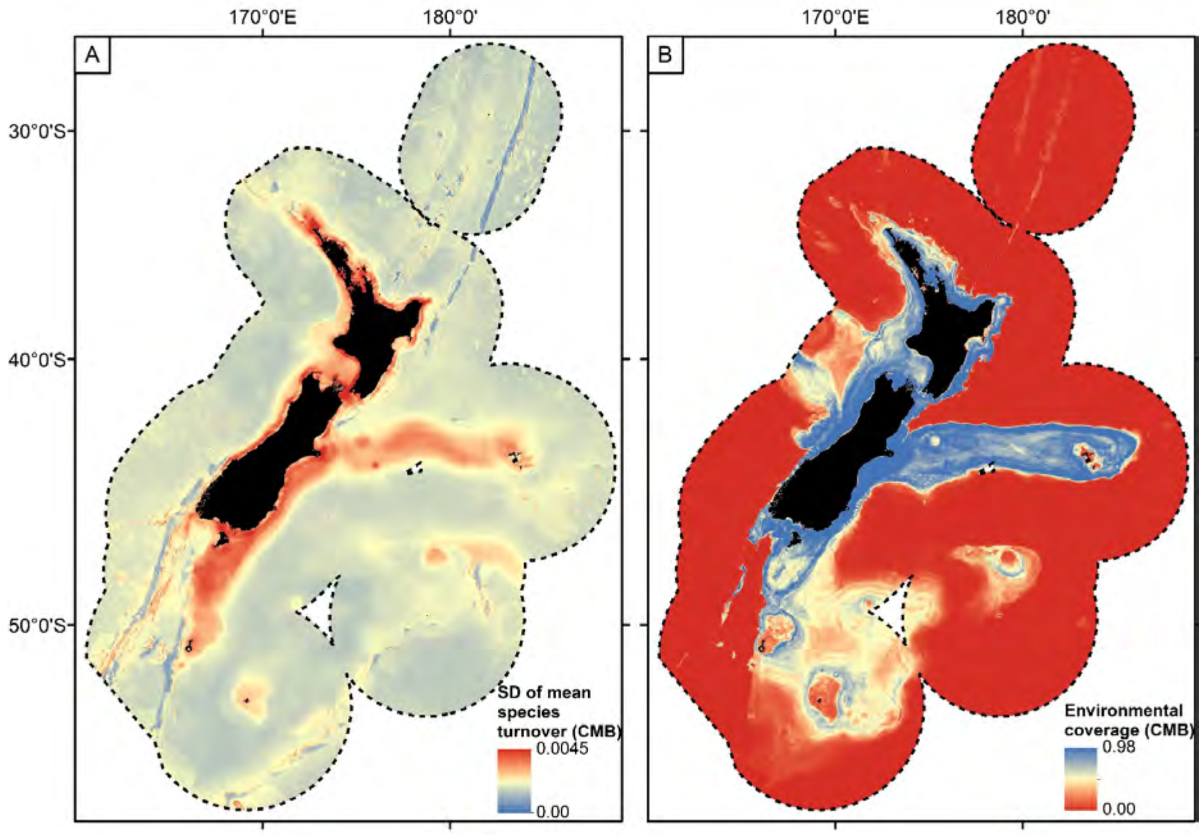
Uncertainty in species turnover

- Spatially explicit model uncertainty was estimated using two methods



A. How well we think the model works
B. How well we think we have sampled the NZ environment

Blue Confident — Red Less confident

Talk overview

- Recap › How was the New Zealand SCC developed
- Considerations
- Applications of the NZ SCC

Talk overview

- Recap › How was the New Zealand SCC developed
- Considerations › Caveats › Strengths and Weaknesses
- Applications of the NZ SCC

Caveats and assumptions

- Co-occurring species **considered** assemblages
- Assume **biodiversity is well represented** (approx. 1700 taxa across 4 biotic groups)
- **Data coverage appropriate**

  Environmental coverage → deep water not well covered
- Subtidal invertebrates → **genus** (ideally better to have species data)

Strengths and weaknesses: Weaknesses

- **No abundance** information

  When does presence of a sponge indicate a sponge garden?

- **Temporally** and spatially **smoothed**

  Mismatch between biological and environmental data, no seasonality explicitly incorporated

- **Only seafloor taxa**

  No pelagic taxa / water column

- **Data 'quality'** varied by biotic group

  Differences in sampling techniques

- Patchy knowledge of **seafloor types**
- Despite descriptions of biodiversity, **'Groups' are not intuitive**

Strengths and weaknesses: Strengths

- **Comprehensive** dataset collated

  Biological and environmental

- **Hi-resolution** (1km) spatial predictions across the EEZ

  250m in the Territorial Sea

- Estimates of **uncertainty** produced
- **Turnover** information (spatial estimates) retained
- **Different number of groups** can be used
- More manageable **description of biodiversity**

  Group description created & 75 groups easier than > 1700 species

Talk overview

- Recap › How was the New Zealand SCC developed
- Considerations › Caveats › Strengths and Weaknesses
- Applications of the NZ SCC

Talk overview

- Recap › How was the New Zealand SCC developed
- Considerations › Caveats › Strengths and Weaknesses
- Applications of the NZ SCC › Describing Biodiversity › Spatial planning › Future work

Describing Biodiversity

1. Environmental and biological summary

Example: Group 30

2. Group Description

Group 30 is a large widespread group (Figure 6.1) occurring on the continental shelf north of the Subtropical Front in warm, moderate productivity coastal waters (Table 6.5). This group is characterised by moderate oxygen concentrations and low dissolved silicate and nitrate concentrations at depth (Table 6.5). Benthic invertebrate assemblages are diverse and are characterised by high frequency occurrence of the squid Nototodarus, multiple coral species, and low frequency bivalve, brachiopod and gastropod occurrence (Table 6.6). Fish assemblages are diverse, with ~130 demersal fish taxa and ~50 reef fish taxa. Demersal fish assemblages are characterised by high frequency tarakihi, barracouta, jack mackerel and school sharks, and reef fish assemblages are characterised by very high frequency occurrence of nearly 20 taxa including perch, damselfish and morwong (Table 6.6). This group has a very high number of samples for benthic invertebrates and demersal fish and very low samples for macroalgae and reef fish (Table 6.6). Overall confidence in modelled relationships is moderate – high for this group (high confidence for 'combined' biotic group environmental coverage and moderate for model variability (SD), Table 6.7). Note, there is low sample number and low confidence associated with model variability of reef fish (Table 6.7).

3. Similar groups

Closely related to group 31; more loosely related to group 32.

4. Characterising environmental conditions

Table 6.5: Group 30 characterising environmental conditions

Environmental variable	Mean value	Qualitative description
Bathymetry	129 m	Shelf depth
Slope	0.34 °	Low slope
Bottom silicate	4.91 µmol l^{-1}	Low concentrations of silicate at depth
Dissolved oxygen at depth	5.21 µmol l^{-1}	Moderate concentrations of oxygen at depth
Temperature at depth	14.15 °C km^{-1}	High bottom water temperature
Downward vertical flux of particulate organic matter at the seabed	41.22 mgC m^{-2} d^{-1}	Moderate productivity
Turbidity	0.002 m-1	Low turbidity

5. Characterising Species

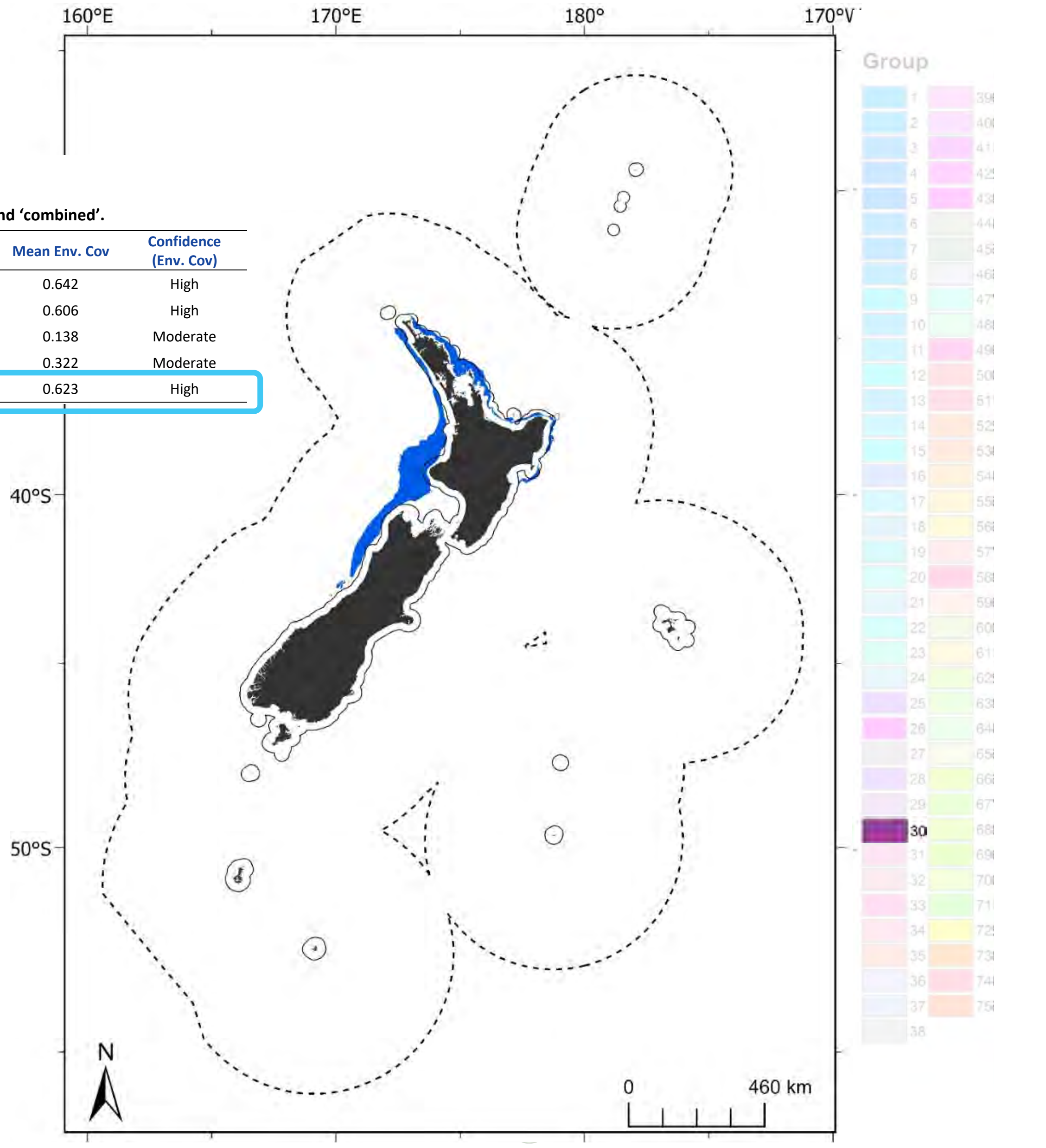
Table 6.6: Species name, mean frequency occurrence and % contribution to group 30 similarity for those species contributing to a total of 70% of the group similarity or > 4 % to the group similarity. Groups with no species present or where data was insufficient to run analyses are reported as na.

Taxa type	Sampling gear	n samples	Unique taxa	Scientific name	Common name/broad descriptor	Mean frequency occurrence	% contribution to similarity
Benthic invertebrates	LLG.LMG	1271	154	*Nototodarus*	Squid	0.92	99.06
	MMG	65	191	*Lyreidus*	Crab	0.4	15.8
				Heteromolpadia	Sea cucumber	0.31	10.71
				Ophiozonoida	Brittle star	0.31	10
				Monomyces	Coral	0.32	7.15
				Peronella	Sea cucumber	0.26	5.21
	SMG	70	154	*Monomyces*	Coral	0.13	11.8
				Saccella	Bivalve	0.11	10.51
				Caryophyllia	Coral	0.1	7.98

6. Uncertainty ranges

Table 6.73: Mean uncertainty values for group 30 by biotic group and 'combined'.

Taxa	Mean SD	Confidence (SD)	Mean Env. Cov	Confidence (Env. Cov)
Benthic invertebrates	0.002	Moderate	0.642	High
Demersal fish	0.003	Moderate	0.606	High
Macroalgae	0.002	Moderate	0.138	Moderate
Reef fish	0.004	Low	0.322	Moderate
Combined	0.003	Moderate	0.623	High



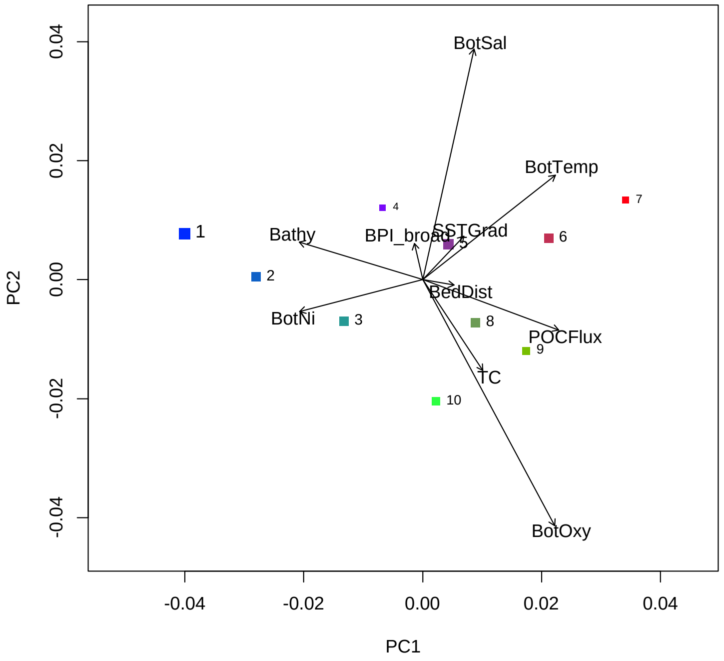
Describing Biodiversity

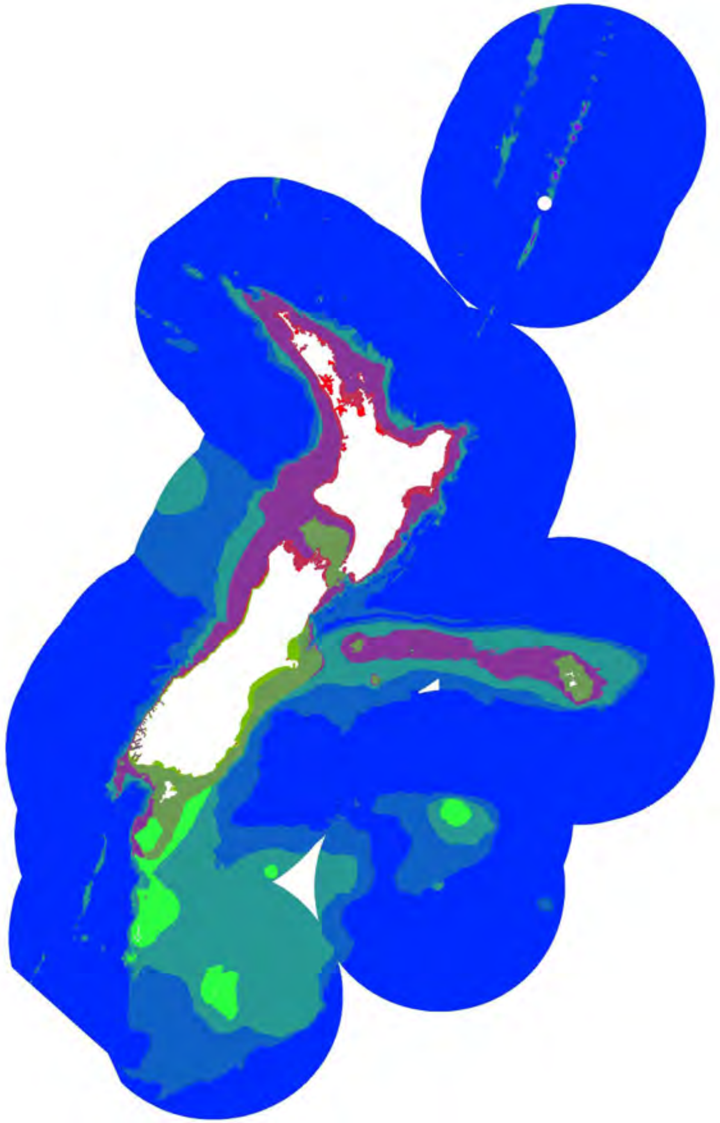
1. Environmental and biological summary

2. Spatial estimate of biodiversity

Describing Biodiversity

Define ecologically meaningful bioregions

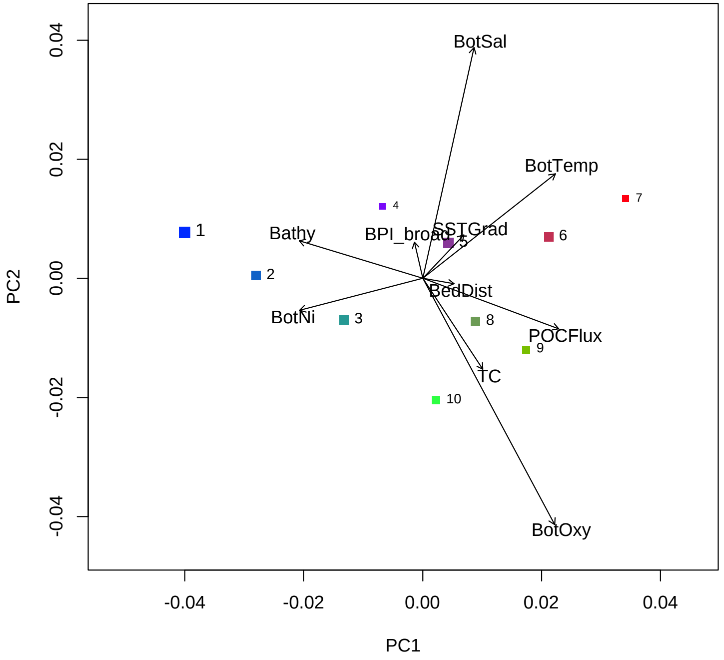


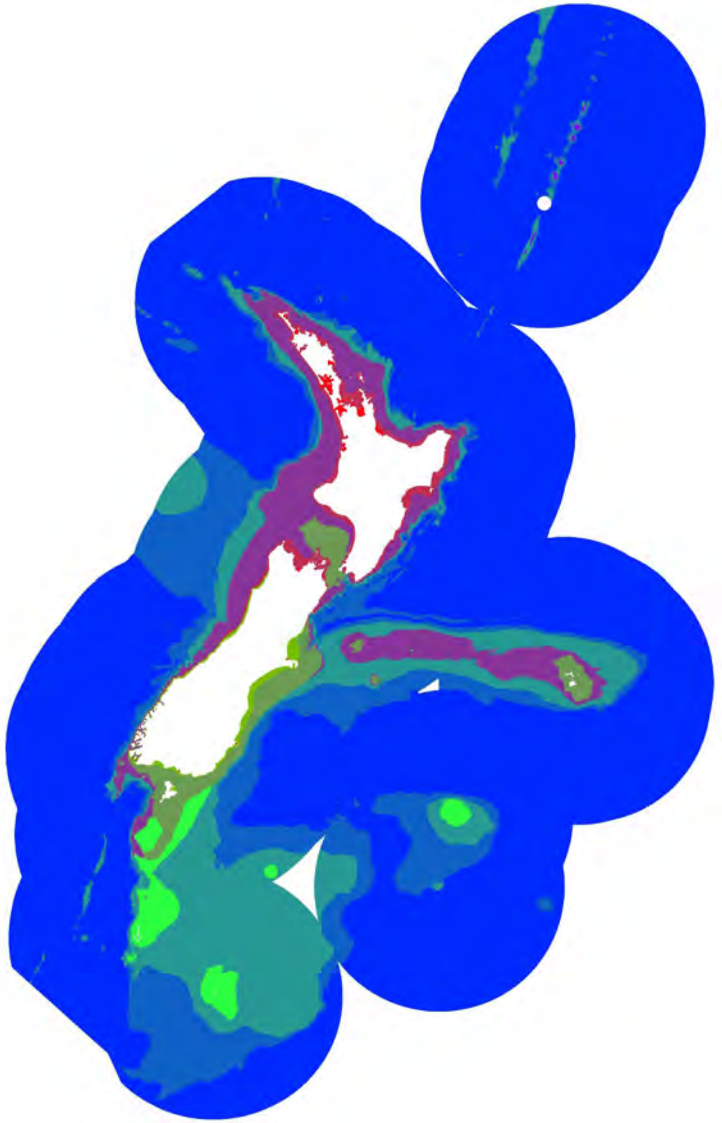


Describing Biodiversity

Define ecologically meaningful bioregions

Hierarchical classification





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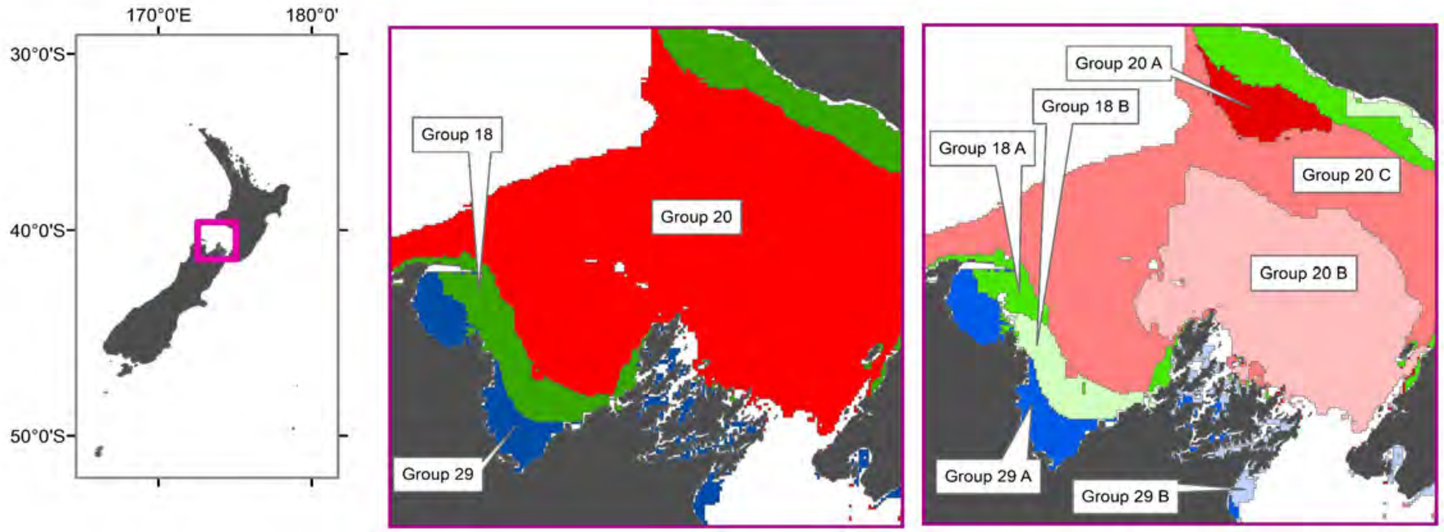
Describing Biodiversity

Define ecologically meaningful bioregions

Hierarchical classification



Describing Biodiversity

1. Environmental and biological summary
2. Spatial estimate of biodiversity
3. Informing identification of

   Key Ecological Areas → reports by

   Stephenson et al., 2018 and Lundquist et al., 2020

Describing Biodiversity

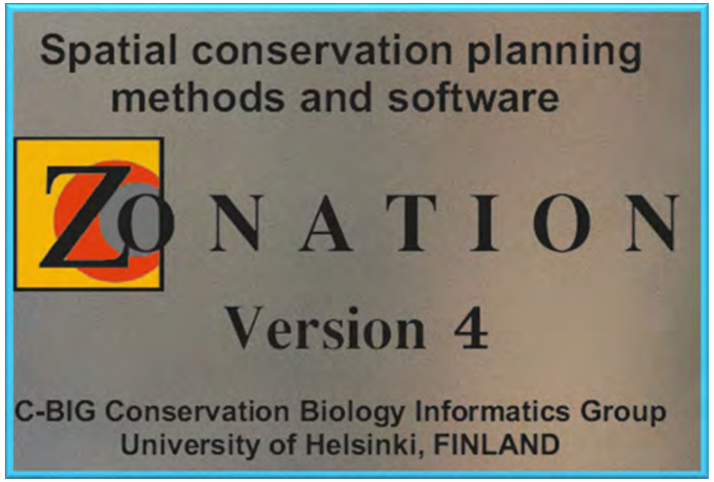
- Environmental and biological summary
- Broad spatial estimate of biodiversity
- Informing identification of Key Ecological Areas (2 of 9)

Uniqueness, rarity, endemism

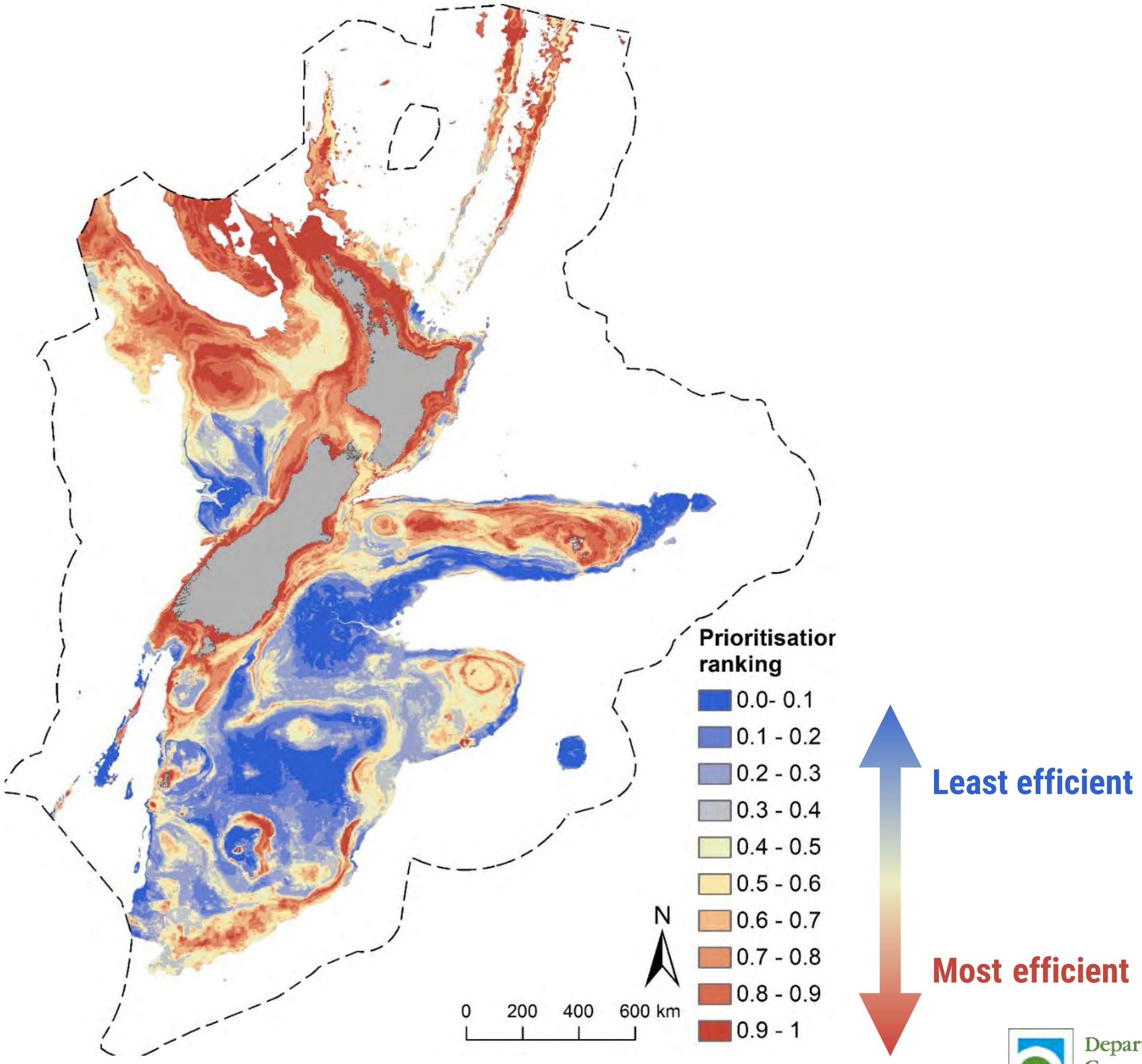
Biological diversity

Spatial planning

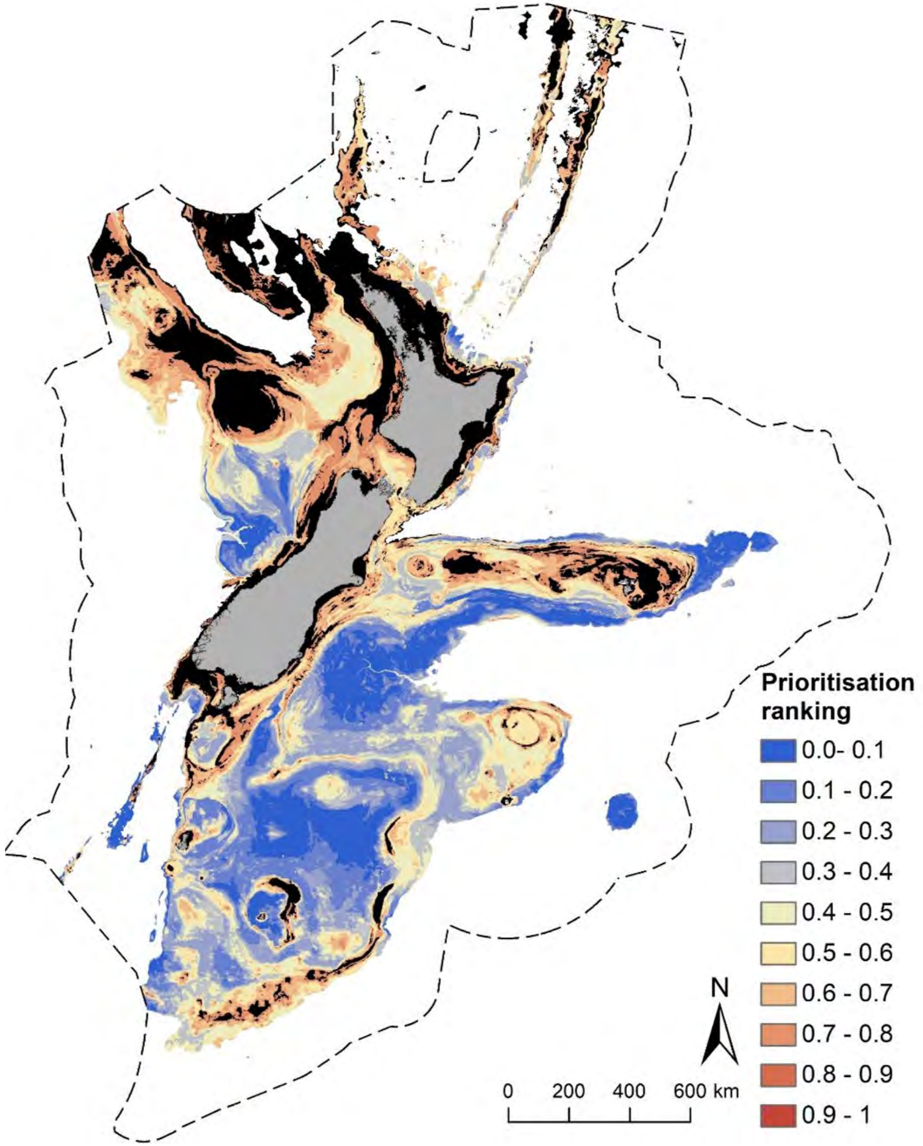
- Next section covers Gradient Forest classifications but **not necessarily NZ SCC** → still active research
- Guide decisions in a **systematic, transparent, repeatable** way
- Conservation planning: combine spatial layers → Aim to find **smallest area** that provides **maximum value** (species representation)



Spatial planning



Spatial planning



Least efficient

Most efficient

The 20% top areas

Spatial planning

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Ocean and Coastal Management
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ELSEVIER

Species composition and turnover models provide robust approximations of biodiversity in marine conservation planning

Fabrice Stephenson[a,*], John R. Leathwick[b], Shane Geange[c], Atte Moilanen[d,e], C. Roland Pitcher[f], Carolyn J. Lundquist[a,g]

- **Recent research**

Aim

Compare the effectiveness of a conservation planning analysis using a Gradient-Forest classification of demersal fish vs “more traditional” estimates of individual species’ distributions

Spatial planning

- How can we use the New Zealand SCC in Zonation?
- Ecological theory → different components of biodiversity:

Alpha α → species richness


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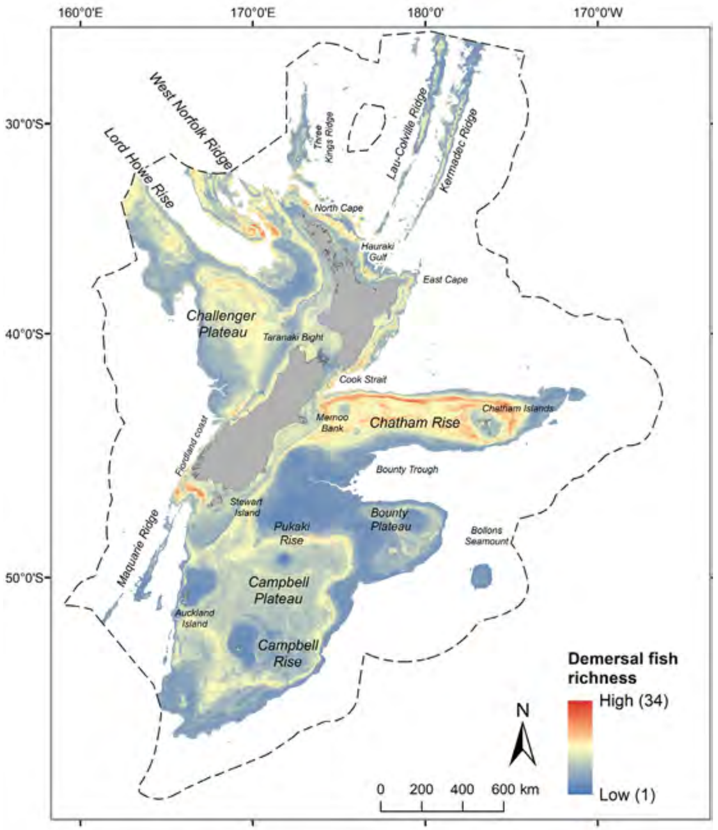

Spatial planning

- How can we use the New Zealand SCC in Zonation?
- Ecological theory → different components of biodiversity:

Alpha α → species richness

Beta β → within group similarity
→ between group similarity


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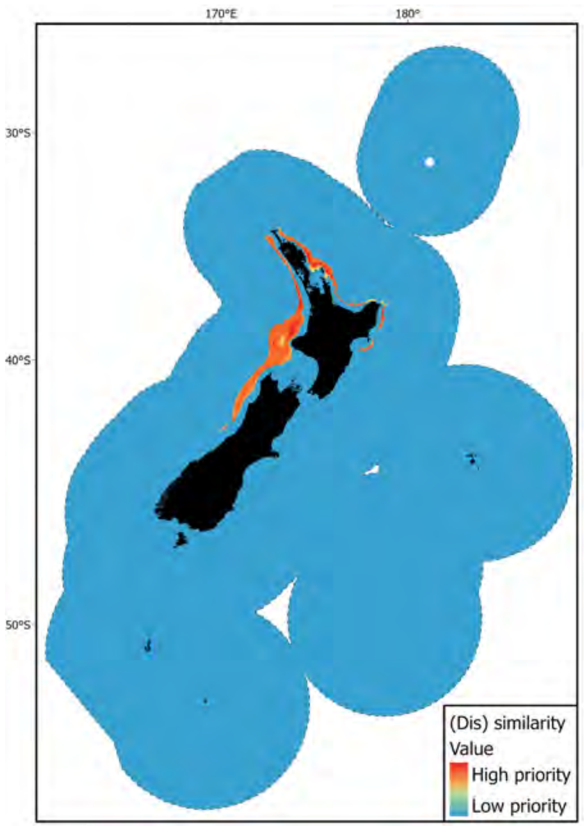

Spatial planning

- How can we use the New Zealand SCC in Zonation?
- Ecological theory → different components of biodiversity:

Alpha α → species richness

Beta β → within group similarity
→ between group similarity

Gamma γ → bioregionalization


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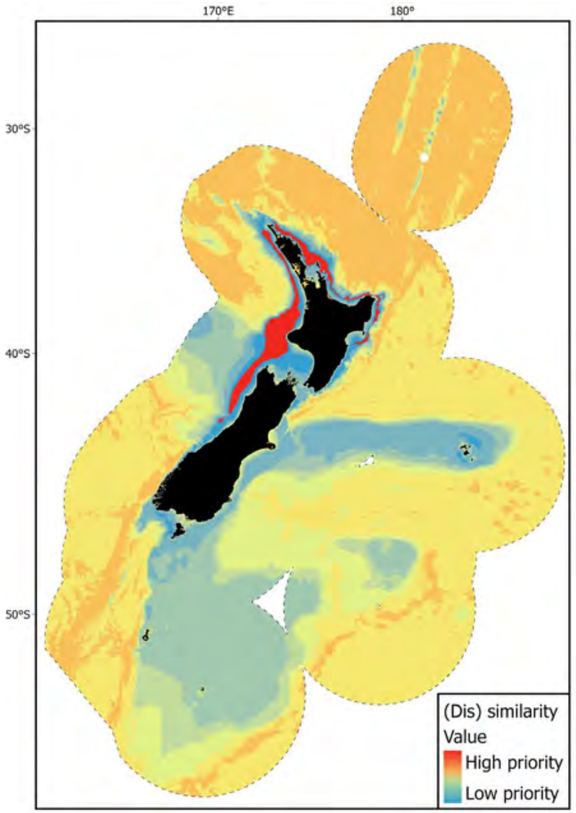

Spatial planning

DEMERSAL FISH EXAMPLE


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- Slightly lower efficiency compared to individual species' distributions **BUT**

- Marine environment: often data poor
  - **~27,000 samples** → GF model (representing 253 species) and 217 individual species models
  - **5,000 samples** → GF model (representing 249 species) but only 145 individual species models

- Much easier to communicate with **stakeholders** and **managers**
  - Reduction of data layers – (253 species → 30)
  - New Zealand SCC: ~ 1700 species → **75**

Spatial planning

- 'Simple' spatial planning examples

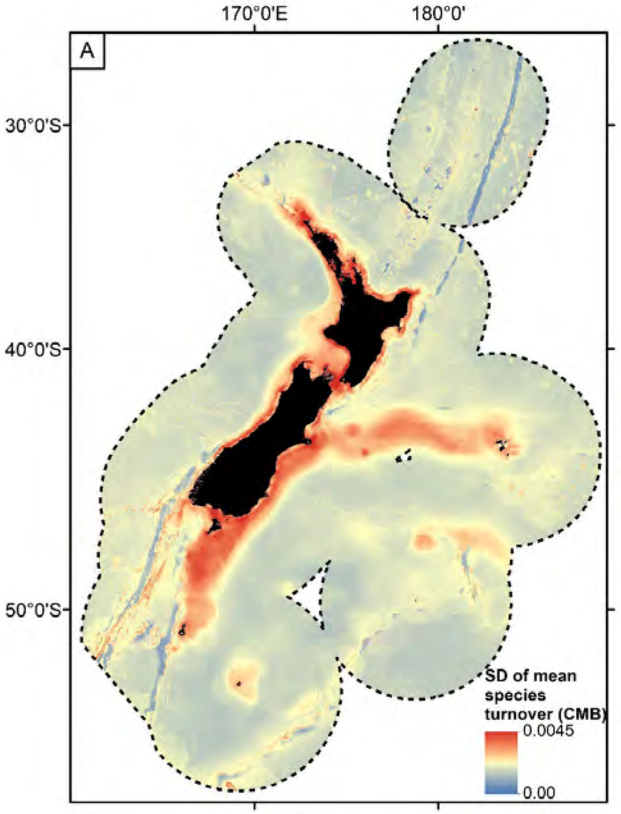
- Other information that should be considered
  - Accounting for uncertainty
  - 'Naturalness' → i.e. impacts / changes
  - Complementary biodiversity information
    (biogenic habitats, protected species / species of value, pelagic species)
  - "Guidance for the use of decision-support tools for identifying optimal areas for biodiversity conservation" (Lundquist et al., 2021)

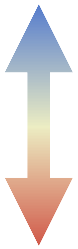
- Other values / priorities (e.g., cultural values, fishing, tourism, shipping, aquaculture).

Future directions of research

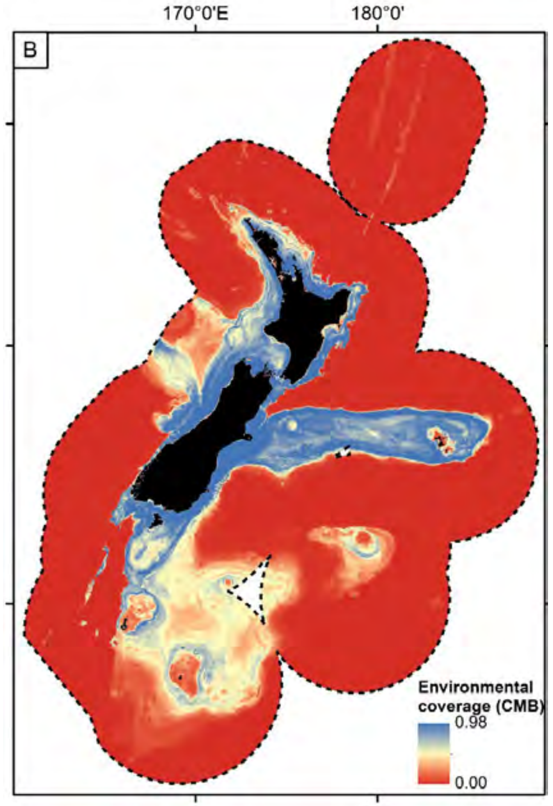
How do we use the estimates of uncertainty?

How well we think the model works





How well we think we have sampled the NZ environment



Spatial planning

- Explored for individual species' distributions (Sustainable Seas phase II project 3.2)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COASTAL AND MARINE ECOLOGY

Cetacean conservation planning in a global diversity hotspot: dealing with uncertainty and data deficiencies

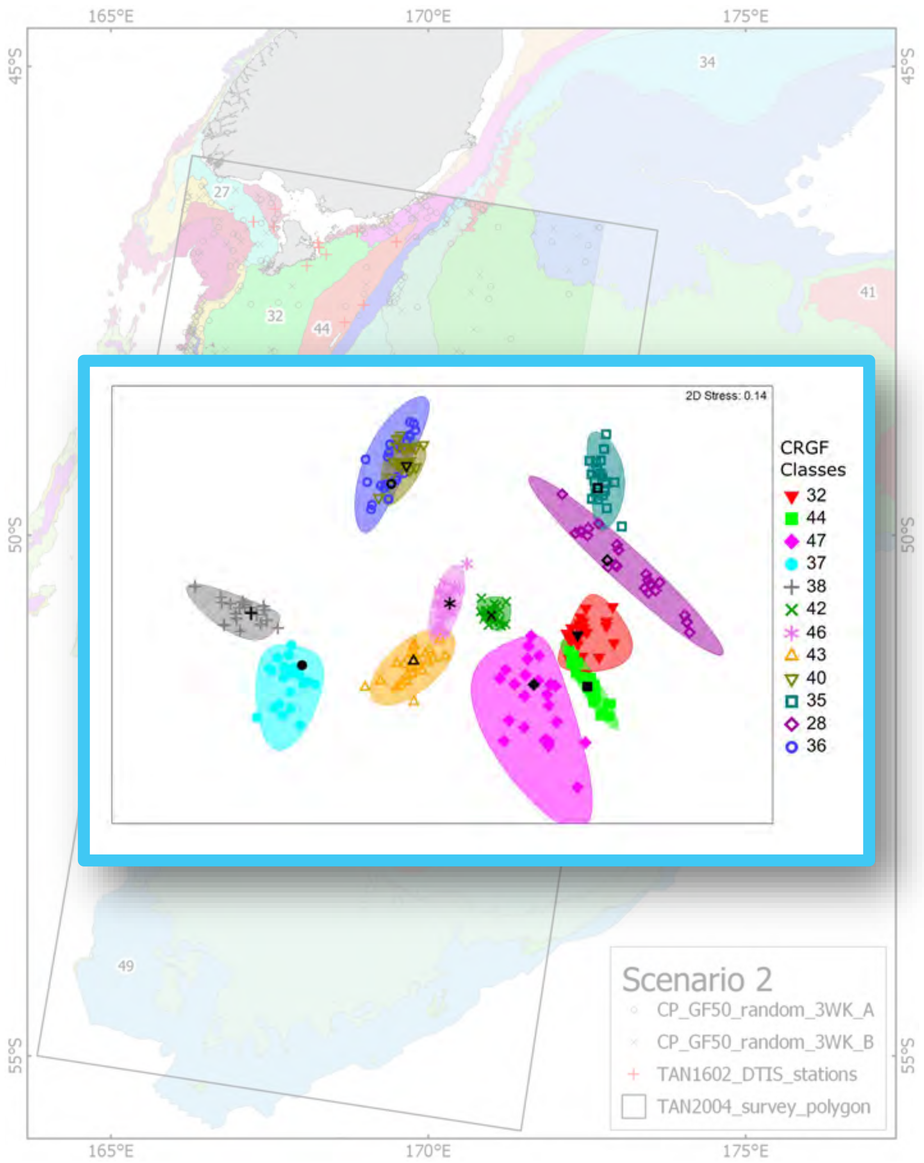
Fabrice Stephenson,[1,†] Judi E. Hewitt,[1,2] Leigh G. Torres,[3] Théophile L. Mouton,[4] Tom Brough,[1] Kimberly T. Goetz,[5,6] Carolyn J. Lundquist,[1,7] Alison B. MacDiarmid,[6] Joanne Ellis,[8] and Rochelle Constantine[7,9]

- Not yet explored for classifications but concepts transferable

Future directions of research

- Does the New Zealand SCC represent less common species
    - Validation of the classification with independent data planned

- Do predictions work for places where we don't have data?
  E.g. Bowden et al., (AEBR in press)
  Stephenson et al. (AEBR in press)



Future directions of research

- Does the NZ SCC represent less common species (i.e. for which we can't do an individual prediction)?
  - Validation of the classification with independent data planned
- Do predictions work for places where we don't have data? E.g., Bowden et al., (AEBR in press) & Stephenson et al. (AEBR in press)
- Further integration of "habitat types" / descriptions
  - Where are the coral gardens? Or the kelp forests?
- Different number of groups and application to different scales

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Ngā mihi – panel discussion

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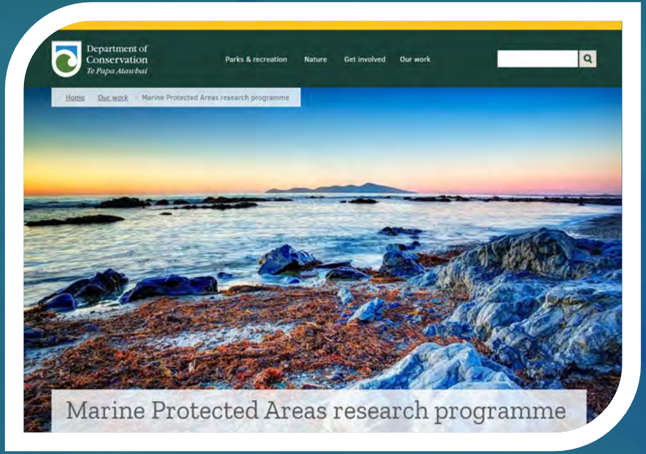

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