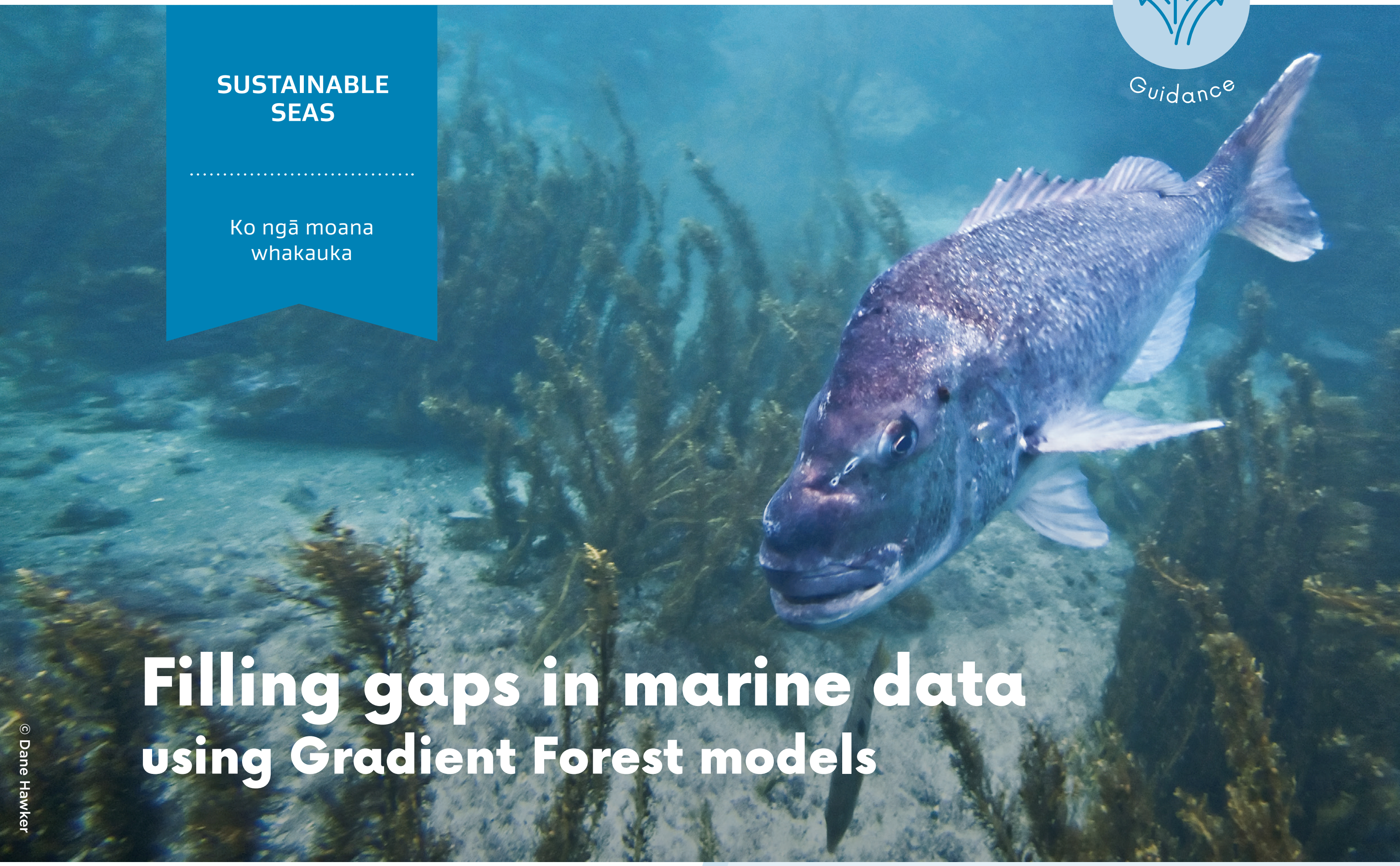
National Science Challenges



SUSTAINABLE SEAS

Ko ngā moana whakauka

Guidance

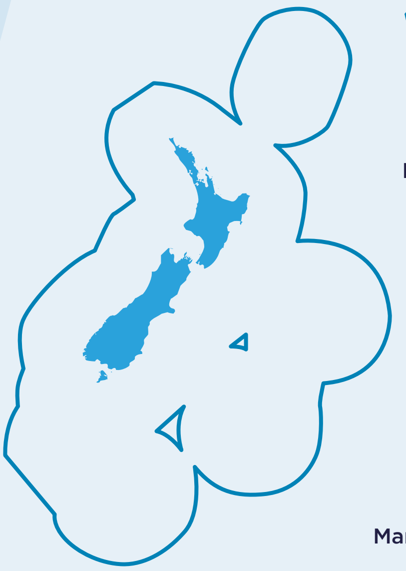
Filling gaps in marine data
using Gradient Forest models

Aotearoa New Zealand's waters cover a vast area, most of which is deep sea.

While many coastal areas and some offshore areas like the Chatham Rise have been well characterised, large parts of the EEZ remain unsampled as marine surveys in deep, offshore habitats are logistically difficult and expensive.

The lack of comprehensive information about what species are where, and in what numbers, makes it difficult to:

- Understand the distribution of most species, particularly rare species or those found only in a few locations
- Identify biodiversity 'hotspots'
- Make robust management decisions about resource use and conservation



4.1m km²
Total marine area

600
Marine species/genera that we have distribution models of

21,000
Marine species we know about but do not have models for

43,000
Marine species estimated yet to be discovered

Predicting marine biodiversity across Aotearoa New Zealand's

We used a Gradient Forest model to accurately model how 253 species of bottom-feeding (demersal) fish species were grouped together over a range of environments within the New Zealand Continental Shelf Zone to depths of 2,000 m.

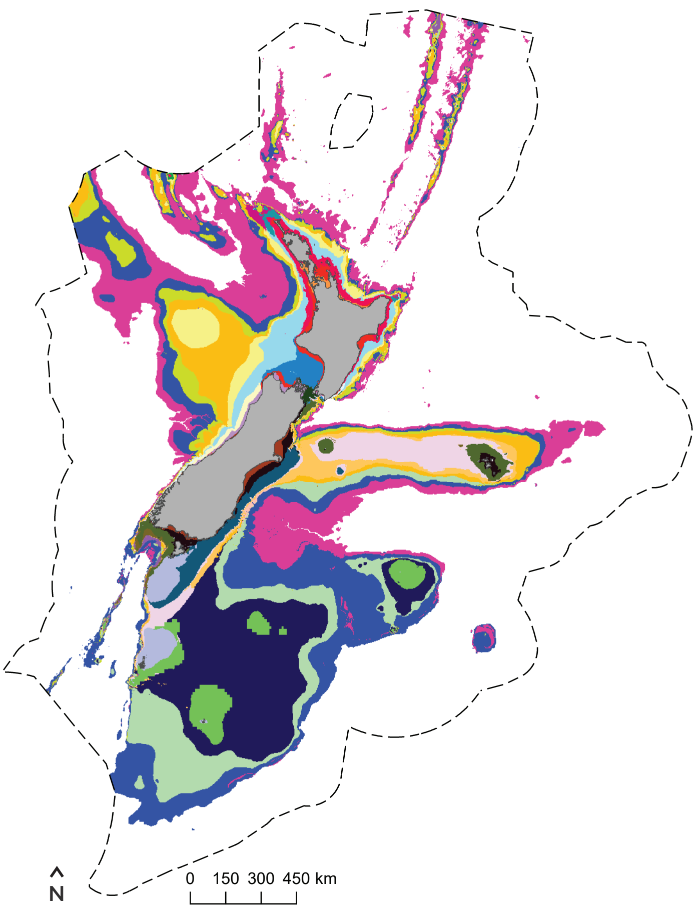
The model pooled a large number of existing data sets, combining environmental information with demersal fish occurrence records (data of where a species has/has not been found). It then grouped fish species according to the oceanographic and environmental conditions in which they live – ie species that tend to be found in the same habitats (eg cold, deep water) at the same time.

We used these groups, or 'community assemblages', as a proxy to estimate patterns of species diversity in inaccessible areas – using information from common species to 'fill the gaps' where data was limited for less common species.

We validated the model with independent data, which showed it was very robust at predicting patterns of species composition (species that make up the community assemblage) and turnover (the change in species composition over space).

We, jointly with a NIWA project, then used our 30 demersal fish community assemblages to determine optimal locations for biodiversity conservation, and to explore trade-offs between resource use and biodiversity conservation.

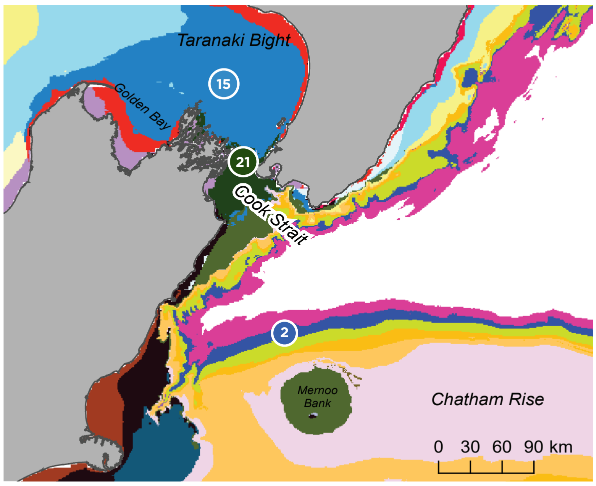
Figure 1. Each number represents a community assemblage of demersal fish that thrive in similar oceanographic and environmental conditions



Classification Groupings

1	5	6	14	16	30	24	19	23	26
2	4	13	22	18	29	21	28	11	7
3	8	15	17	20	10	27	25	12	9

Figure 2. Cook Strait close up



Group 15

Environment: intermediate-to-shallow depths, high salinity and tidal currents, found north of the subtropical front

Key species: ling, javelinfish, lookdown dory, gemfish, silver roughy, deepsea flathead, leatherjacket

Group 2

Environment: very deep cold waters, low oxygen, species are widespread

Key species: orange roughy, Johnson's cod, Baxter's dogfish, four-rayed rattail, basketwork eel, smooth oreo

Group 21

Environment: intermediate-to-shallow depths, moderate oxygen, moderate-to-high currents, mostly found north of subtropical fronts

Key species: John Dory, barracouta, spiny dogfish, school shark, yellowtail jack mackerel

vast marine area

Summary of the research

207,000 records of occurrence from **27,400** locations, showing presence/absence of **253** demersal fish species from research trawl surveys in the waters surrounding New Zealand

Detailed environmental data eg tidal current speeds, temperature gradients, salinity, seafloor roughness, sediment type

↓

30 community assemblages with clear differences in environmental characteristics

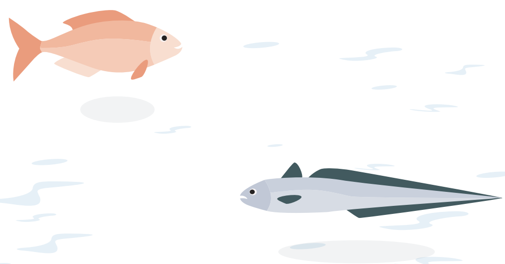
↓ USED TO

Determine biodiversity hot spots, and optimal locations for biodiversity conservation

Explore trade-offs between resource use and biodiversity conservation

This approach is particularly useful as it:

- Requires less data to run than considering 100s of species individually
- Provides 30 assemblages or ‘communities’ for decision makers to consider, which is:
  - » Easier than an individual assessment for each of the 253 species
  - » More holistic as these species interact and affect one another
- Predicts assemblages that serve as proxies for rare species that cannot be modelled as they are poorly represented in available data

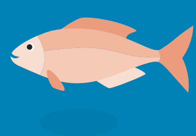


Marine spatial planning

Gradient Forest models could be used to support marine spatial planning.

Contact

To find out more about how Gradient Forest models could support your initiatives, contact **Fabrice Stephenson** (fabrice.stephenson@niwa.co.nz) or **Carolyn Lundquist** (carolyn.lundquist@niwa.co.nz)



Academic publications

- Stephenson F, Leathwick J, Francis M and Lundquist C (2020). A New Zealand demersal fish classification using Gradient Forest models. *New Zealand Journal of Marine and Freshwater Research* 54(1): 60–85
- Stephenson F, Leathwick JR, Geange SW, Bulmer RH, Hewitt JE, Anderson OF, Rowden AA and Lundquist CJ (2018). Using Gradient Forests to summarize patterns in species turnover across large spatial scales and inform conservation planning. *Diversity and Distributions* 24:1641–1656

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November 2020

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