Marine Biodiversity Framework

Expert evaluation of Biological Diversity maps

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Contents

Tables

Figures

Executive summary

In Aotearoa New Zealand, officials from the Department of Conservation (DOC), Ministry for Primary Industries (MPI) and the Ministry of the Environment (MfE) have developed a work plan to take a multi-agency approach to ensure the long-term health and resilience of coastal and marine ecosystems. This plan included the development of a shared agency view of national priorities for marine biodiversity. A key priority is a consistent approach to identifying areas of importance for biodiversity. Such areas are regularly integrated into decision-making and management across a range of marine policy, including planning for marine protected areas, aquaculture, and renewable energy. Agencies have agreed to implement the Key Ecological Areas (KEA) framework developed by the Marine Protected Areas Science Advisory Group to build a standardised mapping methodology for each criterion. The KEA framework describes nine criteria that can be used to identify areas of high conservation value. In early 2023, the National Institute of Water and Atmospheric Research Ltd. (NIWA) developed a framework to map criterion 6, Biological Diversity. A KEA under the Biological Diversity criterion is an area that "contains comparatively higher diversity of ecosystems, habitats, communities or species, or has higher genetic diversity".

Habitat suitability models for macroalgae, seafloor invertebrates, cetaceans, and demersal fish and distribution maps for seabirds, were used to generate maps of biodiversity for different groups based on taxonomy, life-history traits, or morphology (for example, for macroalgae two groups were developed, one for canopy-forming macroalgae and another for all other macroalgae). Following this recent work, the inter-agency working group (comprised of officials from the Department of Conservation (DOC), Ministry for Primary Industries (MPI) and the Ministry of the Environment (MfE) is seeking expert guidance on the usefulness of the maps produced for informing spatial planning. Subsequently, this project seeks to assess the accuracy of the maps from a panel of experts with knowledge of ecology and distribution of biodiversity relevant to each mapped biological group. Using a Delphi approach experts were asked to: 1) assess their knowledge of the distribution of biodiversity for mapped groups; 2) assess the representation of taxa in each respective biodiversity group; 3) comment on taxa missing from groups; 4) score the spatial distribution of biodiversity; 5) comment on the areas that are accurate; and 6) comment on the areas that they perceive are inaccurate.

Experts identified key taxa that were absent from mapped biological diversity groups, and indicated areas where mapped biodiversity was notably accurate, and areas that departed from what they would expect. Experts provided scores for biological diversity maps based on their understanding of the distribution and ecology of respective groups, with scores ranging from 1 (very accurate) to 5 (inaccurate). As each group was assessed by multiple experts, a weighted mean accuracy score was calculated for each group, based on spatial accuracy scores weighted by respective expert knowledge. Thirty-five out of 65 maps received mean weighted accuracy scores <3, indicating they could be useful for marine spatial planning (with careful consideration), 18 maps received mean weighted accuracy scores between 3 – 3.5 indicating they are potentially useful for marine spatial planning, and 12 maps (mainly for cetaceans) received poor scores rounding to 4 or 5, indicating that they should not be used for marine spatial planning. This report also summarises expert commentaries of each biological diversity map assessment, which can be used to further guide the use of the maps within future spatial planning efforts. Moreover, the information should be used to identify priority taxa for modelling (to fill taxonomic gaps) and identify priority areas for sampling (to fill spatial gaps, or to survey areas identified as inaccurate by experts).

1 Introduction

In 2022, Marine Directors from the Department of Conservation (DOC), the Ministry for Primary Industries (MPI), and the Ministry for the Environment (MfE) agreed to progress a marine biodiversity mapping framework ('Biodiversity Mapping'). The purpose of the framework was to develop a shared agency view of national priorities for marine biodiversity to inform management decisions across a range of legislation. The objective was to develop a portfolio of maps that map taxon-specific areas of ecological importance as identified by the Key Ecological Areas (KEA) criteria, and to develop guidance on how the maps could be used to inform marine management decisions.

Agencies have agreed to implement the Key Ecological Areas (KEA) framework developed by the Marine Protected Areas Science Advisory Group to build a standardised mapping methodology for each criterion. The KEA framework describes nine criteria that can be used to identify areas of high conservation value. These criteria include: 1) Vulnerability, Fragility, Sensitivity or Slow Recovery; (2) Uniqueness / Rarity / Endemism; (3) Special Importance for Life History Stages; (4) Importance for Threatened / Declining Species and Habitats; (5) Biological Primary Productivity; (6) Biological Diversity; (7) Naturalness; (8) Ecological Function; and (9) Ecological Services.

Agencies (DOC/MPI/MfE) formed a working group (hereafter referred to as the 'inter-agency' working group) to oversee the development of the maps and prioritise which of the KEA criteria to map first, through a combined science and policy process. Marine Directors approved the working group's decision to use 'Biological diversity' as the first criterion for mapping. NIWA was commissioned to map the Key Ecological Areas (KEA) criterion 'biological diversity', defined as an area that "contains comparatively higher diversity of ecosystems, habitats, communities or species, or has higher genetic diversity", based on the rationale that these areas are important for evolutionary processes, for species and ecosystem resilience and contribute towards large-scale biodiversity.

The resulting contract report (Cook et al. 2023), included a framework for mapping Biological Diversity using three different methodologies and applied it to five high-level taxa including macroalgae, seabirds, demersal fish, seafloor invertebrates and cetaceans. Three methodologies were applied to existing spatial distribution layers for species and species complexes within each group to map biodiversity across space: stacked richness, Zonation prioritisation (Cook et al. 2023) and macroecological modelling (Brough et al. in review). The macroecological method was only applied to invertebrate taxa. The methodologies incorporated model uncertainties for the spatial layers (where available), with an additional consideration of seafloor condition for seafloor invertebrates. The impact of fishing on benthic invertebrate communities was accounted for by applying layers (i.e., naturalness) that provide taxa-specific scaling of habitat suitability to reflect the extent of modification due to bottom trawling (Cook et al. 2023).

Alongside the report, NIWA produced 67 biodiversity maps to show estimates of biological diversity for each taxa group (Table 1-1, with example maps provided in Figure 1-1 and Figure 1-2), to which thresholds can be applied to identify the highest diversity areas (or conversely low areas of diversity). Maps were assessed qualitatively by the report authors and scored as either accurate, somewhat accurate, or largely inaccurate based upon how well mapped biodiversity patterns represented known areas of high and low biodiversity for each group. Forty-three maps were assessed as being somewhat accurate, with eight maps scoring as accurate, and 16 maps assessed as being largely inaccurate. Following this exercise, the interagency working group recommended that as a priority, expert evaluations of the biodiversity map outputs be undertaken. Additional evaluation of mapped outputs by taxonomic experts could identify which maps are suitable for integration into management decisions (and can be used now), which maps require refinement, and which maps are uninformative. This evaluation can allow for the maps showing patterns in biodiversity to be used with more confidence in informing management decisions.

1.1 Aims

The aim of this work was to develop and implement an approach for evaluating biodiversity maps produced by Cook et al. (2023) using expert knowledge. An expert panel was assembled to support the evaluation. Using a Delphi survey (questionnaire) based evaluation process, assessments for each biodiversity map were sought. Compiled expert assessments were used to inform the use of biodiversity maps for management and identify spatial and taxonomic gaps that could guide future work.

Table 1-1: Broad and disaggregated biodiversity groups mapped, and number of taxa (species, species complexes or genera layers) included in analyses to map each biodiversity group.

Broad taxa group and number of taxa	Disaggregated group	Number of taxa in disaggregated group
Seafloor invertebrates (*n* = 205)	Key biogenic habitat forming	33
	Mobile	125
	Sessile	37
	Pelagic	10
Macroalgae (*n* = 82)	Canopy-forming	14
	Other macroalgae	68
Demersal fish (*n* = 234)	Benthic	45
	Pelagic	22
	Bentho-pelagic	39
	Bathyal-pelagic	39
	Bathyal-demersal	82
	Reef associated	7
Cetaceans (*n* = 12)	Whales	5
	Delphinidae	7
Seabirds (*n* = 73)	Shags	11
	Albatrosses	12
	Penguins	9
	Shearwaters	8
	Petrels	28
	Other seabirds	5

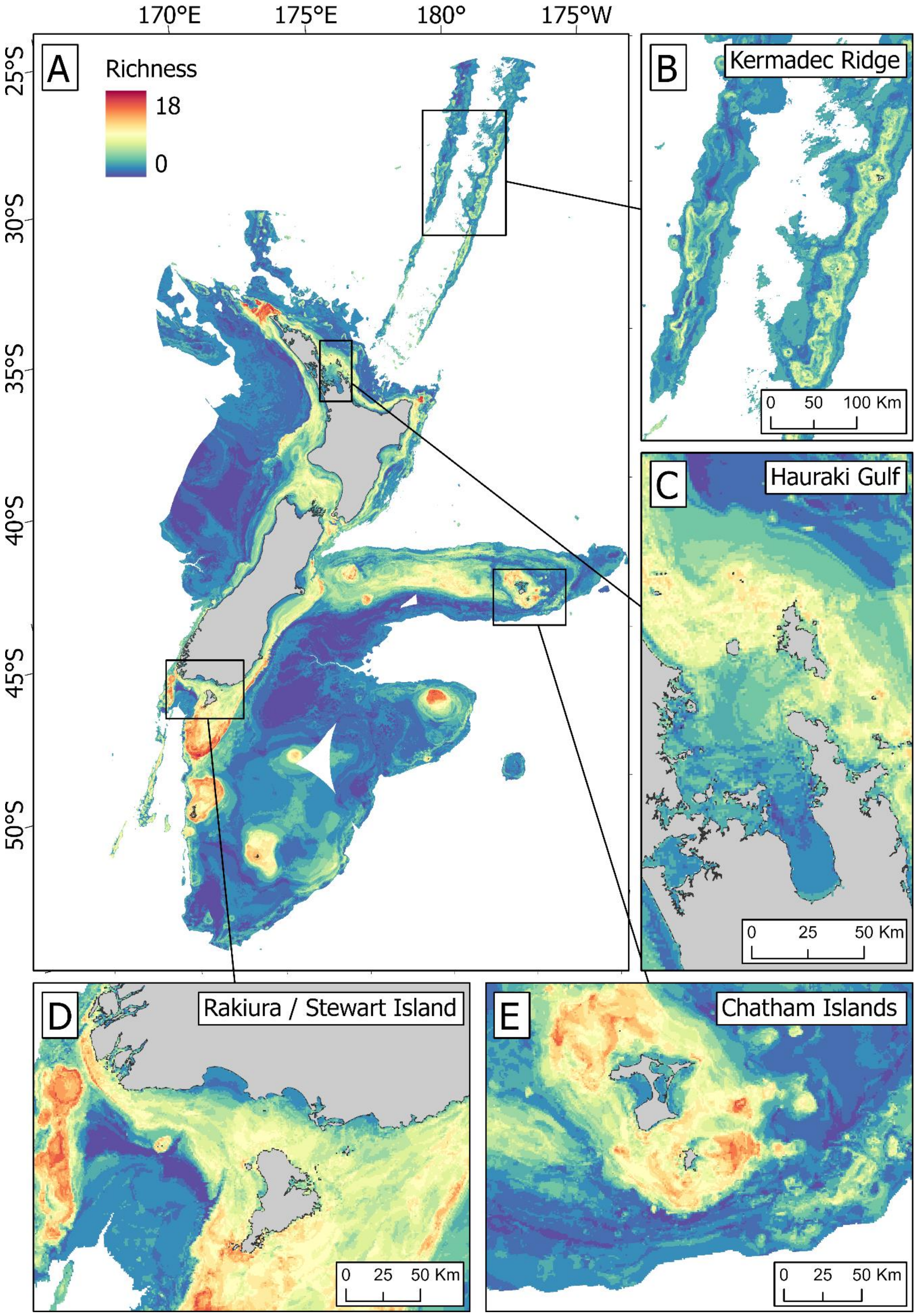

Figure 1-1: Example of a biological diversity map produced by Cook et al. (2023). Example is for the sessile seafloor invertebrate group (37 taxa; no condition or fishing impact applied), developed using the stacked approach.

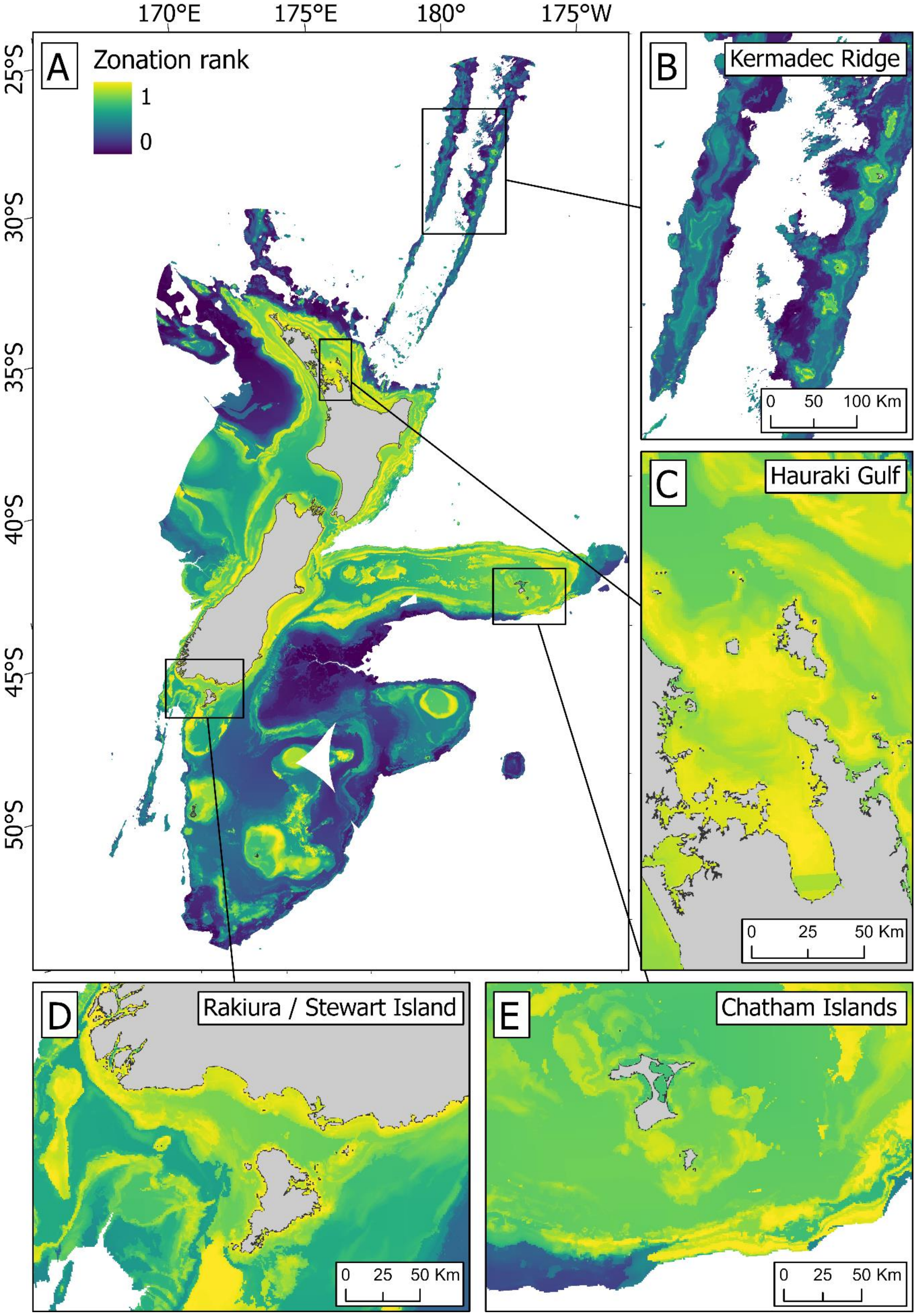

Figure 1-2: Example of a biological diversity map produced by Cook et al. (2023). Example is for all demersal fish (234 taxa), developed using the Zonation approach.

2 Methods

2.1 Expert panel

Expert panels were assembled for each 'broad level' biodiversity group (i.e., cetaceans, seafloor invertebrates, seabirds, demersal fish, macroalgae) (Table 2-1). Experts selected for each group represent taxonomic or ecological experts of biodiversity groups, or taxa constituents within each broad or disaggregated biodiversity group. For example, experts assembled for the macroalgae group generally had broad knowledge of macroalgal taxonomy, ecology, and distribution, whereas for seafloor invertebrates, experts assembled had specific knowledge of taxa group constituents (e.g., sponges, crustaceans, or bryozoans).

An initial goal of a minimum of five expert respondents per biodiversity group was established to ensure that collectively experts had knowledge of entire mapped groups that often include many individual taxa. Further, it was desirable to gain evaluations from many experts for each group (within time and budgetary constraints) so that evaluation scores were not based on a single evaluation, or few conflicting responses. Responses from several experts therefore permits calculation of average scores, and determination of majority agreement or consensus among experts. In total, 36 experts were contacted and asked to carry out the evaluation of biodiversity maps. However, based on capacity of taxonomic experts, typically only three to four experts per biodiversity group, were able to participate in the expert evaluation (Table 2-1).

Table 2-1: Name and affiliation of experts that carried out the evaluation of biodiversity maps.

Biodiversity group	Expert and affiliation
Seafloor invertebrates	Michelle Kelly (NIWA)
	Dennis Gordon (NIWA)
	Di Tracey (NIWA)
	Rachael Peart (NIWA)
	Owen Anderson (NIWA)
	Darren Stevens (NIWA)
	Kareen Schnabel (NIWA)
Macroalgae	Kate Neill (NIWA)
	Maren Preuss (NIWA)
	Shane Geange (DOC)
Cetaceans	Dave Lundquist (DOC)
	Will Rayment (University of Otago)
	Tom Brough (NIWA)
	Anton Van Helden (DOC)

Biodiversity group	Expert and affiliation
Demersal Fish	Brit Finucci (NIWA) Darren Parsons (NIWA)* Owen Anderson (NIWA) Clinton Duffy (Auckland Museum)
Seabirds	Chris Gaskin (Northern NZ Seabird Charitable Trust) Nicholas Daudt (University of Otago) Graeme Taylor (DOC)

**Expert provided feedback and commentary but not scores of biodiversity distribution accuracy*

2.2 Expert assessment process

Draft evaluation criteria and the assessment process were presented to some of the experts at an in-person workshop in November 2023. The assessment process was explained to experts and questions about the Cook et al. (2023) project and outputs were answered. The assessment process was designed to mirror a Delphi approach (similar to Stephenson et al. 2022), in which experts were provided with a series of instructions and biodiversity maps relevant to their expertise. This approach was used to minimise the opportunity for 'groupthink' to occur, an issue that can greatly impact expert input gained from group sessions (Dalkey and Helmer 1963; Nasa et al. 2021). Experts were given the opportunity to examine instructions, examination criteria, and biodiversity maps at their leisure.

Experts were provided with a two-page instruction sheet (see example for cetaceans in Appendix A), with a general description of the project and its aims, as well as a set of evaluation criteria (Table 2-2 to Table 2-4). The second document contained a table for entry of assessment scores and comments, and maps of biodiversity groups requiring evaluation. The empty data table contained space for three scores, and three spaces for comments, per biodiversity group map. The first criterion was for a self-assessment of the expert's perceived knowledge of the distribution of biodiversity for their assigned taxonomic group. Scores range from 1 – Very high level of knowledge to 4 – Low level of knowledge of biodiversity spatial patterns. The second assessment criterion was an assessment of how well a given biodiversity group was represented by the taxa included. This criterion indicated whether there were key taxonomic groups missing from the analysis that the experts felt would impact the mapped biodiversity patterns. Scores ranged from 1 – Very representative, to 4 – Not representative of the biodiversity group. The final criterion was based on the spatial distribution of biodiversity. Experts were asked to score the maps based on how accurate they believed the mapped biodiversity patterns were. Scores ranged from 1 – Very accurate to 5 – Inaccurate. The evaluation criteria used here were similar to the ones developed by Stephenson et al. (2023a), with certain adjustments to the criteria given biodiversity maps were being evaluated here instead of single-taxon models.

Experts were also given the opportunity to provide comments while reflecting on some of the scores provided. The first comment box allowed the experts to list any key taxa that they considered missing from the biodiversity groups. The next two comment boxes were based on the accuracy of spatial predictions. Experts were given the opportunity to provide further critical appraisal of mapped biodiversity by indicating certain geographic areas which they considered to be accurate or inaccurate representations of biodiversity. Experts were not required to provide commentary; if they were to consider a biodiversity map 'inaccurate', we did not expect them to reflect on certain areas that may have been comparatively accurate. Finally, experts were asked to comment on the usefulness of the mapped biodiversity group for inferring spatial patterns of biodiversity and for use in marine spatial planning.

An example of the instructions and worksheet provided to experts is provided in the appendix (see Appendix A).

Table 2-2: Self-assessment of expert knowledge.

Evaluation score	Description
1 – Very high	Expert confidently knows the **distribution of biodiversity** (including relatively fine scale patterns)
2 – High	Expert confidently knows the **distribution of a subset**, but not all the taxa included in the layer, with broad knowledge of biodiversity
3 – Moderate	Expert has **some knowledge** of the distribution biodiversity/subset of taxa included in the layer, with some uncertainty
4 – Low	Expert has **little knowledge** of the distribution biodiversity/subset of taxa included in the layer, with some uncertainty

Table 2-3: Assessment of taxa representation in biodiversity groups.

Evaluation score	Description
1 – Very representative	Taxa included are **very representative of biodiversity group.**
2 – Representative	Taxa included are **representative of biodiversity group**, but **some key taxa are missing**.
3 – Somewhat representative	Taxa included are representative of biodiversity group but there are **many key taxa missing from group**.
4 – Not representative	Taxa included are **not representative of biodiversity group**.

Table 2-4: Assessment of spatial predictions of biodiversity distribution.

Evaluation score	Description
1 – Very accurate	Predicted distribution **reflects expert view** of biodiversity (> 80% agreement).
2 – Accurate	Predicted distribution **reflects expert view** of biodiversity, but **some areas may not** be correct (> 60% agreement).

Evaluation score	Description
3 – Somewhat accurate	Predicted distribution **somewhat reflects expert view** of biodiversity but there are **considerable inconsistencies** (i.e., regions of disagreement; > 40% agreement).
4 – Largely inaccurate	Predicted distribution contains **large inconsistencies with the expert's view** of biodiversity (i.e., large regions of disagreement; > 20% agreement).
5 – Inaccurate	Predicted distribution **does not match the expert's view** of biodiversity (i.e., < 20% agreement).

2.3 Compilation of scores and comments

For each biodiversity group and mapping approach, scores were collated for the three 'numbered' criteria (self-assessment of expert knowledge; taxa representation of biodiversity; accuracy of spatial predictions). A single weighted mean map accuracy score was calculated for each mapping approach and biodiversity group by calculating a weighted mean of the map accuracy scores across experts, with weighting being relative to the respective self-assessed expert knowledge score.

The weighted mean map accuracy score (*W*) was calculated as follows:

$$W = \frac{\sum_{i=1}^{n}(w_i X_i)}{\sum_{i=1}^{n} w_i}$$

where:

$n = \text{number of expert assessments}$

$w = \frac{1}{\text{expert assessment of knowledge}}$

$X = \text{accuracy of spatial prediction}$

A weighted mean was used in place of the median to capture the variability in expert ecological and taxonomic expertise, with scores from experts with higher knowledge being more heavily considered into the final score. This was especially relevant for the seafloor invertebrate groupings, where experts were tasked with scoring the biodiversity predictions across all disaggregated biodiversity groups, even if they were more specialised in one taxonomic field.

Comments provided by experts were summarised on a case-by-case basis. For each mapped group, comments were merged if they were similar (consensus or clear majority agreement). Comments that did not relate specifically to the assessment of the maps with respect to their use in spatial planning were omitted from this report for brevity. Comments were edited to remove information that could be used to identify the expert.

2.4 Presentation of results

Weighted mean map accuracy scores were summarised for each biodiversity group and presented alongside the mean expert assessment of knowledge scores. Key comments summarised across disaggregated biodiversity groups are presented in the main text. An overall box and whisker plot was used to visualise the weighted mean map accuracy between biodiversity mapping approaches (stacked, Zonation and MEM) for each taxa group. Additionally, for each taxa group, the weighted mean map accuracy score was graphically represented to highlight differences between disaggregated biodiversity groups and approaches. Summary statistics were calculated in RStudio (R Core Team 2013; RStudio 2020) and figures were produced using the *ggplot2* package (Wickham et al. 2019). Maps were produced using ArcGIS Pro v. 3.1.

3 Results

3.1 Biological Diversity map evaluation overview

High weighted mean map accuracy scores indicate maps that poorly represent biodiversity. For all taxa groups except seabirds, the Zonation approach resulted in maps that better represent biodiversity than the stacked richness approach (Figure 3-1). The weighted mean map accuracy scores for all biodiversity maps (including all biodiversity groups and mapping approaches) ranged from 1 'very accurate' and 4.55 between 'largely inaccurate' and 'inaccurate'. The zonation approach biodiversity maps for seafloor invertebrates and macroalgae all received weighted mean map accuracy scores ranging from 2-3, between the 'accurate' and 'somewhat accurate categories (noting that scores from the individual experts had a broader range than this), whereas maps for all other taxa and approaches had a wider spread of scores. The MEM approach was conducted for combined seafloor invertebrates only, with a weighted mean map accuracy score of 2.40. Cetacean maps were least representative of biodiversity patterns across taxa groups.

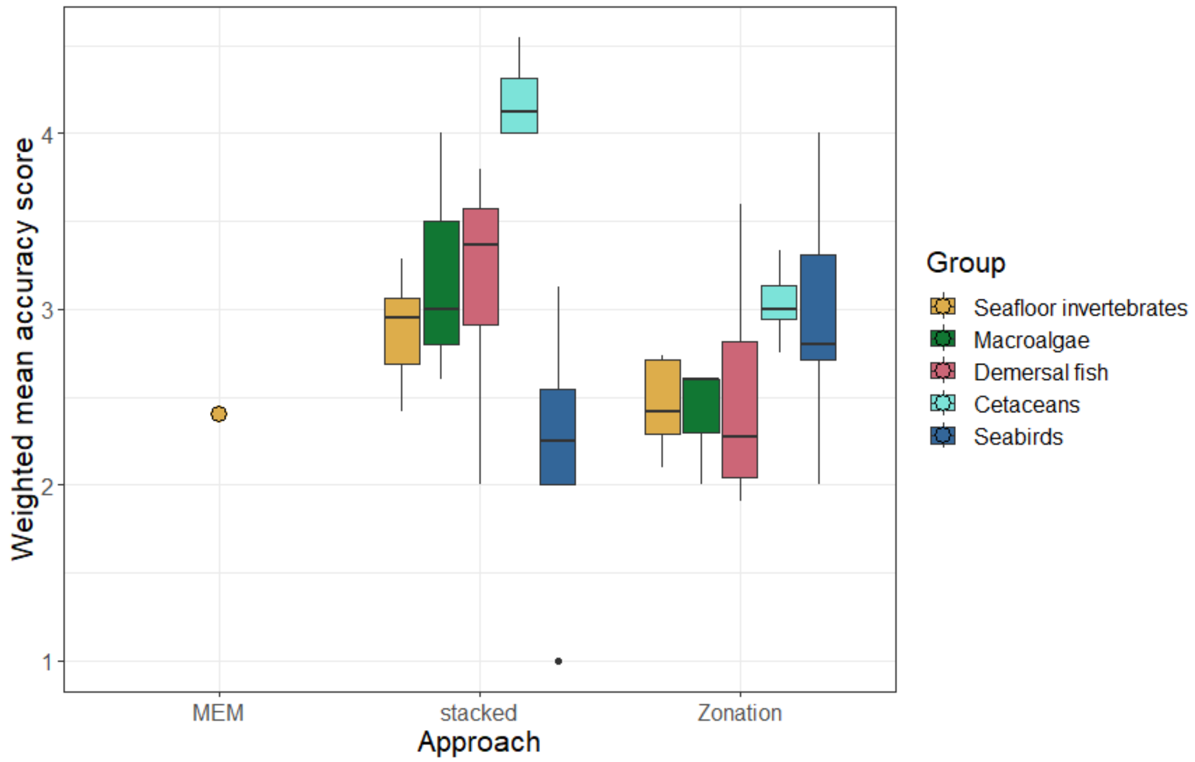

Figure 3-1: Weighted mean map accuracy across the three biodiversity mapping approaches: macroecological model (MEM); stacked richness; and Zonation. Mean accuracy scores for each disaggregated biodiversity group were weighted by expert knowledge of the respective group and are summarised here for each taxa group. Boxes show interquartile range of the weighted mean map accuracy scores, whiskers show min and max, black dots show outliers and horizontal lines show the median.

3.2 Seafloor invertebrates

3.2.1 Expert knowledge

Generally, experts rated their level of knowledge as 'High' to 'Moderate' with a mean knowledge score of 2.52. For the most part, experts commented that they describe themselves as 'confident' on the distribution of biodiversity of seafloor invertebrates. However, self-assessment of expert knowledge varied significantly within the seafloor invertebrate group, and experts tried to highlight their key areas of expertise, and conversely where their knowledge gaps lay. For example, some experts highlighted that while they were somewhat confident with biogenic habitat forming invertebrates, they were mainly confident with "sponge-associated" communities. Another expert mentioned that their expertise was mainly "with stony branching corals, the black [corals], stylasterid hydrocorals and gorgonian octocorals", while other experts mentioned that they were "confident with Bryozoa and assemblages". One expert noted that they were "confident with habitat-forming octocorals, less-so with stony corals" and "not confident" with other taxa in the key biogenic habitat forming group. For the sessile group, one expert highlighted that their confidence was high for cup corals (*Flabellum*, *Monomyces*, *Stephanocyathus*, *Caryophyllia*) and less so for the sea anemone *Bolocera*, and the soft corals *Anthomastus* and *Heteropolypus*.

For the mobile invertebrates group, experts mentioned that they were "moderately confident", or confident with taxonomy and some distributions, but not of all taxa in the group. One expert mentioned that they were "confident with peracarid crustaceans (isopods and amphipods), less so for the decapods [… and] not confident for the other mobile fauna”. For the pelagic invertebrates group, experts commented that they were “moderately confident” but more confident with other invertebrate groups. Two experts commented that they were “confident with commercial squid species” and had a “good knowledge of […] squid taxa” from trawl survey species and areas. One expert noted that they were confident with “peracarid crustaceans (isopods and amphipods)” but not pelagic invertebrates.

For the “all seafloor invertebrates combined” group (including the macroecological model), the experts mentioned that they were “more confident with corals” but were generalists with other groups within Cnidaria, and that they were “confident” with the taxa listed considering the large number of biogenic habitat-forming taxa and sessile seafloor invertebrates.

3.2.2 Taxonomic representation

Aside from the scores provided on the representation of taxa in biodiversity groups, the experts provided commentary on any key taxa they felt were missing. Summarising the commentary provided, experts mentioned that taxa that form worm thickets are missing from the key biogenic habitat forming invertebrates group, while another mentioned that “there are a lot of anemones [missing] e.g., [family] Actinostolidae and [family] Hormathidae”. Other experts mentioned that in general, “not enough sponge taxa area included” and that [family] Paramuriceidae and [family] Anthothelidae [octocorals] are common and missing”. Many of the comments for the sessile group were the same as those provided for the key biogenic habitat forming invertebrates group. For instance, “not enough sponge taxa” and “other anemones”. Additionally, one expert highlighted that some soft coral species were absent, including the genus *Taiaroa* “an important component of deep-sea soft bottoms” as well as *Kotatea* [and] *Ushanaia* spp. “for inshore areas”. One expert mentioned that the representation of cup corals was “ok”.

However, experts mentioned on several occasions that they would suggest changes to the components of certain disaggregated biodiversity groups. One expert mentioned that the genus *Caberea* (Bryozoa) was perhaps not a *key* biogenic habitat former while others mentioned that the genus *Telesto* (octocoral) and the genus *Anthoptilum* (sea pen) do not strictly “meet the description ‘key biogenic habitat former’”. Additionally, one expert highlighted that many of the taxa in the sessile group are technically locally mobile. Note: the use of the term sessility in this context was used to describe taxa limited and no locomotive ability i.e., sessile, semi-sessile, burrowing, or creeping locomotion.

For the mobile invertebrates combined group, one expert commented that the taxa listed were “pretty good” noting that a lot of common taxa were included. Another expert simply mentioned that many “amphipods and isopods” are not included while another noted that missing taxa included *Acutiserolis*, *Gastroptychus* and *Sternostylus*. Additionally, one expert pointed out that there are circa 3,300 crustaceans in the region, and that while the “majority of abundant taxa” are represented in the group, crustaceans and other taxa are “woefully underrepresented in real terms”.

For the pelagic invertebrates group, one expert commented that “pelagic crustacean fauna such as the Copepoda, some Amphipoda, Euphausiidae, and [jellyfish]/salps are [extremely] important in ecosystem function and are missing from this analysis” while another commented that the squid taxa included “seem limited to common trawl caught taxa”. One expert mentioned that a “myriad of natant decapods” are missing, while another simply described the listed taxa as “somewhat representative” of pelagic invertebrates. An expert also took the opportunity to mention that some taxonomy had been updated, pointing out that the “common warty squid […] *Onykia ingens* is now *Moroteuthopsis ingens*”.

For the all seafloor invertebrates combined group, expert comments on taxonomic gaps were mostly positive, mentioning that the list was “fairly representative overall”, constituted a “reasonable subset” and “from the coral perspective, good representation and […] a good range of invertebrates [overall]”. However, two experts noted that both Bryozoa and Porifera taxa are not as well represented as they could be.

3.2.3 Map accuracy

When comparing the weighted mean map accuracy scores between the three approaches, the Zonation maps scored the most accurate for all disaggregated biodiversity groups, except for the sessile group with no naturalness applied which (scored the same), and the pelagic grouping where the stacked approach scored more accurately (Figure 3-2). Stacked richness and Zonation maps for the mobile invertebrates group scored the poorest, with application of the fishing impact (naturalness) layer appeared to slightly increase map accuracy. However, application of the fishing impact (naturalness) layer seemed to have inconsistent effects across all groupings. All disaggregated biodiversity groups and approaches scored between 2 (‘Accurate’) and 3 (‘Somewhat Accurate’) except the stacked richness approach for the mobile group (with and without naturalness applied) and for the key biogenic habitat forming invertebrate group with naturalness applied which had a mean score of 3.07 (Table 3-1). Summaries of expert commentaries on how well and poorly the maps represented specific geographic areas of known high and low richness are provided in the section below.

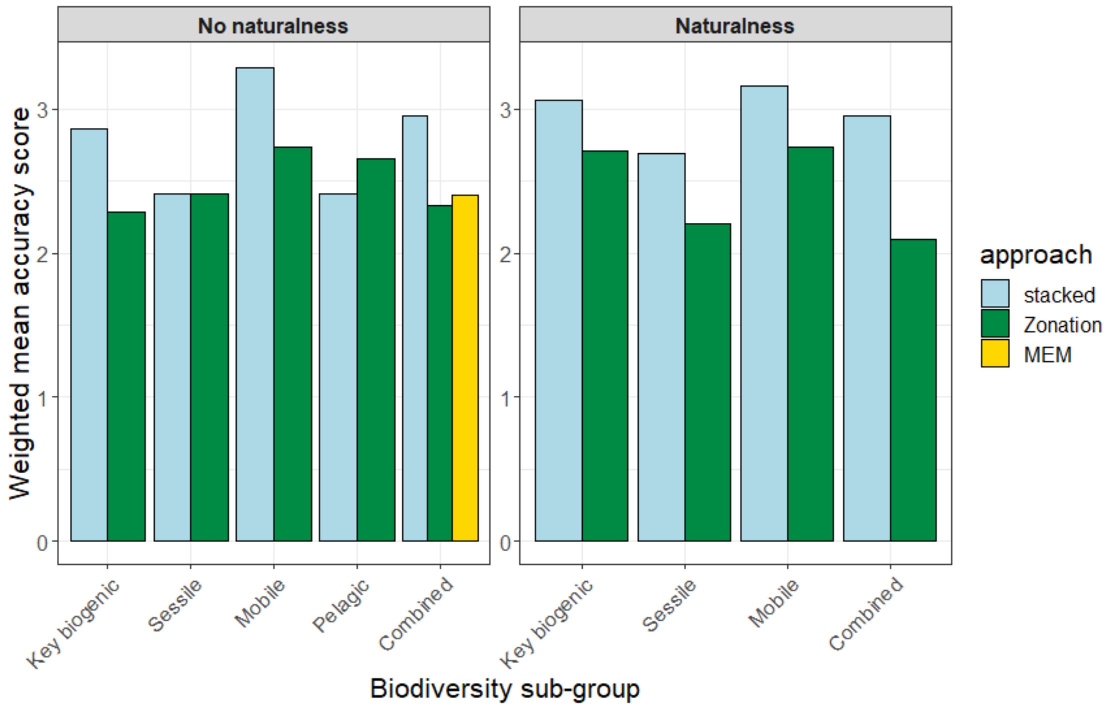

Figure 3-2: Weighted mean map accuracy scores for the seafloor invertebrate disaggregated biodiversity groups. coloured bars represent scores for each biodiversity mapping approach (stacked richness, Zonation and macroecological modelling (MEM)), with and without a fishing impact (naturalness) layer applied. High scores indicate lower accuracy.

Table 3-1: Weighted mean map accuracy scores, mean expert knowledge scores and mean taxa representation scores for seafloor invertebrate biodiversity groups.

Taxon Group	Disaggregated biodiversity group	Approach	Inclusion of naturalness (fishing impact; for seafloor invertebrates)	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Seafloor invertebrates	Key biogenic habitat forming	stacked	N	2.87	1.88	1.75
Seafloor invertebrates	Key biogenic habitat forming	stacked	Y	3.07	1.88	1.75
Seafloor invertebrates	Key biogenic habitat forming	Zonation	N	2.29	2.13	1.75
Seafloor invertebrates	Key biogenic habitat forming	Zonation	Y	2.71	2.13	1.75
Seafloor invertebrates	Sessile	stacked	N	2.41	2.13	2.75
Seafloor invertebrates	Sessile	stacked	Y	2.69	2.13	2.75
Seafloor invertebrates	Sessile	Zonation	N	2.41	2.13	2.75
Seafloor invertebrates	Sessile	Zonation	Y	2.21	2.13	2.75
Seafloor invertebrates	Mobile	stacked	N	3.29	2.88	2.5
Seafloor invertebrates	Mobile	stacked	Y	3.17	2.88	2.5
Seafloor invertebrates	Mobile	Zonation	N	2.74	2.88	2.5
Seafloor invertebrates	Mobile	Zonation	Y	2.74	2.88	2.5
Seafloor invertebrates	Pelagic	stacked	N	2.42	3.38	3.125
Seafloor invertebrates	Pelagic	Zonation	N	2.65	3.38	3.125
Seafloor invertebrates	All combined seafloor invertebrates	stacked	N	2.95	2.63	2.33
Seafloor invertebrates	All combined seafloor invertebrates	stacked	Y	2.95	2.63	2.33

Taxon Group	Disaggregated biodiversity group	Approach	Inclusion of naturalness (fishing impact; for seafloor invertebrates)	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Seafloor invertebrates	All combined seafloor invertebrates	Zonation	N	2.33	2.63	2.33
Seafloor invertebrates	All combined seafloor invertebrates	Zonation	Y	2.10	2.63	2.33
Seafloor invertebrates	All combined seafloor invertebrates	MEM	N	2.40	2.83	2.33

3.2.4 Areas well represented by the biodiversity maps

Stacked approach

For the key biogenic habitat forming invertebrates group mapped with the stacked approach, expert comments highlighted several areas that they believed the biodiversity values were realistic. Foremost, experts highlighted areas of topographic relief that they believed matched their expectations of biodiversity. Experts specifically noted that the "Macquarie and Kermadec Ridges are OK" that the "Chatham Rise" looks reasonable, and that the "Bollon's [seamount] is high as expected". One expert noted that "Macquarie Ridge is a standout" mentioning that while there has been "little sampling in this region, […] certainly all the selected taxa occur here". Experts also noted that "low value predicted around the islands […] makes sense", and that the "west coast [South Island] is low as expected". For the sessile group, experts noted that "Spirits Bay / Cape Reinga [is] pretty good" and that Macquarie Ridge is good. Another expert listed Three Kings, Snares Island, Auckland Island, and the Chatham Rise as "good" and the Hauraki Gulf as OK. Experts also mentioned that the "moderate diversity along [the] top of the Chatham Rise and along coastal areas [is] probably accurate". An expert did mention that the listed taxa are a mix of "groups located on hard bottom, or in sediment", but that if they considered the cup corals included in the group, "the maps are OK".

For the mobile invertebrates group, expert commentary was diverse. Expert comments ranged from "mostly good" to "not very accurate". Experts elaborated, noting that the "Macquarie Ridge is reasonable as [they] wouldn't expert as much [diversity] as for the [other groups]" and that they would have expected to see a richness "gradient from north to south". One expert mentioned that "the low [richness mapped off] the west coast of the North Island may be more accurate due to the high energy of the area". For the pelagic group, experts mentioned that "it makes sense that biodiversity is higher around areas of high productivity such as the sub-tropical convergence" and that the map "matches high biodiversity areas for benthic inverts, as [they] would expect". One expert pointed out that the Chatham Rise is high, as they would expect based on where squid fisheries occur.

For the group that combined all seafloor invertebrates, experts commented that the maps will reflect "sampling intensity" noting that "unsurprisingly" the Chatham Rise was mapped with high richness. Another expert noted the same, mentioning that the Chatham Rise area was "very high". One expert mentioned that high mapped richness in shallow areas around Kermadec Islands "makes sense".

For the macroecological model, one expert commented that the map was "really good; quite accurate overall" noting that the "Macquarie Ridge [is] very high as one would expect" and that the Fiordland and Chatham Rise areas looked pretty good too, adding that they felt this was the "best map" they had been shown. However, another expert commented that the high value in the Macquarie Ridge area is at odds with their impression of sampling effort. They comment that the Chatham Rise, Southern Plateau, and Kermadec regions are well captured.

Zonation approach

For the key biogenic habitat invertebrates group mapped with the Zonation approach, one expert simply described the map as "much more accurate" while another said that "based on *existing* knowledge, it is accurate". Others highlighted key areas that were well captured, for example "based on the known distributions for the various corals [the map] makes sense […] on the Chatham Rise, Kermadec [Ridges], and Southern region", agreeing with other experts who noted that the "high diversity on the Chatham Rise and Kermadec seamounts [are] well covered" and that "Bay of Plenty seamounts and Northland diversity" are also well captured. Another expert mentioned that the "low diversity along [the] west coast [South Island] and Bounty Trough [is] as expected". For sessile invertebrates, experts in general provided less commentary. However, again the Zonation approach seemed an improvement on the stacked approach. Experts commented that "Coastal areas are shown better" that the patterns "seem OK on the Chatham Rise" and that the "east coast of the North Island, flanks of the Chatham Rise, Kermadec Ridge, and subantarctic islands" are well captured. One expert noted that the map was "overall, pretty good".

For the mobile invertebrates group mapped with the Zonation approach, several experts mentioned that their comments were the same as for the stacked approach. Two experts mentioned that the Zonation maps were "potentially better" and that they seem "more accurate". Specifically, they pointed out that there was a better depth gradient, where deeper areas were shown to have lower richness, but adding that the "north to south gradient was still not captured". Certain areas were deemed to be "well captured" or "well represented" including Chatham Rise, Chatham Islands, Hauraki Gulf, Rakiura [Stewart Island], Spirits Bay, Three Kings, and the Kermadec Ridge". For the pelagic invertebrates group, expert commentary was almost identical for the Zonation approach as for the stacked approach, with experts commenting that "it makes sense that biodiversity is higher around areas of high productivity such as the sub-tropical convergence" and that the map matches where high biodiversity occurs for other benthic invertebrate species, as they would expect.

For the all seafloor invertebrates combined group mapped with the Zonation approach, experts mentioned that the biodiversity distribution was "pretty good overall", that the area along the Kermadec Ridges is represented better than the stacked approach, and that the "Zonation [approach] seems to [capture] the west coast of the South Island" better. Finally, one expert noted that high value on the Graveyard Seamounts was "to be expected" and that biodiversity patterns at Three Kings are "OK".

3.2.5 Areas poorly represented by the biodiversity maps

Stacked approach

For the key biogenic habitat invertebrates group, experts pinpoint areas where they would have expected more or less biodiversity value than was captured by the map. Overall, experts noted that "coastal biodiversity [is] poorly captured" by the analysis. One expert broadly mentioned that they would have "expected higher richness in [the] northwest North Island region". Specifically, experts listed the following areas as having lower biodiversity value than expected: Spirits Bay / Cape Reinga, the Three Kings shelf, Bay of Plenty, North of Taranaki, Campbell Plateau, the Hauraki Gulf, Snares Islands, Stewart Island, and northeast of Banks Peninsula. For the sessile invertebrates group, in general experts provided less commentary, but mentioned that they "would expect higher richness in the [Campbell] plateau" and that the soft "sediment areas [in the] west coast South Island should have [higher] richness". From one expert's perspective, the most "high-diversity areas [were] not represented", identifying the Bounty Trough and seamounts more generally, as poorly captured areas.

For the mobile invertebrates group, experts commented that the "Spirits Bay / Cape Reinga [area] is not high enough" and that the "Colville Ridge, Three Kings, and Norfolk Ridge, [are] extremely biodiverse and not well captured". Two experts noted that the continental margins / shelf areas are not well represented, while two experts also commented that the map highlights sampling bias. For example, one expert noted that the map is an "indication of sampling frequency" while another specifically highlighted that the Bounty Trough is highly diverse for molluscs and small crustaceans, but that this is not well represented in available datasets. For the pelagic group, many experts didn't provide commentary on poorly captured areas, however, one expert noted that they "would expect biodiversity to be low, but present in [the] Cook Strait and on the West Coast of the South Island where arrow squid are captured on trawl surveys".

For all seafloor invertebrates combined, one expert noted that they would have expected higher richness in the Hauraki Gulf while another indicated this expectation for the northwest region of the North Island. Similarly, one expert mentioned they would have expected higher richness on the "west coast of both [the North and South] Islands" explaining in particular that, there are "sponge beds off Taranaki", for example. Conversely, an expert noted that while they did expect the shallow areas around islands such as the Kermadec [Islands], they would not have expected the same for other "island areas" including for example, "slightly west of the Chatham [Islands]". For the macroecological model, experts note that the "North Cape isn't perfect", that in general, predicted richness is a "bit low on Seamounts" but that in contrast, the "Boland Seamount and Campbell Plateau are a bit high". One expert questioned the very high richness along the Macquarie Ridge and conversely, queried the overall low richness along the west coast area. One expert mentioned that there are "pockets of high diversity" that are not typically captured by these types of modelling exercises, and highlighted that there is evidence of high invertebrate richness from fisheries by-catch along the west Norfolk Ridge. Another expert commented that they would have expected more patches of very high richness to be predicted throughout the mapped extent.

Zonation approach

For key biogenic habitat forming invertebrates group, experts commented that the map generated with the Zonation approach was "OK for deeper waters, [but] not that applicable for shallow regions". Furthermore, one expert noted that the "northeast coast is a bit too low" while another mentioned that the “top of the Chatham Rise shows high diversity, but [in reality] is lower than the flanks” adding that biodiversity values in “shallow soft-bottom areas” were too high in general. Conversely, another expert pointed out that that this map was a good representation of our “ignorance as well as knowledge” given that the meiobenthos (note: maps represent macroinvertebrates, the expert is referring to overall benthic biodiversity representation) in the Bounty Trough represent an area of high biodiversity, so the low value present in the map is “not accurate”. For the sessile group, experts commented that “broadly speaking, biodiversity [value] is perhaps generally too high”. Similarly, experts mentioned specifically that the west coast South Island, Hauraki Gulf, and Hawkes Bay were possibly too high, while the Bounty Trough and Macquarie Ridge were too low. One expert highlighted that (considering cup corals), shallow coastal areas are potentially “over-represented”.

For the mobile invertebrates group, several experts pointed out that the map was similar to the stacked approach, and thus their comments were the same. One expert commented that they did “not think that this [is] an accurate representation of the poorly sampled areas. The majority of the map is less a representation of species richness and more [an] indication of sampling [intensity]”. The commentary experts provided on the pelagic invertebrates group mapped with the Zonation approach was almost identical to comments for the stacked approach. However, one expert noted that the predicted richness was a “bit too high throughout the EEZ” adding that they “wouldn’t expect that level of pelagic invertebrate diversity […] in the Hauraki Gulf”, for example.

For all seafloor invertebrates combined, experts commented that the “Macquarie Ridge [region] could be higher”. Additionally, one expert noted that, considering corals in particular, the high value around Islands was “odd” but that some groups like cup corals do occur in relatively shallow waters.

3.2.6 Usefulness for planning purposes and additional commentary

Experts were asked to provide commentary on the usefulness of mapped biodiversity groups for planning purposes, and some experts took the opportunity to provide additional general commentary on the maps. For key biogenic habitat invertebrates, expert commentary ranged from “not useful” to ‘not *that* useful” to “somewhat useful”. Some explanation was given by experts including that, while the map was considered somewhat useful, the group was “too low on sponges”, conversely another expert mentioned that the “group was useful” but not the map(s). One expert asserted that the map was “really coarse and therefore, not informative”. The comments above echo those for the sessile invertebrates, though two experts note that the group/maps “could/possibly be useful”. One of these experts explains that there is “too much variability in the invertebrates [in the taxa group], even within the cup [corals], some are found in sediment, others on hard structures”.

Experts provided some additional commentary, via email or within the worksheet. To summarise some of the commentary, experts sometimes felt it was extremely difficult to assess groups that contained many taxa outside of their area of expertise. For example, many experts who assessed the key biogenic habitat forming invertebrates group felt they could not assess the pelagic invertebrates group. Furthermore, experts highlighted that the distribution of some taxa such as “non-habitat forming octocorals” are poorly known, and so it is difficult to assess biodiversity distribution patterns. One expert made the point that *Epizoanthus* (Zoantharia) have a symbiotic relationship with hermit crabs, so perhaps should be considered ‘mobile’ in place of sessile.

For the mobile invertebrates group, expert commentary ranged greatly. One expert did not comment on usefulness, another commented that the stacked approach map was “not really useful” while the

Zonation approach was "somewhat useful". Additionally, one expert took the opportunity to say that while the maps "should be […] ground-truthed [… they] are a good starting point" and that they are "useful", if not "essential" for spatial planning. For the pelagic invertebrates group, experts provided the same comments on the stacked and Zonation approach maps. Two experts did not feel they could comment on usefulness, one expert commented that the maps were "somewhat useful" while another commented that the maps were "fairly useful" as "broad [biodiversity] patterns [are] believable".

For all seafloor invertebrates combined and the macroecological modelling approach, expert commentary ranged from "useful" to "somewhat useful". Some explanation was given by experts, including that while they deemed some of the maps useful, it must be acknowledged that certain taxa groups, including sponges, are underrepresented. One expert provided overarching commentary on the usefulness of the biodiversity maps for planning purposes. They mentioned that "more data is needed" and that the grid resolution (1 km x 1 km) is "too coarse for planning purposes", they also noted that existing knowledge in several regions is poor, specifically referencing the Bounty Trough, but mention that recent surveys will close some of these gaps. Another expert commented specifically on the macroecological model, noting that it was somewhat useful considering that the method allows for inclusion of *all* available invertebrate records i.e., that rare and data-poor taxa can still be incorporated.

Application of the naturalness (fishing impact) layer

In general, experts did not provide much commentary on the maps with naturalness (fishing impact) applied. Comments often highlighted that they were not certain of the fine-scale distribution of fishing impact (i.e., the impact layers used) so they mentioned that many of their comments on the maps without naturalness, still applied. However, there were several specific comments pertaining to the differences between maps with and without naturalness. In particular, one expert assessed that "in places, [the application] of fishing impact [appears] too strong", and another expert noted that "coastal [areas] are too low". However, in some areas, biodiversity value was considered too high "if fishing impact is being considered". This was a point raised by other experts, who assessed that the Stewart Island / Foveaux Strait and Hauraki Gulf areas were too high. Note: the fishing impact layer (naturalness) layer used did not include dredge fisheries, which have been active in these regions. For the mobile invertebrates group, experts noted little difference when naturalness was applied, though two experts commented that the reduction in high value on the Chatham Rise was "reasonable".

3.3 Macroalgae

3.3.1 Expert knowledge

Generally, experts rated their level of knowledge as 'high' to 'moderate', with a mean score of 2.5 across the disaggregated biodiversity groups. When given the opportunity, experts commented on their self-assessed knowledge level with respect to taxa groupings or certain mapped areas. For instance, one expert highlighted that while they were "confident with broad scale [macroalgae] distribution patterns" they were "less so at fine scales"; in this case the comment applied to all groups. Other experts commented specifically on regions where they were more or less confident with macroalgae biodiversity patterns, mentioning that they had "data and field experiences" from the Far North (Rāwhiti), Banks Peninsula, and the Wellington region, but that they were "not so confident" with the Mercury Islands area east of the Coromandel Peninsula, and highlighted their commentary with an inset on the maps provided of these areas of low confidence.

3.3.2 Taxonomic representation

Aside from the scores provided on the representation of taxa in biodiversity groups, the experts provided commentary on any taxa they felt were missing. Summarising the commentary provided, experts noted that the list of taxa included in the other macroalgae and all macroalgae combined groups were "only representative of commonly collected species". One expert provided lists of "key genera" missing from the groups, noting that from the other macroalgae group, "*Dictyota*, *Perithalia*, *Sporochnus*, *Scytothamnus*, *Apophlaea*, *Ballia*, *Jania*, *Nothogenia*, *Delesia*, *Laingia*, *Adamsiella*, *Callophyllis*, *Gracilaria*, *Champia*, and *Rhodymenia"* were not represented, and from the canopy-forming macroalgae group, "*Landsburgia*, *Desmarestia*, *Hormosira*, *Phyllotrichia*" and *Lessonia"* were missing. *Lessonia* was also highlighted by other experts. The combination of these two lists was mentioned as key genera missing from the all macroalgae combined group.

3.3.3 Map accuracy

The Zonation approach maps scored the most accurate for the two disaggregated biodiversity groups, with the same accuracy score for both approaches for all macroalgae combined group (Figure 3-3). The Zonation approach map for the canopy-forming macroalgae group was scored the most accurate, and the stacked richness map for the other macroalgae group scored the poorest. All approaches for disaggregated groups scored between 2-3 ('Accurate' to 'Somewhat accurate') except the stacked richness map for other macroalgae which scored a 4 ('Largely inaccurate') (Table 3-2). Summaries of expert commentaries are provided in the section below.

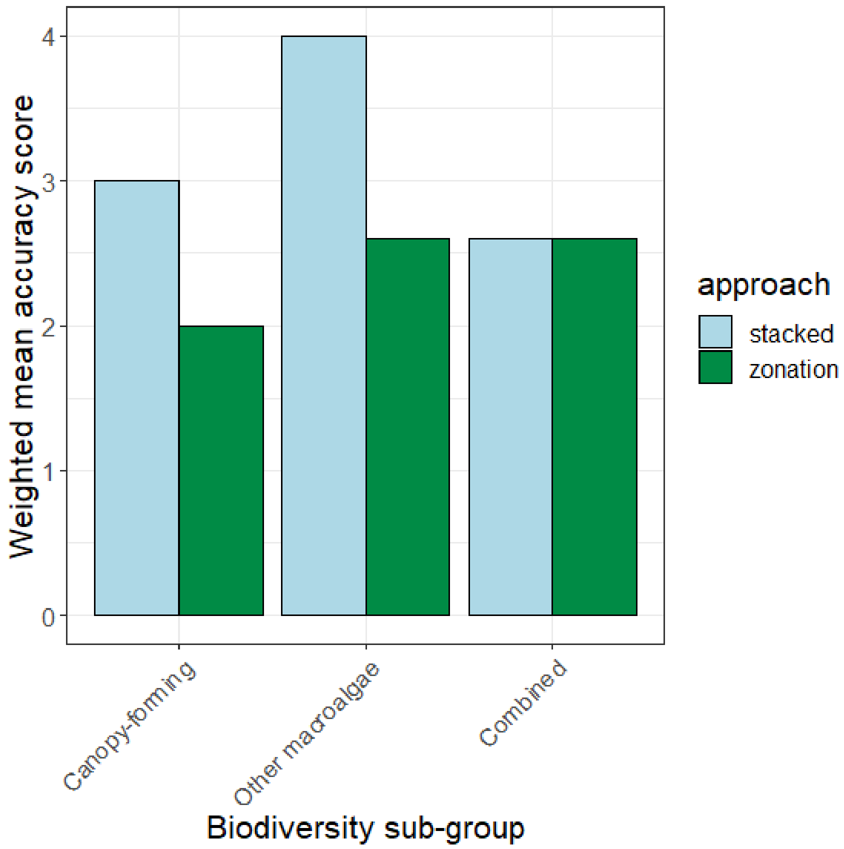

Figure 3-3: Weighted mean map accuracy scores for the macroalgae disaggregated biodiversity groups. Coloured bars represent scores for the stacked richness and Zonation biodiversity mapping approaches. High scores indicate lower accuracy.

Table 3-2: Weighted mean map accuracy scores, mean expert knowledge scores and mean taxa representation scores for macroalgae biodiversity groups.

Taxon Group	Disaggregated biodiversity group	Approach	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Macroalgae	Canopy-forming	stacked	3.00	2.50	1.5
Macroalgae	Canopy-forming	Zonation	2.00	2.50	1.5
Macroalgae	Other macroalgae	stacked	4.00	2.50	3.5
Macroalgae	Other macroalgae	Zonation	2.60	2.50	3.5
Macroalgae	All combined macroalgae	stacked	2.60	2.50	2.5
Macroalgae	All combined macroalgae	Zonation	2.60	2.50	2.5

3.3.4 Areas well represented by the biodiversity maps

Stacked approach

For canopy-forming macroalgae biodiversity mapped with the stacked approach, experts commented that the Wellington region was “high as expected” and that “Cape Karikari, Mokohinau [Island], Hahei, Tuhua, Castle Point, Ngawi, Wainuiomata, Wellington South Coast, Mākara, Kapiti Island, Stewart [Island] are high as expected”. One expert also commented that Long Bay (North Auckland) is mapped with low biodiversity, “as expected”. For other macroalgae, experts commented that the Wellington region was well captured, and that areas including “Castle Point, Ngawi, and Wainuiomata […] are high as expected” and “Long Bay is low as expected”. For the all macroalgae combined group, experts repeated many of the same areas as they mentioned for the disaggregated groups. Firstly, the Wellington region was identified as being well captured, and that “Ngawi, [… and the] east coast of Stewart Island [is] high, as expected”. However, one expert took the opportunity to mention that they were unsure of the accuracy of the biodiversity value mapped in Ahipara and to the east of Lake Grassmere.

Zonation approach

For canopy-forming macroalgae mapped with the Zonation approach, experts commented that “Cape Karikari, Mokohinau [Island], Hahei, Tuhua, Castle Point, Ngawi, Wainuiomata, Wellington South Coast, Mākara, Kapiti Island, Cape Reinga, Poor Knights Islands, Leigh, Tāwharanui, Patea reef, Stewart [Island], Kaikōura, Banks Peninsula, and Fiordland up to Big Bay are high as expected”. Additionally, experts noted that patches of high biodiversity values mapped in the Marlborough Sounds, for example, the “western side and northern tip of Long Island”, are “as expected”. For other macroalgae, experts commented again that the Wellington region was the “best area captured [of the map insets]” and that the following areas were mapped with “high value as expected”: Cape Reinga, Karikari, Mokohinau [Island], Hahei, Tuhua, Ngawi, Wainuiomata, Wellington South Coast, Mākara, Poor Knight Islands, Leigh, Tāwharanui, Kaikōura, and Banks Peninsula”. Additionally, one expert noted that “high value” biodiversity patches in the Marlborough Sounds (western side and northern tip of Long Island), were also “as expected”. For all macroalgae combined, experts mentioned again that the Wellington region was well captured, and that the following high biodiversity areas were well captured: “Cape Reinga, Karikari, Mokohinau [Island], Hahei, Tuhua, Ngawi, Wainuiomata, Mākara, Poor Knights Islands, Leigh, Tāwharanui, and Kaikōura”. However, one expert mentioned that the “high [biodiversity] values are at a very coarse spatial scale”.

3.3.5 Areas poorly represented by the biodiversity maps

Stacked approach

For canopy-forming macroalgae under the stacked approach, experts commented that they would have expected “higher diversity” or that areas mapped were “unexpectedly low” in “Cape Reinga, Poor Knight Islands, Leigh, Tāwharanui, Patea Reef, Marlborough Sounds, Fiordland, [east coast of Northand], and Banks Peninsula”. For other macroalgae, one expert commented that the following areas were “unexpectedly low”: Mokohinau [Island], Tuhua, Cape Reinga, Cape Karikari, Poor Knight Islands, Tuhua, Hahei, Tāwharanui, Patea Reef, Titahi Bay, Mākara, Kapiti Island, Mana Island” while other experts commented that they would have expected “even diversity [patterns] along the South Coast in Wellington” and that they would have expected “higher diversity” in the areas around the Mercury Islands, Banks Peninsula, and east coast of the Far North (east coast of Northand). For all macroalgae combined, experts mentioned that they would have expected higher biodiversity values mapped in three of the inset maps (Mercury Islands, Banks Peninsula, and east coast of Northand), while another expert mentioned that the biodiversity patterns around the coast were "surprisingly homogeneous".

Zonation approach

For canopy-forming macroalgae, experts mentioned that they would have expected higher diversity to be mapped in the Wellington Region, and in contrast, that the "Eastern end of Palliser Bay adjacent to Whāngaimoana beach, Ōpunake and north of Ōakura [are] higher than expected". For other macroalgae, some experts noted that, like the stacked approach, they would have expected "higher diversity" in the areas around the Mercury Islands, Banks Peninsula, and east coast of the Far North. Another expert highlighted the following areas, noting that the diversity mapped was higher than expected: "Eastern end of Palliser Bay adjacent to Whāngaimoana beach, Ōpunake, Bell Block, and parts of [the] Marlborough sounds, particularly bays and coves at the head of the sounds". Finally, one expert noted that "Kapiti Island, and reefs offshore from Patea [are] lower than expected". For all macroalgae combined, experts mentioned that they would have expected higher biodiversity values mapped around "Kapiti Island, and reefs offshore from Patea", as well as Rāwhiti, the surrounds of the Mercury Islands, and Banks Peninsula. Furthermore, one of the experts noted that the "Eastern end of Palliser Bay adjacent to Whāngaimoana beach, Ōpunake, Bell Block, and parts of Marlborough sounds, particularly bays and coves at the head of the sounds are all higher than expected".

3.3.6 Usefulness for planning purposes and additional commentary

Experts were asked to provide commentary on the usefulness of mapped biodiversity groups for planning purposes, and some experts also provided general commentary on the maps. For the canopy-forming macroalgae group, experts mentioned that for the stacked approach, the map was of "limited use for broad scale patterns" or that it was useful for certain areas like "Wellington, but not useful for planning [purposes] as intertidal diversity is excluded". For the Zonation approach, experts noted that the map was "somewhat useful for broad-scale [biodiversity] patterns" but that "some areas may be overestimated". For the other macroalgae group, experts mentioned that the stacked approach map again was of "limited use for broad scale [biodiversity] patterns and "not useful", again because "intertidal diversity is excluded". Experts agreed that the other macroalgae group mapped with the Zonation approach was "somewhat useful" but noted that "biodiversity patterns might be underestimated". Finally, for all macroalgae combined, commentary also varied between approaches. For the stacked approach commentary varied between "somewhat useful" and "not useful", with experts mentioning that at "finer spatial scales" the map could but be useful but that they were "unsure of the usefulness at a national scale [given] the broadly homogeneous [biodiversity] patterns". For the Zonation approach, experts agreed that the map was "somewhat useful" but highlighted that "biodiversity might be underestimated" and that its usefulness hinging on scale, being "less [useful] for fine scales".

3.4 Demersal fish

3.4.1 Expert knowledge

Generally, experts rated their level of knowledge between 'Very high' and 'High', with a mean score of 1.9. Experts then took the opportunity to detail where their knowledge was based. For instance, one expert commented that they were more confident with chondrichthyan taxa. Some experts mentioned that they were more confident with commercial and recreational target species, while one expert mentioned that they were more confident with commercially fished species only. Finally, one expert noted that their "knowledge of inshore and shelf species is best" but that they "have a good understanding of the distribution and diversity of upper slope species" too.

3.4.2 Taxonomic representation

Aside from the scores provided on the representation of taxa in biodiversity groups, the experts provided commentary on any key taxa they felt were missing. For demersal fish, on several occasions, experts noted inaccuracies in the nomenclature of fish species or disagreed with the placement of certain taxa into groupings. Corrected taxonomic information and suggested alternative disaggregated biodiversity groups are summarised and shown in Appendix B (Table B-2). Experts also highlighted some taxonomic gaps for specific biodiversity groups. For the benthic group, experts noted that there was "good representation" but highlighted that their comments depended on the definition of 'benthic' used. Another expert noted that the "group may not be well represented by available data, [especially for] shallow rocky reef species". For the bathyal-demersal group, again experts highlighted grouping issues, e.g., *Alopias vulpinus* is a pelagic species. While one expert mentioned that the taxa included in the group are "well represented by trawl catch records". For the bathyal-pelagic group experts again mentioned that there was "good representation", again caveating that this is dependent on definitions. One expert noted that "*Neoachiropsetta milfordi* should be in bathyal-demersal group", for example. For the benthopelagic group, one expert commented that, in terms of chondrichthyans, the taxa are "fairly well" covered, while another expert commented that the group "is well represented by trawl catch records" but that "*Kathetostoma binigrasella* should be in benthic group with the other stargazers". For the pelagic group, experts commented that several taxa should be in other groups (or that the group should be split), noting that the taxa included are a mixture of inshore, epipelagic and bathydemersal species". In terms of missing taxa, experts commented that "open ocean highly migratory species, for example, tuna [are] not included" and that "mako, porbeagle, blue shark, white shark, mobula rays" are missing. For the reef group, experts commented that "almost all of them" are missing, and specifically, that "no chondrichthyans are included [even though] there are a few species occurring in NZ e.g., *Carcharhinus galapagensis*" around the Kermadec Islands mainly. Additionally, one expert commented that "five species [may be] too few" to represent reef fish while another listed some "abundance omissions" including, parore (*Girella tricuspidata*), red moki (*Cheilodactylus spectabilis*), sweep (*Scorpis lineolata*), blue maomao (*Scorpis violacea*), marblefish (*Aplodactylus etheridgii*), [Sandager's] wrasse (*Coris sandeyeri*), black angel fish (*Parma alboscapularis*), [and] two spot demoiselles (*Chromis dispilus*)". Finally, for the all combined group, experts provided little additional commentary, though one expert pointed out that "reef species" are underrepresented.

3.4.3 Map accuracy

The Zonation approach maps scored more accurately than the stacked richness approach across all fish biodiversity disaggregated groups except the benthic and reef fish groups which had the same accuracy score (Figure 3-4). The Zonation approach map for the combined demersal fish group was scored the most accurate with a mean score of 1.9, and the stacked richness map for the pelagic fish disaggregated group scored the poorest with a mean score of 3.8. (Table 3-3). Summaries of expert commentaries are provided in the section below.

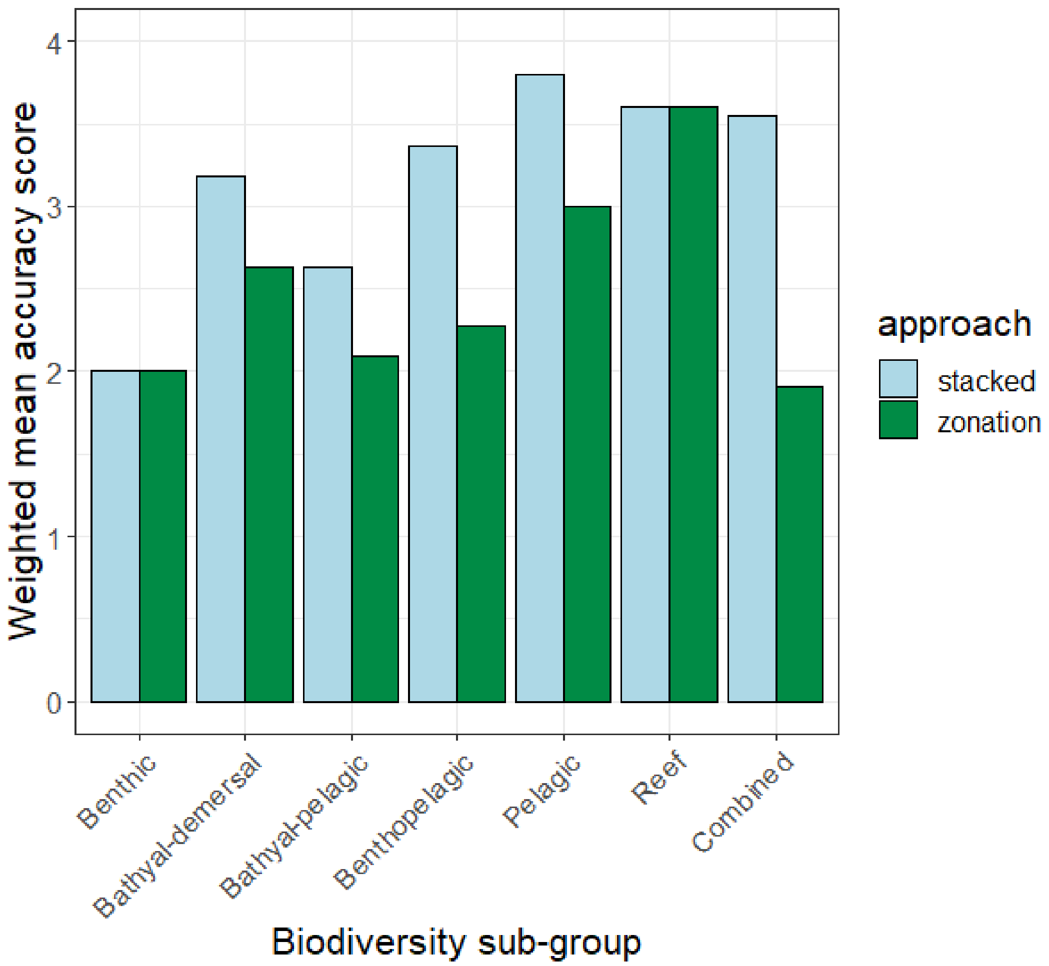

Figure 3-4: Weighted mean map accuracy scores for the demersal fish disaggregated groups. Coloured bars represent scores for the stacked richness and Zonation biodiversity mapping approaches. High scores indicate lower accuracy.

Table 3-3: Weighted mean map accuracy scores, mean expert knowledge scores and mean taxa representation scores for demersal fish biodiversity groups.

Taxon Group	Disaggregated biodiversity group	Approach	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Demersal fish	Benthic	stacked	2.00	1.67	2
Demersal fish	Benthic	Zonation	2.00	1.67	2
Demersal fish	Bathyal-demersal	stacked	3.18	2.00	2.33
Demersal fish	Bathyal-demersal	Zonation	2.64	2.00	2.33
Demersal fish	Bathyal-pelagic	stacked	2.64	2.00	4

Taxon Group	Disaggregated biodiversity group	Approach	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Demersal fish	Bathyal-pelagic	Zonation	2.09	2.00	4
Demersal fish	Benthopelagic	stacked	3.36	2.00	3
Demersal fish	Benthopelagic	Zonation	2.27	2.00	3
Demersal fish	Pelagic	stacked	3.80	1.33	4
Demersal fish	Pelagic	Zonation	3.00	1.33	4
Demersal fish	Reef	stacked	3.60	2.33	3.5
Demersal fish	Reef	Zonation	3.60	2.33	3.5
Demersal fish	All combined demersal fish	stacked	3.55	2.00	2
Demersal fish	All combined demersal fish	Zonation	1.91	2.00	2

3.4.4 Areas well represented by the biodiversity maps

Stacked approach

For the benthic fish group mapped using the stacked approach, experts commented that “coastal regions are high as expected”, specifically mentioning the “east coast of the South Island and Southern New Zealand”. Another expert mentioned that areas of high diversity “suspiciously match areas subject to [high] research trawling e.g., east coast of the South Island”. One expert noted that the map “does a reasonable job” of reflecting diversity of inshore demersal taxa, while another notes that low diversity in deeper areas was “as expected”. Another expert mentioned that they “generally agree[d] with predictions at the scale of the Hauraki Gulf [compared to] east Northland and Bay of Plenty” mentioning that “trawl surveys show lower diversity in the [Hauraki] Gulf”. For the bathyal-demersal group, experts commented that the “high richness in deep [areas], and low [richness] in shallow [is] as expected”, in particular mentioning areas of high richness on north and east Chatham Rise, east coast of the North Island, west coast of the South Island, and bottom of the South Island (Puysegur Trench). For the bathyal-pelagic group, experts mentioned that their commentary would be similar to bathyal-demersal, given they would expect “similar patterns”, though one expert noted that the “Northern Chatham Rise” area was well captured. For the benthopelagic group, one expert wanted it noted that they were “not too sure what to expect”, while another mentioned that the central area of the Chatham Rise, and bottom of the South Island (Puysegur Trench) were well captured. For the pelagic group, experts mentioned that the “higher diversity in the north [is] as expected” and that the map captures “North Island and inshore [areas] well”. For the reef group, experts commented that richness was high in coastal areas “and lower generally on west coasts, as expected” and that the stacked approach map was “more realistic” than the Zonation approach as “cells below known depth ranges of the species used are given a zero”, i.e., low diversity in deeper waters. For the all combined group, experts mentioned that the “Chatham Rise, head of the Puysegur Trench and upper slope diversity generally” were well captured.

Zonation approach

For the benthic group mapped with the Zonation approach, one expert commented on observing "low diversity in deeper regions and high [diversity] in shallow [regions are] as expected". Another commented that high diversity in coastal areas, southern New Zealand, and the east coast of the South Island, is high "as expected", while another mentioned that "Zonation seems better than [the stacked approach]. For the bathyal-demersal group, experts highlighted that much of the areas well captured were the same, but that biodiversity "patterns [were] less clear with the Zonation [approach]". One expert specifically mentioned that the "Chatham Rise, west coast South Island, [southern New Zealand] (Puysegur Trench), and Challenger Plateau" were well captured. For the bathyal-pelagic group, again one expert noted that they would expect similar patterns as for bathyal-demersal while another expert noted that the "Chatham Rise, west coast South Island, [southern New Zealand] (Puysegur Trench), and Challenger Plateau" were well captured. For the benthopelagic group, again one expert noted that they were not too "sure what to expect" while another expert mentioned that the Zonation approach produced "much better representation" than the stacked approach, highlighting the Chatham Rise, east and west coasts of the South Iland and coastal regions in general as matching expectations of high diversity. For the pelagic group, only one expert commented on areas well captured, noting that the "inshore, coastal waters, Hauraki Gulf, Stewart Island, [and] west coast South Island" were well represented. For the reef group, one expert commented that the map "Doesn't look as useful" as the stacked approach map, and added that an accurate reef substrate layer was required to improve it. For the all combined group, one expert commented that areas of high diversity on the "Chatham Rise, east coast South Island, coastal areas, Puysegur [Trench]" and topographic features, i.e., "rises" in the sub Antarctic region were well captured. Another expert commented that the map showed "higher richness in shallow areas" than the Zonation approach.

3.4.5 Areas poorly represented by the biodiversity maps

Stacked approach

For the benthic fish group, experts provided limited commentary on poorly captured areas, though one expert mentioned that they "would expect higher richness in shallow coastal areas". One expert added that they would not agree with the higher value areas "north of Waiheke Island" or in the outer Hauraki Gulf. For the bathyal-demersal group, experts provided limited commentary, though one expert mentioned that biodiversity value in "southern Chatham Rise [and] the Sub Antarctic plateau" were poorly captured. For the bathyal-pelagic group, only one expert provided comments on poorly captured areas, highlighting the "Subantarctic [Plateau] and Puysegur [Trench, southern South Island]". For the benthopelagic group, one expert mentioned that the "east coast South Island [and] more coastal areas, particularly [in the] North Island" region were not well captured. For the pelagic group, experts mentioned that the "low diversity in deeper oceanic waters around northern [areas of the] North Island [was] unexpected" and that the map poorly captures offshore areas, e.g., "Chatham [Islands] and surrounds and southern distributions". For the reef group, one expert commented that the map "does not reflect observed patterns in reef fish diversity at all" as highest reef fish diversity is in northern New Zealand, but the species in the group are "widespread or southern New Zealand taxa", inferring that reef fish diversity is poorly captured. Another expert mentioned similarly that Northland and the Chatham Island region were poorly captured. One expert added that the higher diversity in the inner Hauraki Gulf was "incorrect" and in fact, "shallow water reef fish diversity is higher on the cleaner water reefs outside of the gulf". For the all combined group, experts commented that they would have "expect[ed] high richness in shallow areas, as well as deep [areas]" and specifically that "diversity of shelf (200 m depth) is not captured due to the natural bias toward deep water taxa in the data set". Finally, one expert commented that the southern Chatham Rise, subantarctic region, and coastal areas e.g., east coast South Island, are not well captured.

Zonation approach

For the benthic fish group, experts commented that they would have expected higher value around the Chatham Islands, and that the map "appears to be identifying more [high biodiversity] areas below 200 m depth [than expected], possibly due to the inclusion of some upper slope taxa (e.g., *Antimora*)". For the bathyal-demersal group, one expert commented that perhaps the "coastal, inshore areas" are not well represented, noting that they wouldn't expect high bathyal-demersal diversity inshore. For the bathyal-pelagic group, no commentary was provided. For the benthopelagic group, no commentary was provided. For the pelagic group, one expert commented that the biodiversity distribution was "quite different" to the stacked approach and the subantarctic area contained "surprising[ly]" high value. For the reef group, one expert commented that the map "does not reflect observed patterns in reef fish diversity at all". For the all combined group, experts did not provide commentary for the Zonation approach map.

3.4.6 Usefulness for planning purposes and additional commentary

Experts were asked to provide commentary on the usefulness of mapped biodiversity groups for planning purposes, and some experts also provide general commentary on the maps. For the benthic group, expert commentary ranged from "moderately useful" to "useful". For the bathyal-demersal group, experts commented that the map was "very useful", "not very useful" or "of no use" (given the group constituents). For the Zonation map, expert commentary was similar, though commentary ranged from "moderately" to "somewhat" useful. For the bathyal-pelagic group, comments on usefulness were as follows: "moderately useful", "not very useful", or "of no use" (given the group constituents). For the Zonation approach, comments were the same except one expert noted the group was potentially useful, but provided a caveat that it lacked representation of chondrichthyans. For the benthopelagic group, experts said that the map was "moderately" and "not very useful", or "not useful". For the Zonation approach, commentary was the same except one expect said the map was "useful" (compared to "not useful" for the stacked approach map). For the pelagic group mapped with the stacked approach, experts commented that the map was "moderately" or "not very useful", or "not useful". Commentary was similar for the Zonation approach, with expects saying the map was "useful" (compared to "not very useful" for the stacked approach map). For the reef group, experts commented that the map was "moderately" or "not" useful. One expert commented that the reef group map was "not useful" as "the suite of reef taxa used is completely inadequate". For the Zonation reef fish map, experts agreed that the map/group was not useful. For the all combined fish group, experts commented that the map was "somewhat", "less" or "not" useful. One expert provided a caveat that it was "of most use for conservation of middle depth and deep-water taxa". For the all combined group mapped with the Zonation approach, commentary was a bit more positive, with experts describing the map as "moderately useful", "somewhat useful", or "useful".

All experts provided detailed commentary and advice on biodiversity groupings / classifications. Suggestions are summarised and provided in Appendix B. However, experts also provided some overarching commentary; these points included general commentary on the methodology or use of richness proxies for spatial planning regarding demersal fish. This commentary did not fit into any of the prescribed comment boxes provided to experts and was provided via communications with experts. First, one expert highlighted that some key chondrichthyan species were missing, which may explain why the southern Chatham Rise area is not represented as high value. Another expert commented on the difficulty appraising the maps, given that groups contain fish that “cover large geographic range[s] that would not […] occur together”; they provide elephant fish and snapper as an example and highlight the combination of very rare and common taxa within groups. The same expert highlighted a challenge when classifying taxa into groups; some species occur across the ‘functional zones’ of the groups used. For instance, “snapper [are] an important part of reef fish communities, but also occur off reef”.

Multiple experts commented on the source of the underlying data used to build the models, noting how it may bias outputs. For instance, one expert mentioned that trawl survey data is not useful for certain species of interest such as highly migratory pelagic sharks and protected species. Another expert added that “as the data comes from mostly bottom trawls and is referred to as the demersal fish data set”, the groups bathyal-demersal and bathyal-pelagic should not be distinguished. Commenting on the all combined maps, the expert mentioned that reef fishes and pelagic species “should probably be excluded from the data set because they’re not really demersal fishes and research trawls are unlikely to provide an accurate picture of their distributions”. The same expert also commented specifically on the biases in the underlying dataset, with reference to the all combined group: “the main problem with combining everything into a single demersal data set is that it is strongly biased toward deepwater taxa, the result being that patterns over the continental and insular shelves are not well resolved”. Instead, they suggest that that it would be more sensible to “produce shelf (low water to 200 m depth) and slope (200 to 2500 m depth) models [and include] species with overlapping depth distributions in both data sets”. Finally, several experts commented that for reef fish, there was an inherent issue in that the map predicts biodiversity value into areas where there are no reefs, and one expert questioned whether an accurate rocky reef spatial dataset could be used to improve the map.

3.5 Cetaceans

3.5.1 Expert knowledge

Generally, experts rated their level of knowledge as ‘Very high’ to ‘High’ with a mean score of 1.92. With respect to Delphinidae, experts recorded that they were “confident with inshore Delphinids, [but] less confident with pilot whales and orca” and that they were “confident with Hector’s and Maui [with] broad knowledge of others but some uncertainty”. For whales, one expert commented that they were “confident with Bryde’s, southern right whale and sperm whale, [with] broad knowledge of humpback and blue whale but some uncertainty”. While another expert mentioned that they were “confident about baleen whales [but] less certain about sperm whales”. Finally, another expert mentioned that they are “familiar with all the species […] that are present in New Zealand” and that they have a “broad understanding of the data available for these species [whales and dolphins]”.

3.5.2 Taxonomic representation

In addition to the scores provided on the representation of taxa in biodiversity groups, the experts provided commentary on any key taxa they felt were missing. Summarising the commentary provided, one expert mentioned that “across dolphins and whales, the species list contains most of the more common species" but all experts agreed that certain species were missing. Foremost, the experts drew attention to the absence of beaked whales from the taxa list. Furthermore, from the Delphinidae group, experts commented that the "majority of pelagic / oceanic Delphinidae are missing", in particular many "Globicephalinae [species] are not included" and that key species missing also include false killer whale and the southern right whale dolphin, mentioning that the southern right whale dolphin is likely resident inshore but infrequently sighted. From the whale group, experts commented that "whole families of whales are missing", not just beaked whales ("Ziphiidae: 13 species [in] NZ") but also Kogiidae (two NZ species), and more seasonally effected baleen whales (e.g., minke, sei, and fin whales). Note: several additional taxa, including beaked whales were modelled by Stephenson et al. (2020) using relative environmental suitability models but were not included in the biodiversity maps produced by Cook et al. (2023) as there was limited data available to statistically validate them. Minke, sei, and fin whale distributions were also modelled by Stephenson et al. (2020), but again weren't included in the biodiversity maps, as statistical measures of uncertainty were not available for these models.

In general, experts provided less commentary on Zonation maps as they were provided sequentially after the stacked approach maps. However, unless reflected in the scores and specifically in the commentary, experts often mentioned that their commentary was applicable to the Zonation and stacked approaches.

3.5.3 Map accuracy

The Zonation approach maps scored more accurately than the stacked richness approach across all disaggregated biodiversity groups (Figure 3-5). The Zonation approach map for the EEZ-wide combined cetacean group was scored the most accurately with a mean score of 2.75, with the stacked richness map for the same group scoring the poorest with a mean score of 4.55 (Table 3-4). Mean group scores were mainly close to 3 ('Somewhat accurate') to 4 ('Largely inaccurate). Summaries of expert commentaries are provided in the section below.

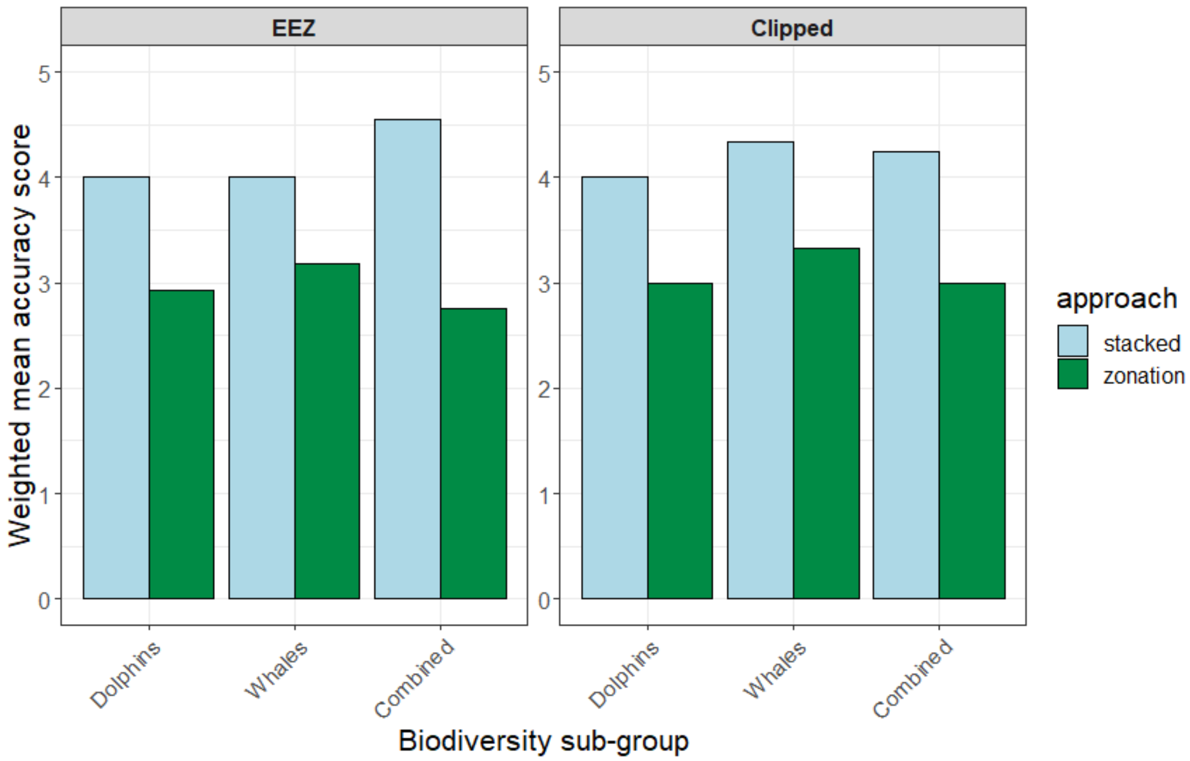

Figure 3-5: Weighted mean map accuracy scores for the cetacean disaggregated groups. Coloured bars represent scores for the stacked richness and Zonation biodiversity mapping approaches. High scores indicate lower accuracy.

Table 3-4: Weighted mean map accuracy scores, mean expert knowledge scores and mean taxa representation scores for cetacean biodiversity groups.

Taxon Group	Disaggregated biodiversity group	Approach	Extent clipped to 'adequate' environmental coverage	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Cetaceans	Dolphins	stacked	N	4.00	2.00	2.75
Cetaceans	Dolphins	stacked	Y	4.00	1.67	2.67
Cetaceans	Dolphins	Zonation	N	2.93	2.00	2.75
Cetaceans	Dolphins	Zonation	Y	3.00	1.67	2.67
Cetaceans	Whales	stacked	N	4.00	2.25	2.75
Cetaceans	Whales	stacked	Y	4.33	2.00	2.75
Cetaceans	Whales	Zonation	N	3.18	2.25	2.75
Cetaceans	Whales	Zonation	Y	3.33	2.00	2.75

Taxon Group	Disaggregated biodiversity group	Approach	Extent clipped to 'adequate' environmental coverage	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Cetaceans	All combined cetaceans	stacked	N	4.55	2.00	3
Cetaceans	All combined cetaceans	stacked	Y	4.25	1.67	3
Cetaceans	All combined cetaceans	Zonation	N	2.75	1.67	3
Cetaceans	All combined cetaceans	Zonation	Y	3.00	1.67	3

3.5.4 Areas well represented by the biodiversity maps

Stacked approach

For Delphinidae, expert comments ranged from "none of these look especially realistic" to specific commentary on well captured areas, for example, that the "importance of North Cape area [was] somewhat captured" and the low diversity in the "nearshore east coast of the [South Island] was fairly accurate", including in the "Canterbury Bight, south [of the] Taranaki Bight, and Snares [Island] Shelf". Experts also commented that the "[high] diversity around the Solander Island is likely accurate" and that the "moderate biodiversity [mapped in the] shelf areas, e.g., Chatham Rise, [was] well captured". Additional commentary included that the nearshore areas were "likely to be most accurate" given that the datasets used to train the models were comprised of sightings that were more abundant inshore "reflecting the investment […] in that space", and that the "species [included] are largely inshore". For whales, experts commented on few areas that were well captured. Comments ranged from "none" with regard to areas that match to experts' knowledge of whale biodiversity to "inshore Canterbury Bight is potentially somewhat realistic" and that "high diversity off Kaikōura well represented". One expert mentioned that "deeper areas" were more likely to have a range of species than shallower areas, which they assessed was "reflected in [the stacked approach] map". For the all taxa combined maps, experts noted that certain areas on the "Kermadec, Lau-Colville and Macquarie Ridges" that were mapped with high diversity, were likely "accurate" and that high diversity mapped off the northeast of Northland was "realistic". Furthermore, the "low diversity in the Canterbury and South Taranaki Bight [was] likely OK".

Zonation approach

For Delphinidae mapped with the Zonation approach, experts commented that "high diversity coastal areas [were] well captured". In particular, high diversity areas "along the [northeast] of the North Island, east coast of the [South Island]" and some offshore areas like the "seamounts on the Kermadec and Macquarie Ridges". Experts also commented that "low diversity" mapped in deeper, offshore waters and on "shelf habitat between Stewart [Island] and Auckland Island" was "likely correct". For whales, experts commented that the high diversity areas in the "Hauraki Gulf, Kaikōura [canyon], South Taranaki Bight, Fiordland coast, and off North Cape" were "likely realistic" or "well captured". For all cetaceans combined, experts mentioned that "high coastal diversity" was "well captured" naming the Hauraki Gulf, Kaikōura Canyon, and off Banks Peninsula as examples. Additionally, one expert commented that the east coast South Island was "relatively well captured" and that in addition to coastal areas mentioned above, the "Bay of Plenty [was] well represented". Furthermore, the same expert mentions that "low diversity areas in the Bounty Trough and north of the Chatham Rise [were] likely realistic". Offshore, experts mention that high diversity that coincides with topographic features on Kermadec Ridge is "realistic".

3.5.5 Areas poorly represented by the biodiversity maps

Stacked approach

For Delphinidae, one expert commented that "the nearshore areas [shown with insets] look overly extrapolated and [are] unlikely to match reality". Experts also commented that they would "expect higher diversity inshore" and "around the shelf-break [off] the east coast of the South Island". One expert noted that there are "unexpected hotspots of diversity in [the] Far North and low diversity off Banks Peninsula", while other experts commented that they would expect "high diversity at geomorphologically distinct habitat[s] such as canyons at Kaikōura, Pegasus canyon, [and] Otago". They also remarked they would expect higher diversity "in the north-east of the [North Island], and on "seamounts along the Kermadec, Lau-Colville and Macquarie Ridges". Finally, for Delphinidae, experts commented that the mapped biodiversity offshore was "dubious" and that they would have expected "offshore areas to have lower diversity". One expert pointed out that "the majority of sightings effort [offshore] is from either fishing grounds or offshore petroleum surveys, both of which are [spatially] biased sources". For whales, experts commented that they would expect "coastal areas to have higher diversity for the [mapped species]" compared to offshore areas, in particular, that "low diversity areas in Northland [and] Auckland were contrary to knowledge of diversity patterns in these areas". Furthermore, experts mentioned that "broad predictions of high diversity for all southern offshore waters [were] likely incorrect" and that areas of high biodiversity in northern offshore waters "make no sense". One expert noted that "large swaths" of high value areas were not captured, mentioning that "the Hikurangi Trench […] is an area of high diversity" for numerous species, including sperm whales and various beaked whales. For all cetaceans combined, experts commented that they would "expect higher diversity inshore", and "offshore areas to have lower diversity", and that "high biodiversity in the [deep] waters in the [southern areas of the map] was likely inaccurate". Finally, experts commented that high diversity on the "Otago shelf break [was] not well captured" and that the "Hauraki Gulf [was] not well represented as a biodiversity hotspot".

Zonation approach

For Delphinidae biodiversity mapped with the Zonation approach, experts commented that they "would have expected more differentiation in Otago, Canterbury, and Northland Shelf and the Hauraki Gulf" in place of "generic diversity patterns". Another expert mentioned that they would expect "higher diversity [for Delphinidae] on the Challenger Plateau and lower [diversity] over the Kermadec [Ridge]". For whales, experts commented that they would "expect higher diversity inshore generally", and that they would expect to see low diversity "around the subantarctic islands […] for these taxa". Furthermore, one expert mentioned that the low diversity on the "east coast [South Island] is incorrect" and that the "high diversity on [the] Auckland, Campbell, and Bounty Island shelves [is also] incorrect". Finally, for all cetaceans combined, experts noted that the high diversity around the subantarctic islands is "not correct" and "poorly represented". One expert mentioned that the east coast of the South Island “should have more differentiation” and that “nearshore habitat [in this area] seems to have higher diversity, which is unlikely”.

3.5.6 Usefulness for planning purposes and additional commentary

Experts were asked to provide commentary on the usefulness of mapped biodiversity groups for planning purposes, and some experts also provided general commentary on the maps. For the all cetaceans combined group, expert commentary varied somewhat between “not useful” and “somewhat useful”. For Delphinidae, commentary varied from “useful” but with the caveat that it was “not useful” for pilot whales, or “not particularly useful” or “unlikely representative of all dolphins” or “I would not suggest using this map for planning purposes”. Similarly, experts commented that the whale group was “not useful” or “not particularly useful”. One expert commented that the whale group was of mixed utility because species included have differing distributions (both spatially and temporally), commenting that “Bryde’s whales are resident and highly coastal, sperm whales are resident but very pelagic, while humpback whales largely only migrate through [New Zealand] waters”. This echoes the sentiment of one expert regarding the dynamic nature of cetaceans: “seasonal and temporal that is going to be important to the interpretation of the distribution of any species is missing, and therefore demands even greater caution in using the maps”. Importantly, experts provided some general comments on the utility of the maps including that richness is “only one important facet to consider when planning”, giving the example that Māui dolphin habitat is shown as ‘low richness’ in the maps, “but would still need to be taken into account during planning as [they are] a critically endangered sub-species”. Furthermore, it was highlighted by experts that some areas may be low richness areas but are “still critical habitat for some species” while mentioning that the whale group “doesn’t reflect seasonal migration patterns”. In particular, one expert mentions that whilst an area might be “used infrequently [it] may play a significant role in the animals’ life history”. Finally, there was one comment on the clipping of some maps to 2000 m, where one expert mentioned that it is “not sensible for large baleen whales which move across oceanic basins without regard for depth”. Note: the maps were clipped to 2000 m with regard to environmental coverage (Stephenson et al. 2020), to remove areas of the environmental space that were poorly captured by the training data available for the models.

Overarching commentary was provided by some experts, and these points included general commentary on the methodology or use of richness proxies for spatial planning with regard to cetaceans. This commentary did not fit into any of the prescribed comment boxes provided to experts and was provided via communications with experts. Experts commented on the complete absence of some species which “contribute a lot to cetacean diversity” but have a “cryptic nature” and “which are poorly known and so not covered at all here, e.g., beaked whales”. Importantly, one expert noted on occasions that the use of richness metrics for cetaceans “understates the importance of some areas for critical behaviour of single species, e.g., Port Ross in the Auckland Islands as a breeding / calving ground for southern right whales” and “strap-tooth whales appear to use the shallow waters of the Hauraki Gulf routinely, [but are] considered [to be] deep-water animals”. One expert provided specific commentary on the datasets used to train underlying species models, given their familiarity with sightings data. They mention that “the degree of extrapolation is high for the data that is available” and that “a lack of systematic survey effort to underpin these maps means they should be used with considerable caution”. Conversely, one expert commented that the Zonation method for mapping biodiversity “gave results which more closely matched [their] expectations”.

3.6 Seabirds

3.6.1 Expert knowledge

Generally, experts rated their level of knowledge as 'Very high' to 'High', with a mean score of 1.9 across all disaggregated biodiversity groups. Typically, experts commented that they describe themselves as "familiar with overall species distributions" or "confident" with all species in terms of distribution. Many of the responses detailed sources of expert knowledge, including: "based on tracking data" or "based on general observations rather than tracking" or highlighting that knowledge comes from "tracking data from some, but most taxa [included in the petrel group] are not tracked". Finally, some experts highlighted that while they have general knowledge of taxa included in some groups, they have "very general knowledge of foraging behaviour [with respect to all seabirds combined]" or are not familiar with their "particularities [with respect to penguins and shags]". Finally, one expert noted that they were not as confident on "shags and penguins".

3.6.2 Taxonomic representation

In addition to the scores provided on the representation of taxa in biodiversity groups, the experts provided commentary on key taxa that they felt were missing. When assessing the representativeness of taxa in groups, experts noted that "no taxa are missing" from the albatross, penguin, or shearwaters groups. From the petrel group, experts highlighted that the black-winged petrel (*Pterodroma nigripennis*) and grey-backed storm petrel (*Garrodia nereis*) are "important representatives in the north and south Aotearoa [NZ], respectively" and are missing from the group. From the "others" group, experts noted that a variety of taxa were missing, including "white-fronted tern, black-fronted tern, sooty tern, Antarctic tern, red-billed gull, black-backed gull, grey ternlet, black-billed gull, white-fronted tern, black-fronted tern, New Zealand fairy tern, grey and black noddies, and red-tailed tropicbird".

The experts also noted out-of-date taxonomies and inaccuracies in taxonomic information. For instance, they highlight that the "'Codfish Island Diving Petrel' should be 'Whenua Hou Diving Petrel'"; "'Blue Penguin' should be 'Little Penguin'"; "Fiordland crested Penguin is *Eudyptes pachyrhynchus*"; Flesh-footed Shearwater is *Ardenna carneipes*, Fluttering Shearwater is *Puffinus gavia*, North Island Little Shearwater is *Puffinus assimilis haurakiensis*, Kermadec Little Shearwater is *Puffinus assimilis kermadecensis*, and Subantarctic Little Shearwater is *Puffinus elegans*". Furthermore, several inaccuracies in nomenclature were noted in the shag group, where "taxonomy is out of date". Foremost the "Stewart Island Shag is now split into Otago (*Leucocarbo chalconotus*) and Foveaux (*Leucocarbo stewartia*) Shags", and "Spotted and Pitt Island Shags are now placed in the genus *Phalacrocorax*" and the blue shag has been merged with the spotted shag". These issues are highlighted in Appendix B.

3.6.3 Map accuracy

The stacked richness maps scored more accurately than the Zonation approach across all disaggregated biodiversity groups, except for the shearwaters and other seabirds groups (Figure 3-6). The stacked richness approach map for the Shag group was scored the most accurate with a mean score of 1, which was the highest scoring disaggregated biodiversity group across all taxa. On the contrary, the Zonation map for the Shags was the poorest scoring, with a mean score of 4 (Table 3-5). Mean group scores ranged between 1 ('Very accurate') to 4 ('Largely inaccurate). Summaries of expert commentaries are provided in the section below.

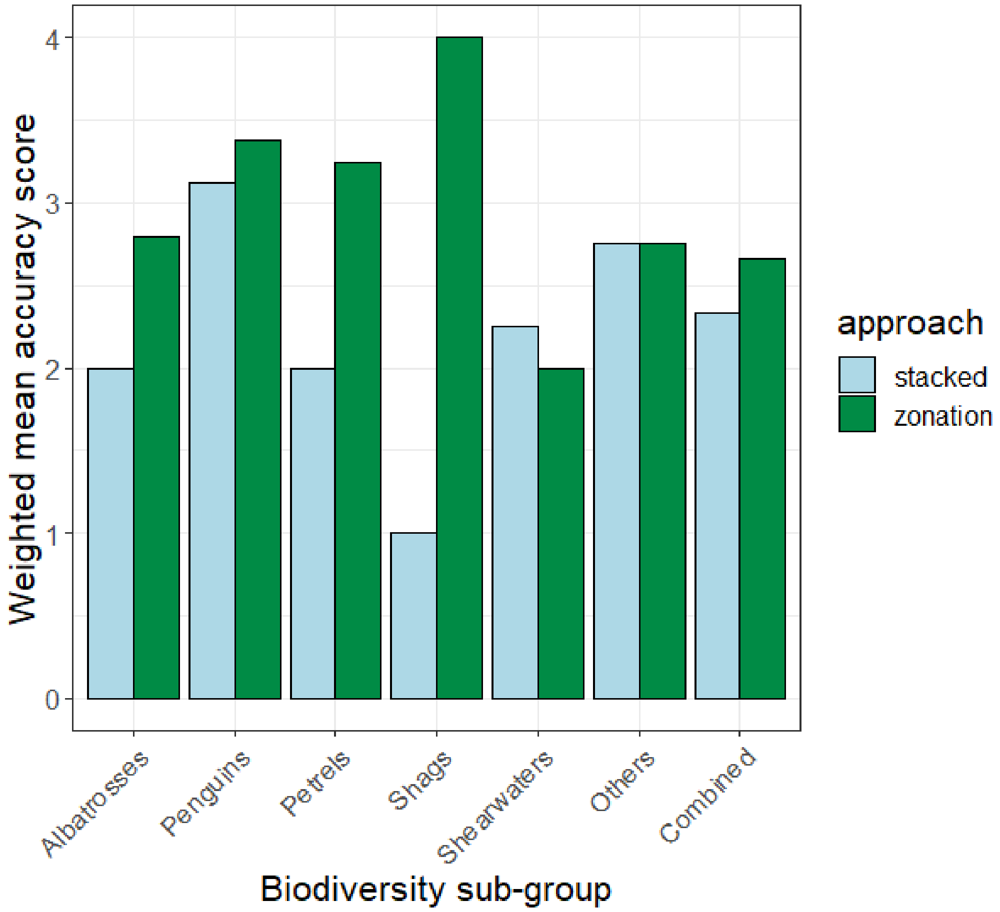

Figure 3-6: Weighted mean map accuracy scores for the seabird disaggregated groups. Coloured bars represent scores for the stacked richness and Zonation biodiversity mapping approaches. High scores indicate lower accuracy.

Table 3-5: Weighted mean map accuracy scores, mean expert knowledge scores and mean taxa representation scores for seabird biodiversity groups.

Taxon Group	Disaggregated biodiversity group	Approach	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Seabirds	Albatrosses	stacked	2.00	1.33	1
Seabirds	Albatrosses	Zonation	2.80	1.33	1
Seabirds	Penguins	stacked	3.13	2.33	1
Seabirds	Penguins	Zonation	3.38	2.33	1
Seabirds	Petrels	stacked	2.00	1.67	1.67
Seabirds	Petrels	Zonation	3.25	1.67	1.67
Seabirds	Shags	stacked	1.00	2.00	1.33
Seabirds	Shags	Zonation	4.00	2.00	1.33

Taxon Group	Disaggregated biodiversity group	Approach	Weighted mean map accuracy score	Mean expert knowledge	Mean taxonomic representation
Seabirds	Shearwater	stacked	2.25	1.67	1.33
Seabirds	Shearwater	Zonation	2.00	1.67	1.33
Seabirds	Other seabirds	stacked	2.75	2.33	3
Seabirds	Other seabirds	Zonation	2.75	2.33	3
Seabirds	All combined seabirds	stacked	2.33	2.00	2
Seabirds	All combined seabirds	Zonation	2.67	2.00	2

3.6.4 Areas well represented by the biodiversity maps

Experts provided commentary on areas of both high and low mapped richness that matched their expectations of seabird biodiversity patterns in New Zealand waters.

Stacked approach

For albatross biodiversity mapped with the stacked approach, experts commented that the map "captures the importance of the Chatham Rise, Campbell Plateau, shelf break zones, and around the South Island". For penguins, experts commented that for hoiho (yellow-eyed penguin) the "distribution is reasonable" and that the "east coast of the South Island is high as [expected]". Another expert provided more detail, mentioning that "foraging during breeding is [captured], based on colony sites along coastlines and islands and foraging ranges, and is generally captured. Therefore, low biodiversity areas (during breeding), [are] as expected". For shags, experts consistently commented positively on the stacked approach map. Comments included "good agreement" with expectations, and the "map shows major breeding areas and dispersal zones and inshore foraging behaviour". Additionally, one expert noted that "most coastal areas have high values as expected, especially around Auckland, Marlborough Sounds and [southeast] South Island between Otago and Rakiura [Stewart Island]". For the shearwater group, experts noted that the map shows "some of the activity in the north" and that the several feeding/breeding areas northeast of the North Island, east of the South Island, and south of Rakiura (Stewart Island) are represented as expected. For petrels, experts commented that the map "captures the more widespread use of the entire EEZ of this group" in particular, areas north of the Chatham Rise, Bounty Trough, and in seas off the west side of the South Island. One expert simply mentioned that there were "mostly high values all over New Zealand, as expected". For the others group, experts noted that the map correctly highlights the "more northern concentrations of these species" which are both coastal and pelagic, and that given the species in the group, the "higher richness" in coastal areas is "expected". Few comments were made on the all seabirds combined group, and one expert noted that the map "shows reasonable [biodiversity distribution] pattern".

Zonation approach

For albatross taxa mapped with the Zonation approach, experts said that the well captured areas were the same as for the stacked approach. For penguins mapped with the Zonation approach, experts commented that the many of the same areas were well captured as for stacked approach but one mentioned that the "east coast of the South Island and subantarctic [Islands are] high, as expected". For shags mapped with the Zonation approach, the commentary from experts was brief highlighting a few areas that were well captured including, "high value in coastal areas" and, "some of the breeding areas". However, note the 'areas poorly represented by the biodiversity maps' commentary for this map, in particular (Section 3.6.5). For shearwaters, experts mentioned that many of the same comments applied to the Zonation approach map as for the stacked approach, but one expert noted that the map "shows some areas OK in north and south" and that it "does show the hotspot off Banks Peninsula used by multiple [shearwater] species". For petrels mapped with the Zonation approach, experts noted that the same commentary made for the stacked approach largely applies. However, additional commentary included that the "northeast of the North Island, [and] Kermadec [Islands are] high, as expected". Experts commented that many of the same comments applied to the Zonation approach for the other group, though one expert mentioned that the "Zonation [approach] shows the general pattern better than the [stacked approach] map". Finally, for all seabirds combined, again there was little commentary, but one comment read that the map "captures quite a lot of [inshore] areas OK".

3.6.5 Areas poorly represented by the biodiversity maps

Stacked approach

For albatross taxa, experts pinpointed areas where they felt biodiversity value was low or missing. For instance, biodiversity value was lower than expected in the "Bounty Islands, Fiordland area, eastern Wairarapa and east of Kaikōura". Another expert provided a link to a GIS tool that shows where protected species bycatch has occurred and noted that the "west coast South Island [and] northeastern North Island and Kermadec [Islands]" are poorly captured. For penguins, experts first commented that the Blue/Little Penguin are "much more coastal" than shown and therefore the biodiversity value around the North Island is "grossly overestimated" as they are the "only penguin in the north". Similarly, experts also noted that there was "too much emphasis on a single inshore species in the top half of the South Island", specifically "west coast and north of Banks Peninsula". Finally, one expert commented that the map "underplays the more pelagic distribution of crested penguins in the south", mentioning that "Tawaki and Snares crested distribution is poorly captured, and the Antipodes are under-represented". Experts provided no comment on areas poorly represented by the stacked approach map for shags. For shearwaters, some experts provided strong commentary on the map, indicating "major issues" and "very strong bias to coastal foraging". In particular, experts highlighted that the map "totally misses huge concentrations around Stewart Island, Snares [Islands], Auckland, Campbell and Chatham [Islands]". Furthermore, one expert highlighted that the static nature of the shearwater map fails to account for "movement through the EEZ post-breeding towards the east and north of [New Zealand], and subsequent return to breeding grounds post-migration". For petrels, experts highlighted that the following areas should be shown with higher biodiversity value: "east of Chatham [Islands], southeast of the EEZ" and "areas north of the Kermadec [Islands], west of Three Kings, and the [Subantarctic Islands]". Experts provided little commentary on the others group (given the mix of species), but one expert noted that they were not sure what species would be driving the richness north of New Zealand. For all seabirds combined, experts commented that the combined map seems to have "hidden the importance of oceanic areas for seabirds", in particular that the north of the EEZ and around the Kermadec Islands are poorly captured and that the area to the south of the EEZ, where there is pelagic and albatross activity, is also underrepresented.

Zonation approach

For albatross, experts commented that the map "overemphasises [the importance of] the Three Kings region and the same discrepancies are found in the [stacked approach] map". Another expert mentioned that they thought the biodiversity value in the "Northland Plateau" was perhaps too high. Additionally, one expert mentioned that the area of the EEZ mapped with low biodiversity was incorrect, and that "petrels and albatrosses are present throughout the EEZ". For penguins, it was noted that the high value in the North Island compared to the South Island is at odds with what would be expected. For shags mapped with the Zonation approach, the commentary provided by experts is a stark contrast to the comments provided on the stacked approach. Experts were clear that the map was "poor" and that the "offshore areas should not be as high biodiversity areas, given shags are coastal birds", furthermore that they are "very coastal; within 10 km of land in most cases". Experts noted that many of the same commentary applied to the Zonation map as for the stacked approach map, but that the Zonation map "underdoes [the] importance of areas in southern New Zealand" highlighting tītī (sooty shearwaters) mainly. For petrels, experts highlighted that the following areas are too low: "west of Kermadec [Islands], around the subantarctic [Islands], the Bounty Trough, east of the North Island and north of the Chatham Rise". Conversely one expert noted that they would not expect such high value in areas "northwest of the South Island". Few comments were provided for the Zonation approach map for the others group (many of the same comments applied), but one expert explained that there was generally too much high value in offshore areas. Finally, for all seabirds combined, experts noted that the pelagic areas should have higher value, that "petrels and albatrosses are present throughout […] the EEZ", and that the Chatham Rise area should have higher biodiversity value.

3.6.6 Usefulness for planning purposes and additional commentary

Experts were asked to provide commentary on the usefulness of mapped biodiversity groups for planning purposes, and some experts also provided general commentary on the maps. For albatrosses, two experts noted that the stacked approach maps were "reasonable" and "useful" while one, noted that it was "not useful". For the Zonation albatross map, two experts commented that the map was "reasonable" or that "it seems more useful than the stacked [approach] map, and one expert assessed that it "needs improving". For penguins, two experts noted that the stacked approach map was "not very useful", while one expert commented that the group was "useful". For penguins mapped with the Zonation approach, there was consensus that experts felt the map was "not very useful". For shag biodiversity mapped with the stacked approach, experts agreed that the map was "good", "useful", and "somewhat useful". Conversely, experts remarked that the Zonation approach map for shags was "not useful" at all or "requires improvement". For shearwaters, expert commentary on usefulness varied from "useful" to "not very useful", to "not useful at all, and requires remaking" (these comments apply to the stacked and Zonation approaches). Commentary on the usefulness on the petrel stacked approach mapped varied from "useful" and "reasonable", to "not useful". For the Zonation approach, experts commented that the petrels map was either "not very useful" or "somewhat useful". Experts provided a variety of commentary on the usefulness of the others group and maps, from "mostly OK" to "not useful". One expert commented that the "group mixes species with very different natural histories, adaptations, and needs" and so was probably not useful for planning purposes for either modelling approach. For all seabirds combined mapped with the stacked approach, two experts agreed that the map was "somewhat useful", whereas one expert believed that the map was "not particularly useful". Finally for the Zonation approach, experts disagreed on the usefulness of the all seabirds combined map. Two (three?)

experts said that it was “not useful” or needed improvements. In contrast, one expert made the point that the map “seems very useful as it [appears] to have captured the essential areas to ‘seabirds’ across Aotearoa [New Zealand]”.

Overarching commentary was provided by some experts, and these points included general commentary on the underlying datasets, biodiversity groups, and methodologies. First, one expert highlighted some key points on the underlying spatial datasets used to create biodiversity maps. They note that the “seaward extension” mapping is adequate for limited range species (gannets, penguins, shags, gulls, and terns). However, for other species like albatross, petrels and shearwaters that may breed at the same coastal locations, coastal areas will only account for a limited portion of their range and not include “their often-wide-ranging foraging distributions”. The approach additionally does not account “for the wide-ranging distribution of highly pelagic species […] nor does it take account of species migration patterns”. Another expert highlighted that the groupings used for petrels and others are at odds with what they would assess as useful for conservation purposes. They highlight that grouping “black and giant petrels with storm petrels/prions does not seem to support any conservation action” and instead, they recommend grouping taxa in terms of “guilds” for example, planktivorous, and mainly fish or squid diets. They indicate that this would provide a more informative group for assessing overlaps with possible threats (e.g., climate change and certain fisheries). The same expert notes that the others group is highly variable in terms of taxa grouped together, questioning the usefulness of the group. Finally, they also make the point that several species are classified to subspecies level, and they instead recommend that subspecies are combined to species level but that the existence of subspecies for those taxa is stressed.

Finally, one expert took the opportunity to stress one area that was consistently underrepresented in the biodiversity maps, Rangitāhua / Kermadec Islands. They mention that the islands represent a “unique place for seabirds and seabird species within [New Zealand] waters”, noting that the inclusion of more taxa that reside there would increase the importance of the region in seabird biodiversity maps.

4 Discussion

4.1 Interpretation of expert appraisal

Generally, most biodiversity maps achieved a mean weighted map accuracy score between 1-3 (Figure 3-1). As indicated in Figure 3-1, the Zonation approach was deemed more accurate than the stacked approach for most groups. However, there were differences in the mean weighted accuracy scores obtained, depending on the taxa group. For cetaceans, the stacked approach performed poorly compared to the Zonation approach (evident in Figure 3-1), whereas for seabirds, the stacked approach performed much better than the Zonation approach (Figure 3-1). For all taxa groups, there was considerable variability within disaggregated biodiversity groups, depending on both the group mapped and the approach used. For instance, the mean weighted map accuracy score for seabird biodiversity maps created using the stacked approach was >4 and for Zonation it was ~3, but for shags mapped with the stacked approach it was 1. This indicates that the accuracy of the approach used is dependent on the biodiversity group and taxa included, but likely most importantly, the underlying data. Again, for shags, experts noted that their distribution is limited to ~10 km from the coast, therefore sightings information used to create underlying distribution maps have a better chance of accurately representing biodiversity distributions than taxa with wide-ranging, pelagic, or transient (migratory) distributions.

Expert scores were weighted based on self-assessments of knowledge; weighted-means of map accuracy therefore provide a good basis for assessing whether predicted biodiversity distributions are suitable for spatial planning purposes. Expert self-assessment of knowledge scores varied between biodiversity groups (and disaggregated groups therein). For instance, seabird and cetacean experts provided scores indicating level of knowledge, but for seafloor invertebrates, self-assessments were much more variable across disaggregated groups. This highlights the differences in expertise between groups (generalists and ecologists compared to specialised taxonomists), but also the variability within groups, where the seafloor invertebrate group includes taxa from several different phyla. Most distribution models used to generate the estimates of biodiversity in Cook et al. (2023) had already been assessed by experts at the genus or species level (exceptions: seabird, cetacean and macroecological models). For previous modelling exercises which involved expert evaluation steps like the one applied here (Stephenson et al. 2023a; Bennion et al. 2024), a cut-off of 4 – largely inaccurate, was used to inform use of model predictions for spatial planning exercises (i.e., if a model prediction was scored with a 4 or 5 it was not used for spatial planning). However, in past approaches, only one expert assessment was conducted per map, and the level of commentary received was minimal compared to the present study. In this work, most maps (53 out of 65) assessed by experts obtained a 'passing' score <4 when the weighted mean accuracy score was rounded to the nearest integer. However, in some cases, maps that scored <4, were also described as not useful by most experts, for example, the penguin maps in the seabird group. Thus, for this assessment, maps that had a weighted mean accuracy score <3 was suggested to be useful for marine spatial planning, a score of 3-3.5 was suggested to be potentially useful for marine spatial planning (e.g., omitting certain inaccurate geographic areas as identified by the expert commentary), and a score rounding to 4 or 5 (i.e., >3.5) was considered not to be useful for marine spatial planning (see Table 5-1 in Recommendations). Additionally, some experts highlighted that their scoring of map accuracy was influenced by their field of study and knowledge of certain taxa contained within the taxa lists, compared to experts that provided a more general approach to appraisals. Such self-assessed knowledge, along with taxonomic group representativeness, and additional expert commentary on the approaches and underlying data that should be considered in union with respective scores of map accuracy (see Recommendations below).

4.2 Taxonomic, spatial, and temporal gaps identified by experts

Experts provided valuable commentary on taxonomic gaps within mapped biodiversity groups, but also on the various spatial, temporal, and underlying data gaps that impact the biodiversity distribution patterns produced by Cook et al. (2023).

Experts noted that key taxa were poorly represented in some groups. For seafloor invertebrates, this includes various sponge (Porifera) and Bryozoa taxa. Many sponges and bryozoans are biogenic habitat formers, forming sponge gardens and bryozoan thickets, which support diverse species assemblages (Wood et al. 2012; Maldonado et al. 2017). Underrepresentation of these taxa in particular can limit the value of biodiversity maps striving to represent "key biogenic habitat formers". Examples of some taxa that were not modelled by Stephenson et al. (2023a) and therefore were not available for biodiversity mapping (Cook et al. 2023), for example the following sponge genera: *Axinella, Pararhaphoxya, Iophon, Raspailia*. Some of these taxa are relatively common and provide critical ecosystem functioning roles, i.e., creation of habitat, refugia for associated species, and biogeochemical cycling. With reference to crustaceans, one expert pointed out that available models represent many abundant taxa but given there are >3,000 crustacean species in the region, crustacea are woefully underrepresented.

For other groups, like cetaceans, taxa missing from biodiversity groups caused other issues, including large swaths of areas known to be biodiverse, not being represented as so. This was most profound in several deeper areas where deep diving beaked whales (Ziphiidae) were not included in the biodiversity map of 'whales'. Six beaked whale species (*Mesoplodon densirostris, Mesoplodon densirostris, Tasmacetus shepherdi, Ziphius cavirostris, Mesoplodon grayi,* and *Berardius arnuxii*) were modelled by Stephenson et al. (2020) and therefore were available for inclusion in the compilation of biological diversity maps. However, it was decided by Cook et al. (2023) that models produced without empirical data of species occurrence (i.e., with relative environmental suitability or 'RES' modelling) would not be included in the stacked or Zonation approaches. The same issue applies to Globicephalinae, of which several species were also modelled using the RES approach (Stephenson et al. 2020) and therefore not included in biodiversity maps produced by Cook et al. (2023). These taxa represent a significant gap in the data available for mapping cetacean biodiversity that cannot easily be filled given a lack of sightings information (Stephenson et al. 2020) and their cryptic nature.

For macroalgae, one comment by experts applies to several of the biodiversity groups; that the taxa in the group are "only representative of commonly collected species". This statement captures sentiments offered by many of the experts, that taxa included in various biodiversity groups represented those of commercial value or regularly by-caught (biases due to fisheries), or sampling effort (e.g., in the case of cetaceans, taxa represented are those found close to the shore where sightings are more likely to occur). These biases have knock-on implications for spatial biases given effort / density of species occurrence information used to generate underlying models and the overlapping niches of taxa represented. The latter point means that niches of rare or underrepresented taxa in difficult-to-access (e.g., offshore, or very deep) areas will not be accurately represented in biodiversity maps.

Experts took the opportunity to comment on the biodiversity groups and their taxa constituents. In some cases, experts suggested changes to the groups' name (e.g., renaming the 'bathyal-demersal' to 'bathydemersal') or shifting taxa to different groups (e.g., suggesting *Pseudocaranx georgianus* would be better placed in the pelagic group than in the reef group). Additionally, in some cases, experts provided suggestions on how biodiversity groups could be used to more appropriately reflect overlapping life histories. For seabirds, one expert suggested that the 'petrels' group could be divided by 'guilds' (e.g., planktivorous, mostly squid diet, mostly fish diet) to more accurately represent taxa with similar modalities. Given the breadth of responses received across taxa groups, this information has been summarised in Appendix B. Future efforts to improve biodiversity maps for use in spatial planning should take heed of the information in this table.

Finally, several experts made the point that static maps of biodiversity do not accurately show biodiversity patterns for temporally dynamic species like migratory birds and whales. On several occasions experts referred to areas that are of critical importance for life histories of highly mobile species, e.g., important breeding or feeding grounds, pointing out that the maps do not show high biodiversity in these areas given their transient use. However, experts in some cases made it clear that even if the space is not used routinely, it can still represent a critical space for species and an seasonally high area of biodiversity, e.g., Hector's dolphin hotspots at Banks Peninsula (Brough et al. 2019; Brough et al. 2023). Dynamic modelling approaches (e.g., seasonal) could be used to better understand spatio-temporal biodiversity patterns of species. For example, see Stephenson et al. (2023b) for these approaches applied to marine predators in the Hauraki Gulf. Regardless, it is important to note that the approach used by Cook et al. (2023) was undertaken to represent Biological Diversity. Separate frameworks, that specifically target key ecological criteria such as "special importance for life history stages" or "ecosystem service/function" could be used to ensure critical areas for activities like breeding and feeding are represented in any spatial planning efforts.

4.3 Limitations of the approach

Various limitations of the appraisal approach used here must be acknowledged when interpreting both commentary and map accuracy scores. Some of these limitations are common to other 'Delphi-style' approaches, while others are specific to the maps or method used to attain expert evaluations of biodiversity maps.

- As apparent from the commentary received, experts usually focused on map insets (for example see B, C, D, and E in Figure 1-1). However, this focus could have impacted the extent that experts appraised the full spatial extent of the maps as a whole. In future, careful attention should be placed on selected insets given the impact it can have on the effectiveness of appraisals.
- Many experts were asked to assess biodiversity maps of groups that included taxa that were outside of their field of expertise. Some experts noted familiarity with species assemblages associated with their field of study, but in some cases, experts explained that they were placing greater focus on taxa that they had familiarity with. If there were particularly few taxa in a given group that they were familiar with, this could impact their assessment. Note: it is hoped that this would be captured by the self-assessment of expert knowledge, but in some cases, experts refused to provide input on disaggregated biodiversity groups with which they had low confidence.

- The biodiversity groups were determined by broader ecosystem ecologists, building upon information from the Key Ecological Areas workstream and other similar work. Taxonomic experts were not included in the biodiversity grouping process, and in some cases, experts suggested altering the taxa included in disaggregated biodiversity groups (see Appendix B for details).

- Many experts commented that they were confident with biodiversity patterns in well studied areas or areas they had surveyed or viewed data from, but that it was challenging for them to assess broad-scale biodiversity patterns at the scale of the study extent (e.g., whole EEZ), given many areas at these scales have been poorly sampled/studied.

- It was challenging to find experts with capacity and willingness to participate in the process. Many experts did not have the time available to commit to the evaluation or could take part but could only provide a small amount of their time. This resulted in variation in the effort/time given to the appraisal and depth of commentary received, though this varied between groups. For example, experts were asked to appraise 19 maps for seafloor invertebrates but only six for macroalgae. Experts with fewer groups to assess typically provided more detail on each map. For example, for the macroalgae group detailed lists of genera not represented in the maps were provided (Section 3.3.2), whereas for seafloor invertebrates, commentary was generally high level.

- While the aim of this work was a Delphi-style approach where experts undertook the process in their own time, and on their own, this wasn't possible in all cases. Due to time constraints, three of the seafloor invertebrate experts requested that their feedback be provided in a meeting process, to expediate the appraisal process. Furthermore, given availability, two of the macroalgal experts conducted the appraisal together, and provided their feedback in one worksheet.

- Many experts drew attention to the mixing of taxa with different functional and life-history traits in within disaggregated biodiversity groups. In some cases, experts mentioned that these groupings made it difficult to assess biodiversity patterns as taxa that would not co-occur were mapped together (e.g., see commentary on penguins within the seabird group). It should be noted that while this is a potential issue for experts in terms of the appraisal, the process prior to this evaluation (Cook et al. 2023) was aimed at creating maps representing biological diversity. Mapping functionally important and areas important for life-history stages (e.g., breeding or feeding) should be addressed in a separate process.

- As some experts provided their input together, and others declined to provide scores for some disaggregated biodiversity groups (or provide any scores at all), there are unequal sample sizes across groups. Commentary has been summarised regardless of whether an expert was comfortable providing scores or not, but it should be noted that while the map accuracy scores were weighted by expert knowledge, the commentary provided was not. Therefore, when interpreting expert commentary, it should be noted that a variety of expertise and knowledge levels are represented.

5 Recommendations

Use of biodiversity maps for spatial management

- Weighted mean accuracy scores should be used to inform the use of maps for spatial management, whilst considering the expert knowledge scores and taxon representativeness scores for the groups. Previous studies used an accuracy score cut-off of ≥4 to inform whether models/maps should be used for spatial planning (Stephenson et al. 2023a; Bennion et al. 2024). The work here differs somewhat as weighted mean accuracy scores were generated; however, the same cut-off is recommended, with some additional considerations. Biodiversity maps with weighted mean accuracy scores that round to 4 or 5 (e.g., largely inaccurate and inaccurate) should not be used for spatial management. Additionally, if mean self-assessed expert knowledge is >3 (moderate to low) then caution should be placed on expert feedback (and therefore use of associated map). Otherwise, we suggest maps with mean scores between 3 – 3.5 could potentially be used with careful consideration (e.g., potentially omitting specific areas identified as inaccurate by experts) and those with scores <3 could be used for spatial management, but their use should be considered on a case-by-case basis, drawing on the respective expert commentary. Additionally, biodiversity maps for groups that score poorly (>3) for taxon representativeness could still be integrated into spatial planning, but the name of the group may need to be reconsidered, so that the value of the layer is not over-represented. Biodiversity map scores and recommendations on the use of maps for spatial planning and informing management are provided in Table 5-1. A spreadsheet containing summarised expert evaluation scores, recommendations on the use of the maps (as shown in Table 5-1), and additional metadata accompanies this report[1].

- Expert evaluations (commentary and scores) should be used to inform use of the biodiversity maps for spatial planning purposes. As well as the scores informing which maps are potentially suitable for spatial planning, the comments are relevant to the interpretation of the map use. For example, if using a map where experts have commented that a mapped high biodiversity area is inconsistent with their knowledge, then this particular area could be disregarded or down-weighted during spatially-explicit decision making.

- Limitations of the models used to create the biodiversity maps should be acknowledged and considered during the interpretation of biodiversity maps. For example, underlying habitat suitability models are based on occurrence information. Therefore, biodiversity maps (richness surrogates) do not reflect taxa abundances (Cook et al. 2023; Stephenson et al. 2023a).

- The biodiversity maps should not be used to inform management decisions in isolation, and in some cases other types of information may be more relevant for informing a specific management question. For example, once maps are developed for the KEA criterion "areas important for like history stages", they may be of greater importance for informing the management of seabird populations than biodiversity

[1] Supplementary spreadsheet: Expert_evaluation_summary_table.xlsx

maps. Additionally, in some situations it may be prudent to interpret the biodiversity maps alongside other sources of information, such as individual species distribution maps and point location records, amongst others.

Table 5-1: Weighted mean map accuracy score, mean expert knowledge score and mean taxonomic representation score for each biodiversity group and approach, with categories of potential usefulness for marine spatial planning (MSP). Note: useful for MSP recommendation (yes, potentially, no) and the rationale provided are the opinion of the authors of this report, based on the compiled feedback from experts.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Seafloor invertebrates	Key biogenic habitat forming	Stacked	2.87	1.88	1.75	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and taxon representativeness.
Seafloor invertebrates	Key biogenic habitat forming	Stacked – naturalness	3.07	1.88	1.75	Potentially	Inclusion of naturalness potentially reduces map accuracy.
Seafloor invertebrates	Key biogenic habitat forming	Zonation	2.29	2.13	1.75	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge, and high taxon representativeness.
Seafloor invertebrates	Key biogenic habitat forming	Zonation – naturalness	2.71	2.13	1.75	Potentially	Inclusion of naturalness potentially reduces map accuracy.
Seafloor invertebrates	Sessile	Stacked	2.41	2.13	2.75	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge, and taxon representativeness.
Seafloor invertebrates	Sessile	Stacked – naturalness	2.69	2.13	2.75	Potentially	Inclusion of naturalness potentially reduces map accuracy.
Seafloor invertebrates	Sessile	Zonation	2.41	2.13	2.75	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	Sessile	Zonation - naturalness	2.21	2.13	2.75	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Seafloor invertebrates	Mobile	Stacked	3.29	2.88	2.5	Potentially	Map scored between somewhat accurate, and largely inaccurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	Mobile	Stacked - naturalness	3.17	2.88	2.5	Potentially	Map scored between somewhat accurate, and largely inaccurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	Mobile	Zonation	2.74	2.88	2.5	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	Mobile	Zonation - naturalness	2.74	2.88	2.5	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	Pelagic	Stacked	2.42	3.38	3.125	Potentially*	Although map scored between accurate and somewhat accurate, expert knowledge scored between moderate – low, *noting that the group may not be taxonomically representative so could be renamed appropriately.
Seafloor invertebrates	Pelagic	Zonation	2.65	3.38	3.125	Potentially*	Although map scored between accurate and somewhat accurate, expert knowledge scored between moderate – low, *noting that the group may not be taxonomically representative so could be renamed appropriately.
Seafloor invertebrates	All combined seafloor invertebrates	Stacked	2.95	2.63	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	All combined seafloor invertebrates	Stacked - naturalness	2.95	2.63	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Seafloor invertebrates	All combined seafloor invertebrates	Zonation	2.33	2.63	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	All combined seafloor invertebrates	Zonation - naturalness	2.10	2.63	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Seafloor invertebrates	All combined seafloor invertebrates	MEM	2.40	2.83	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Macroalgae	Canopy-forming	Stacked	3.00	2.50	1.5	Potentially	Map scored somewhat accurate, with high-moderate expert knowledge and high taxon representativeness.
Macroalgae	Canopy-forming	Zonation	2.00	2.50	1.5	Yes	Map scored accurate, with high-moderate expert knowledge and taxon representativeness.
Macroalgae	Other macroalgae	Stacked	4.00	2.50	3.5	No	Map scored largely inaccurate.
Macroalgae	Other macroalgae	Zonation	2.60	2.50	3.5	Yes*	Map scored somewhat accurate, with high-moderate expert knowledge, *noting that group may not be taxonomically representative so could be renamed appropriately.
Macroalgae	All combined macroalgae	Stacked	2.60	2.50	2.5	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.
Macroalgae	All combined macroalgae	Zonation	2.60	2.50	2.5	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and taxon representativeness.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representation (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Demersal fish	Benthic	Stacked	2.00	1.67	2	Yes*	Map scored accurate, with high expert knowledge and moderate taxon representativeness *noting that group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Benthic	Zonation	2.00	1.67	2	Yes*	Map scored accurate, with high expert knowledge and moderate taxon representativeness *noting that group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Bathyal-demersal	Stacked	3.18	2.00	2.33	Potentially	Map scored between somewhat accurate, and largely inaccurate, with high expert knowledge and high-moderate taxon representativeness.
Demersal fish	Bathyal-demersal	Zonation	2.64	2.00	2.33	Yes	Map scored between accurate and somewhat accurate, with high-moderate expert knowledge and high-moderate taxon representativeness.
Demersal fish	Bathyal-pelagic	Stacked	2.64	2.00	4	Yes*	Map scored between accurate and somewhat accurate, with high expert knowledge, *noting that group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Bathyal-pelagic	Zonation	2.09	2.00	4	Yes*	Map scored between accurate and somewhat accurate, with high expert knowledge, *noting that group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Benthopelagic	Stacked	3.36	2.00	3	Potentially*	Map scored between somewhat accurate, and largely inaccurate, with high expert knowledge, * noting that group may not be taxonomically representative so could be renamed appropriately.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Demersal fish	Benthopelagic	Zonation	2.27	2.00	3	Yes*	Map scored between accurate and somewhat accurate, with high expert knowledge, *noting that group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Pelagic	Stacked	3.80	1.33	4	No	Map scored between somewhat accurate and largely inaccurate (but rounded to largely inaccurate) and were not taxonomically representative.
Demersal fish	Pelagic	Zonation	3.00	1.33	4	Potentially*	Map scored somewhat accurate, with high expert knowledge, *noting that the group may not be taxonomically representative so could be renamed appropriately.
Demersal fish	Reef	Stacked	3.60	2.33	3.5	No	Map scored between somewhat accurate and largely inaccurate (but rounded to largely inaccurate) and were not taxonomically representative.
Demersal fish	Reef	Zonation	3.60	2.33	3.5	No	Map scored between somewhat accurate and largely inaccurate (but rounded to largely inaccurate) and were not taxonomically representative.
Demersal fish	All combined demersal fish	Stacked	3.55	2.00	2	No	Map scored between somewhat accurate and largely inaccurate (but rounded to largely inaccurate).
Demersal fish	All combined demersal fish	Zonation	1.91	2.00	2	Yes	Map scored accurate, with high expert knowledge and representative taxon group scores.
Cetaceans	Dolphins	Stacked (EEZ)	4.00	2.00	2.75	No	Map scored largely inaccurate.
Cetaceans	Dolphins	Stacked (Clipped)	4.00	1.67	2.67	No	Map scored largely inaccurate.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Cetaceans	Dolphins	Zonation (EEZ)	2.93	2.00	2.75	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and moderate taxon representativeness.
Cetaceans	Dolphins	Zonation (Clipped)	3.00	1.67	2.67	Potentially	Map scored somewhat accurate, with high expert knowledge and moderate taxon representativeness.
Cetaceans	Whales	Stacked (EEZ)	4.00	2.25	2.75	No	Map scored largely inaccurate.
Cetaceans	Whales	Stacked (Clipped)	4.33	2.00	2.75	No	Map scored largely inaccurate.
Cetaceans	Whales	Zonation (EEZ)	3.18	2.25	2.75	Potentially	Map scored somewhat accurate – largely inaccurate, with high-moderate expert knowledge and taxon representativeness.
Cetaceans	Whales	Zonation (Clipped)	3.33	2.00	2.75	Potentially	Map scored somewhat accurate – largely inaccurate, with high-moderate expert knowledge and taxon representativeness.
Cetaceans	All combined cetaceans	Stacked (EEZ)	4.55	2.00	3	No	Map scored largely inaccurate.
Cetaceans	All combined cetaceans	Stacked (Clipped)	4.25	1.67	3	No	Map scored largely inaccurate.
Cetaceans	All combined cetaceans	Zonation (EEZ)	2.75	1.67	3	Yes*	Map scored between accurate and somewhat accurate, with high expert knowledge, * noting that the group may not be taxonomically representative so could be renamed appropriately.
Cetaceans	All combined cetaceans	Zonation (Clipped)	3.00	1.67	3	Potentially*	Map scored somewhat accurate, with high expert knowledge, * noting that the group may not be taxonomically representative so could be renamed appropriately.
Seabirds	Albatrosses	Stacked	2.00	1.33	1	Yes	Map scored accurate with high expert knowledge and taxon representativeness.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representation (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Seabirds	Albatrosses	Zonation	2.80	1.33	1	Yes	Map scored accurate – somewhat accurate, with high expert knowledge and taxon representativeness.
Seabirds	Penguins	Stacked	3.13	2.33	1	Potentially	Map scored somewhat accurate – largely inaccurate, with high expert knowledge.
Seabirds	Penguins	Zonation	3.38	2.33	1	Potentially	Maps scored somewhat accurate – largely inaccurate, with high expert knowledge.
Seabirds	Petrels	Stacked	2.00	1.67	1.67	Yes	Map scored accurate, with high expert knowledge and taxon representativeness.
Seabirds	Petrels	Zonation	3.25	1.67	1.67	Potentially	Map scored somewhat accurate – largely inaccurate, with high expert knowledge.
Seabirds	Shags	Stacked	1.00	2.00	1.33	Yes	Map scored accurate, with high expert knowledge and taxon representativeness.
Seabirds	Shags	Zonation	4.00	2.00	1.33	No	Map scored largely inaccurate.
Seabirds	Shearwater	Stacked	2.25	1.67	1.33	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and taxon representativeness.
Seabirds	Shearwater	Zonation	2.00	1.67	1.33	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and taxon representativeness.
Seabirds	Other seabirds	Stacked	2.75	2.33	3	Yes*	Map scored between accurate and somewhat accurate, with moderate-high expert knowledge, * noting that the group may not be taxonomically representative so could be renamed appropriately.
Seabirds	Other seabirds	Zonation	2.75	2.33	3	Yes*	Map scored between accurate and somewhat accurate, with moderate-high expert knowledge, * noting that the group may not be taxonomically representative so could be renamed appropriately.

Taxon Group	Biodiversity group	Approach	Weighted mean map accuracy score (1-5)	Mean expert knowledge (1-4)	Mean taxonomic representa tion (1-4)	Useful for MSP (yes, potentially, no)	Rationale
Seabirds	All combined seabirds	Stacked	2.33	2.00	2	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and taxon representatives.
Seabirds	All combined seabirds	Zonation	2.67	2.00	2	Yes	Map scored between accurate and somewhat accurate, with high expert knowledge and taxon representatives.

Future improvements to biodiversity maps

- The macroecological modelling approach performed adequately for seafloor invertebrates. How this approach would perform for other taxa groups (or at a disaggregated biodiversity group level) is unknown. Elsewhere, macroecological model and stacked [species distribution model] approaches have been shown to have complementary strengths (Dubuis et al. 2011; Biber et al. 2020), therefore development of macroecological models for other groups could be explored to improve accuracy of species richness distribution patterns for some groups.

- For seabirds and cetaceans, experts highlighted the temporally dynamic nature of many species, where species aggregate at different times for breeding or feeding. This means that the biodiversity value of some areas might not be accurately represented by static biodiversity maps. Dynamic modelling approaches could prove informative for highly motile/migratory taxa.

- For some taxa groups, biodiversity maps produced contain a very small proportion of the full number of taxa in that group that are present in New Zealand. For example for the sessile and mobile seafloor invertebrate groups, there are >10,000 marine invertebrate species in New Zealand (Gordon et al. 2010), but only 205 genera used in the maps used here to represent biodiversity. In some cases, these gaps could feasibly be filled by developing further habitat suitability models with existing information (e.g., for seabirds, and additional models sponges and Bryozoa), for other taxa, like beaked whales, these gaps are harder, if not impossible to currently fill given they are data-poor (Stephenson et al., 2020) and cryptic in nature. In these cases, careful attention should be given to areas on biodiversity that are not represented given the absence of entire families from included taxa; a way to caveat this could include renaming some biodiversity groups to acknowledge the absence of important groups. Notwithstanding this, in some cases the current biodiversity maps could still be sufficient surrogates for biodiversity distribution patterns of these groups if they include the diversity of functions and life histories within a group, however limitations in taxonomic representation should be acknowledged.

- If the biodiversity groups are to be re-developed and renamed, this should be an expert-informed process before the development of associated biodiversity maps. This would allow for and end-to-end expert review process.

6 Acknowledgements

We want to sincerely thank the panel of experts who took the time to contribute to the evaluation of the Biological Diversity maps (see Table 2-1 for details). Without their input this work would not have been possible. We thank the members of the inter-agency working group who provided guidance and suggestions on the expert evaluation process and feedback on the content of this report. We acknowledge all the data suppliers (see Lundquist et al. 2020; Stephenson et al. 2020; Stephenson et al. 2023a for details) and researchers who contributed to the development of the modelled outputs that were used to develop the biodiversity maps evaluated herein. Finally, we thank Carole Evans for editorial support, and Orlando Lam-Gordillo and Michael Bruce for reviewing this report.

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Appendix A Instructions and worksheet example

Expert assessment of mapped biodiversity in New Zealand waters

The Oceans Secretariat was established in Aotearoa New Zealand in 2021 to take a multi-agency approach to ensure the long-term health and resilience of coastal and marine ecosystems. Officials from the Department of Conservation (DOC), Ministry for Primary Industries (MPI) and the Ministry of the Environment (MfE) developed a work plan which included the development of a shared agency view of national priorities for marine biodiversity. A key priority is a consistent approach to identifying areas of importance for biodiversity. Such areas are regularly integrated into decision-making and management across a range of marine policy including planning for marine protected areas, aquaculture, and renewable energy.

Agencies have agreed to adapt the Key Ecological Areas (KEA) framework developed by the Marine Protected Areas Science Advisory Group (Freeman et al., 2017) to build a standardised mapping methodology for each criterion. The KEA framework describes nine criteria that can be used to identify areas of high conservation value. In early 2023, NIWA developed a framework to map criterion 6, Biological Diversity (Cook et al., 2023). A KEA under the Biological Diversity criterion is an area that "contains comparatively higher diversity of ecosystems, habitats, communities or species, or has higher genetic diversity".

Modelled spatial distributions for macroalgae, seafloor invertebrates, cetaceans, seabirds, and demersal fish (Lundquist et al., 2020; Stephenson et al., 2020; Stephenson et al., 2023) were used to generate maps of biodiversity for different groups based on taxonomy, life-history traits, or morphology. For example, for macroalgae two groups were developed, one for canopy-forming macroalgae and another for all other macroalgae.

Now, the inter-agency working group is seeking expert guidance on the usefulness of the maps produced for informing marine spatial planning. NIWA has subsequently been contracted to obtain an assessment of the accuracy of the maps. The assessment criteria used here is like that used by Stephenson et al. (2023).

We are asking experts to:

1) **assess their knowledge** of the distribution of biodiversity for mapped groups,
2) **assess the representation of taxa** in each respective biodiversity group,
3) **comment on taxa missing** from groups,
4) **score the spatial distribution** of biodiversity,
5) comment on the areas that are **accurate**,
6) comment on the areas that are **inaccurate**,
7) comment on the **usefulness** of the mapped group for planning purposes.

In this document, we provide several resources for the assessment:

1. **criteria for scoring,**
2. **a table for inputting data,**
3. **lists of the taxa combined to form each biodiversity group, and**
4. **a series of maps to assess.** *Note: there are two or more maps per group. This is because two separate techniques were trialled (stacked and Zonation) and for some taxa groups (cetaceans), two different mapped extents were used (whole EEZ and clipped to ~2000 m).*

For queries, please don't hesitate to contact Matt Bennion: matt.bennion@niwa.co.nz

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Expert evaluation criteria

Table A-1: Assessment of expert knowledge.

Evaluation score	Description
1 – Very high	Expert confidently knows the **distribution of biodiversity** (including relatively fine scale patterns)
2 – High	Expert confidently knows the **distribution of a subset**, but not all the taxa included in the layer, with broad knowledge of biodiversity
3 – Moderate	Expert has **some knowledge** of the distribution biodiversity/subset of taxa included in the layer, with some uncertainty
4 – Low	Expert has **little knowledge** of the distribution biodiversity/subset of taxa included in the layer, with some uncertainty

Table A-2: Assessment of taxa representation in biodiversity groups.

Evaluation score	Description
1 – Very representative	Taxa included are **very representative of biodiversity group**
2 – Representative	Taxa included are **representative of biodiversity group**, but **some key taxa are missing**
3 – Somewhat representative	Taxa included are representative of biodiversity group but there are **many key taxa missing from group**
4 – Not representative	Taxa included are **not representative of biodiversity group**

Table A-3: Spatial predictions reflect expert knowledge of biodiversity distribution.

Evaluation score	Description
1 – Very accurate	Predicted distribution **reflects expert view** of biodiversity (> 80% agreement)
2 – Accurate	Predicted distribution **reflects expert view** of biodiversity, but **some areas may not** be correct (> 60% agreement)
3 – Somewhat accurate	Predicted distribution **somewhat reflects expert view** of biodiversity but there are **considerable inconsistencies** (i.e., regions of disagreement; > 40% agreement)
4 – Largely inaccurate	Predicted distribution contains **large inconsistencies with the expert's view** of biodiversity (i.e., large regions of disagreement; > 20% agreement)
5 – Inaccurate	Predicted distribution **does not match the expert's view** of biodiversity (i.e., < 20% agreement)

		Criteria	Assessment of expert knowledge (Table 1)	Assessment of expert knowledge	How well do taxa represent biodiversity group? (Table 2 & 4)	Key taxa missing from biodiversity group	How well do spatial predictions represent biodiversity? (Table 3)	High/low biodiversity areas well captured	High/low biodiversity areas poorly captured	How useful is the mapped group for planning?
		Type	**Score (1-4)**	**Comment**	**Score (1-4)**	**Comment**	**Score (1-5)**	**Comment**	**Comment**	**Comment**
	Example	Example group (e.g., corals)	2	Confident with soft corals but not as confident with stony corals	2	*Alcyonacea sp. X* is a key taxon missing from the group	2	N. Central Chatham Rise is high, as expected. Bounty trough is low, as expected	Would expect higher biodiversity estimates on Kermadec Ridge	Somewhat useful
Fig.	**Approach**	**Group**								
1	**A - Stacked**	Dolphins - whole EEZ								
2	**B - Zonation**	Dolphins - whole EEZ								
3	**A - Stacked**	Whales - whole EEZ								
4	**B - Zonation**	Whales - whole EEZ								

Table A-4: Lists of taxa that comprise each cetacean biodiversity group.

Common name	Species	Family	Biodiversity group
Hector's dolphin	*Cephalorhynchus hectori hectori*	Delphinidae	Delphinidae
Māui dolphin	*Cephalorhynchus hectori maui*	Delphinidae	Delphinidae
Common dolphin	*Delphinus delphis*	Delphinidae	Delphinidae
Dusky dolphin	*Lagenorhynchus obscurus*	Delphinidae	Delphinidae
Bottlenose dolphin	*Tursiops truncatus*	Delphinidae	Delphinidae
Pilot whale	*Globicephala* spp. (complex)	Delphinidae	Delphinidae
Orca, killer whale	*Orcinus orca* (complex)	Delphinidae	Delphinidae
Bryde's whale	*Balaenoptera edeni brydei*	Balaenopteridae	Whale
Southern right whale	*Eubalaena australis*	Balaenidae	Whale
Humpback whale	*Megaptera novaeangliae*	Balaenopteridae	Whale
Sperm whale	*Physeter macrocephalus*	Physeteridae	Whale
Blue whale	*Balaenoptera musculus* (complex)	Balaenopteridae	Whale

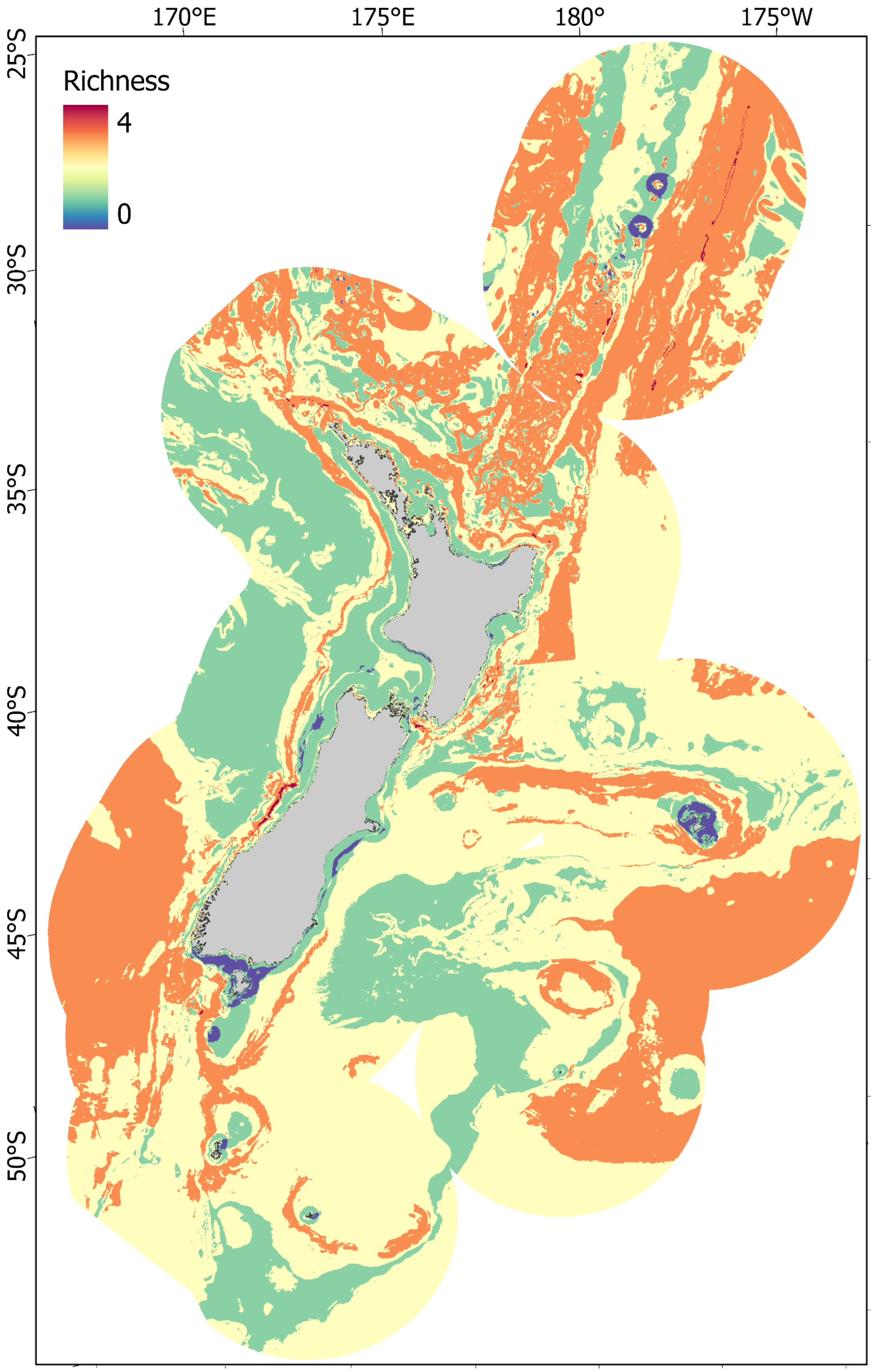

Figure A-1: A – Stacked. Dolphins - whole EEZ.

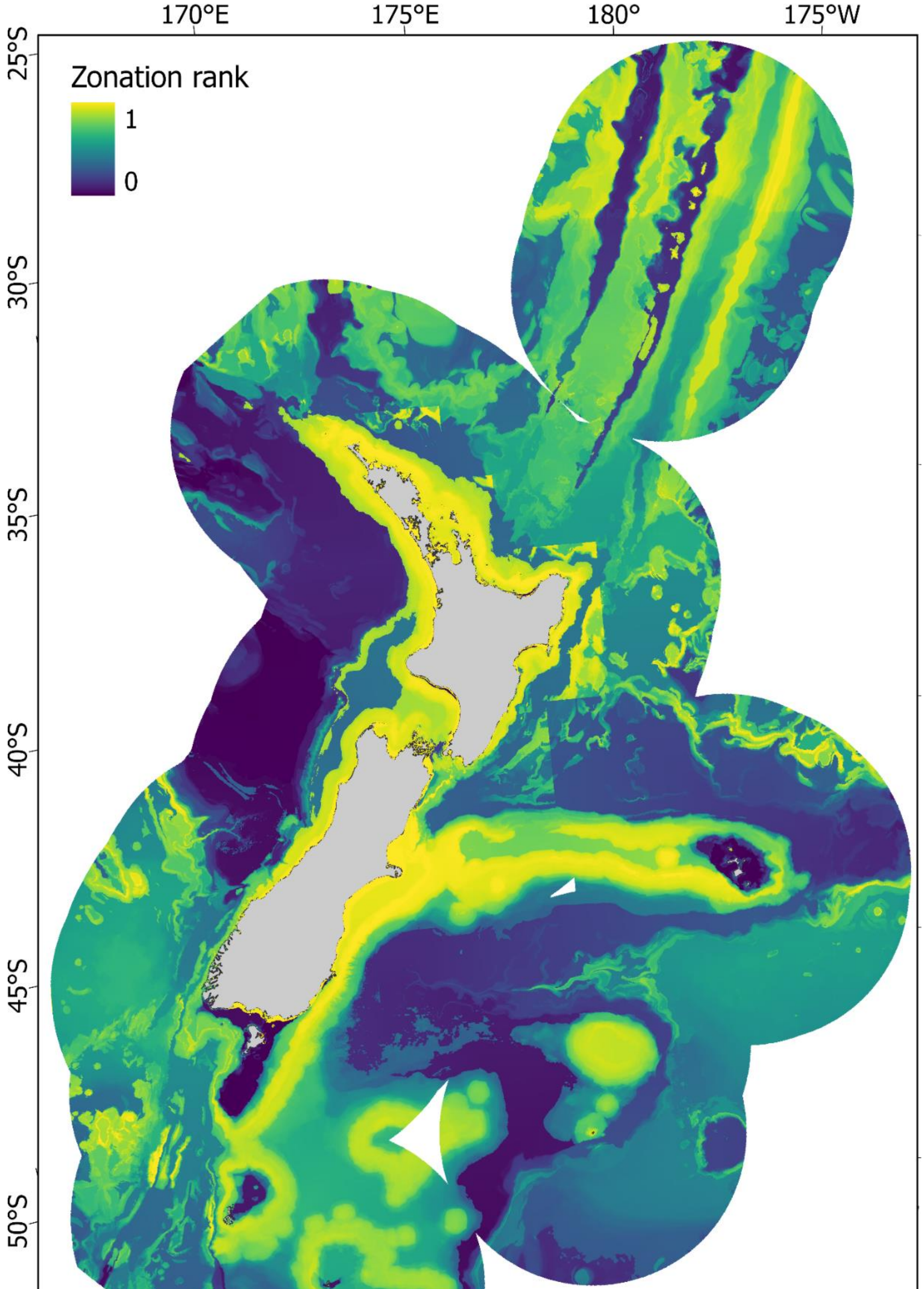

Figure A-2: B – Zonation. Dolphins - whole EEZ. Higher ranked areas indicate areas of high biodiversity.

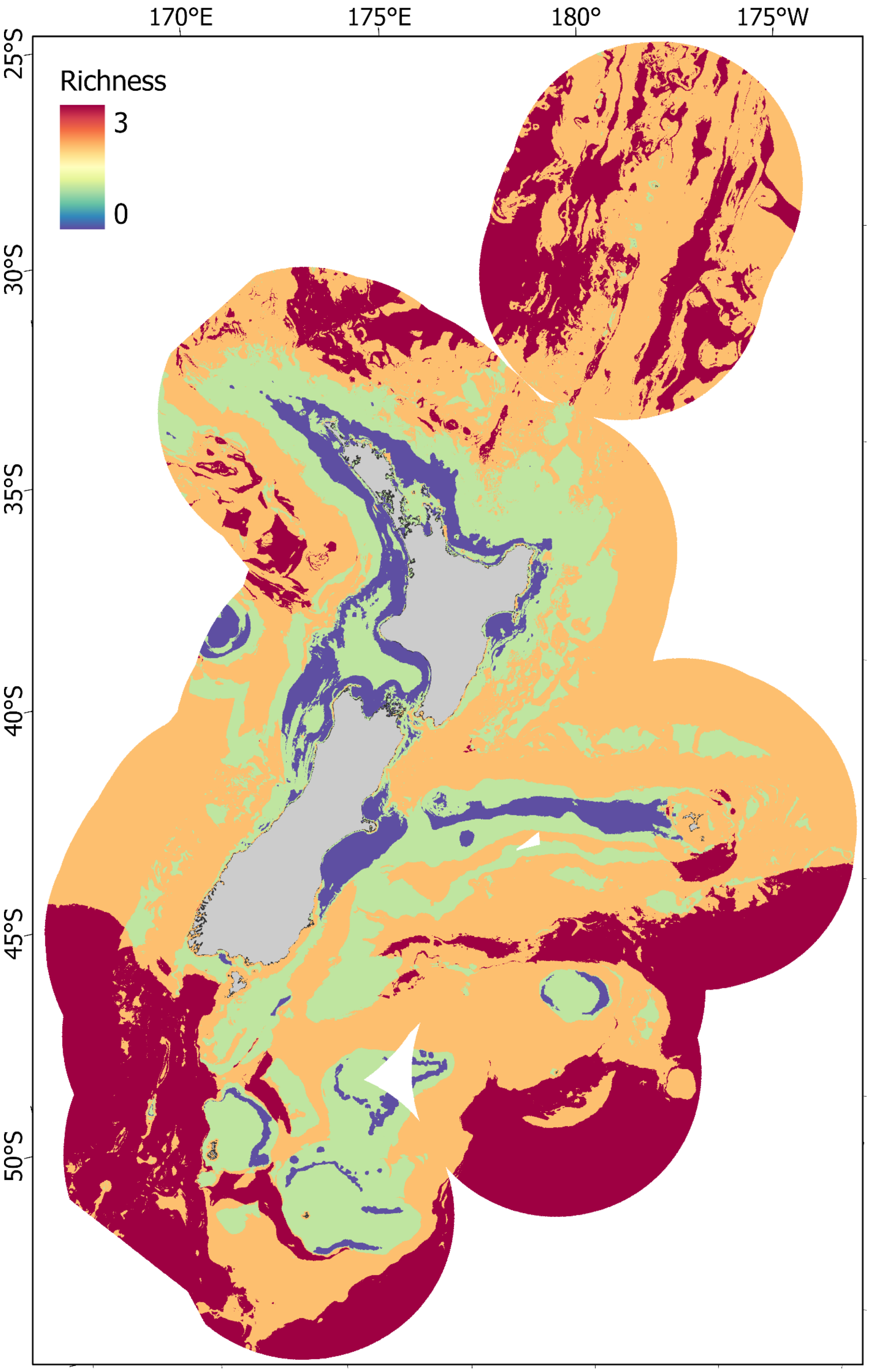

Figure A-3: **A – Stacked. Whales - whole EEZ.**

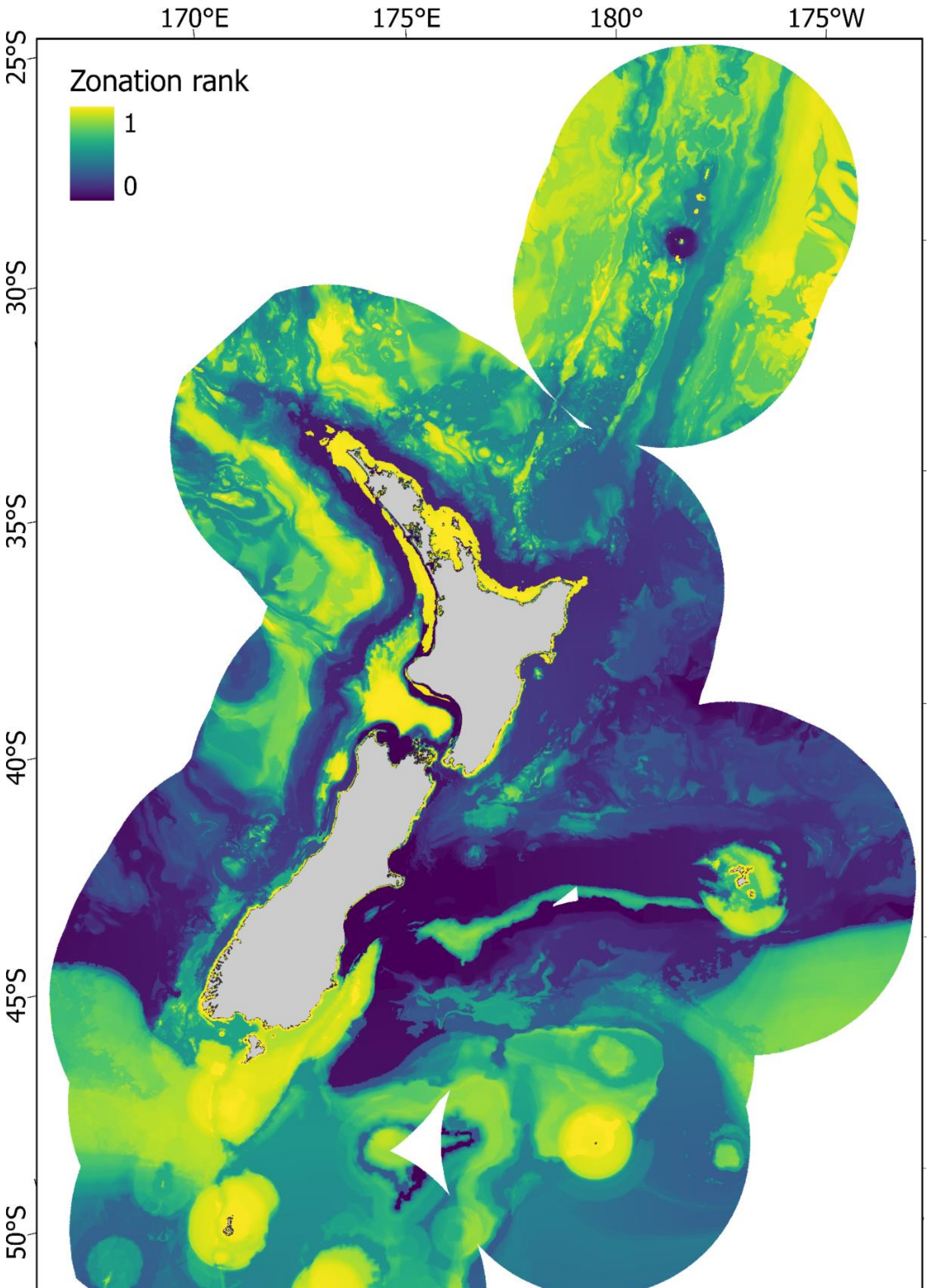

Figure A-4: B – Zonation. Whales - whole EEZ. Higher ranked areas indicate areas of high biodiversity.

Appendix B Taxa lists with expert suggestions

Table B-1: Lists of taxa that comprises the seafloor invertebrate biodiversity group. Specific condition (fishing impact) layers were applied to each seafloor invertebrate taxon based on their morpho-characteristics (LEHS- large, erect, hard, sessile, SFE- small, fragile, encrusting, DBI- deep burrowing infauna). Some taxa were not assigned a category as they were less likely to be affected by bottom-impact trawling (e.g., pelagic taxa).

Phylum	Order	Family	Genus	Common name	Biodiversity group
Cnidaria	Alcyonacea	Isididae	*Acanella*	Bamboo coral	Key biogenic habitat formers
Cnidaria	Alcyonacea	Acanthogorgiidae	*Acanthogorgia*	Soft coral	Key biogenic habitat formers
Cnidaria	Pennatulacea	Anthoptilidae	*Anthoptilum*	Sea pen	Key biogenic habitat formers
Porifera	Sceptrulophora	Aphrocallistidae	*Aphrocallistes*	Sponge	Key biogenic habitat formers
Cnidaria	Antipatharia	Schizopathidae	*Bathypathes*	Black coral	Key biogenic habitat formers
Bryozoa	Cheilostomatida	Candidae	*Caberea*	Bryozoan	Key biogenic habitat formers
Porifera	Haplosclerida	Callyspongiidae	*Callyspongia*	Sponge	Key biogenic habitat formers
Bryozoa	Cheilostomata	Cellariidae	*Cellaria*	Bryozoan	Key biogenic habitat formers
Cnidaria	Alcyonacea	Chrysogorgiidae	*Chrysogorgia*	Soft coral	Key biogenic habitat formers
Cnidaria	Anthoathecata	Stylasteridae	*Conopora*	Red coral	Key biogenic habitat formers
Porifera	Haplosclerida	Callyspongiidae	*Dactylia*	Sponge	Key biogenic habitat formers
Cnidaria	Scleractinia	Caryophylliidae	*Desmophyllum*	Stony coral	Key biogenic habitat formers
Porifera	Tetractinellida	Ancorinidae	*Ecionemia*	Sponge	Key biogenic habitat formers
Cnidaria	Scleractinia	Dendrophylliidae	*Enallopsammia*	Stony coral	Key biogenic habitat formers
Cnidaria	Anthoathecata	Stylasteridae	*Errina*	Red coral	Key biogenic habitat formers
Porifera	Sceptrulophora	Farreidae	*Farrea*	Sponge	Key biogenic habitat formers
Bryozoa	Cheilostomata	Celleporidae	*Galeopsis*	Bryozoan	Key biogenic habitat formers
Porifera	Tetractinellida	Geodiidae	*Geodia*	Sponge	Key biogenic habitat formers
Cnidaria	Scleractinia	Caryophylliidae	*Goniocorella*	Stony coral	Key biogenic habitat formers
Bryozoa	Cyclostomata	Horneridae	*Hornera*	Bryozoan	Key biogenic habitat formers
Porifera	Lyssacinosida	Rossellidae	*Hyalascus*	Sponge	Key biogenic habitat formers
Cnidaria	Alcyonacea	Isididae	*Keratoisis*	Bamboo coral	Key biogenic habitat formers
Cnidaria	Scleractinia	Oculinidae	*Madrepora*	Coral	Key biogenic habitat formers

Phylum	Order	Family	Genus	Common name	Biodiversity group
Cnidaria	Alcyonacea	Primnoidae	*Metafannyella*	Soft coral	Key biogenic habitat formers
Cnidaria	Alcyonacea	Primnoidae	*Narella*	Soft coral	Key biogenic habitat formers
Cnidaria	Alcyonacea	Paragorgiidae	*Paragorgia*	Bubblegum coral	Key biogenic habitat formers
Porifera	Tetractinellida	Vulcanellidae	*Poecillastra*	Sponge	Key biogenic habitat formers
Cnidaria	Scleractinia	Caryophylliidae	*Solenosmilia*	Stony coral	Key biogenic habitat formers
Porifera	Tetractinellida	Ancorinidae	*Stelletta*	Sponge	Key biogenic habitat formers
Cnidaria	Anthoathecata	Stylasteridae	*Stylaster*	Red coral	Key biogenic habitat formers
Porifera	Suberitida	Suberitidae	*Suberites*	Sponge	Key biogenic habitat formers
Cnidaria	Alcyonacea	Clavulariidae	*Telesto*	Soft coral	Key biogenic habitat formers
Cnidaria	Alcyonacea	Primnoidae	*Thouarella*	Soft coral	Key biogenic habitat formers
Arthropoda	Decapoda	Acanthephyridae	*Acanthephyra*	Shrimp	Mobile
Mollusca	Neogastropoda	Buccinulidae	*Aeneator*	Whelk	Mobile
Annelida	Phyllodocida	Nephtyidae	*Aglaophamus*	Polychaete	Mobile
Mollusca	Neogastropoda	Volutidae	*Alcithoe*	Volute	Mobile
Mollusca	Neogastropoda	Ancillariidae	*Amalda*	Snail	Mobile
Echinodermata	Ophiurida	Ophiopyrgidae	*Amphiophiura*	Brittle star	Mobile
Echinodermata	Amphilepidida	Amphiuridae	*Amphioplus*	Brittle star	Mobile
Echinodermata	Amphilepidida	Amphiuridae	*Amphiura*	Brittle star	Mobile
Annelida	Phyllodocida	Aphroditidae	*Aphrodita*	Sea mouse	Mobile
Echinodermata	Echinothurioida	Echinothuriidae	*Araeosoma*	Sea urchin	Mobile
Arthropoda	Decapoda	Aristeidae	*Aristaeomorpha*	Shrimp	Mobile
Arthropoda	Decapoda	Aristeidae	*Aristaeopsis*	Shrimp	Mobile
Arthropoda	Decapoda	Aristeidae	*Aristeus*	Shrimp	Mobile
Echinodermata	Paxillosida	Astropectinidae	*Astromesites*	Sea star	Mobile
Echinodermata	Aspidochirotida	Stichopodidae	*Australostichopus*	Sea cucumber	Mobile
Mollusca	Neogastropoda	Buccinidae	*Austrofusus*	Whelk	Mobile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Echinodermata	Aspidochirotida	Synallactidae	*Bathyplotes*	Sea cucumber	Mobile
Echinodermata	Notomyotida	Benthopectinidae	*Benthopecten*	Sea star	Mobile
Echinodermata	Spatangoida	Brissidae	*Brissopsis*	Sea urchin	Mobile
Arthropoda	Isopoda	Serolidae	*Brucerolis*	Isopod	Mobile
Echinodermata	Pedinoida	Pedinidae	*Caenopedina*	Sea urchin	Mobile
Arthropoda	Decapoda	Campylonotidae	*Campylonotus*	Shrimp	Mobile
Echinodermata	Valvatida	Goniasteridae	*Ceramaster*	Sea star	Mobile
Echinodermata	Notomyotida	Benthopectinidae	*Cheiraster*	Sea star	Mobile
Mollusca	Neogastropoda	Turbinellidae	*Coluzea*	Snail	Mobile
Mollusca	Neogastropoda	Buccinulidae	*Cominella*	Whelk	Mobile
Echinodermata	Forcipulatida	Stichasteridae	*Cosmasterias*	Sea star	Mobile
Echinodermata	Valvatida	Solasteridae	*Crossaster*	Sea star	Mobile
Arthropoda	Decapoda	Homolidae	*Dagnaudus*	Carrier crab	Mobile
Echinodermata	Camarodonta	Echinidae	*Dermechinus*	Sea urchin	Mobile
Arthropoda	Decapoda	Paguridae	*Diacanthurus*	Hermit crab	Mobile
Echinodermata	Paxillosida	Astropectinidae	*Dipsacaster*	Sea star	Mobile
Arthropoda	Decapoda	Leucosiidae	*Dittosa*	Crab	Mobile
Echinodermata	Spatangoida	Loveniidae	*Echinocardium*	Sea urchin	Mobile
Echinodermata	Camarodonta	Echinidae	*Echinus*	Sea urchin	Mobile
Mollusca	Littorinimorpha	Naticidae	*Falsilunatia*	Snail	Mobile
Mollusca	Littorinimorpha	Ranellidae	*Fusitriton*	Snail	Mobile
Annelida	Phyllodocida	Glyceridae	*Glycera*	Polychaete	Mobile
Arthropoda	Lophogastrida	Lophogastridae	*Gnathophausia*	Shrimp	Mobile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Echinodermata	Cidaroida	Cidaridae	*Goniocidaris*	Sea urchin	Mobile
Echinodermata	Euryalida	Gorgonocephalidae	*Gorgonocephalus*	Basket starfish	Mobile
Echinodermata	Camarodonta	Echinidae	*Gracilechinus*	Sea urchin	Mobile
Mollusca	Octopoda	Megaleledonidae	*Graneledone*	Octopus	Mobile
Arthropoda	Decapoda	Solenoceridae	*Haliporoides*	Shrimp	Mobile
Annelida	Phyllodocida	Polynoidae	*Harmothoe*	Polychaete	Mobile
Echinodermata	Spinulosida	Echinasteridae	*Henricia*	Sea star	Mobile
Echinodermata	Molpadiida	Molpadiidae	*Heteromolpadia*	Sea cucumber	Mobile
Echinodermata	Dendrochirotida	Heterothyonidae	*Heterothyone*	Sea cucumber	Mobile
Echinodermata	Valvatida	Goniasteridae	*Hippasteria*	Sea star	Mobile
Annelida	Eunicida	Onuphidae	*Hyalinoecia*	Polychaete	Mobile
Echinodermata	Echinothurioida	Echinothuriidae	*Hygrosoma*	Sea urchin	Mobile
Arthropoda	Decapoda	Scyllaridae	*Ibacus*	Slipper lobster	Mobile
Arthropoda	Decapoda	Majidae	*Jacquinotia*	Crab	Mobile
Arthropoda	Decapoda	Palinuridae	*Jasus*	Spiny lobster	Mobile
Echinodermata	Elasipodida	Laetmogonidae	*Laetmogone*	Sea cucumber	Mobile
Arthropoda	Decapoda	Majidae	*Leptomithrax*	Crab	Mobile
Arthropoda	Decapoda	Nematocarcinidae	*Lipkius*	Shrimp	Mobile
Arthropoda	Decapoda	Lithodidae	*Lithodes*	King crab	Mobile
Echinodermata	Valvatida	Goniasteridae	*Lithosoma*	Sea star	Mobile
Arthropoda	Decapoda	Paguridae	*Lophopagurus*	Hermit crab	Mobile
Echinodermata	Paxillosida	Luidiidae	*Luidia*	Sea star	Mobile
Arthropoda	Decapoda	Raninidae	*Lyreidus*	Crab	Mobile
Mollusca	Trochida	Calliostomatidae	*Maurea*	Snail	Mobile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Echinodermata	Valvatida	Goniasteridae	*Mediaster*	Sea star	Mobile
Arthropoda	Decapoda	Nephropidae	*Metanephrops*	Lobster	Mobile
Echinodermata	Molpadiida	Molpadiidae	*Molpadia*	Sea cucumber	Mobile
Arthropoda	Decapoda	Munididae	*Munida*	Squat lobster	Mobile
Arthropoda	Decapoda	Munidopsidae	*Munidopsis*	Squat lobster	Mobile
Arthropoda	Isopoda	Cirolanidae	*Natatolana*	Isopod	Mobile
Arthropoda	Decapoda	Ovalipidae	*Nectocarcinus*	Crab	Mobile
Arthropoda	Decapoda	Lithodidae	*Neolithodes*	King crab	Mobile
Arthropoda	Decapoda	Pandalidae	*Notopandalus*	Shrimp	Mobile
Mollusca	Octopoda	Octopodidae	*Octopus*	Octopus	Mobile
Echinodermata	Valvatida	Odontasteridae	*Odontaster*	Sea star	Mobile
Echinodermata	Cidaroida	Cidaridae	*Ogmocidaris*	Sea urchin	Mobile
Echinodermata	Ophiacanthida	Ophiacanthidae	*Ophiacantha*	Sea star	Mobile
Echinodermata	Amphilepidida	Ophiactidae	*Ophiactis*	Brittle star	Mobile
Echinodermata	Euryalida	Asteroschematidae	*Ophiocreas*	Brittle star	Mobile
Echinodermata	Ophiurida	Ophiomusaidae	*Ophiomusa*	Brittle star	Mobile
Echinodermata	Ophiacanthida	Ophiomyxidae	*Ophiomyxa*	Sea star	Mobile
Echinodermata	Amphilepidida	Ophionereididae	*Ophionereis*	Brittle star	Mobile
Echinodermata	Ophiacanthida	Ophiacanthidae	*Ophiophthalmus*	Sea star	Mobile
Echinodermata	Ophiacanthida	Ophiodermatidae	*Ophiopsammus*	Sea star	Mobile
Echinodermata	Amphilepidida	Hemieuryalidae	*Ophiozonella*	Brittle star	Mobile
Echinodermata	Ophiurida	Ophiuridae	*Ophiura*	Brittle star	Mobile
Mollusca	Octopoda	Opisthoteuthidae	*Opisthoteuthis*	Octopus	Mobile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Arthropoda	Decapoda	Oplophoridae	*Oplophorus*	Shrimp	Mobile
Arthropoda	Decapoda	Ovalipidae	*Ovalipes*	Crab	Mobile
Echinodermata	Elasipodida	Laetmogonidae	*Pannychia*	Sea cucumber	Mobile
Echinodermata	Molpadiida	Caudinidae	*Paracaudina*	Sea cucumber	Mobile
Arthropoda	Decapoda	Lithodidae	*Paralomis*	King crab	Mobile
Echinodermata	Spatangoida	Eurypatagidae	*Paramaretia*	Sea urchin	Mobile
Arthropoda	Decapoda	Pasiphaeidae	*Pasiphaea*	Shrimp	Mobile
Mollusca	Pectinida	Pectinidae	*Pecten*	Scallop	Mobile
Mollusca	Neogastropoda	Buccinulidae	*Penion*	Whelk	Mobile
Echinodermata	Clypeasteroida	Laganidae	*Peronella*	Sand dollar	Mobile
Echinodermata	Echinothurioida	Phormosomatidae	*Phormosoma*	Sea urchin	Mobile
Arthropoda	Decapoda	Galatheidae	*Phylladiorhynchus*	Squat lobster	Mobile
Echinodermata	Valvatida	Goniasteridae	*Pillsburiaster*	Sea star	Mobile
Mollusca	Octopoda	Octopodidae	*Pinnoctopus*	Octopus	Mobile
Arthropoda	Decapoda	Pandalidae	*Plesionika*	Shrimp	Mobile
Echinodermata	Paxillosida	Astropectinidae	*Plutonaster*	Sea star	Mobile
Arthropoda	Decapoda	Polychelidae	*Polycheles*	Blind lobster	Mobile
Echinodermata	Paxillosida	Astropectinidae	*Proserpinaster*	Sea star	Mobile
Mollusca	Neogastropoda	Volutidae	*Provocator*	Volute	Mobile
Echinodermata	Paxillosida	Pseudarchasteridae	*Pseudarchaster*	Sea star	Mobile
Echinodermata	Forcipulatida	Stichasteridae	*Pseudechinaster*	Sea star	Mobile
Echinodermata	Camarodonta	Temnopleuridae	*Pseudechinus*	Sea urchin	Mobile
Echinodermata	Aspidochirotida	Synallactidae	*Pseudostichopus*	Sea cucumber	Mobile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Echinodermata	Paxillosida	Astropectinidae	*Psilaster*	Sea star	Mobile
Arthropoda	Decapoda	Goneplacidae	*Pycnoplax*	Crab	Mobile
Mollusca	Cephalaspidea	Scaphandridae	*Scaphander*	Snail	Mobile
Echinodermata	Forcipulatida	Asteriidae	*Sclerasterias*	Sea star	Mobile
Echinodermata	Valvatida	Solasteridae	*Solaster*	Sea star	Mobile
Echinodermata	Spatangoida	Spatangidae	*Spatangus*	Sea urchin	Mobile
Arthropoda	Decapoda	Polychelidae	*Stereomastis*	Blind lobster	Mobile
Arthropoda	Decapoda	Parapaguridae	*Sympagurus*	Hermit crab	Mobile
Mollusca	Pectinida	Pectinidae	*Talochlamys*	Scallop	Mobile
Arthropoda	Decapoda	Majidae	*Teratomaia*	Crab	Mobile
Arthropoda	Decapoda	Trichopeltariidae	*Trichopeltarion*	Crab	Mobile
Mollusca	Neogastropoda	Nassariidae	*Tritia*	Whelk	Mobile
Arthropoda	Decapoda	Chirostylidae	*Uroptychus*	Crab	Mobile
Arthropoda	Decapoda	Inachidae	*Vitjazmaia*	Crab	Mobile
Echinodermata	Forcipulatida	Zoroasteridae	*Zoroaster*	Sea star	Mobile
Mollusca	Pectinida	Pectinidae	*Zygochlamys*	Scallop	Mobile
Echinodermata	Elasipodida	Pelagothuriidae	*Enypniastes*	Sea cucumber	Pelagic
Mollusca	Oegopsida	Histioteuthidae	*Histioteuthis*	Squid	Pelagic
Arthropoda	Decapoda	Nematocarcinidae	*Nematocarcinus*	Shrimp	Pelagic
Mollusca	Oegopsida	Ommastrephidae	*Nototodarus*	Squid	Pelagic
Mollusca	Oegopsida	Onychoteuthidae	*Onykia*	Squid	Pelagic
Chordata	Pyrosomatida	Pyrosomatidae	*Pyrosoma*	Tunicate	Pelagic
Mollusca	Myopsida	Loliginidae	*Sepioteuthis*	Squid	Pelagic
Arthropoda	Decapoda	Sergestidae	*Sergestes*	Prawn	Pelagic
Mollusca	Oegopsida	Cranchiidae	*Teuthowenia*	Squid	Pelagic
Mollusca	Oegopsida	Ommastrephidae	*Todarodes*	Squid	Pelagic
Mollusca	Limida	Limidae	*Acesta*	Bivalve	Sessile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Cnidaria	Leptothecata	Lafoeidae	*Acryptolaria*	Hydroid	Sessile
Cnidaria	Leptothecata	Aglaopheniidae	*Aglaophenia*	Hydroid	Sessile
Arthropoda	Amphipoda	Ampeliscidae	*Ampelisca*	Amphipod	Sessile
Cnidaria	Alcyonacea	Alcyoniidae	*Anthomastus*	Soft coral	Sessile
Annelida	Scolecida	Maldanidae	*Asychis*	Bamboo worm	Sessile
Cnidaria	Actiniaria	Actiniidae	*Bolocera*	Sea anemone	Sessile
Brachiopoda	Terebratulida	Terebratellidae	*Calloria*	Brachiopod	Sessile
Cnidaria	Scleractinia	Caryophylliidae	*Caryophyllia*	Stony coral	Sessile
Bryozoa	Cheilostomata	Celleporidae	*Celleporina*	Bryozoan	Sessile
Cnidaria	Leptothecata	Zygophylacidae	*Cryptolaria*	Hydroid	Sessile
Bryozoa	Cyclostomata	Lichenoporidae	*Disporella*	Bryozoan	Sessile
Cnidaria	Zoantharia	Epizoanthidae	*Epizoanthus*	Anemone like coral	Sessile
Annelida	Eunicida	Eunicidae	*Eunice*	Bristle worm, bobbit worm	Sessile
Bryozoa	Cheilostomata	Microporellidae	*Fenestrulina*	Bryozoan	Sessile
Cnidaria	Scleractinia	Flabellidae	*Flabellum*	Coral	Sessile
Brachiopoda	Terebratulida	Terebratellidae	*Gyrothyris*	Brachiopoda	Sessile
Porifera	Haplosclerida	Chalinidae	*Haliclona*	Sponge	Sessile
Cnidaria	Alcyonacea	Alcyoniidae	*Heteropolypus*	Soft coral	Sessile
Brachiopoda	Terebratulida	Terebratulidae	*Liothyrella*	Brachiopod	Sessile
Porifera	Poecilosclerida	Coelosphaeridae	*Lissodendoryx*	Sponge	Sessile
Cnidaria	Leptothecata	Aglaopheniidae	*Lytocarpia*	Hydroid	Sessile
Brachiopoda	Terebratulida	Terebratellidae	*Magasella*	Brachiopod	Sessile
Annelida	Scolecida	Maldanidae	*Maldane*	Bamboo worm	Sessile
Bryozoa	Cheilostomata	Microporidae	*Micropora*	Bryozoan	Sessile
Cnidaria	Scleractinia	Flabellidae	*Monomyces*	Coral	Sessile
Cnidaria	Leptothecata	Plumulariidae	*Nemertesia*	Hydroid	Sessile

Phylum	Order	Family	Genus	Common name	Biodiversity group
Brachiopoda	Terebratulida	Terebratellidae	*Neothyris*	Brachiopod	Sessile
Mollusca	Carditida	Carditidae	*Pleuromeris*	Clam	Sessile
Mollusca	Cardiida	Cardiidae	*Pratulum*	Clam	Sessile
Mollusca	Carditida	Carditidae	*Purpurocardia*	Clam	Sessile
Bryozoa	Cheilostomata	Smittinidae	*Smittina*	Bryozoan	Sessile
Annelida	Sabellida	Serpulidae	*Spirobranchus*	Polychaete	Sessile
Cnidaria	Scleractinia	Caryophylliidae	*Stephanocyathus*	Stony coral	Sessile
Cnidaria	Leptothecata	Sertulariidae	*Symplectoscyphus*	Hydroid	Sessile
Mollusca	Venerida	Veneridae	*Tawera*	Clam	Sessile
Bryozoa	Cyclostomata	Cerioporidae	*Telopora*	Bryozoan	Sessile

Table B-2: Lists of taxa that comprises demersal fish biodiversity group.

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Bigscale brown slickhead, largescaled brown slickhead	Alepocephalidae	*Alepocephalus australis*	Bathyal-demersal	Bathydemersal
Alert Pigfish	Congiopodidae	*Alertichthys blacki*	Bathyal-demersal	Bathydemersal
Deepwater spiny skate, Thorny skate	Rajidae	*Amblyraja hyperborea*	Bathyal-demersal	Bathydemersal
Giant hatchetfish	Sternoptychidae	*Argyropelecus gigas*	Bathyal-demersal	Bathydemersal
Longtail skate, Softnose skate	Arhynchobatidae	*Arhynchobatis asperrimus*	Bathyal-demersal	Bathydemersal
Hairy conger	Congridae	*Bassanago hirsutus*	Bathyal-demersal	Bathydemersal
Longnose deepsea skate	Arhynchobatidae	*Bathyraja shuntovi*	Bathyal-demersal	Bathydemersal
Deepsea lizardfish	Bathysauridae	*Bathysaurus ferox*	Bathyal-demersal	Bathydemersal
Smooth deepsea skate	Arhynchobatidae	*Brochiraja asperula*	Bathyal-demersal	Bathydemersal
Prickly deepsea skate	Arhynchobatidae	*Brochiraja spinifera*	Bathyal-demersal	Bathydemersal
Dawson's cat shark	Scyliorhinidae	*Bythaelurus dawsoni*	Bathyal-demersal	Bathydemersal
Banded bellowsfish, Redbanded bellowsfish	Macroramphosidae	*Centriscops humerosus*	Bathyal-demersal	Bathydemersal
Leafscale gulper shark	Centrophoridae	*Centrophorus squamosus*	Bathyal-demersal	Bathydemersal
Potuguese dogfish	Somniosidae	*Centroscymnus coelolepis*	Bathyal-demersal	Bathydemersal

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Owston'sdogfish	Somniosidae	*Centroscymnus owstonii*	Bathyal-demersal	Bathydemersal
Longnose velvet dogfish, Golden dogfish (Aus.)	Somniosidae	*Centroselachus crepidater*	Bathyal-demersal	Bathydemersal
Pink frogmouth, Coffinfish, red frogmouth	Chaunacidae	*Chaunax spp.*	Bathyal-demersal	Bathydemersal
Carpenter's chimaera, Purple chimaera	Chimaeridae	*Chimaera lignaria*	Bathyal-demersal	Bathydemersal
Frill shark	Chlamydoselachidae	*Chlamydoselachus anguineus*	Bathyal-demersal	Bathydemersal
Spottyface rattail	Macrouridae	*Coelorinchus acanthiger*	Bathyal-demersal	Bathydemersal
Blacklip rattail	Macrouridae	*Coelorinchus celaenostomus*	Bathyal-demersal	Bathydemersal
Banded rattail	Macrouridae	*Coelorinchus fasciatus*	Bathyal-demersal	Bathydemersal
Notable rattail	Macrouridae	*Coelorinchus innotabilis*	Bathyal-demersal	Bathydemersal
Kaiyomaru rattail	Macrouridae	*Coelorinchus kaiyomaru*	Bathyal-demersal	Bathydemersal
Mahia rattail	Macrouridae	*Coelorinchus matamua*	Bathyal-demersal	Bathydemersal
Darkbanded rattail	Macrouridae	*Coelorinchus maurofasciatus*	Bathyal-demersal	Bathydemersal
Upturned-snout rattail	Macrouridae	*Coelorinchus mycterismus*	Bathyal-demersal	Bathydemersal
Oliver's rattail	Macrouridae	*Coelorinchus oliverianus*	Bathyal-demersal	Bathydemersal
Smallbanded rattail	Macrouridae	*Coelorinchus parvifasciatus*	Bathyal-demersal	Bathydemersal
Roughhead rattail	Macrouridae	*Coelorinchus trachycarus*	Bathyal-demersal	Bathydemersal
Deepsea pigfish	Congiopodidae	*Congiopodus coriaceus*	Bathyal-demersal	Bathydemersal
Humpback rattail	Macrouridae	*Coryphaenoides dossenus*	Bathyal-demersal	Bathydemersal
Serrulate rattail	Macrouridae	*Coryphaenoides serrulatus*	Bathyal-demersal	Bathydemersal
Four-ray rattail	Macrouridae	*Coryphaenoides subserrulatus*	Bathyal-demersal	Bathydemersal
Lookdown dory, King dory (Australia)	Cyttidae	*Cyttus traversi*	Bathyal-demersal	Bathydemersal
Seal shark, Black shark	Dalatiidae	*Dalatias licha*	Bathyal-demersal	Bathydemersal
Shovelnosed dogfish, Brier shark (Aus.)	Centrophoridae	*Deania calcea*	Bathyal-demersal	Bathydemersal
Basketwork eel	Synaphobranchidae	*Diastobranchus capensis*	Bathyal-demersal	Bathydemersal
Common messmate	Carapidae	*Echiodon cryomargarites*	Bathyal-demersal	Bathydemersal
White cardinalfish, White deepsea cardinal	Epigonidae	*Epigonus denticulatus*	Bathyal-demersal	Bathydemersal
Bigeye cardinalfish, Bigeye deepsea cardinal	Epigonidae	*Epigonus lenimen*	Bathyal-demersal	Bathydemersal

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Robust cardinalfish, Robust deepsea cardinal	Epigonidae	*Epigonus robustus*	Bathyal-demersal	Bathydemersal
Deepsea cardinalfish, Black deepsea cardinal	Epigonidae	*Epigonus telescopus*	Bathyal-demersal	Bathydemersal
Eucla cod	Euclichthyidae	*Euclichthys polynemus*	Bathyal-demersal	Bathydemersal
Ling	Ophidiidae	*Genypterus blacodes*	Bathyal-demersal	Bathydemersal
Slender smooth-hound	Pseudotriakidae	*Gollum attenuatus*	Bathyal-demersal	Bathydemersal
Black halosaur, Abyssal halosaur	Halosauridae	*Halosauropsis macrochir*	Bathyal-demersal	Bathydemersal
Common halosaur	Halosauridae	*Halosaurus pectoralis*	Bathyal-demersal	Bathydemersal
Longnose spookfish, Longnose chimaera	Rhinochimaeridae	*Harriotta raleighana*	Bathyal-demersal	Bathydemersal
Deepsea flathead, Deepsea ghostflathead	Hoplichthyidae	*Hoplichthys haswelli*	Bathyal-demersal	Bathydemersal
Pale ghost shark, Brown ghostshark	Chimaeridae	*Hydrolagus bemisi*	Bathyal-demersal	Bathydemersal
Black ghostshark, Little black ghostshark	Chimaeridae	*Hydrolagus homonycteris*	Bathyal-demersal	Bathydemersal
Dark ghost shark (ghost shark), Mottled ghostshark	Chimaeridae	*Hydrolagus novaezealandiae*	Bathyal-demersal	Bathydemersal
Pointynose blue ghost shark, Purple ghostshark	Chimaeridae	*Hydrolagus trolli*	Bathyal-demersal	Bathydemersal
Pineapple rattail	Trachyrincidae	*Idiolophorhynchus andriashevi*	Bathyal-demersal	Bathydemersal
Smallhead cod	Moridae	*Lepidion microcephalus*	Bathyal-demersal	Bathydemersal
Schmidt's cod, Giant lepidion	Moridae	*Lepidion schmidti*	Bathyal-demersal	Bathydemersal
Orange perch	Serranidae	*Lepidoperca aurantia*	Bathyal-demersal	Bathydemersal
Javelinfish	Macrouridae	*Lepidorhynchus denticulatus*	Bathyal-demersal	Bathydemersal
Blackspot rattail	Macrouridae	*Lucigadus nigromaculatus*	Bathyal-demersal	Bathydemersal
Carinate rattail, Ridge scaled rattail	Macrouridae	*Macrourus carinatus*	Bathyal-demersal	Bathydemersal
Spiky oreo	Oreosomatidae	*Neocyttus rhomboidalis*	Bathyal-demersal	Bathydemersal
Squashed face marlinspike	Macrouridae	*Nezumia namatahi*	Bathyal-demersal	Bathydemersal
Spineback	Notacanthidae	*Notacanthus sexspinis*	Bathyal-demersal	Bathydemersal
Prickly dogfish	Oxynotidae	*Oxynotus bruniensis*	Bathyal-demersal	Bathydemersal
Yellow boarfish, Bigspine boarfish	Pentacerotidae	*Pentaceros decacanthus*	Bathyal-demersal	Bathydemersal
Rubyfish	Emmelichthyidae	*Plagiogeneion rubiginosum*	Bathyal-demersal	Bathydemersal

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Smooth oreo	Oreosomatidae	*Pseudocyttus maculatus*	Bathyal-demersal	Bathydemersal
Blobfish	Psychrolutidae	*Psychrolutes microporos*	Bathyal-demersal	Bathydemersal
Japanese gurnard	Triglidae	*Pterygotrigla andertoni*	Bathyal-demersal	Bathydemersal
Snubnosed eel	Synaphobranchidae	*Simenchelys parasitica*	Bathyal-demersal	Bathydemersal
Northern spiny dogfish, Green-eyed dogfish	Squalidae	*Squalus griffini*	Bathyal-demersal	Bathydemersal
New Zealand torpedo	Torpedinidae	*Tetronarce nobiliana*	Bathyal-demersal	Bathydemersal
Velvet rattail	Macrouridae	*Trachonurus gagates*	Bathyal-demersal	Bathydemersal
White rattail	Trachyrincidae	*Trachyrincus aphyodes*	Bathyal-demersal	Bathydemersal
Unicorn rattail	Trachyrincidae	*Trachyrincus longirostris*	Bathyal-demersal	Bathydemersal
Cape scorpionfish, Sea perches	Sebastidae	*Trachyscorpia eschmeyeri*	Bathyal-demersal	Bathydemersal
Grenadier cod	Moridae	*Tripterophycis gilchristi*	Bathyal-demersal	Bathydemersal
Bigscale brown slickhead, largescaled brown slickhead	Alepocephalidae	*Alepocephalus australis*	Bathyal-demersal	Bathydemersal
Smooth lanternshark, Slender lanternshark (Aus.)	Etmopteridae	*Etmopterus pusillus*	Bathyal-demersal	Bathypelagic
Sharpnose sevengill shark	Hexanchidae	*Heptranchias perlo*	Bathyal-demersal	Bentho-pelagic
Thresher shark	Alopiidae	*Alopias vulpinus*	Bathyal-demersal	Pelagic
Redbait, Red baitfish	Emmelichthyidae	*Emmelichthys nitidus*	Bathyal-demersal	Pelagic
Finless flounder	Achiropsettidae	*Neoachiropsetta milfordi*	Bathyal-pelagic	Bathydemersal
Smallscale brown slickhead	Alepocephalidae	*Alepocephalus antipodianus*	Bathyal-pelagic	Bathypelagic
Black oreo	Oreosomatidae	*Allocyttus niger*	Bathyal-pelagic	Bathypelagic
Warty oreo	Oreosomatidae	*Allocyttus verrucosus*	Bathyal-pelagic	Bathypelagic
Pale toadfish	Psychrolutidae	*Ambophthalmos angustus*	Bathyal-pelagic	Bathypelagic
Fangtooth	Anoplogastridae	*Anoplogaster cornuta*	Bathyal-pelagic	Bathypelagic
Silverside	Argentinidae	*Argentina elongata*	Bathyal-pelagic	Bathypelagic
Dark cusk	Ophidiidae	*Brotulotaenia nigra*	Bathyal-pelagic	Bathypelagic
Viperfish	Stomiidae	*Chauliodus sloani*	Bathyal-pelagic	Bathypelagic
McMillan's rattail	Macrouridae	*Coryphaenoides mcmillani*	Bathyal-pelagic	Bathypelagic
Abyssal rattail	Macrouridae	*Coryphaenoides murrayi*	Bathyal-pelagic	Bathypelagic
Striate rattail	Macrouridae	*Coryphaenoides striaturus*	Bathyal-pelagic	Bathypelagic
Warty seadevil	Ceratiidae	*Cryptopsaras couesii*	Bathyal-pelagic	Bathypelagic

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Spinyfin, Black roughy, black discfish	Diretmidae	*Diretmichthys parini*	Bathyal-pelagic	Bathypelagic
Discfish, Silver discfish	Diretmidae	*Diretmus argenteus*	Bathyal-pelagic	Bathypelagic
Johnson's cod, Johnson's slender cod	Moridae	*Halargyreus johnsonii*	Bathyal-pelagic	Bathypelagic
Orange roughy	Trachichthyidae	*Hoplostethus atlanticus*	Bathyal-pelagic	Bathypelagic
Giant barracudina, Barracudinas	Paralepididae	*Magnisudis prionosa*	Bathyal-pelagic	Bathypelagic
Pearlside, Pennant pearlside	Sternoptychidae	*Maurolicus australis*	Bathyal-pelagic	Bathypelagic
Smalltooth pelagic cod, Pelagic cods	Melanonidae	*Melanonus gracilis*	Bathyal-pelagic	Bathypelagic
Largetooth pelagic cod, Arrowtail pelagic cod	Melanonidae	*Melanonus zugmayeri*	Bathyal-pelagic	Bathypelagic
Limp eelpout	Zoarcidae	*Melanostigma gelatinosum*	Bathyal-pelagic	Bathypelagic
Black javelinfish, Black whiptail (Aus.)	Macrouridae	*Mesobius antipodum*	Bathyal-pelagic	Bathypelagic
Ribaldo	Moridae	*Mora moro*	Bathyal-pelagic	Bathypelagic
Snipe eel, Blackspot snipe eel	Nemichthyidae	*Nemichthys scolopaceus*	Bathyal-pelagic	Bathypelagic
Giant black dragonfish, Speckled dragonfish	Stomiidae	*Opostomias micripnus*	Bathyal-pelagic	Bathypelagic
Lighthousefish, Silver lighthousefish	Phosichthyidae	*Phosichthys argenteus*	Bathyal-pelagic	Bathypelagic
Robust pelagic basslet, Rotund cardinalfish	Howellidae	*Rosenblattia robusta*	Bathyal-pelagic	Bathypelagic
Slender ragfish	Centrolophidae	*Schedophilus huttoni*	Bathyal-pelagic	Bathypelagic
Elongated bristlemouth fish	Gonostomatidae	*Sigmops spp.*	Bathyal-pelagic	Bathypelagic
Talismania longifilis, Threadfin slickhead	Alepocephalidae	*Talismania longifilis*	Bathyal-pelagic	Bathypelagic
Squaretail	Tetragonuridae	*Tetragonurus cuvieri*	Bathyal-pelagic	Bathypelagic
Furry whiptail	Macrouridae	*Trachonurus villosus*	Bathyal-pelagic	Bathypelagic
Tasmanian ruffe	Centrolophidae	*Tubbia spp.*	Bathyal-pelagic	Bathypelagic
Elongate dory	Zeniontidae	*Zenion sp*	Bathyal-pelagic	Bathypelagic
Shortsnout lancetfish	Alepisauridae	*Alepisaurus brevirostris*	Bathyal-pelagic	Pelagic
Rudderfish	Centrolophidae	*Centrolophus niger*	Bathyal-pelagic	Pelagic
Dealfish, Peregrin dealfish	Trachipteridae	*Trachipterus trachypterus*	Bathyal-pelagic	Pelagic
Common roughy	Trachichthyidae	*Paratrachichthys trailli*	Bathyal-pelagic	Reef

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Snapper	Sparidae	*Chrysophrys auratus*	Benthic	Bentho-pelagic
Silver dory, Pink dory	Cyttidae	*Cyttus novaezealandiae*	Benthic	Bentho-pelagic
Rig	Triakidae	*Mustelus lenticulatus*	Benthic	Bentho-pelagic
Porae	Cheilodactylidae	*Nemadactylus douglasii*	Benthic	Bentho-pelagic
Tarakihi	Cheilodactylidae	*Nemadactylus macropterus*	Benthic	Bentho-pelagic
Sowfish, Giant boarfish	Pentacerotidae	*Paristiopterus labiosus*	Benthic	Bentho-pelagic
Red cod	Moridae	*Pseudophycis bachus*	Benthic	Bentho-pelagic
Bass	Polyprionidae	*Polyprion americanus*	Benthic	Bentho-pelagic or Reef
Hagfish, Common hagfish	Myxinidae	*Eptatreus spp.*	Benthic	
Violet cod	Moridae	*Antimora rostrata*	Benthic	
Pink cod	Moridae	*Auchenoceros punctatus*	Benthic	
Spotted flounder	Rhombosoleidae	*Azygopus flemingi*	Benthic	
Swollenhead conger	Congridae	*Bassanago bulbiceps*	Benthic	
Elephant fish	Callorhinchidae	*Callorhinchus milii*	Benthic	
Red Gurnard, Gurnard	Triglidae	*Chelidonichthys kumu*	Benthic	
Brill	Rhombosoleidae	*Colistium guntheri*	Benthic	
Turbot	Rhombosoleidae	*Colistium nudipinnis*	Benthic	
Pigfish, Southern pigfish	Congiopodidae	*Congiopodus leucopaecilus*	Benthic	
Globefish	Tetraodontidae	*Contusus richei*	Benthic	
Bonyskull toadfish	Psychrolutidae	*Cottunculus nudus*	Benthic	
Sand stargazer	Leptoscopidae	*Crapatalus novaezelandiae*	Benthic	
Long-tailed stingray	Dasyatidae	*Dasyatis thetidis*	Benthic	
Smooth Skate	Rajidae	*Dipturus innominatus*	Benthic	
Spotted stargazer	Uranoscopidae	*Genyagnus monopterygius*	Benthic	
Sandfish, Beaked salmon, sand eel	Gonorynchidae	*Gonorynchus forsteri*	Benthic	
Giant stargazer, Monkfish	Uranoscopidae	*Kathetostoma giganteum*	Benthic	
Scaly gurnard	Triglidae	*Lepidotrigla brachyoptera*	Benthic	

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Crested flounder	Bothidae	*Lophonectes mongonuiensis*	Benthic	
Snipefish	Macroramphosidae	*Macroramphosus scolopax*	Benthic	
Dark toadfish	Psychrolutidae	*Neophrynichthys latus*	Benthic	
Crested Bellowfish	Macroramphosidae	*Notopogon lilliei*	Benthic	
Blue cod	Pinguipedidae	*Parapercis colias*	Benthic	
Yellow cod, Yellow weever	Pinguipedidae	*Parapercis gilliesii*	Benthic	
Cucumber fish	Paraulopidae	*Paraulopus spp.*	Benthic	
Lemon sole	Rhombosoleidae	*Pelotretis flavilatus*	Benthic	
Sole (complex)	Rhombosoleidae	*Peltorhamphus spp.*	Benthic	
Yellowbelly flounder	Rhombosoleidae	*Rhombosolea leporina*	Benthic	
Sand flounder	Rhombosoleidae	*Rhombosolea plebeia*	Benthic	
Greenback flounder	Rhombosoleidae	*Rhombosolea tapirina*	Benthic	
Spiny seadragon	Syngnathidae	*Solegnathus spinosissimus*	Benthic	
Red mullet, goatfish	Mullidae	*Upeneichthys porosus*	Benthic	
Brown stargazer	Uranoscopidae	*Xenocephalus armatus*	Benthic	
Longfin boarfish	Pentacerotidae	*Zanclistius elevatus*	Benthic	
Rough skate	Rajidae	*Zearaja nasuta*	Benthic	
Carpet Shark	Scyliorhinidae	*Cephaloscyllium isabellum*	Benthic	
Pacific spookfish, Widenose chimaera	Rhinochimaeridae	*Rhinochimaera pacifica*	Bentho-pelagic	Bathydemersal
Largespine velvet dogfish	Somniosidae	*Scymnodon macracanthus*	Bentho-pelagic	Bathydemersal
Broadnose sevengill shark	Hexanchidae	*Notorynchus cepedianus*	Bentho-pelagic	Benthic
Banded stargazer	Uranoscopidae	*Kathetostoma binigrasella*	Bentho-pelagic	Benthic
Longsnout lancetfish	Alepisauridae	*Alepisaurus ferox*	Bentho-pelagic	Pelagic
Butterfly perch	Serranidae	*Caesioperca lepidoptera*	Bentho-pelagic	Reef
Hapuku, Groper	Polyprionidae	*Polyprion oxygeneios*	Bentho-pelagic	Reef
Eagle ray	Myliobatidae	*Myliobatis tenuicaudatus*	Bentho-pelagic	Reef
Moki, Blue moki	Latridae	*Latridopsis ciliaris*	Bentho-pelagic	
Leatherjacket	Monacanthidae	*Meuschenia scaber*	Bentho-pelagic	
Longfinned beryx, Imperador (Australia)	Berycidae	*Beryx decadactylus*	Bentho-pelagic	
Capro dory	Zeniontidae	*Capromimus abbreviatus*	Bentho-pelagic	

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Thickhead Rattail	Macrouridae	*Cetonurus crassiceps*	Bentho-pelagic	
Oblique-banded rattail	Macrouridae	*Coelorinchus aspercephalus*	Bentho-pelagic	
Two saddle rattail	Macrouridae	*Coelorinchus biclinozonalis*	Bentho-pelagic	
Bollons' rattail	Macrouridae	*Coelorinchus bollonsi*	Bentho-pelagic	
Cook's rattail	Macrouridae	*Coelorinchus cookianus*	Bentho-pelagic	
Kermadec rattail	Macrouridae	*Coelorinchus kermadecus*	Bentho-pelagic	
Short-tailed black ray	Dasyatidae	*Dasyatis brevicaudata*	Bentho-pelagic	
Filamentous rattail	Bathygadidae	*Gadomus aoteanus*	Bentho-pelagic	
School shark, Grey boy, tope	Triakidae	*Galeorhinus galeus*	Bentho-pelagic	
Silver conger	Congridae	*Gnathophis habenatus*	Bentho-pelagic	
Silver roughy	Trachichthyidae	*Hoplostethus mediterraneus*	Bentho-pelagic	
Bluenose	Centrolophidae	*Hyperoglyphe antarctica*	Bentho-pelagic	
Bulbos rattail	Macrouridae	*Kuronezumia bubonis*	Bentho-pelagic	
Starnose black rat	Macrouridae	*Kuronezumia leonis*	Bentho-pelagic	
Frostfish	Trichiuridae	*Lepidopus caudatus*	Bentho-pelagic	
Hoki, Blue grenadier (Aus.)	Merlucciidae	*Macruronus novaezelandiae*	Bentho-pelagic	
Hake, Southern hake	Merlucciidae	*Merluccius australis*	Bentho-pelagic	
Southern blue whiting	Gadidae	*Micromesistius australis*	Bentho-pelagic	
Dwarf cod	Moridae	*Notophycis marginata*	Bentho-pelagic	
Smallscale cod	Nototheniidae	*Notothenia microlepidota*	Bentho-pelagic	
Gemfish	Gempylidae	*Rexea solandri*	Bentho-pelagic	
Common warehou, Blue warehou	Centrolophidae	*Seriolella brama*	Bentho-pelagic	
Silver warehou	Centrolophidae	*Seriolella punctata*	Bentho-pelagic	
Blunthead puffer	Tetraodontidae	*Sphoeroides pachygaster*	Bentho-pelagic	
Spiny dogfish	Squalidae	*Squalus acanthias*	Bentho-pelagic	
Mirror dory	Zeidae	*Zenopsis nebulosa*	Bentho-pelagic	
John dory	Zeidae	*Zeus faber*	Bentho-pelagic	
Southern lanternshark	Etmopteridae	*Etmopterus granulosus*	Pelagic	Bathydemersal
Lucifer dogfish, Blackbelly lanternshark (Aus)	Etmopteridae	*Etmopterus lucifer*	Pelagic	Bathypelagic
Witch	Bothidae	*Arnoglossus scapha*	Pelagic	Benthic

Common name	Family name	Scientific name	Biodiversity group	Updated Biodiversity group
Barracouta	Gempylidae	*Thyrsites atun*	Pelagic	
Greenback jack mackerel, Horse mackerel	Carangidae	*Trachurus declivis*	Pelagic	
Yelloweye mullet, Herring, sprat	Mugilidae	*Aldrichetta forsteri*	Pelagic	
Deepwater burrfish	Diodontidae	*Allomycterus pilatus*	Pelagic	
Kahawai	Arripidae	*Arripis trutta*	Pelagic	
Alfonsino, Splendid alfonsino	Berycidae	*Beryx splendens*	Pelagic	
Ray's bream	Bramidae	*Brama spp.*	Pelagic	
Anchovy	Engraulidae	*Engraulis australis*	Pelagic	
Ragfish	Centrolophidae	*Pseudoicichthys australis*	Pelagic	
Hector's lanternfish	Myctophidae	*Lampanyctodes hectoris*	Pelagic	
Common tubeshoulder	Platytroctidae	*Persparsia kopua*	Pelagic	
Pilchard, Sardine	Clupeidae	*Sardinops sagax*	Pelagic	
Blue mackerel, English mackerel, Pacific	Scombridae	*Scomber australasicus*	Pelagic	
Kingfish, Yellowtail kingfish	Carangidae	*Seriola lalandi*	Pelagic	
White warehou	Centrolophidae	*Seriolella caerulea*	Pelagic	
Hammerhead shark, Smooth hammerhead shark	Sphyrnidae	*Sphyrna zygaena*	Pelagic	
Sprat (complex)	Clupeidae	*Sprattus spp.*	Pelagic	
Slender jack mackerel, Chilean jack mackerel	Carangidae	*Trachurus murphyi*	Pelagic	
Yellowtail jack mackerel, Horse mackerel	Carangidae	*Trachurus novaezelandiae*	Pelagic	
Silver trevally	Carangidae	*Pseudocaranx georgianus*	Reef	Pelagic
Girdled wrasse	Labridae	*Notolabrus cinctus*	Reef	
Trumpeter	Latridae	*Latris lineata*	Reef	
Spotty	Labridae	*Notolabrus celidotus*	Reef	
Banded wrasse	Labridae	*Notolabrus fucicola*	Reef	
Scarlet wrasse, Red soldierfish	Labridae	*Pseudolabrus miles*	Reef	

Table B-3: Lists of taxa that comprises the macroalgae biodiversity group.

Phylum	Order	Family	Species	Biodiversity group
Ochrophyta	Fucales	Sargassaceae	*Carpophyllum angustifolium*	Canopy-forming algae

Phylum	Order	Family	Species	Biodiversity group
Ochrophyta	Fucales	Sargassaceae	*Carpophyllum flexuosum*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Carpophyllum maschalocarpum*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Carpophyllum plumosum*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Cystophora retroflexa*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Cystophora scalaris*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Cystophora torulosa*	Canopy-forming algae
Ochrophyta	Fucales	Durvillaeaceae	*Durvillaea antarctica*	Canopy-forming algae
Ochrophyta	Laminariales	Lessoniaceae	*Ecklonia radiata*	Canopy-forming algae
Ochrophyta	Laminariales	Laminariaceae	*Macrocystis pyrifera*	Canopy-forming algae
Ochrophyta	Fucales	Seirococcaceae	*Marginariella boryana*	Canopy-forming algae
Ochrophyta	Fucales	Seirococcaceae	*Marginariella urvilliana*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Sargassum sinclairii*	Canopy-forming algae
Ochrophyta	Fucales	Sargassaceae	*Landsburgia quercifolia*	Canopy-forming algae
Ochrophyta	Ectocarpales	Adenocystaceae	*Adenocystis utricularis*	Other algae
Rhodophyta	Halymeniales	Halymeniaceae	*Aeodes nitidissima*	Other algae
Rhodophyta	Gracilariales	Gracilariaceae	*Agarophyton chilense*	Other algae
Rhodophyta	Ceramiales	Wrangeliaceae	*Anotrichium crinitum*	Other algae
Rhodophyta	Bonnemaisoniales	Bonnemaisoniaceae	*Asparagopsis armata*	Other algae
Ochrophyta	Scytothamnales	Bachelotiaceae	*Bachelotia antillarum*	Other algae
Rhodophyta	Balliales	Balliaceae	*Ballia callitricha*	Other algae
Rhodophyta	Gelidiales	Gelidiaceae	*Capreolia implexa*	Other algae
Ochrophyta	Sporochnales	Sporochnaceae	*Carpomitra costata*	Other algae
Rhodophyta	Gigartinales	Caulacanthaceae	*Caulacanthus ustulatus*	Other algae
Chlorophyta	Bryopsidales	Caulerpaceae	*Caulerpa brownii*	Other algae
Chlorophyta	Bryopsidales	Caulerpaceae	*Caulerpa flexilis*	Other algae
Chlorophyta	Bryopsidales	Caulerpaceae	*Caulerpa geminata*	Other algae
Rhodophyta	Ceramiales	Ceramiaceae	*Centroceras clavulatum*	Other algae
Chlorophyta	Cladophorales	Cladophoraceae	*Chaetomorpha aerea*	Other algae
Rhodophyta	Rhodymeniales	Champiaceae	*Champia novae-zelandiae*	Other algae
Rhodophyta	Gigartinales	Gigartinaceae	*Chondracanthus chapmanii*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Chondria macrocarpa*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Cladhymenia oblongifolia*	Other algae
Rhodophyta	Bangiales	Bangiaceae	*Clymene coleana*	Other algae
Chlorophyta	Bryopsidales	Codiaceae	*Codium convolutum*	Other algae
Chlorophyta	Bryopsidales	Codiaceae	*Codium fragile*	Other algae
Chlorophyta	Bryopsidales	Codiaceae	*Codium gracile*	Other algae
Ochrophyta	Ectocarpales	Scytosiphonaceae	*Colpomenia sinuosa*	Other algae
Rhodophyta	Corallinales	Corallinaceae	*Corallina aff ferreyrae*	Other algae
Rhodophyta	Gracilariales	Gracilariaceae	*Crassiphycus proliferus*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Dasyclonium incisum*	Other algae
Ochrophyta	Desmarestiales	Desmarestiaceae	*Desmarestia ligulata*	Other algae
Ochrophyta	Ectocarpales	Ectocarpaceae	*Ectocarpus siliculosus*	Other algae

Phylum	Order	Family	Species	Biodiversity group
Rhodophyta	Ceramiales	Callithamniaceae	*Euptilota formosissima*	Other algae
Rhodophyta	Gelidiales	Gelidiaceae	*Gelidium caulacantheum*	Other algae
Rhodophyta	Gigartinales	Gigartinaceae	*Gigartina atropurpurea*	Other algae
Rhodophyta	Gigartinales	Gigartinaceae	*Gigartina macrocarpa*	Other algae
Rhodophyta	Halymeniales	Halymeniaceae	*Grateloupia urvilleana*	Other algae
Rhodophyta	Gigartinales	Phyllophoraceae	*Gymnogongrus furcatus*	Other algae
Rhodophyta	Gigartinales	Phyllophoraceae	*Gymnogongrus torulosus*	Other algae
Ochrophyta	Sphacelariales	Stypocaulaceae	*Halopteris funicularis*	Other algae
Ochrophyta	Sphacelariales	Stypocaulaceae	*Halopteris virgata*	Other algae
Rhodophyta	Ceramiales	Delesseriaceae	*Haraldiophyllum crispatum*	Other algae
Rhodophyta	Ceramiales	Delesseriaceae	*Hymenena variolosa*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Laurencia distichophylla*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Laurencia thyrsifera*	Other algae
Rhodophyta	Ceramiales	Wrangeliaceae	*Lophothamnion hirtum*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Lophurella hookeriana*	Other algae
Chlorophyta	Cladophorales	Cladophoraceae	*Lychaete herpestica*	Other algae
Rhodophyta	Gracilariales	Gracilariaceae	*Melanthalia abscissa*	Other algae
Chlorophyta	Cladophorales	Siphonocladus clade	*Microdictyon mutabile*	Other algae
Ochrophyta	Syringodermatales	Syringodermataceae	*Microzonia velutina*	Other algae
Ochrophyta	Ectocarpales	Chordariaceae	*Myriogloea intestinalis*	Other algae
Rhodophyta	Halymeniales	Halymeniaceae	*Pachymenia dichotoma*	Other algae
Rhodophyta	Halymeniales	Halymeniaceae	*Pachymenia lusoria*	Other algae
Ochrophyta	Ectocarpales	Scytosiphonaceae	*Petalonia binghamiae*	Other algae
Rhodophyta	Plocamiales	Plocamiaceae	*Plocamium angustum*	Other algae
Rhodophyta	Plocamiales	Plocamiaceae	*Plocamium cartilagineum*	Other algae
Rhodophyta	Plocamiales	Plocamiaceae	*Plocamium cirrhosum*	Other algae
Rhodophyta	Gigartinales	Kallymeniaceae	*Psaromenia berggrenii*	Other algae
Rhodophyta	Gigartinales	Gigartinaceae	*Psilophycus alveatus*	Other algae
Rhodophyta	Gelidiales	Gelidiaceae	*Pterocladiella capillacea*	Other algae
Rhodophyta	Bangiales	Bangiaceae	*Pyropia plicata*	Other algae
Rhodophyta	Gigartinales	Cystocloniaceae	*Rhodophyllis membranacea*	Other algae
Rhodophyta	Gigartinales	Gigartinaceae	*Sarcothalia decipiens*	Other algae
Rhodophyta	Ceramiales	Delesseriaceae	*Schizoseris dichotoma*	Other algae
Ochrophyta	Ectocarpales	Scytosiphonaceae	*Scytosiphon lomentaria*	Other algae
Rhodophyta	Gigartinales	Phyllophoraceae	*Stenogramma interruptum*	Other algae
Rhodophyta	Ceramiales	Rhodomelaceae	*Vidalia colensoi*	Other algae
Ochrophyta	Fucales	Xiphophoraceae	*Xiphophora chondrophylla*	Other algae
Ochrophyta	Fucales	Xiphophoraceae	*Xiphophora gladiata*	Other algae
Ochrophyta	Dictyotales	Dictyotaceae	*Zonaria turneriana*	Other algae

Table B-4: Lists of taxa that comprises the seabird biodiversity group.

Common name	Species Name	Updated common name	Updated species name	Biodiversity group
Antipodean Wandering Albatross	*Diomedea antipodensis*		*Diomedea antipodensis antipodensis*	Albatross
Campbell Island Mollymawk	*Thalassarche impavida*			Albatross
Chatham Island Mollymawk	*Thalassarche eremita*			Albatross
Gibson's Wandering Albatross	*Diomedea antipodensis gibsoni*			Albatross
Grey-headed Mollymawk	*Thalassarche chrysostoma*			Albatross
Light-mantled Sooty Albatross	*Phoebetria palpebrata*			Albatross
Northern Buller's Mollymawk	*Diomedea bulleri platei*			Albatross
Northern Royal Albatross	*Diomedea sanfordi*			Albatross
White-capped Mollymawk	*Thalassarche steadi*			Albatross
Salvin's Mollymawk	*Thalassarche salvini*			Albatross
Southern Buller's Mollymawk	*Thalassarche bulleri*			Albatross
Southern Royal Albatross	*Diomedea epomophora*			Albatross
Australasian Gannet	*Morus serrator*			Other
Brown Skua	*Stercorarius antarcticus*			Other
Caspian Tern	*Hydroprogne caspia*			Other
Masked Booby	*Sula dactylatra*			Other
Pacific White Tern	*Gygis alba*			Other
Chatham Island Blue Penguin	*Eudyptula minor chathamensis*	Little penguin	*Eudyptula minor minor*	Penguin
Eastern Rockhopper Penguin	*Eudyptes chrysocome filholi*			Penguin
Erect-crested Penguin	*Eudyptes sclateri*			Penguin
Fiordland Crested Penguin	*Sternula nereis*		*Eudyptes pachyrhynchus*	Penguin
Northern Blue Penguin	*Eudyptula minor iredalei*	Little penguin	*Eudyptula minor minor*	Penguin
Snares Crested Penguin	*Eudyptes robustus*			Penguin

Common name	Species Name	Updated common name	Updated species name	Biodiversity group
Southern Blue Penguin	*Eudyptula minor minor*	Little penguin	*Eudyptula minor minor*	Penguin
White-flippered Blue Penguin	*Eudyptula minor albosignata*	Little penguin	*Eudyptula minor minor*	Penguin
Yellow Eyed Penguin	*Megadyptes antipodes*			Penguin
Antarctic Prion	*Pachyptila desolata*			Petrels
Black-bellied Storm Petrel	*Fregetta tropica*			Petrels
Black Petrel	*Procellaria parkinsoni*			Petrels
Broad-billed Prion	*Pachyptila vittata*			Petrels
Chatham Island Petrel	*Pterodroma axillaris*			Petrels
Chatham Island Taiko	*Pterodroma magentae*			Petrels
Codfish Island Diving Petrel	*Pelecanoides georgicus whenuahouensis*	Whenua Hou Diving Petrel		Petrels
Cooks Petrel	*Pterodroma cookii*			Petrels
Fairy Prion	*Pachyptila turtur*			Petrels
Grey-faced Petrel	*Pterodroma gouldi*			Petrels
Grey Petrel	*Procellaria cinerea*			Petrels
Kermadec Petrel	*Pterodroma neglecta*			Petrels
Kermadec Storm Petrel	*Pelagodroma albiclunis*			Petrels
Mottled Petrel	*Pterodroma inexpectata*			Petrels
Northern Diving Petrel	*Pelecanoides urinatrix urinatrix*			Petrels
Northern Giant Petrel	*Macronectes halli*			Petrels
NZ Storm Petrel	*Fregetta maoriana*			Petrels
NZ White-faced Storm Petrel	*Pelagodroma marina*			Petrels
Pycroft's Petrel	*Diomedea sanfordi*		Pterodroma pycrofti	Petrels
Snares Cape pigeon	*Daption capense*	Cape petrel		Petrels
Soft-plumaged Petrel	*Pterodroma mollis*			Petrels
Southern Diving Petrel	*Pelecanoides urinatrix*		*Pelecanoides urinatrix chathamensis*	Petrels
Subantarctic Diving Petrel	*Pelecanoides urinatrix exsul*			Petrels
Westland Petrel	*Procellaria westlandica*			Petrels
White-bellied Storm Petrel	*Fregetta grallaria*			Petrels

Common name	Species Name	Updated common name	Updated species name	Biodiversity group
White-chinned Petrel	*Procellaria aequinoctialis*			Petrels
White-headed Petrel	*Pterodroma lessonii*			Petrels
White-naped Petrel	*Pterodroma cervicalis*			Petrels
Auckland Island Shag	*Leucocarbo colensoi*			Shags
Blue Shag	*Mergus australis oliveri*	Spotted Shag	*Stictocarbo punctatus*	Shags
Bounty Island Shag	*Leucocarbo ranfurlyi*			Shags
Campbell Island Shag	*Leucocarbo campbelli*			Shags
Chatham Island Shag	*Leucocarbo onslowi*			Shags
King Shag	*Leucocarbo carunculatus*			Shags
Little Black Shag	*Phalacrocorax sulcirostris*			Shags
Pied Shag	*Phalacrocorax varius varius*			Shags
Pitt Island Shag	*Phalacrocorax featherstoni*			Shags
Spotted Shag	*Stictocarbo punctatus*		*Phalacrocorax punctatus*	Shags
Stewart Island Shag	*Leucocarbo chalconotus*	Otago shag	*Leucocarbo chalconotus*	Shags
Stewart Island Shag	*Leucocarbo stewarti*	Foveaux shag	*Leucocarbo stewarti*	Shags
Bullers Shearwater	*Ardenna bulleri*			Shearwater
Flesh-footed Shearwater	*Puffinus carneipes*		*Ardenna carneipes*	Shearwater
Fluttering Shearwater	*Sternula nereis*		*Puffinus gavia*	Shearwater
Huttons Shearwater	*Puffinus huttoni*			Shearwater
Kermadec Little Shearwater	*Puffinus gavia kermadecensis*		*Puffinus assimilis kermadecensis*	Shearwater
North Island Little Shearwater	*Puffinus assimilis*		*Puffinus assimilis haurakiensis*	Shearwater
Sooty Shearwater	*Ardenna grisea*			Shearwater
Wedge-tailed Shearwater	*Ardenna pacifica*			Shearwater

Table B-5: Lists of taxa that comprises the cetacean biodiversity group. 'Complex' denotes that multiple species or sub-species were included in the model. See Stephenson et al. (2020) for details.

Common name	Species	Family	Biodiversity group
Hector's dolphin	*Cephalorhynchus hectori hectori*	Delphinidae	Delphinidae
Māui dolphin	*Cephalorhynchus hectori maui*	Delphinidae	Delphinidae
Common dolphin	*Delphinus delphis*	Delphinidae	Delphinidae
Dusky dolphin	*Lagenorhynchus obscurus*	Delphinidae	Delphinidae
Bottlenose dolphin	*Tursiops truncatus*	Delphinidae	Delphinidae
Pilot whale	*Globicephala* spp. (complex)	Delphinidae	Delphinidae
Orca, killer whale	*Orcinus orca* (complex)	Delphinidae	Delphinidae
Bryde's whale	*Balaenoptera edeni brydei*	Balaenopteridae	Whale
Southern right whale	*Eubalaena australis*	Balaenidae	Whale
Humpback whale	*Megaptera novaeangliae*	Balaenopteridae	Whale
Sperm whale	*Physeter macrocephalus*	Physeteridae	Whale
Blue whale	*Balaenoptera musculus* (complex)	Balaenopteridae	Whale