# Identification of significant ecological areas for the Otago coastal marine area

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# Executive summary


The Otago Regional Council (ORC) contracted NIWA to identify marine significant ecological areas (SEAs) within the Otago coastal marine area (CMA) in order to uphold its role as a territorial authority under the Resource Management Act. This programme of work had four core objectivises

- The collation, systematic review and formatting of spatial datasets housed by ORC, NIWA and third parties
- The identification of SEAs under prescribed management classes that describe similar ecological features and face the same threats to anthropogenic stressors
- Classification of the coastal marine area using an agreed habitat classification
- A gap analyses for each management class to determine the priorities for future surveys and monitoring programmes

The project's objectives and available data were presented to a stakeholder workshop in December 2021 and the availability of third-party datasets was explored. A total of 106 datasets comprising 643 spatial layers were collated, reviewed and deemed to hold usable information across sixteen different management classes. The datasets were formatted in R, using best practise procedures, to ensure consistent spatial domains, extents and data formats. All datasets used for SEA identification using decision support tools were converted to gridded 250 m x 250 m raster datasets.

Two methods of SEA identification were employed dependant on the quantity and extent of information available for each management class. For classes with a significant volume of overlapping data on the distribution of ecological features, the decision support tool Zonation was used to systematically identify SEAs with the top 30% of priority areas being used to guide the establishment of SEA boundaries. For classes with no overlapping datasets and/or when features occurred in confined and discrete locations, a manual SEA designation process was used based on the distribution of established ecological features. The number of SEAs per management class varied between 1 and 42 and were distributed throughout the CMA. Areas around Otago Peninsula and Dunedin had a high number of SEAs which reflects both the importance of this area and the uneven distribution in available spatial data. While the best available information was used for SEA identification, there are instances where SEAs require ground-truthing and/or extent definition when the best available information had some associated uncertainty. Such instances have been flagged in a geodatabase of SEAs that will be made available to ORC along with this report.

A number of gaps concerning particular ecological features and geographic areas were identified. Significant gaps exist for intertidal benthic invertebrates, reef fish, marine mammals, and seafloor geomorphic features. Locations on the Catlins coast and North Otago, along with offshore areas, are also generally poorly represented by the available data. Recommendations for cost-effective ground-truthing and monitoring programmes are made that will enable updating of the results presented in this study. Such programmes will allow for a detailed understanding of the distribution of biodiversity within the Otago CMA to guide future management by a range of stakeholders.

# 1 Introduction

## 1.1 Background and policy framework

As a territorial authority, Otago Regional Council (ORC) have management responsibilities over the coastal marine area (CMA), which extends from mean high water spring tide mark at the shore out to 12 nm (Figure 1-1). Within this context, regional councils have obligations under Section 6 of the Resource Management Act 1991 (RMA). Of particular relevance to this report, regional councils must provide for the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna (Section 6(c)). Regional councils also need to give effect to policies of the New Zealand Coastal Policy Statement 2010 (NZCPS), in particular, Policy 11a and 11b – to protect indigenous biological diversity (biodiversity) in the coastal environment. This responsibility is often enacted through the designation of significant ecological areas (SEAs) in the marine realm – where adverse impacts to significant biodiversity features are prevented and/or mitigated.

The identification and designation of SEAs requires acquisition and appraisal of the underpinning data on coastal biodiversity and habitats, and aligning these datasets with criteria to designate areas of significant indigenous vegetation and significant habitats of indigenous fauna in the coastal environment. Ecological criteria have been designated nationally by the Department of Conservation (Freeman et al. 2017), and datasets assessed with respect to their alignment with these criteria have been compiled at regional scales for other regional authorities (e.g., Environment Southland, McCartain et al. 2021; Auckland Council, Brough et al. 2021a; Hawke's Bay Regional Council; Lundquist et al. 2020). The NZCPS also provides its own ecological significance criteria (Figure 2-2), which can further guide regional councils on the assessment of areas for ecological significance. A stocktake involving the collection and assessment of data on marine fauna and flora within the Otago region will aid in the designation of SEAs, and identify gaps that can be targeted by new sampling and monitoring programmes.

Datasets for coastal biodiversity and habitats include those datasets developed or collated by Otago Regional Council, and by a diversity of other organisations including NIWA, universities and other research institutions. Nationally, the Marine Science Advisory Group (MSAG), a central government advisory group that includes representatives from the Department of Conservation (DOC), the Ministry for Primary Industries (MPI) and the Ministry for the Environment (MfE), is also addressing significant gaps in data on marine ecosystems and biodiversity. The MSAG recently funded the compilation of datasets that address nine key ecological area (KEA) criteria, based on criteria identified for ecologically and biologically significant areas (EBSAs) under the Convention on Biological Diversity (Clark et al. 2014; Freeman et al. 2017). National KEA layers can be assessed for their role in supplementing gaps in knowledge of marine ecosystems and biodiversity in the Otago region, and include datasets addressing nine key ecological area criteria (Stephenson et al. 2018; Lundquist et al. 2020a). Additionally, the KEA and associated projects led to the development of over 600 predictive layers based on species distribution models (SDMs) representing predicted habitat suitability of cetaceans, demersal fish, rocky reef fish, benthic invertebrates, and macroalgae (Lundquist et al. 2020a) and a new seafloor community classification for Aotearoa New Zealand (Stephenson et al. 2022)

## 1.2 Scope and aims

This project included two stakeholder workshops and a desktop data collation and assessment exercise. Drawing upon existing data and additional data supplied following the first workshop, one objective was to compile datasets to inform the identification of significant ecological sites and habitats within the CMA of the Otago region, out to the 12 nautical mile (nm) limit. The project did not include field work to validate ecological information that was supplied. Potential significance was assigned to sites and habitats on the basis of meeting one or more of nine KEA criteria and/or NZCPS criteria, and prioritisation was based on the Zonation decision support tool for classes with sufficient spatial data (see below).

The specific aims of the project included:

1. Introduce the project and the process of identifying SEAs and decision support tools at an Otago regional stakeholder workshop, and seek third party datasets that can fill gaps in the identification of SEAs.
2. Summarise and evaluate the quality of the various data sets that could be used in the assessment of SEAs, drawing on ORC, NIWA and external databases, including data that are made available to NIWA following the first workshop. Reformat as required, and allocate datasets to management classes that represent similarly in responses to threats in the CMA.
3. Utilise the Zonation decision support tool to identify SEAs for the Otago CMA for each management class.
4. Identify significant gaps in data availability that are barriers to accurate spatial planning within the Otago CMA.
5. Present at a final Otago regional stakeholder workshop to showcase and acquire stakeholder input on the final results of the project.
6. Submit report and associated geospatial datasets to support SEA identification.


**Figure 1-1: The Otago CMA.** The Otago coastal marine areas with notation of the locations featuring in this report.

# 2 Methods

This project used a streamlined process (Figure 2-1) to deliver the identification of SEAs with input from a broad stakeholder group consisting of staff from ORC and other government agencies (Ministry for Primary Industries, Department of Conservation), Ngāi Tahu papatipu runaka, scientists from the University of Otago, and local ecological experts. The project was initiated with a stakeholder workshop in December 2021 where the background, aims and proposed methods of the project were introduced to stakeholders, and a range of potential datasets for informing SEAs were identified and discussed (see Appendix A).

Following the initial workshop, a list of identified datasets was collated from within NIWA, ORC and from third-parties, and datasets were critically reviewed and weighted according to reliability (see next section). Datasets were assessed according to two ecological significance criteria; the Key Ecological Areas significance criteria and criteria specified by policy 11 under the National Coastal Policy Statement (Figure 2-2; Table 2-1). Each dataset that met significance criteria was then attributed to defined management classes (see Section 2.2). All datasets that held relevant information on the identification of SEAs were then formatted and reprojected as needed to consistent projection and grid. SEAs were identified for each management class using either 1) systematic identification of SEAs using spatial decision support tools, or 2) manual SEA identification for management classes informed by discrete, limited, or non-overlapping datasets. Threats to the biodiversity values within each SEA were reviewed, ranked and tabulated. A final stakeholder workshop was held in May 2022 (Appendix A) which showcased the datasets that informed the identification of SEAs, and illustrated the SEAs for each management class. Significant gaps in knowledge of the distribution of significant ecological features were discussed in order to guide future data collection.


**Figure 2-1: Streamlined process.** The process and methods used to identify SEAs in this project.

Policy 11 of the NZ Coastal Policy Statement (2010) – Ecological significance criteria

To **protect** indigenous biological diversity in the coastal environment:

(a) **avoid adverse effects of activities** on:

i. indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists;
ii. taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened;
iii. indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare;
iv. habitats of indigenous species where the species are at the limit of their natural range, or are naturally rare;
v. areas containing nationally significant examples of indigenous community types; and
vi. areas set aside for full or partial protection of indigenous biological diversity under other legislation.

(b) **avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities** on:

i. areas of predominantly indigenous vegetation in the coastal environment;
ii. habitats in the coastal environment that are important during the vulnerable life stages of indigenous species;
iii. indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh;
iv. habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes;
v. habitats, including areas and routes, important to migratory species; and
vi. ecological corridors, and areas important for linking or maintaining biological values identified under this policy.

**Figure 2-2: NZCPS significance criteria.** The National Policy Statement ecological criteria used to assess 'significance' of ecological features in this project.

**Table 2-1: KEA criteria.** The Key Ecological Areas ecological significance criteria used to assess 'significance' of ecological features in this project.

| | Criterion | Definition | Rationale | New Zealand Examples |
|---|---|---|---|---|
| 1 | Vulnerability, fragility, sensitivity, or slow recovery. | Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery. | In the absence of protection, associated biodiversity may not be able to persist. | Biogenic habitats, including bryozoan beds, sponge communities and coldwater corals. Low fecundity and, or high longevity (fish) species such as bramble sharks, hapuku, king tarakihi, orange roughy. |

| | Criterion | Definition | Rationale | New Zealand Examples |
|---|---|---|---|---|
| 2 | Uniqueness/rarity/endemism. | Area contains either (i) unique ("the only one of its kind", rare (occurs only in a few locations) or endemic species, populations or communities; and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanography features. | These areas contain biodiversity that is irreplaceable; non-representation in protected areas may result in loss or reduction in biodiversity or features. These areas contribute towards larger-scale biodiversity. | Hydrothermal vents; seeps; areas containing co-occurring geographically restricted species; biogenic habitats. |
| 3 | Special importance for life history stages. | Areas that are required for a population to survive and thrive. | Species' particular requirements make some areas more suitable for carrying out life history stages. | Fish spawning or nursery grounds; pinniped breeding colonies; migratory corridors; sites where animals aggregate for feeding. |
| 4 | Importance for threatened / declining species and habitats. | Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species. | Protection may enable recovery or persistence of these threatened / declining species or habitats. | Estuaries with populations of threatened shorebirds; foraging areas for marine mammals and seabirds. |
| 5 | Biological productivity. | Area containing species, populations or communities with comparatively higher natural biological productivity. | These areas can support enhanced growth and reproduction, and support wider ecosystems. | Hydrothermal vents; frontal zones; areas of upwelling. |
| 6 | Biological diversity. | Area contains comparatively higher diversity of ecosystems, habitats, communities or species, or has higher genetic diversity. | These areas are important for evolutionary processes, for species' and ecosystem resilience and contribute towards large-scale biodiversity. | Structurally complex communities such as deep-water sponge and coral communities; seamounts. Areas with high diversity of fish and invertebrate species. |

| Criterion | | Definition | Rationale | New Zealand Examples |
|---|---|---|---|---|
| 7 | Naturalness. | Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation. | Provides enhanced ability to protect biodiversity that is in better condition; reduces need to rely on recovery from degraded state (recovery may occur on a different trajectory); these areas may include species and/or habitats that do not occur or are not represented well in more degraded areas; important role as reference sites. | Remote areas; marine areas adjacent to protected terrestrial areas; areas not impacted by bottom trawling or invasive species. |
| 8 | Ecological function. | Area containing species or habitats that have comparatively higher contributions to supporting how ecosystems function. | Some species, habitats or physical processes play particularly important roles in supporting how ecosystems function – their protection provides coincidental protection for a range of other species and wider ecosystem health. | Soft sediment habitats containing high densities of bioturbators; areas of high functional trait diversity; areas with functionally important mesopelagic communities (including myctophids). |

| | Criterion | Definition | Rationale | New Zealand Examples |
|---|---|---|---|---|
| 9 | Ecosystem services. | Area containing diversity of ecosystem services; and/or areas of particular importance for ecosystem services. | Provides for ability to protect species and habitats that provide particularly important services to humans. Provides ability to better contribute to CBD Aichi Target 11. | Areas containing dense populations of filter-feeding invertebrates; areas important for seafood provisioning. Areas important for supporting or regulating ecosystem services (e.g., areas of nutrient regeneration, biogenic habitat provision, carbon sequestration, sediment retention, gas balance, bioremediation of contaminants, storm protection) that underpin the delivery of provisioning or cultural ecosystem services. |

## 2.1 Dataset review

Following methods developed under projects recently undertaken by NIWA for other regional authorities (e.g., Environment Southland, McCartain et al. 2021; Auckland Council, Brough et al. 2021); Hawke's Bay Regional Council, Lundquist, C et al. 2020b), we applied a rigorous approach to review and format spatial datasets that contain some information on areas of ecological significance. All datasets contained information on 'ecological features', i.e., discrete occurrences of species/habitats/ecosystem processes that represent components of Otago's marine ecosystem. Datasets were pooled from a variety of sources: marine ecological datasets possessed by ORC; NIWA-housed datasets; datasets from the Key Ecological Areas research programme administered by NIWA under contracts to the Department of Conservation; and datasets held by third party research/management organisations. Third party datasets were identified at the first workshop held with broad range of stakeholders with interests and knowledge in the Otago CMA, and these datasets were collated and reviewed as part of this project.

All available datasets were reviewed according to four factors: 1) the temporal extent (i.e., age); 2) the spatial extent of the data; 3) methods used to collect the data; and 4) the traceability of the dataset. For 1), we were guided by temporal cut-offs for 'best-available-information' established by experts in marine habitats during a thorough review of marine spatial datasets in the Auckland region (Brough et al. 2021b). Datasets beyond these cut-offs were down-weighted in terms of their contribution towards SEA identification in recognition that older information is preferable to no information. For 2), datasets that contain information for a substantial proportion of the Otago CMA were preferred to those that inform a small number of discrete locations. Only datasets that have information sampled using appropriate methodologies were considered for inclusion within this project and datasets were required to be traceable to particular and reputable field surveys, expert opinion or otherwise reliable sources (e.g., data from commercial fishing operations). Datasets were excluded from further analyses if they contained very old information, represented only a very small area within the CMA, were collected using inappropriate methods, or if their provenance was unclear (i.e., methods or data collector were not traceable).

In order for dataset reliability to be included within the identification of SEAs, a weighting procedure was established based on McCartain et al. (2021) (Table 2-2). Reliability was determined based on a combination of the aforementioned factors and the type of information represented (Table 2-2). For example, datasets that pooled empirical observations on the distribution of ecological features from robust field programs receives the highest weighting, while products derived from those observations (i.e., model predictions or interpolated surfaces) would receive a slightly lower weighting (Table 2-2). Such data quality scores were used as weights when using spatial decision support tools to identify SEAs (see section2 4.1) and were used to inform whether SEAs require ground-truthing or extent definition for both SEA identification methods.

**Table 2-2: Data quality score.** The data quality scores used to weight a dataset's contribution to the identification of SEAs based on its reliability.

| Data quality score | Description | Examples |
|---|---|---|
| 5 | Empirical evidence from observations/surveys | Presence locations (point records), habitat extent with thorough ground-truthing (polygons), multi-beam bathymetry (raster dataset) |
| 4 | Modelled or interpolated evidence confirmed by local data validation or expert opinion | Habitat extent based on interpolation (polygons), modelled biogenic habitat provisions layer (raster) |
| 3 | Modelled or highly interpolated datasets from national scale models, limited or no local data validation | National scale species distribution model with limited local validation (raster). |
| 2 | Anecdotal evidence with no empirical evidence | Finfish spawning habitat (polygon), habitat extent derived from industry opinion |
| 1 | No available evidence | National scale biogenic habitat records with no observations in the Auckland Region. |

## 2.2 Management classes

The available spatial datasets were aggregated into defined 'management classes'; groupings of ecological features that share similar taxonomic and/or biophysical characteristics and are subject to the same threats (Table 2-3). SEAs were identified under each management class, allowing ORC to target the prevention of adverse effects on biodiversity to the same 'types' of habitat/species assemblage, that share the same threats. Previous SEA mapping with territorial authorities has found this approach to be more amenable to RMA policy interventions than designating SEAs that are important for all classes of indigenous biodiversity (McCartain et al. 2021).

In this project, we utilised the list of management classes established for SEA identification in the neighbouring Southland region (McCartain et al. 2021). This initial list was refined with input from stakeholders during the project's first workshop with the 'Fish' management class being split in two; 'Fish – demersal/pelagic' and 'Fish – reef associated'. All other relevant management classes were based on management classes identified in the Southland analysis.

**Table 2-3: Management classes.** List of the sixteen management classes used to pool ecological features and under which to identify SEAs. The relevant section of the national coastal policy statement criteria represented by each class is provided.

| Management Class | Definition/examples | Section of NZCPS Policy 11 | SEA method |
|---|---|---|---|
| **Benthic invertebrates-intertidal** | Important locations for intertidal benthic invertebrates (e.g., cockle beds) | Section (a) and (b) | Zonation |
| **Benthic invertebrates-subtidal** | Important locations for sub-tidal benthic invertebrates – not necessarily biogenic habitat formers (e.g., hotspots for taxa with key ecosystem functions). | Section (b) | Zonation |
| **Biogenic habitats - invertebrates (Bivalves, bryozoans, sponges, corals, tube building worms)** | Important locations for biogenic habitats formed by benthic invertebrates (e.g., oyster reef, bryozoan thicket). | Section (a) and (b) | Zonation |
| **Coastal vegetation** | Important locations for coastal vegetation (e.g., salt marsh, pīngao) | Section (a) and (b) | Zonation |
| **Estuaries/coastal lagoons/wetlands** | Important estuaries, coastal lagoons and wetlands (e.g., Awarua wetland). | Section (b) | Manual |
| **Fish (demersal, pelagic)** | Important locations for fish including demersal, pelagic (e.g., important spawning habitat) | Section (b) | Zonation |
| **Fish (reef associated)** | Important locations for fish including demersal, pelagic (e.g., locations with high abundance of butterfish) | Section (b) | Zonation |
| **Kelp forest** | Important locations for 3-dimensional biogenic habitat formed by kelp stands (e.g., *Macrocystis pyrifera*) | Section (b) | Zonation |
| **Marine flora** | Important locations for aquatic plants including seagrass and all algae taxa (except biogenic kelp forest). | Section (a) and (b) | Zonation |
| **Marine Mammals terrestrial (breeding/haul out)** | Locations important for marine mammals on land (e.g., fur seal/sea lion breeding colonies) | Section (a) and (b) | Manual |
| **Marine Mammals ocean** | Locations important for marine mammals at sea (e.g., foraging locations) | Section (a) and (b) | Zonation |

| Management Class | Definition/examples | Section of NZCPS Policy 11 | SEA method |
|---|---|---|---|
| **Naturally uncommon ecosystems** | Occurrence of naturally rare coastal, terrestrial, habitats (e.g., seabird burrowed soils, rock stacks). | Section (a) and (b) | Manual |
| **Pelagic productivity** | Potentially important locations for high primary productivity from phytoplankton activity (e.g., areas of high ChlA concentration, Southland Current convergence zone) | | Manual |
| **Sea/shorebirds - marine (foraging locations)** | Locations important for shore/seabirds at sea that represent foraging areas (e.g., sightings hotspots) | Section (a) and (b) | Zonation |
| **Sea/shorebirds - terrestrial (roosting and nesting locations)** | Locations important for shore/seabirds on land that represent roosting/nesting areas (e.g., penguin colonies) | Section (a) and (b) | Zonation |
| **Seafloor geomorphological features** | Locations with notable geomorphic features on the seafloor (e.g., submarine canyons, extensive reef platforms) | Section (b) | Manual |

## 2.3 Dataset formatting

Spatial datasets are typically represented by a broad range of formats – from non-digitised datasheets (e.g., excel files), to feature class geographic information system (GIS) datasets (e.g., point, polygons, lines) and gridded cell-based data (e.g., raster datasets). To systematically identify SEAs, it is necessary to format datasets so that spatial information is represented in the same way for each management class. The use of spatial decision support tools for SEA identification requires all input data on biodiversity to be represented as gridded raster datasets (Moilanen et al. 2009). Thus, features class data were converted to rasters using the following methods:

*Point datasets*

Point data are used to represent the spatial occurrence of species, habitats or ecological processes but typically possess no information on a feature's extent (i.e., home range, habitat extent). Point datasets were rasterised in two ways: 1) Datasets were rasterised such that each grid cell within a defined buffer around a point were coded as present (1), with remaining cells coded as absent (0). Buffer size varied between 250-1000 m depending on the taxa/habitat and was informed by expert opinion on the likely extent of a species/habitat occurrence. This approach was used for datasets where each point represents a unique spatial occurrence that bears no spatial relationship with other points in the datasets (Figure 2-3). Datasets that pooled observations of the same or similar species/habitats, collected using similar sampling methods during systematic surveys, were rasterised using kernel density estimation (KDe) (Worton 1989). KDe generates a raster dataset that represents the density of the underlying point data based on a fixed interpolation function which is defined by the smoothing/bandwidth parameter (a fixed distance). Here, we used Silverman's rule of thumb (Silverman 2018) to generate bandwidth parameters for each point dataset (Figure 2-3).

For both methods, point datasets were rasterised at 250 m x 250 m cell resolution, for the full extent of the Otago CMA.

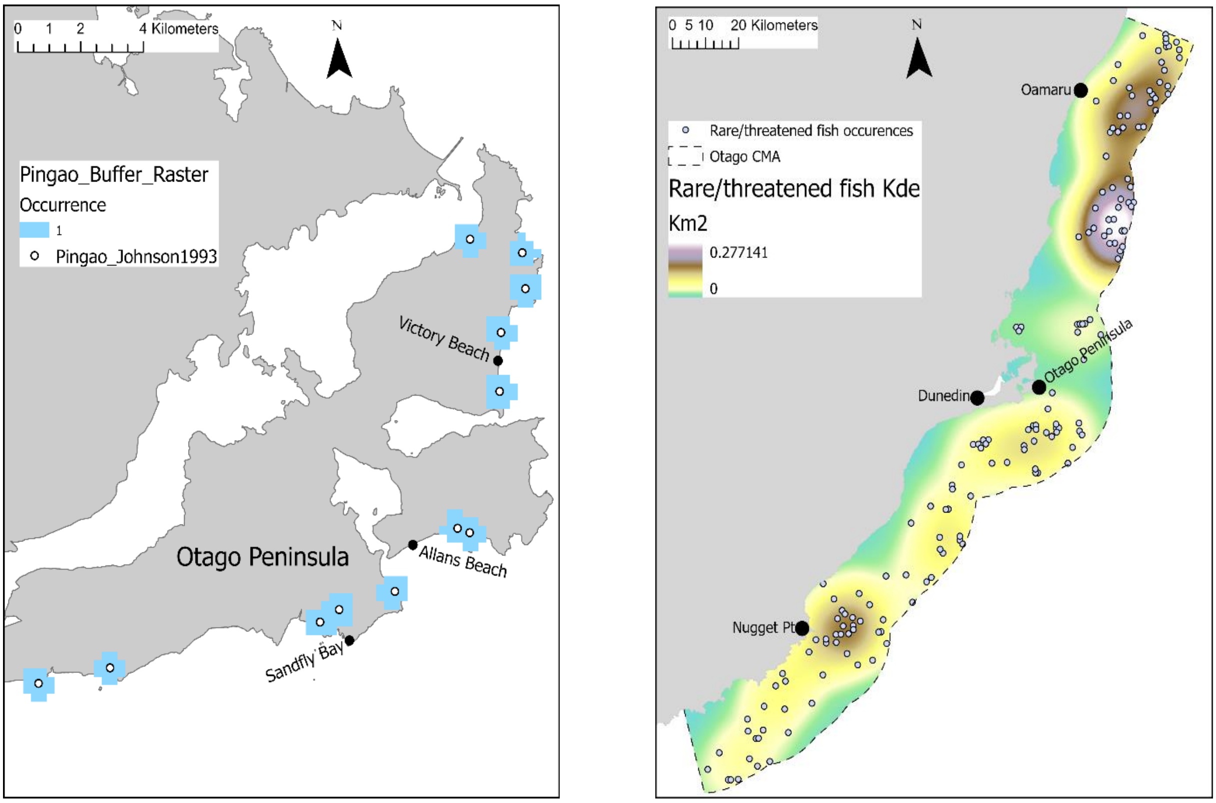


**Figure 2-3: Formatting point data.** Examples of formatting point data as raster datasets using two methods. Converting buffered areas around points to occurrence (left), and using KDe to construct a density surface (right).

*Polygon datasets*

Polygon datasets are often used to portray the extent of species/habitats with geographic boundaries. Polygon features may also contain useful ancillary information to guide the use of data, e.g., habitat quality, temporal extent or limitations. Polygons were rasterised to denote the extent of the ecological feature they represent (coded by 1). All areas outside of polygons were set to 0.

*Raster datasets*

It was necessary to format several existing raster datasets to ensure consistent cell alignment, extent and resolution. A study-area template was generated for the full extent of the Otago CMA (for marine based management classes), and another for the full Otago region (for terrestrial based management classes, e.g., bird colonies). The extent of the template was defined based on the geographic boundaries of the Otago region, and a 250 m x 250 m grid was configured using an Albers Equal Area spatial projection recently developed for the NZ region (Wood et al. 2020).

All existing raster datasets were matched to the relevant template, with grid-cell values being resampled with bilinear interpolation when changes in resolution were required. All processing was undertaken in R (R Core Team 2022) using the package *raster* (Hijmans 2019).

## 2.4 Significant area designation

Depending on the type of information available for a management class, one of two methods were used to identify SEAs. When a class was informed by a substantial number of overlapping datasets the decision support tool Zonation (Moilanen et al. 2009) was used to identify SEAs. In contrast, when the available information was more limited, non-overlapping and suggestive of discrete, isolated areas of importance, a manual method of identification was used. See Table 2-3 for the method used for each management class.

### 2.4.1 Zonation

The decision support tool Zonation (Moilanen et al. 2009) provides spatial prioritisation analyses that systematically identify spatial solutions for meeting defined management objectives (Lundquist et al. 2021). Objectives are characterised by a suite of 'scenarios' that include various options associated with the typical decision points around marine spatial planning. These include the analysis area, data gaps, uncertainty, habitat condition, cost, spatial resolution, cell aggregation, connectivity and weightings assigned to any of the key biodiversity inputs (Lundquist et al. 2021).

In this project, our objectives were to identify the locations that support the highest biodiversity value for each management class (Table 2-3), while considering differences in dataset quality. Zonation spatial prioritisations were developed for each management class using the core area cell removal rule, a warp factor of 1000, and no offsetting for habitat condition, uncertainty or cost. The input biodiversity layers were weighted according to their respective data quality score (Table 2-2), with additional weighting being given to species/habitats of particular significance (e.g., endangered species that meet Policy 11 section a) following discussions with ORC. The resultant spatial prioritisations (e.g., Figure 2-4) were used to guide the construction of SEAs based on either 1) the top 30% the prioritisation area or 2) the top 100% of the prioritisation area. The latter was used for relatively restricted coastal habitats (e.g., seagrass, saltmarsh) where, given the relative rarity of the habitats, it was agreed that the full extent of each habitat should be included within a SEA. The use of Zonation for prioritisation of these rarer habitats provides ORC with the future opportunity to distinguish between SEAs based on habitat quality or size in the future.

Polygons were constructed to represent the boundaries of individual SEAs that took into consideration the top 30% of priority areas from the Zonation analysis as well as minimising boundary complexity - an important consideration for monitoring and enforcement (Brough et al. 2021a). A polygon feature class layer of the total SEAs for each management class is provided.

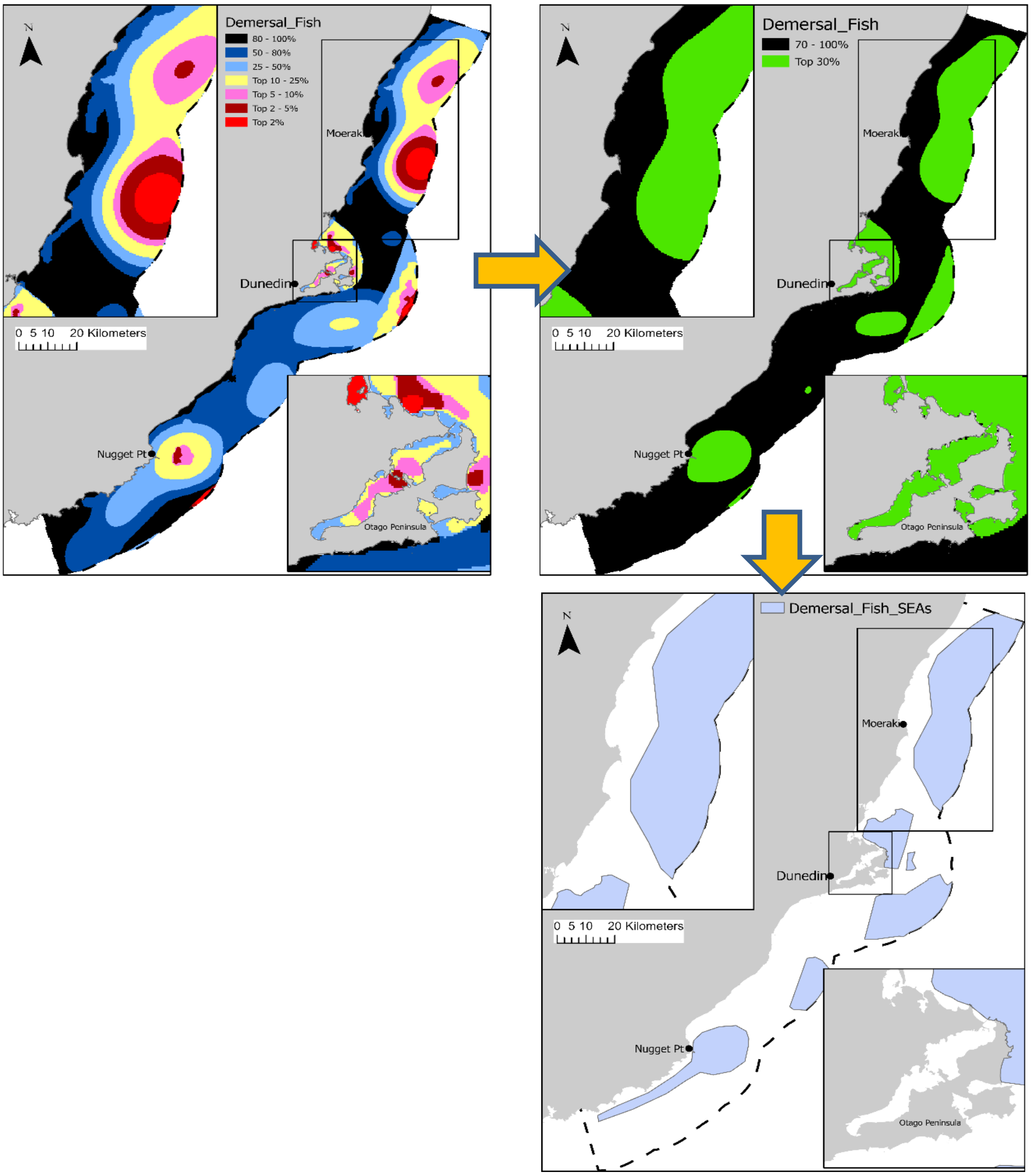


**Figure 2-4: Zonation SEA delineation.** Example of SEA delineation using Zonation where the output of a spatial prioritisation (top left) is converted to represent the top 30% priority areas (top right), with the final SEA boundaries being constructed as polygons (bottom). Note in this example using the demersal fish class, commercially sensitive data on catch distribution is masked out.

## 2.4.2 Manual delineation

Manual delineation was undertaken in ArcGIS Pro (ESRI), by constructing/copying polygon features using existing datasets. Construction of SEA polygons was undertaken when the underlying spatial dataset consisted of point or raster datasets and polygons were copied when the spatial dataset consisted of polygon features (e.g., layers for pinniped colony extents, naturally uncommon ecosystems, estuaries). SEA polygon construction aimed to use the smallest area to capture the spatial bounds of the ecological feature represented by point/polygon data. However, due to the inherent subjectivity associated with this process it is recommended such SEAs are the focus of extent definition (see Section 6.2).

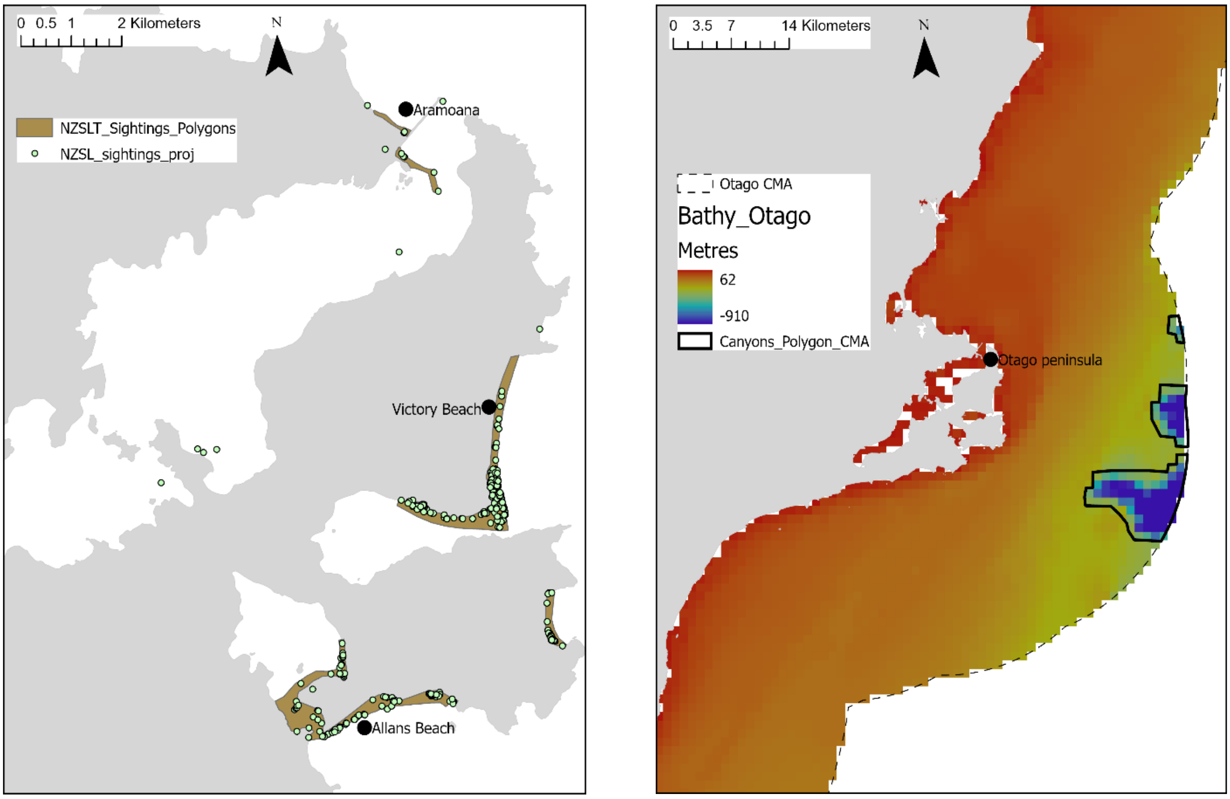


**Figure 2-5: Example of manual SEA delineation.** Examples of manual delineation of SEAs using point dataset (left) and raster datasets (right), where non-overlapping ecological features are defined manually for NZ sea lion haul outs and submarine canyons respectively.

# 3 Results

In the following section we provide information on the available datasets, their appropriateness for identifying SEAs, and the ecological significance criteria they inform. We also provide the results of the identification of significant areas for each management class. A geodatabase of feature class polygon GIS layers (ESRI format) denoting the SEAs for each class has been prepared and is made available with this report. Each SEA layer contains the attributes described in Table 3-1, and the full table for each management class is provided in Appendix B. The outputs of the zonation prioritisation analysis for those management classes for which this method was employed are provided in Appendix C.

**Table 3-1: SEA attributes.** The information provided in the attributes table for the SEAs under each management class.

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Name reflecting the geographic location and management class of the SEA | Unique SEA code | Summary of the ecological features found within the SEA | List of the spatial datasets used to provide evidence on the occurrence of important ecological features | List of the KEA significance criteria met by features within the SEA | List of the National coastal policy statement criteria met by features within the SEA | Whether the SEA requires extent definition (yes/no) | Whether the SEA requires ground-truthing (yes/no) |

## 3.1 Benthic Invertebrates – intertidal

*Datasets*

Following the review process, five datasets had useful information on the distribution of intertidal benthic invertebrates that could be used for identifying SEAs. Three of these datasets originated from ORC studies on mapping the distribution of cockles (e.g., clams; *Austrovenus stutchburyi)* within Otago estuarine environments, including two estuarine habitat mapping studies in Blueskin Bay and the Catlins River Estuary. A point dataset on the locations of green-lipped mussel (*Perna canaliculus*) was available from NIWA and spatial data reporting the distribution (and value) of commercial harvesting for clams was provided by MPI.

**Table 3-2: Datasets for the intertidal benthic invertebrates management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Catlins2016_Substrate_Biogenic | Cockles layer from 2016 intertidal broad scale habitat mapping of Catlins Estuary undertaken by Wriggle Coastal Management for Otago Regional Council | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 8, 9 | 11 b (ii), b (iii), b (iv), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Cockles_ORCEstuary | Cockle layer, mapped as part of a project identifying significant habitats of indigenous fauna across Otago Region, for the Otago Regional Council | Polygon | ORC Marine Shapefiles | 5 | 1, 8, 9 | 11 b (ii), b (iii), b (iv), b (vi) |
| Blueskin2020_21 _Substrate | Cockle layer from 2020-2021 intertidal broad scale habitat mapping of Blueskin Bay undertaken by Salt Ecology for Otago Regional Council | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 8, 9 | 11 b (ii), b (iii), b (iv), b (vi) |
| Perna_Buffer_Presence | Dataset on the occurrence of green shell mussels | Polygon | Moana project/NIWA | 3 | 1, 8, 9 | 11 b (iii), b (iv), b (vi) |
| MPI spatial catch data - clams | MPI catch reporting on Cockles | Raster | MPI | 5 | 1, 8, 9 | 11 b (ii), b (iii), b (iv), b (vi) |

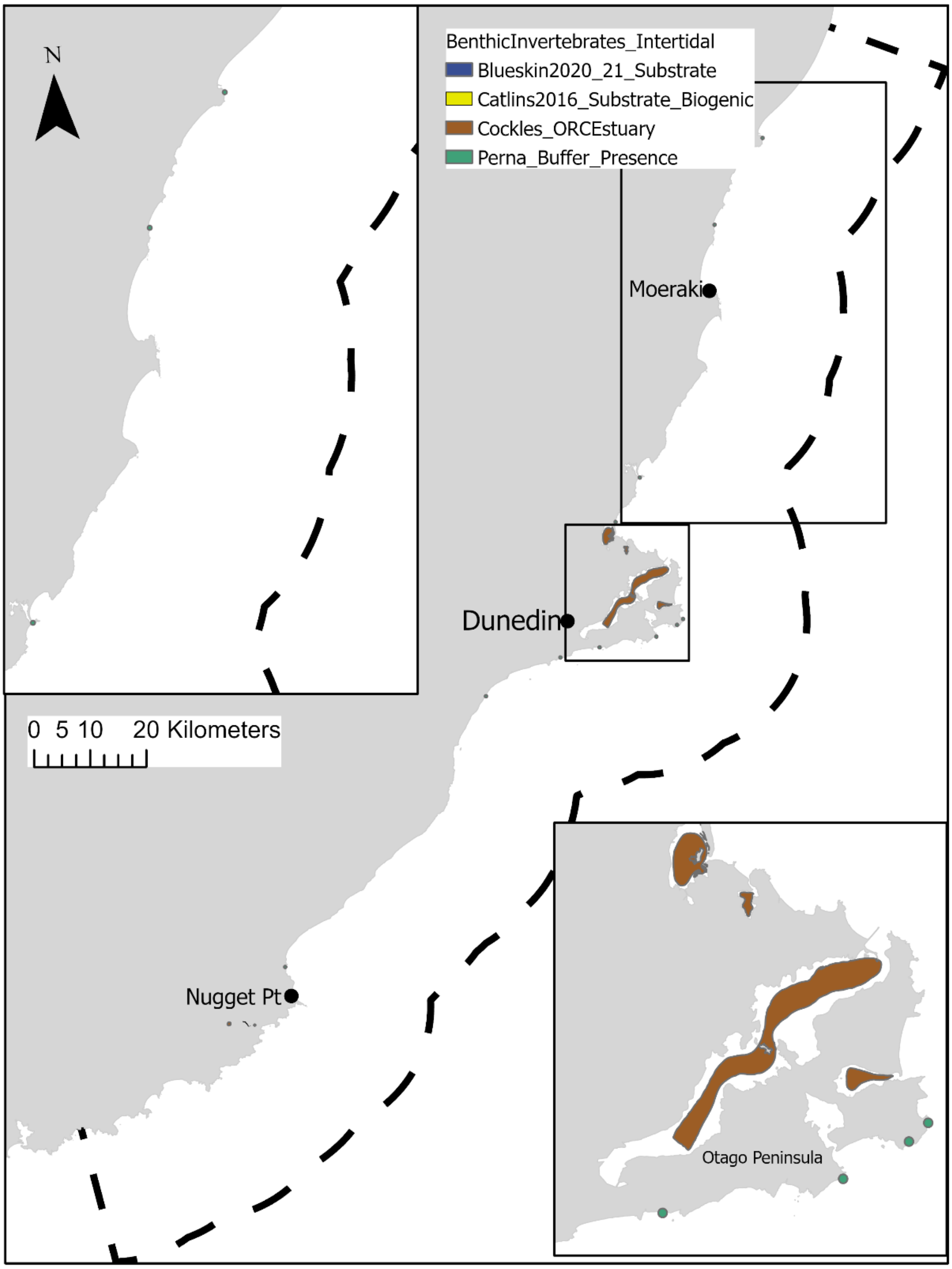


**Figure 3-1: Example data for the intertidal benthic invertebrate management class.** Data layers for the intertidal benthic invertebrate management class include polygons of cockle distribution in mapped estuaries and approximate distribution within confined spatial waterways (e.g., Otago Harbour). The presence locations for green-lipped mussel are also shown.

*Significant areas*

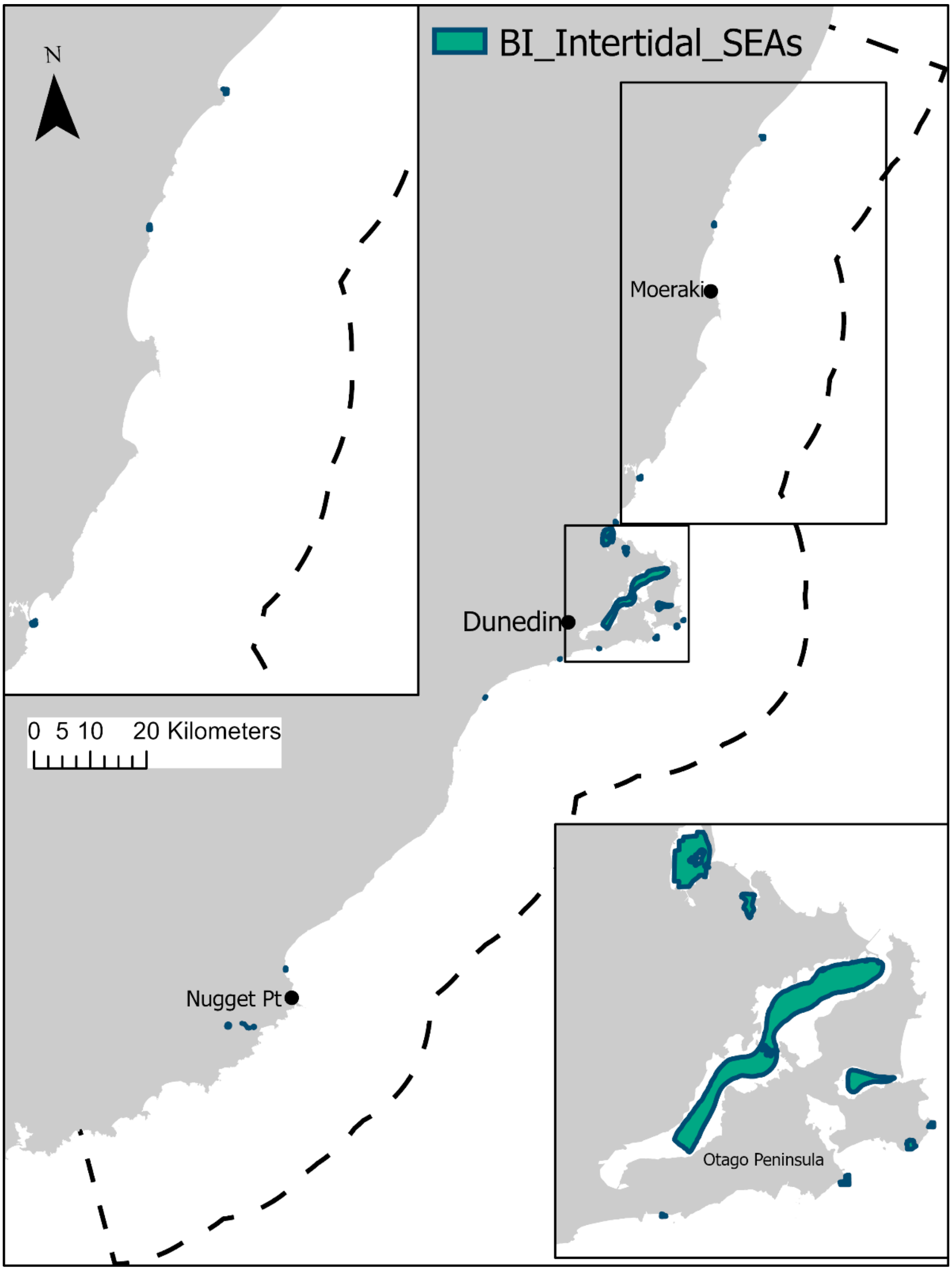


**Figure 3-2: SEAs for the intertidal benthic invertebrate management class.**

Analysis of spatial data on important ecological features for intertidal benthic invertebrates led to the identification of 16 SEAs throughout the Otago region. SEAs were located mainly in the Otago Harbour and around Otago Peninsula, Blueskin Bay and the Catlins River, with smaller SEAs near Kaka Point, Taieri Mouth, Kakaho and Oamaru. SEAs for this class consisted of areas of particular importance and/or occurrence for clam/cockle and green-lipped mussels.

## 3.2 Benthic Invertebrates – subtidal

*Datasets*

For the subtidal benthic invertebrates, six datasets had useful information for identifying SEAs. The national scale species distribution models (SDMs) contained layers for 109 subtidal benthic invertebrate genera which have been expert appraised (Stephenson & Brough et al., submitted). One dataset consists of kernel density layers for benthic invertebrate species within three functional groups (bioturbators, substrate de-stabilisers, substrate stabilisers) (Lundquist et al. 2020a) and the remaining four datasets are point records for endemic, rare, threatened and unique benthic invertebrates (Stephenson et al. 2018).

**Table 3-3: Datasets used for the subtidal benthic invertebrates management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Benthic invertebrate SDMs (109) | Habitat suitability model layers for 109 benthic invertebrate species | Raster | KEA Database | 3 | 1, 2, 4, 6, | 11 a (i), a (v), b (ii), b (iii), b (vi) |
| Benthic_invertebrate_ functional_groups | Kernel density layers for benthic invertebrate species in the functional groups Bioturbators, SubstrateDeStabilizers, SubstrateStabilizers | Raster | KEA Database | 3 | 1, 8, | 11 b (iii), b (vi) |
| Invertebrates_Endemic_OBIS_EEZ | Point records of endemic benthic invertebrates | Point | KEA Database | 3 | 2, 6, | 11 b (iii) |
| Invertebrates_rare_EEZ | Point records of rare benthic invertebrates | Point | KEA Database | 3 | 2, 6 | 11 a (iii) |
| Invertebrates_Threatened_EEZ | Point records of threatened benthic invertebrates | Point | KEA Database | 3 | 2, 4, 6 | 11 a (i) |
| Invertebrates_Unique_EEZ | Point records of unique benthic invertebrates | Point | KEA Database | 3 | 2, 6 | 11 a (iii) |

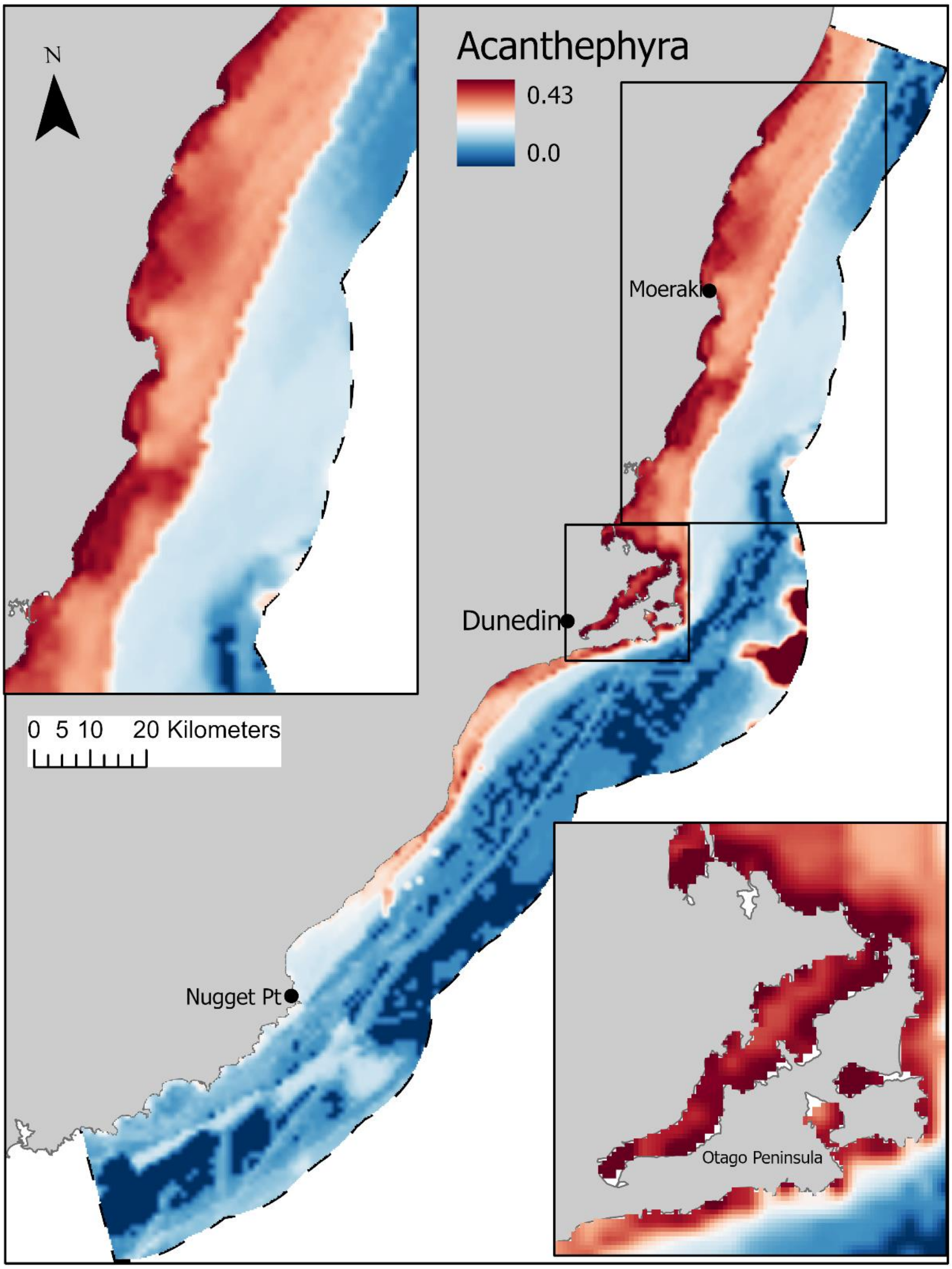


**Figure 3-3: SDM for *Acanthephyra*.** Species distribution model of the shrimp *Acanthephyra*, an example dataset of the subtidal benthic invertebrate management class.

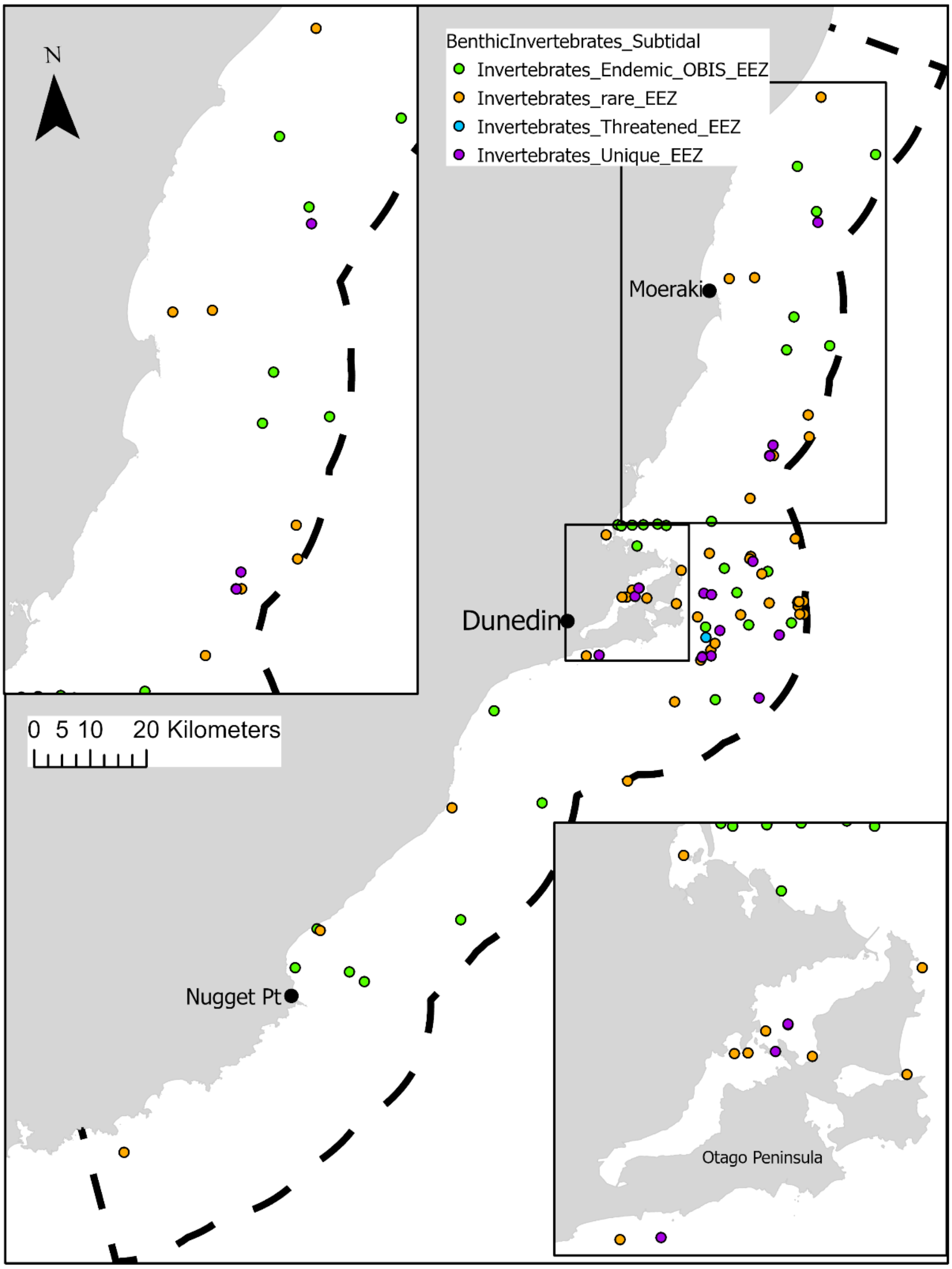


**Figure 3-4: Subtidal invertebrate point data.** Example point layers for the subtidal benthic invertebrate management class.

*Significant areas*

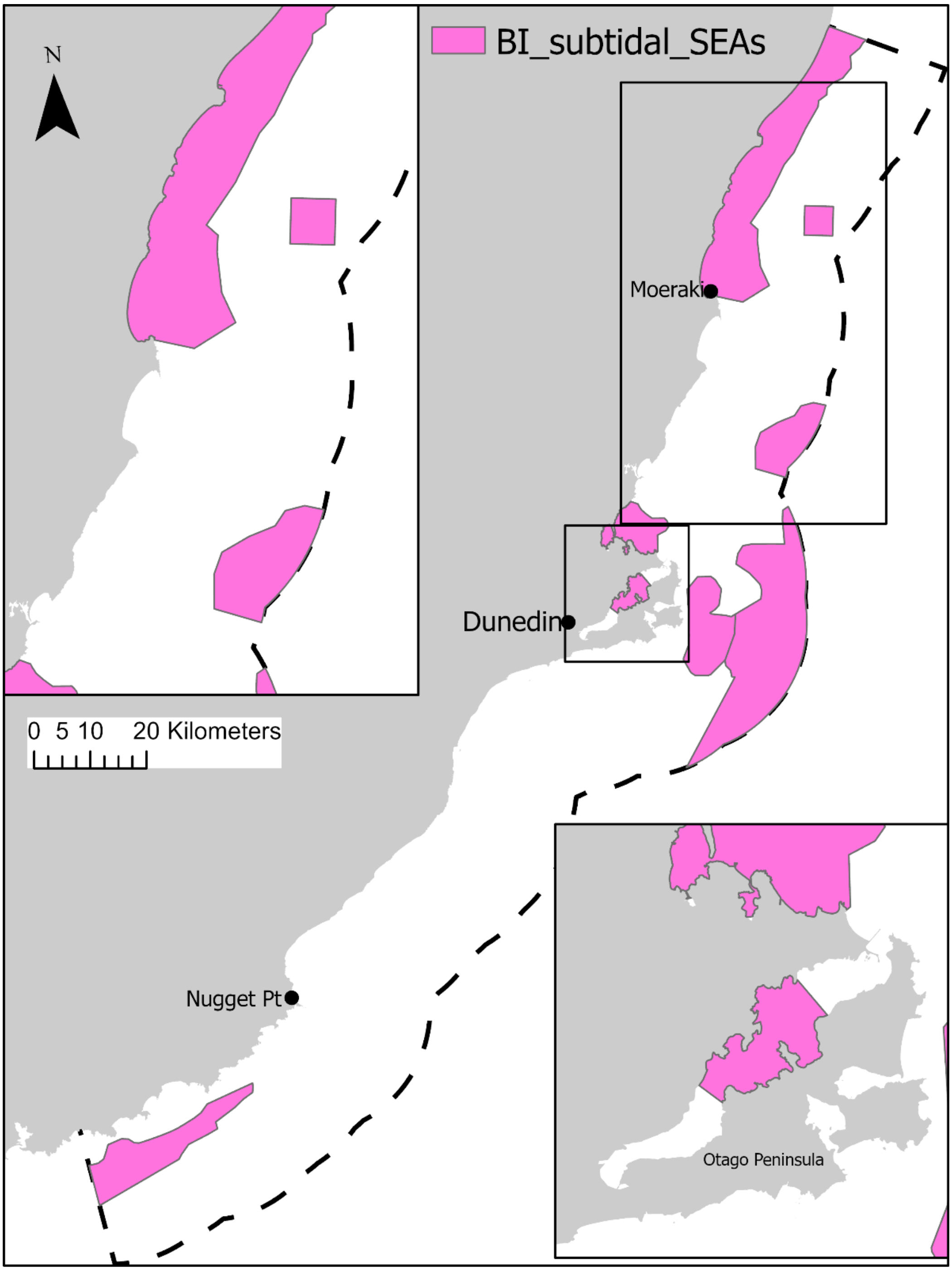


**Figure 3-5: SEAs for the subtidal benthic invertebrate management class.**

Analysis of spatial data on important ecological features for subtidal benthic invertebrates led to the identification of eight SEAs throughout the Otago region. SEAs were located in Otago Harbour, Blueskin Bay, the south Catlins and North Otago Coast, as well as some offshore locations near the Peninsula and around the head of the Karitane Canyon. SEAs for this class consisted of areas highly suitable habitat for numerous benthic invertebrate species and occurrence of rare, threatened or unique species.

## 3.3 Biogenic Habitats – invertebrates

*Datasets*

There were 15 datasets with useful information on the distribution of biogenic habitats that could be used for identifying SEAs. The national scale SDMs contained 64 expert appraised layers for benthic invertebrate biogenic habitat forming genera (Stephenson & Brough et al., submitted). A dataset for protected coral species contained 12 habitat suitability model layers (Anderson et al. 2020). Two additional layers for the downward-structure-formers and upward-structure-formers benthic invertebrate functional groups were included. The DOC SeaSketch database provided two polygon layers for biogenic reef and biogenic bryozoan distributions. The remaining datasets are all point records, and for key reef building bryozoans there are other datasets reviewed in Lundquist et al. (2020). For key bed-forming bivalves there are datasets from OBIS, NIWA Inverts and Te Papa. For sponge garden species there are datasets from OBIS and NIWA-specify. There is one point record for rhodoliths in the Otago region (Lundquist et al. 2020).

**Table 3-4: Datasets used for the biogenic habitats management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Biogenic habitat formers 64 SDMs | National scale habitat suitability model layers for 64 benthic invertebrate biogenic habitat forming genera. | Raster | KEA Database | 3 | 1, 3, 4, 6, 8 | 11 a (iii), b (ii), b (iii), b (vi) |
| Protected Coral models (12) | Habitat suitability model layers for protected coral species | Raster | KEA Database | 3 | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) |
| Benthic_invertebrate_ functional_groups (DownwardStructure, UpwardStructFormers) | Habitat suitability model layers for benthic invertebrate species in the functional groups DownwardStructure, UpwardStructFormers | Raster | KEA Database | 3 | 1, 8, | 11 b (ii), b (iii), b (vi) |
| Bryozoans_AMSmith_ mergedtsp | A bryozoan species-level dataset for sampling collections (e.g. dredging) all around southern New Zealand over the last decade (2010-2018) provided by Abigail Smith. | Point | KEA Database | 3 | 1, 3, 4, 6, 8 | 11 b (ii), b (iii), b (vi) |
| MPA_Habitat_Biogenic | Biogenic layer of MPA Policy habitats of the Otago Regional Council Territorial Sea | Polygon | ORC Marine Shap efiles | 2 | 1, 3, 5, 6, 8 | 11 b (ii), b (iii), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| NIWA_rhodoliths18 | Distribution of Rhodoliths around New Zealand, based on presence-only data of identified specimens collected by NIWA | Point | KEA Database | 5 | 1, 2, 6, | 11 b (ii), b (iii), b (vi ) |
| Obis_clip_keybiv2 | Known distribution of key bed forming bivalves from OBIS-NZ dataset. | Point | KEA Database | 3 | 1, 8 | 11 b (ii), b (iii), b (vi ) |
| Obis_clip_keybryo | Presence-only locations of key reef-building bryozoan species in New Zealand | Point | KEA Database | 3 | 1, 3, 4, 6, 8 | 11 b (ii), b (iii), b (vi ) |
| Obis_clip_keyspg | Known distribution of key 'sponge garden' species in New Zealand. Presence of all species from OBIS-NZ dataset. | Point | KEA Database | 3 | 1, 6, 8 | 11 b (ii), b (iii), b (vi ) |
| Reefs_biogenic | Important biogenic and rocky reefs identified as part of the mapping of significant habitats of indigenous fauna in the marine environment of Otago Region. | Polygon | Doc SeaSketch database | 3 | 1, 3, 5, 6, 8 | 11 b (ii), b (iii), b (vi) |
| Specify_clip_keybiv | Known distribution of key bed forming bivalves from NIWA-Specify dataset, NIWA's Invertebrate Collection | Point | KEA Database | 3 | 1, 8 | 11 b (ii), b (iii), b (vi) |
| Specify_clip_keyspg | Known distribution of key 'sponge garden' species in New Zealand. Presence of all species from NIWA Invert dataset. | Point | KEA Database | 3 | 1, 6, 8 | 11 b (ii), b (iii), b (vi) |
| Tepapa_clip_keybiv | Known distribution of key bed forming bivalves from Te Papa dataset. | Point | KEA Database | 3 | 1, 8 | 11 b (ii), b (iii), b (vi) |
| Wood_Biogenic_ habitats_review | Presence-only locations of key reef-building bryozoan species in New Zealand | Point | KEA Database | 3 | 1, 3, 5, 6, 8 | 11 b (ii), b (iii), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Biogenic_bryozoan | Estimated distribution of bryozoans off Otago Peninsula | Polygon | Doc SeaSketch database | 4 | 1, 2, 4, 6, 8 | 11 b (ii), b (iii), b (vi) |

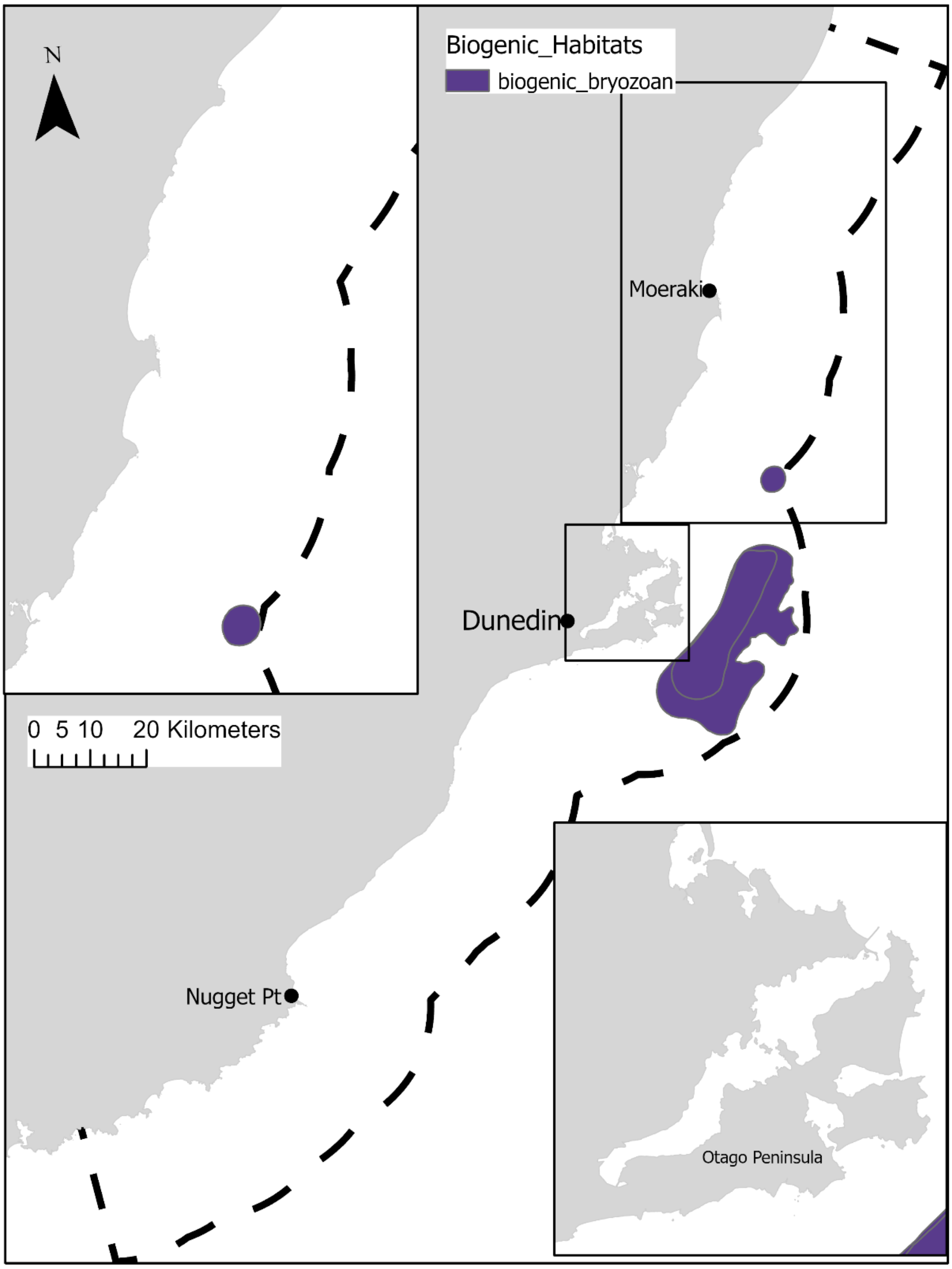


**Figure 3-6: Otago shelf bryozoans.** Estimated distribution of bryozoans off the Otago Peninsula from the DOC SeaSketch database, an example dataset for the biogenic habitats management class.

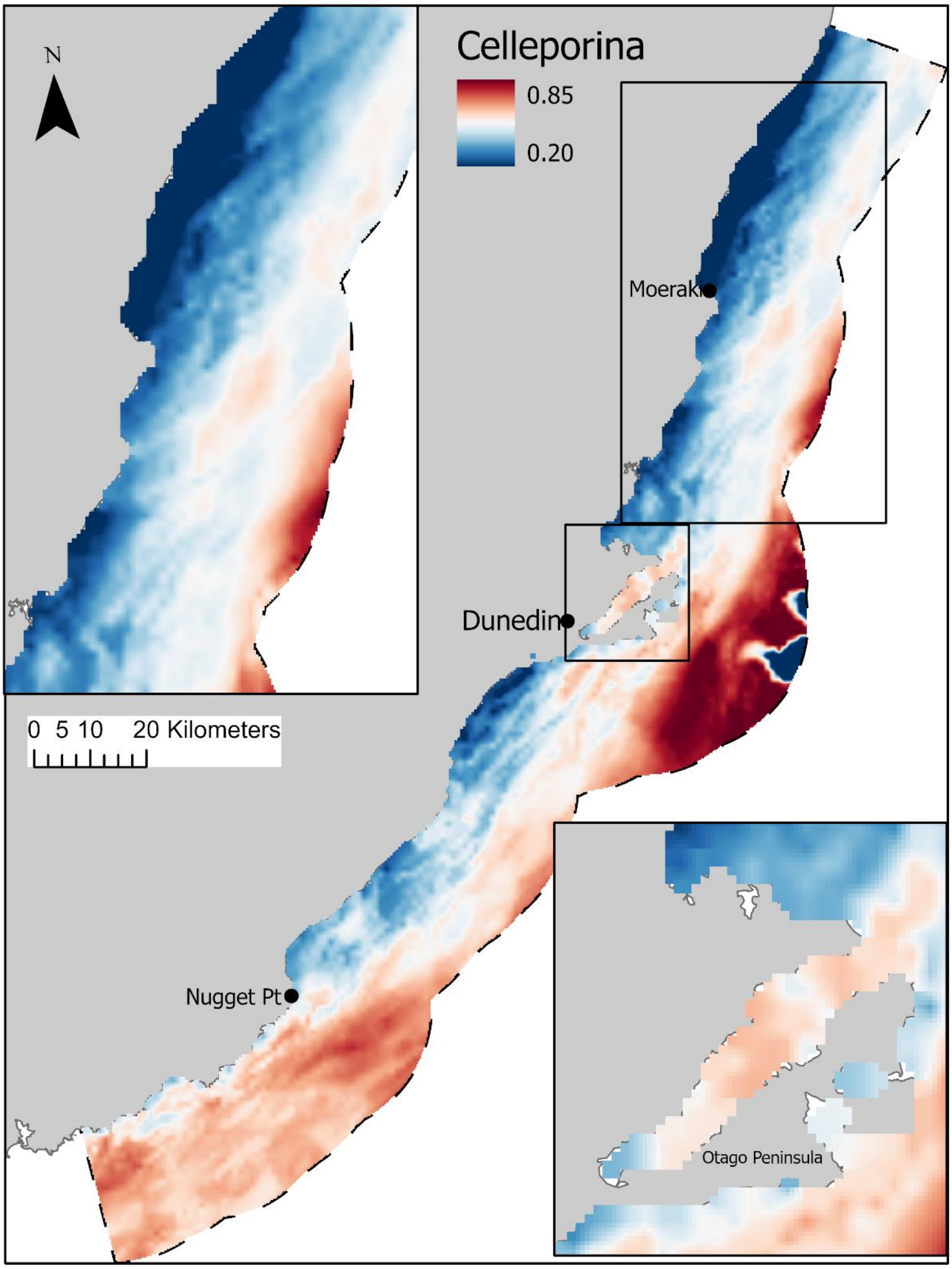


**Figure 3-7: SDM of *Celleporina*.** Species distribution model of the bryozoan *Celleporina*, an example dataset for the biogenic habitat management class.

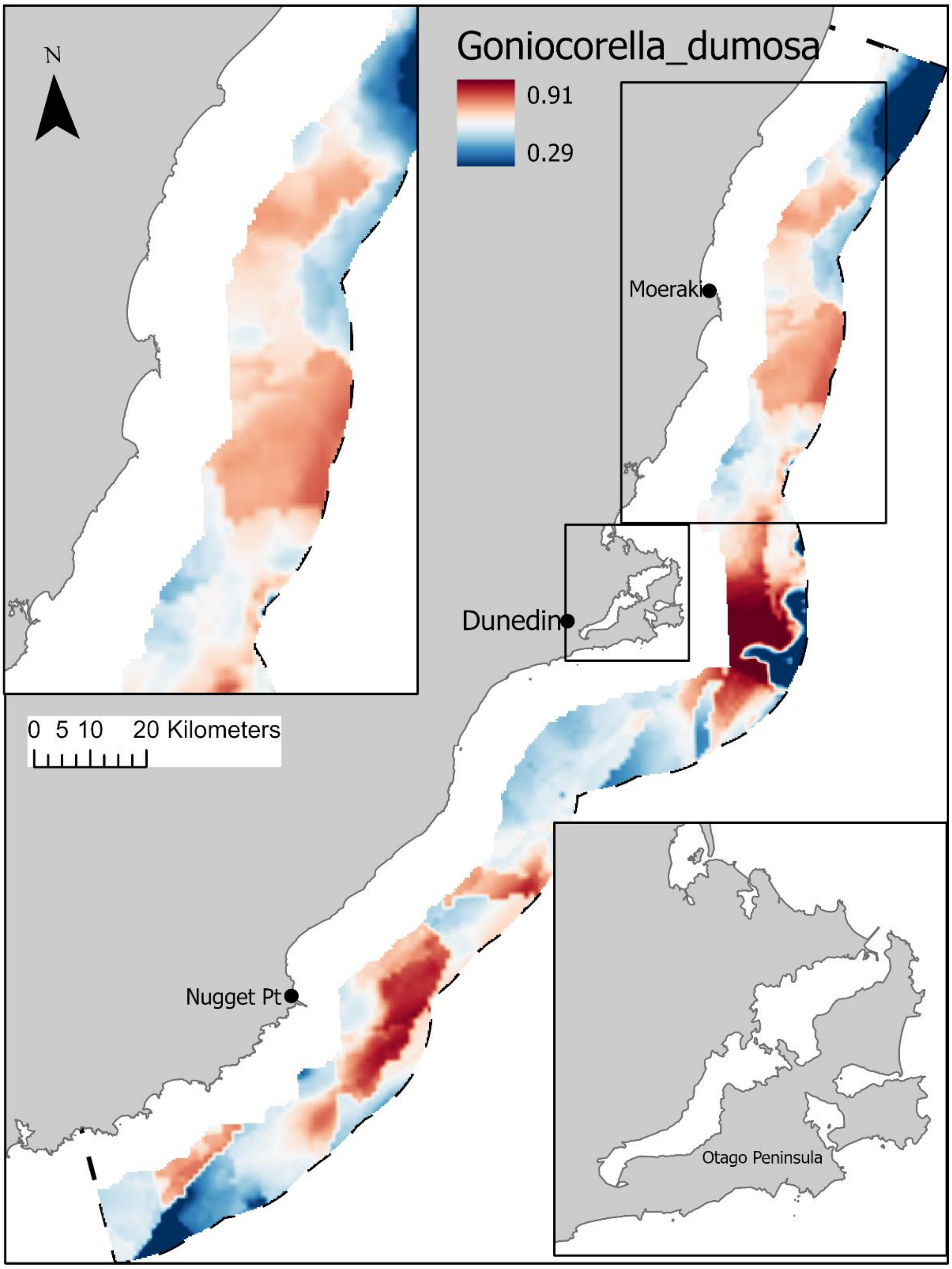


**Figure 3-8: SDM of *Goniocorella dumosa*.** Species distribution model of protected coral *Goniocorella dumosa*, an example dataset for the biogenic habitat management class.

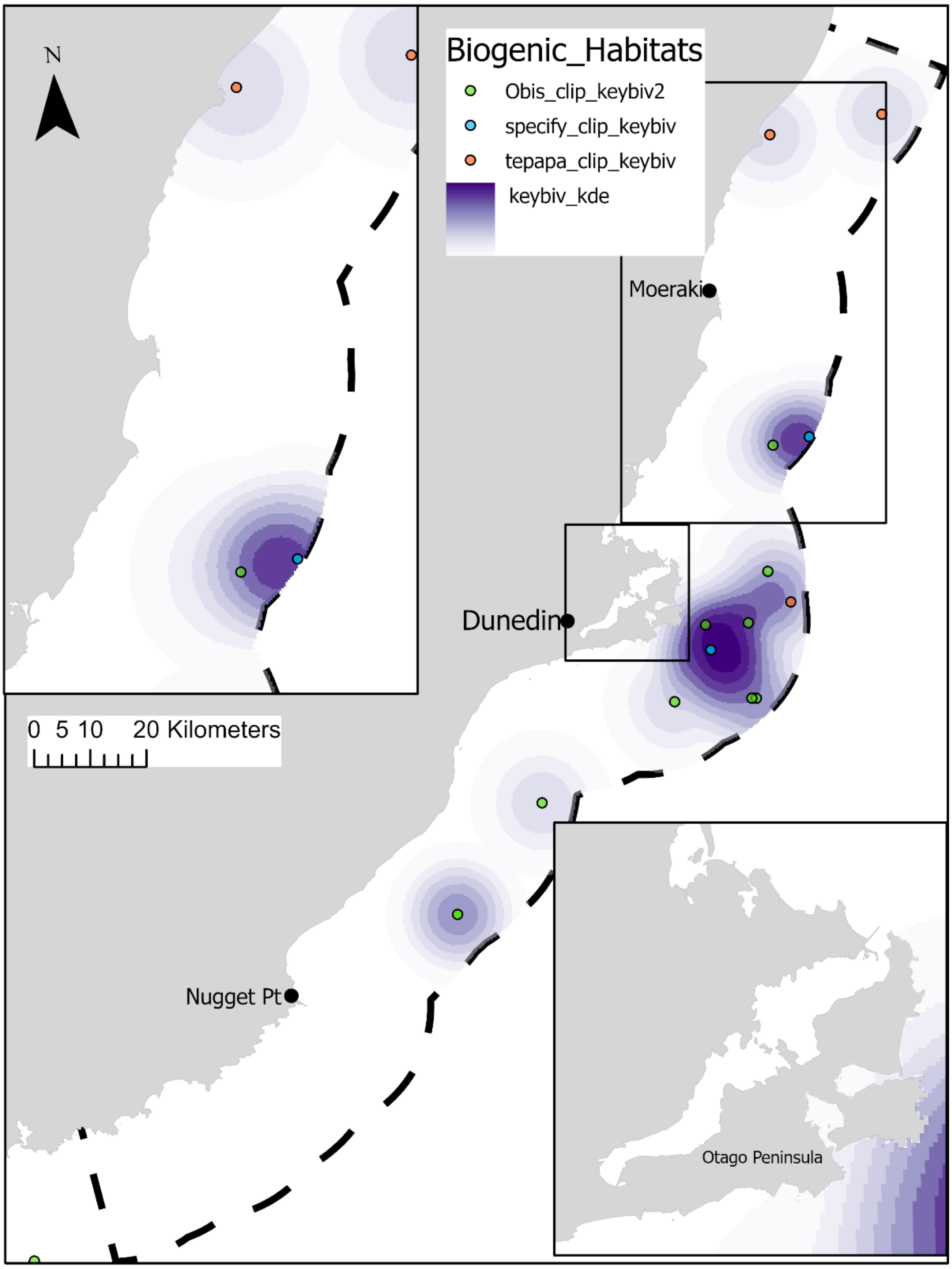


**Figure 3-9: Biogenic point data.** Example point layers of key bivalve species and the generated kernel density for the biogenic habitat management class.

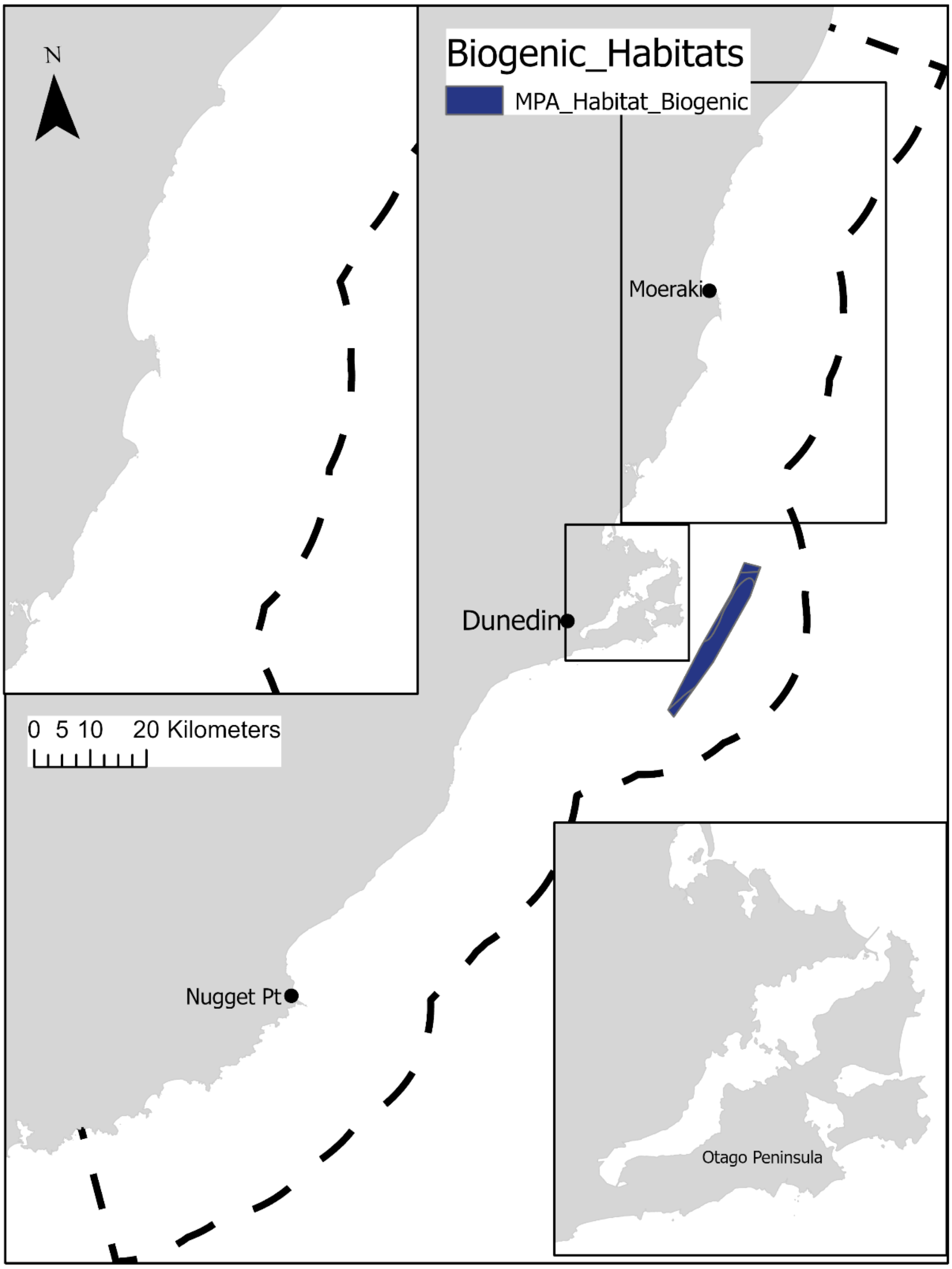


**Figure 3-10: MPA policy - biogenic.** Example biogenic layer from the MPA Policy habitats of the Otago Regional Council Territorial Sea.

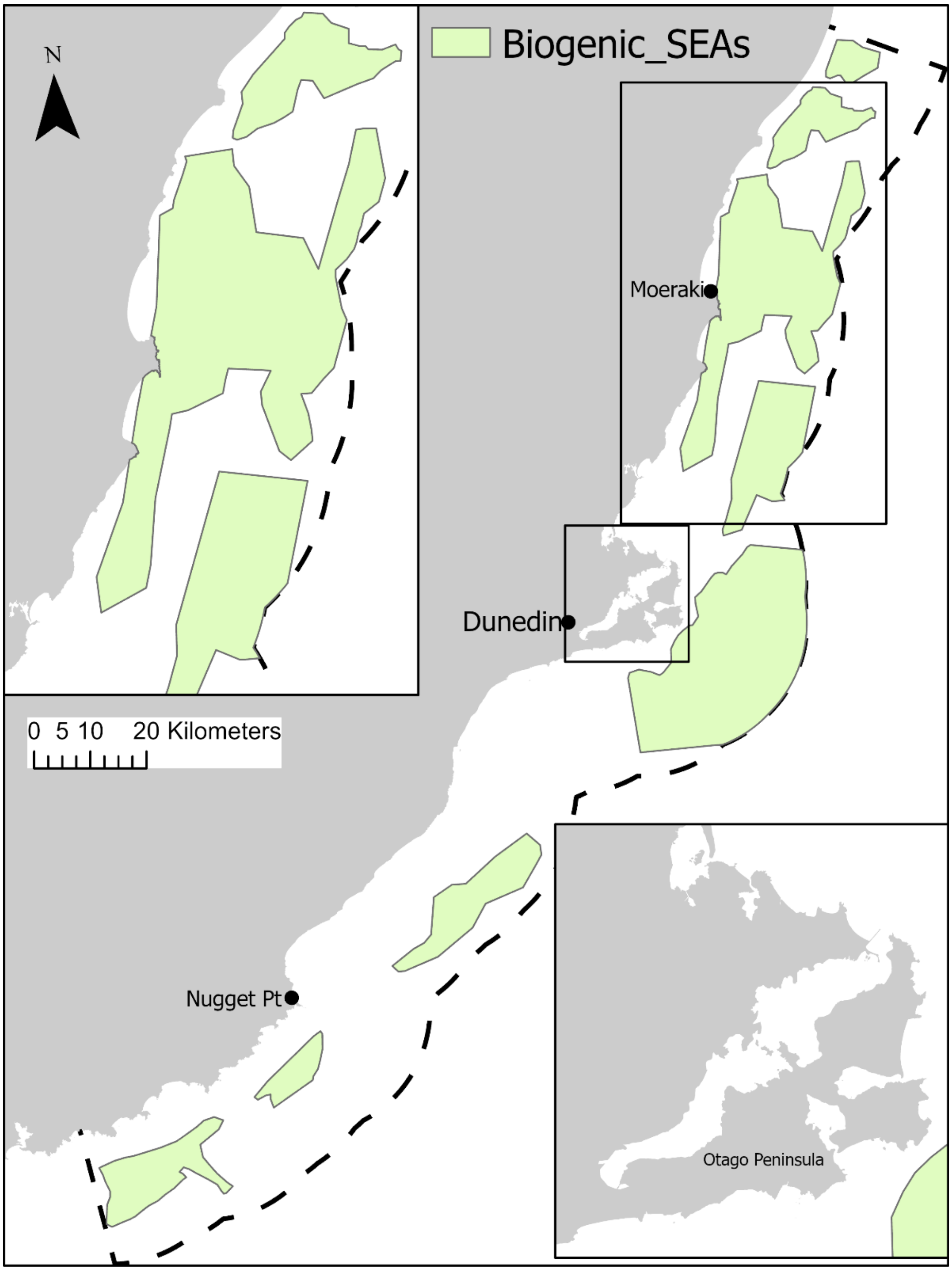


**Figure 3-11: SEAs for the biogenic habitats management class.**

Analysis of spatial data on important ecological features for biogenic habitat forming invertebrate species led to the identification of 8 SEAs throughout the Otago region. SEAs were located mostly off the North Otago coast, one off Otago Peninsula and three smaller SEAs off the South Otago/Catlins coast. SEAs for this class consisted of areas of particular importance and/or occurrence for numerous biogenic habitat-forming species, including bryozoans, bivalves and sponges as well as protected coral species.

## 3.4 Coastal vegetation

*Datasets*

There were ten datasets with useful information on the distribution of coastal vegetation for identifying SEAs. Nine of these originated from ORC studies on mapping the locations of saltmarsh (8) and estuarine shrub (1) within estuarine environments. The remaining two datasets report point records of Pingao *(Ficinia spiralis)* on the Otago peninsula from (Johnson 1993) and from INaturalist observations throughout Otago.

**Table 3-5: Datasets used for the coastal vegetation management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Blueskin2020_21_ SaltMarsh | Mapped distribution of saltmarsh within Blueskin estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Catlins2016_SaltMarsh | Mapped distribution of saltmarsh within Catlins estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Estuarine_Shrub | Mapped distribution of Estuarine shrubs with ORC monitored estuaries | Polygon | ORC Otago GIS map packages, Salt Ecology | 1 | | |
| Kaikorai2018_SaltMarsh | Mapped distribution of saltmarsh within Kaikourai estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Kakanui2021_SaltMarsh | Mapped distribution of saltmarsh within Kakanui estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| MPA_Habitat_SaltMarsh | Distribution of saltmarsh from MPA habitat classification | Polygon | ORC Marine Shapefiles | 3 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Shag2016_SaltMarsh | Mapped distribution of saltmarsh within Shag estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Tokomairiro2018_ SaltMarsh | Mapped distribution of saltmarsh within Tokomairiro estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Waikouaiti2017_ SaltMarsh | Mapped distribution of saltmarsh within Waikouaiti estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 2, 4, 8 | 11 a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| Otago Peninsula Pingao | Observed locations of Pingao on Otago Peninsula from Johnson 1993 | Point | NIWA digitised from Johnson 1993 | 5 | 1, 2, 4, 8 | 11 a (i), a (iii), b( i), b (ii), b (iii), b (v), b (vi) |
| iNaturalist Pingao | Database of citizen science, opportunistic pingao observations from iNaturalist | Point | iNaturalist | 3 | 1, 2, 4, 8 | 11 a (i), a (iii), b( i), b (ii), b (iii), b (v), b (vi) |

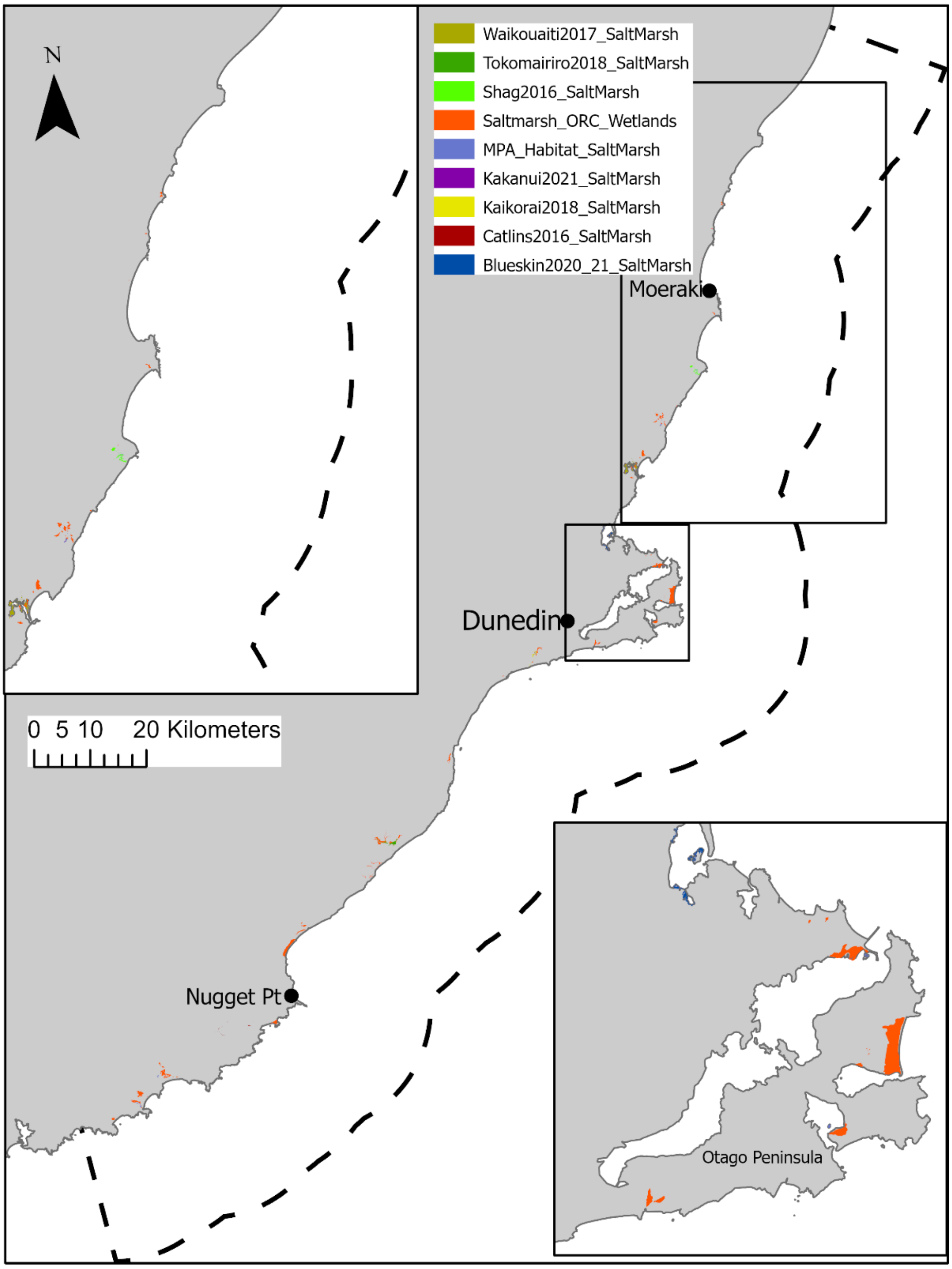


**Figure 3-12: Locations of saltmarsh.** Locations of saltmarsh mapped by Otago regional council, example datasets for the coastal vegetation management class.

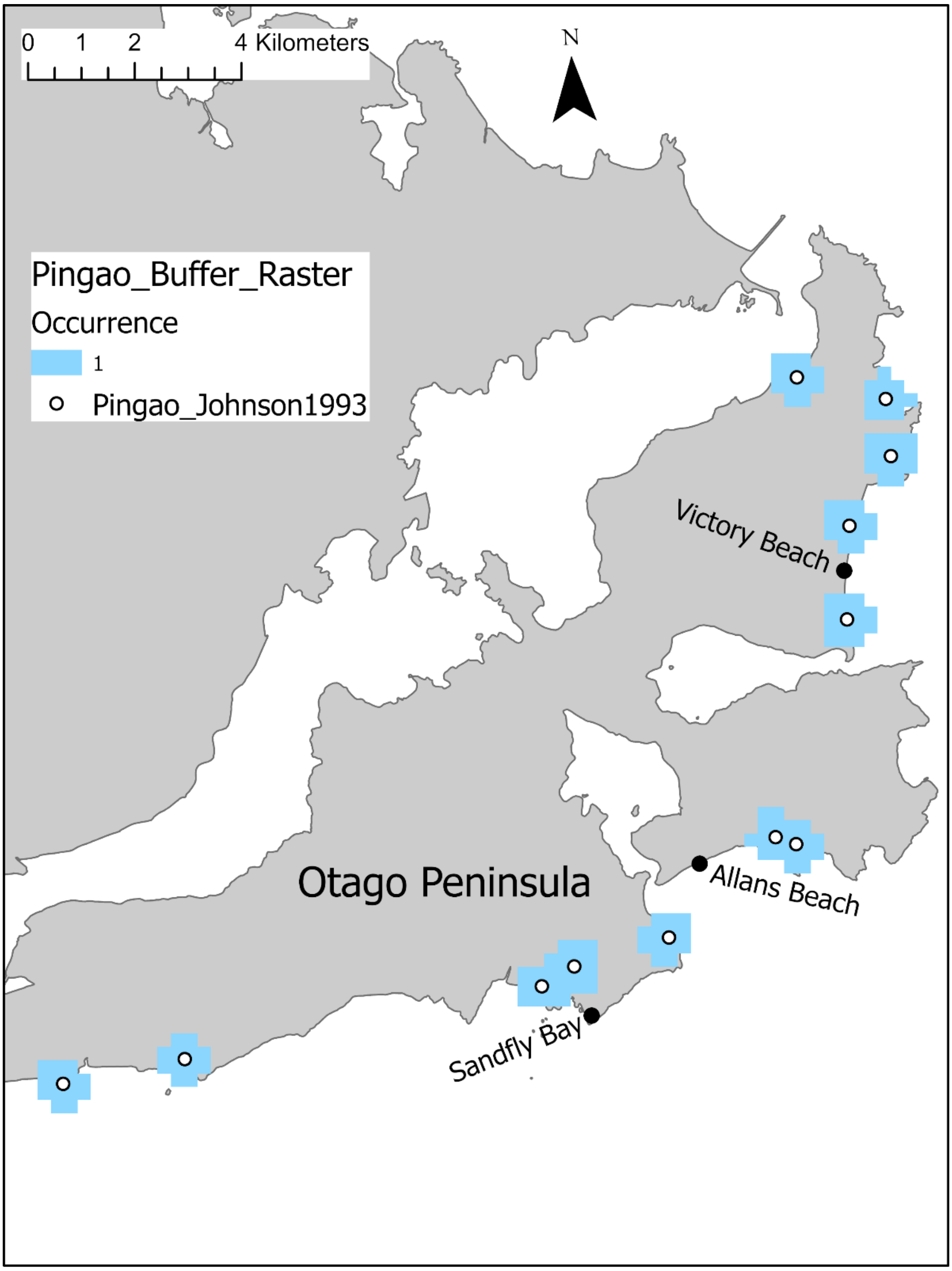


**Figure 3-13: The occurrence of pingao (aka pikao) on the Otago peninsula.** Point records for the occurrence of pikao on the Otago peninsula, an example dataset for the coastal vegetation management class.

*Significant areas*

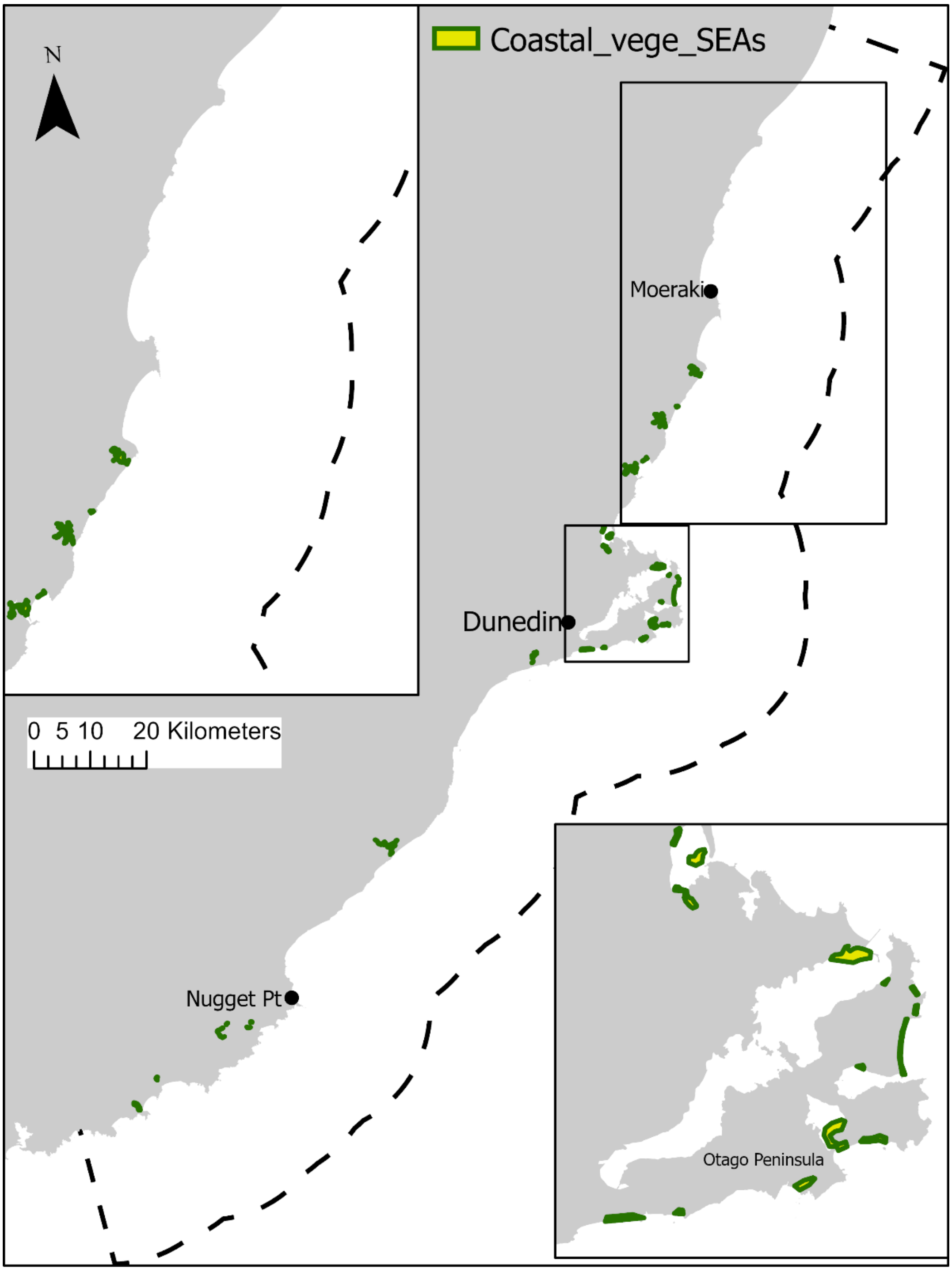


**Figure 3-14: SEAs for the coastal vegetation management class.** Locations of SEAs for the coastal vegetation management class. The outline of each feature has been enlarged to aid in the viewing of smaller features.

Analysis of spatial data on important ecological features for coastal vegetation led to the identification of 22 SEAs throughout the Otago region. SEAs were located mainly on the Otago Peninsula, at Blueskin Bay, Waikouaiti and the Catlins coasts, with some isolated SEAs at the Shag River, Pleasant River Estuary, Bobby's Head and Tokomairiro mouth. SEAs for this class consisted of areas of occurrence for saltmarsh and pingao.

## 3.5 Estuaries/Coastal Lagoons and Wetlands

*Datasets*

There were ten datasets that had useful information on the locations of estuaries, coastal lagoons and wetlands for identifying SEAs. Seven of these originated from ORC studies carried out by Salt Ecology to map the extent of estuaries in Otago. A further ORC dataset provides information on wetland extent, clipped to within 1km of the coastline to determine 'coastal' wetlands. National scale datasets from LINZ provided some information on coastal lagoons.

**Table 3-6: Datasets used for the estuaries/coastal lagoons and wetlands management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Blueskin2020_21_Estuary | The mapped extent of Blueskin Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Catlins2016_Estuary | The mapped extent of Catlins Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Kaikorai2018_Estuary | The mapped extent of Kaikorai Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Kakanui2021_Estuary | The mapped extent of Kakanui Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| ORC2_Wetlands_1km | The mapped extent of wetland in the Otago regions - subset coastal wetlands | Polygon | ORC Marine Shapefiles | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Shag2016_Estuary | The mapped extent of Shag Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Tokomairiro2018_Estuary | The mapped extent of Tokomairiro Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
| --- | --- | --- | --- | --- | --- | --- |
| Waikouaiti2017_Estuary | The mapped extent of Waikouaiti Estuary - intertidal and subtidal | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Nz-lake-polygons-topo_LINZ | LINZ dataset on the distribution and extent of 'lakes', which include some coastal lagoons | Polygon dataset | LINZ | 3 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |
| Nz-lagoon-polygons-topo_LINZ | LINZ dataset on the distribution and extent of 'lagoons', which include some coastal lagoons | Polygon dataset | LINZ | 3 | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) |

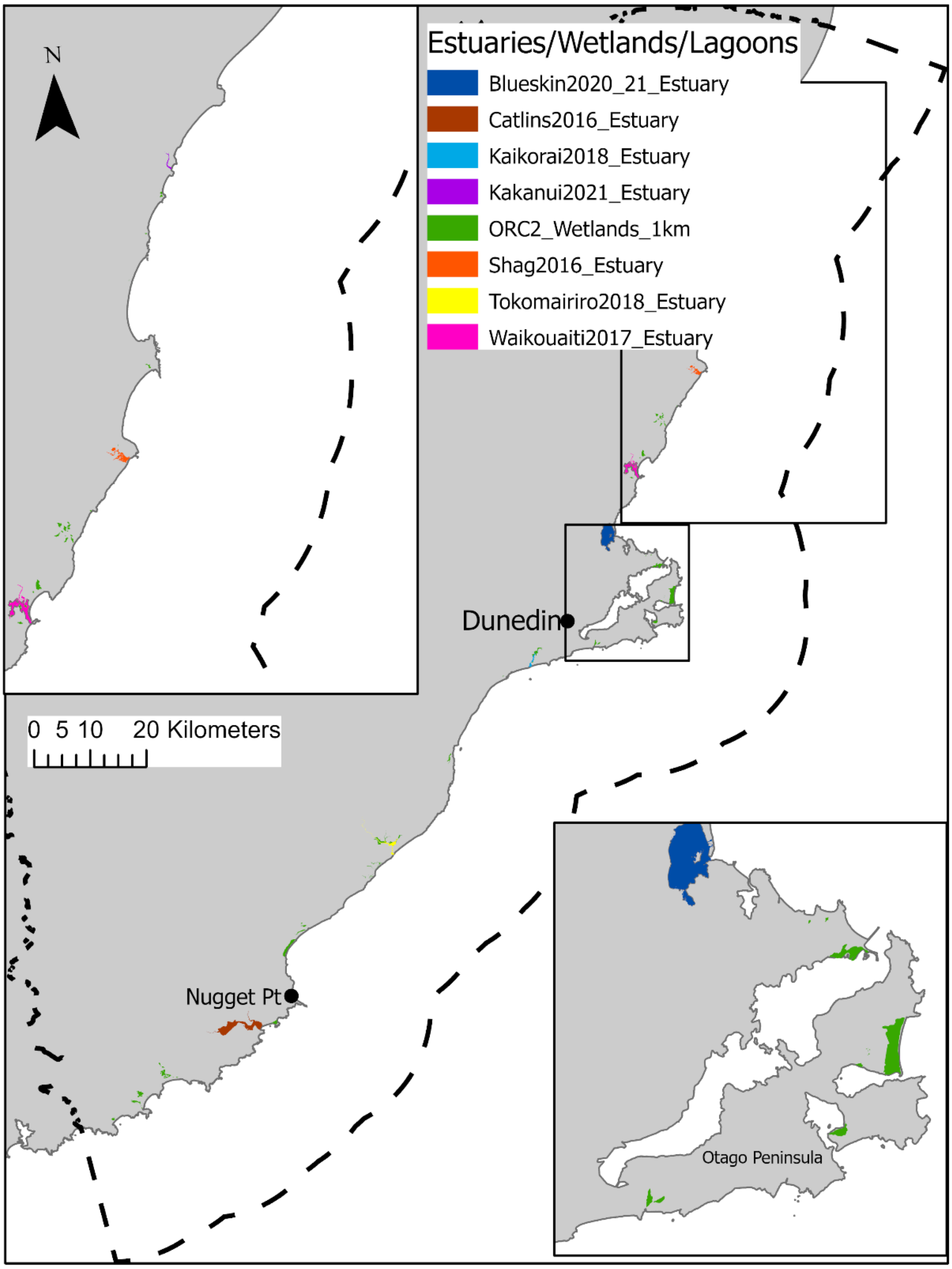


**Figure 3-15: Locations of mapped estuaries.** Locations of estuaries mapped by the Otago regional council, example datasets for the estuaries/wetlands/lagoons management class.

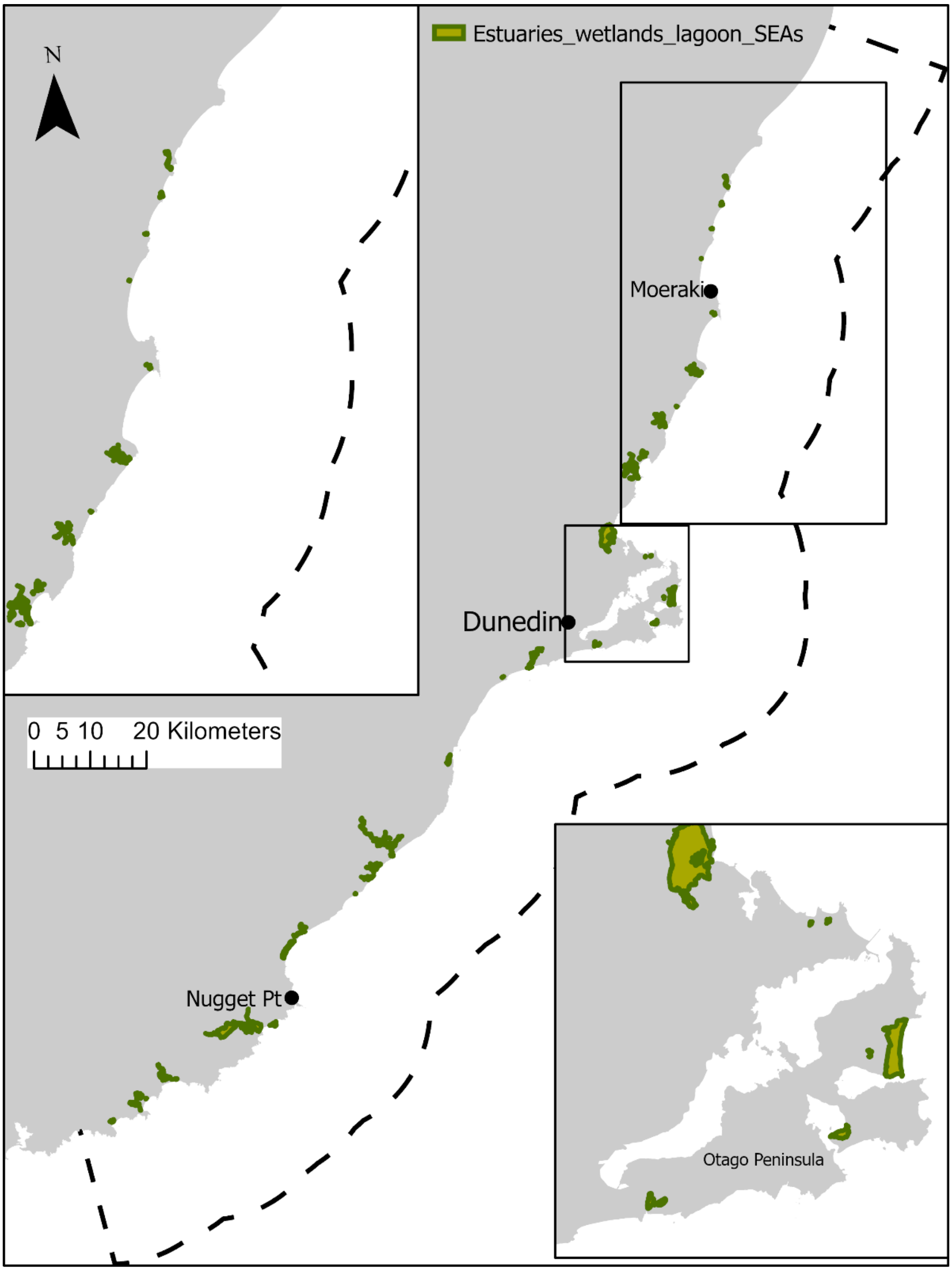


**Figure 3-16: SEAs for the estuaries/coastal lagoons and wetlands management class.** Locations of SEAs for the estuaries/coastal lagoons and wetlands management class. The outline of each feature has been enlarged to aid in the viewing of smaller features.

Spatial data on important ecological features for estuaries/coastal lagoons and wetlands led to the identification of 41 SEAs throughout the Otago region. SEAs were located at all known locations of coastal estuaries, lagoons and wetlands.

## 3.6 Demersal Fish

*Datasets*

Four datasets contained useful information on the distribution of demersal fish for identifying SEAs. The national scale SDM dataset contained 214 expert-appraised species layers (Stephenson & Brough et al., submitted). Another dataset maps expert derived spawning locations for 21 commercially important species. Spatial data reporting the distribution (and value) of commercial harvesting for 10 demersal fish species was provided by MPI was also available (though is not shown due to commercial sensitivities). A final dataset contained four layers of point records for rare, threatened, unique and endemic fish species (Stephenson et al. 2018).

**Table 3-7: Datasets used for the demersal fish management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| 214 Demersal Fish SDMs | National scale SDMs for demersal fish. Expert appraised | Raster | KEA Database | 3 | 6, 9 | 11 a (iii), b (ii), b (iv), b (v) |
| 21 Finfish Spawning areas | Expert derived spawning locations for commercially important species | Polygon | KEA Database | 2 | 3, 6 | 11 b (ii), b (iv), b (v) |
| NZ_fish_point_records_rarity (4 layers) | Occurrence of rare, threatened, unique fish species | Point | KEA Database | 3 | 1, 2, 4, 6 | 11 a (iii), b (ii), b (iv), b (v) |
| MPI spatial catch data - 10 species | Spatial fishing returns (catchKg) for key Otago species | Raster | MPI | 5 | 5, 6, 9 | 11 b (iv) |

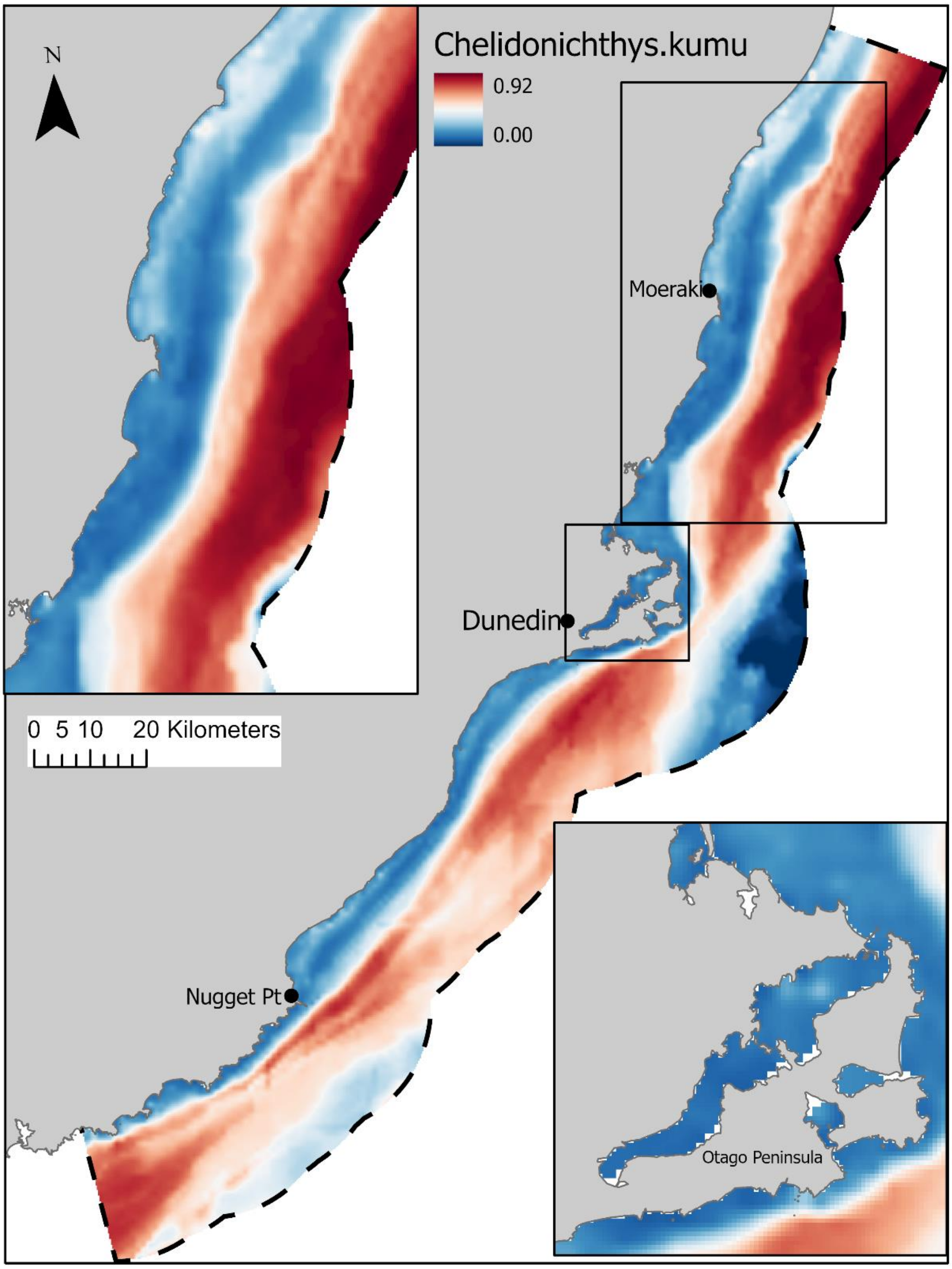


**Figure 3-17: Example dataset from the demersal fish management class.** Species distribution model of gurnard (*Chelidonichthys kumu*) with red indicating areas of high habitat suitability.

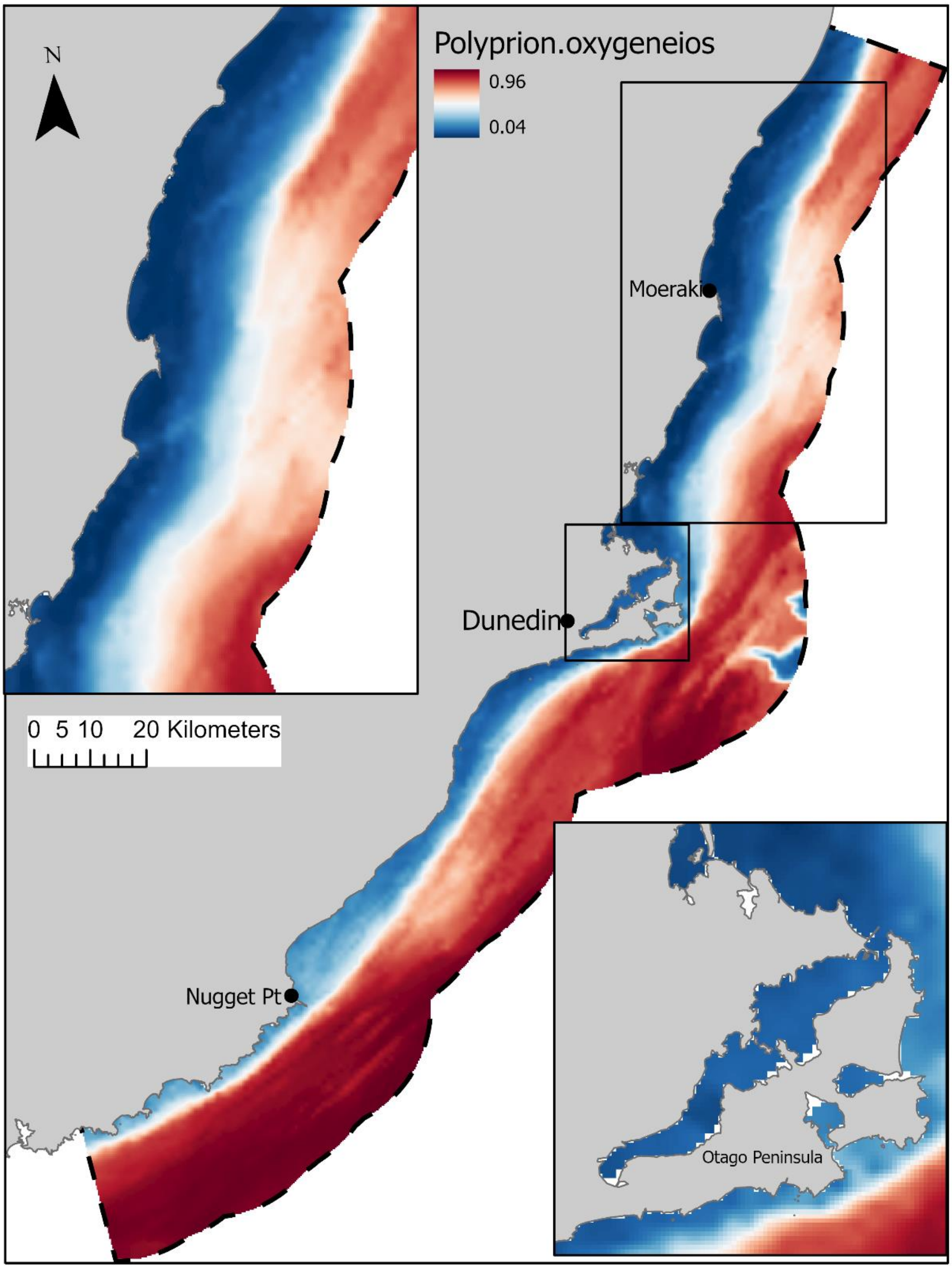


**Figure 3-18: Example dataset from the demersal fish management class.** Species distribution model of hāpuku (*Polyprion oxygeneios*) with red indicating areas of high habitat suitability.

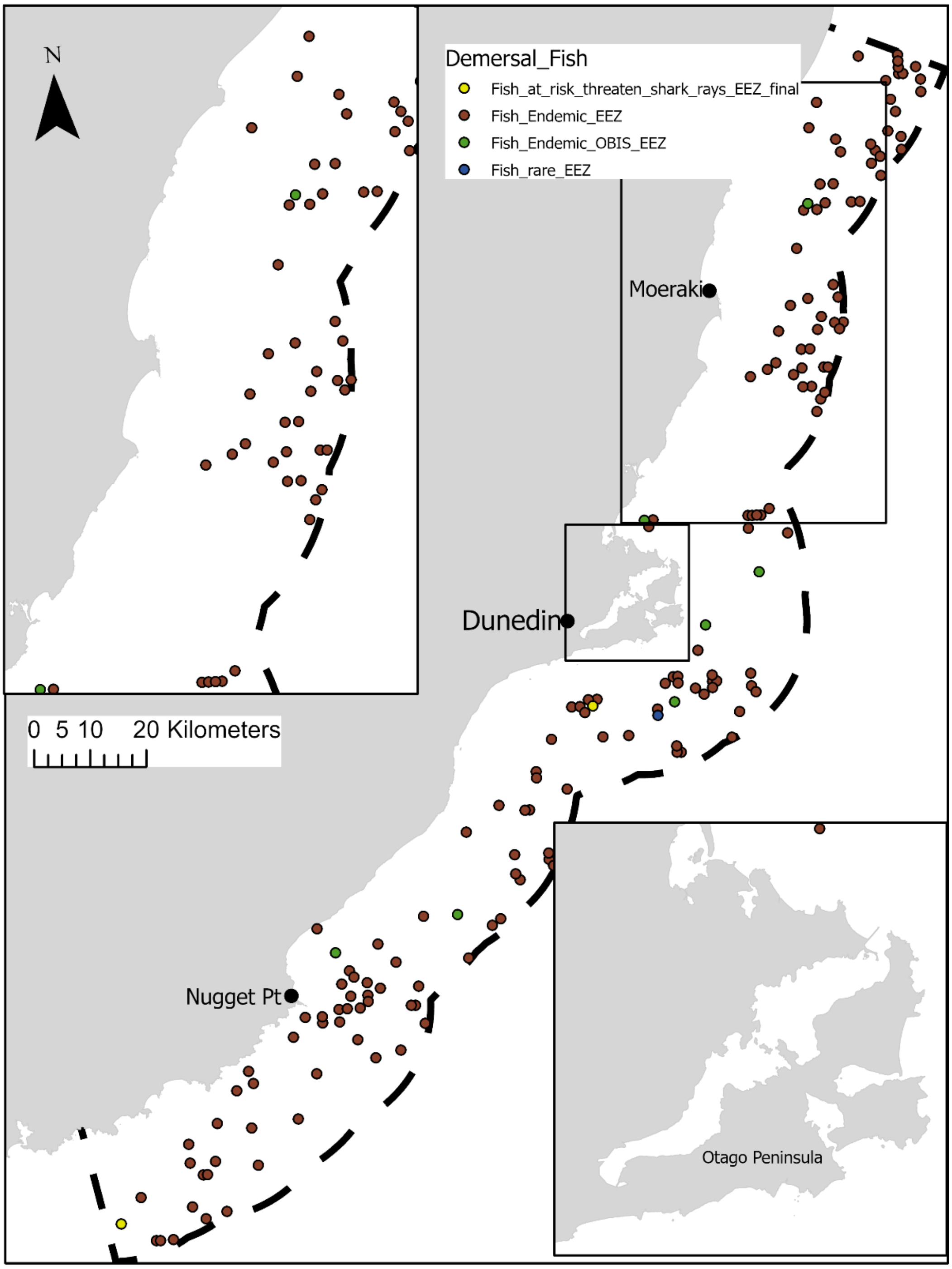


**Figure 3-19: Occurrence of rare, threatened and endemic fish.** Point records of all rare (blue), threatened (yellow) and endemic (green and brown – OBIS) fish, example datasets for the demersal fish management class.

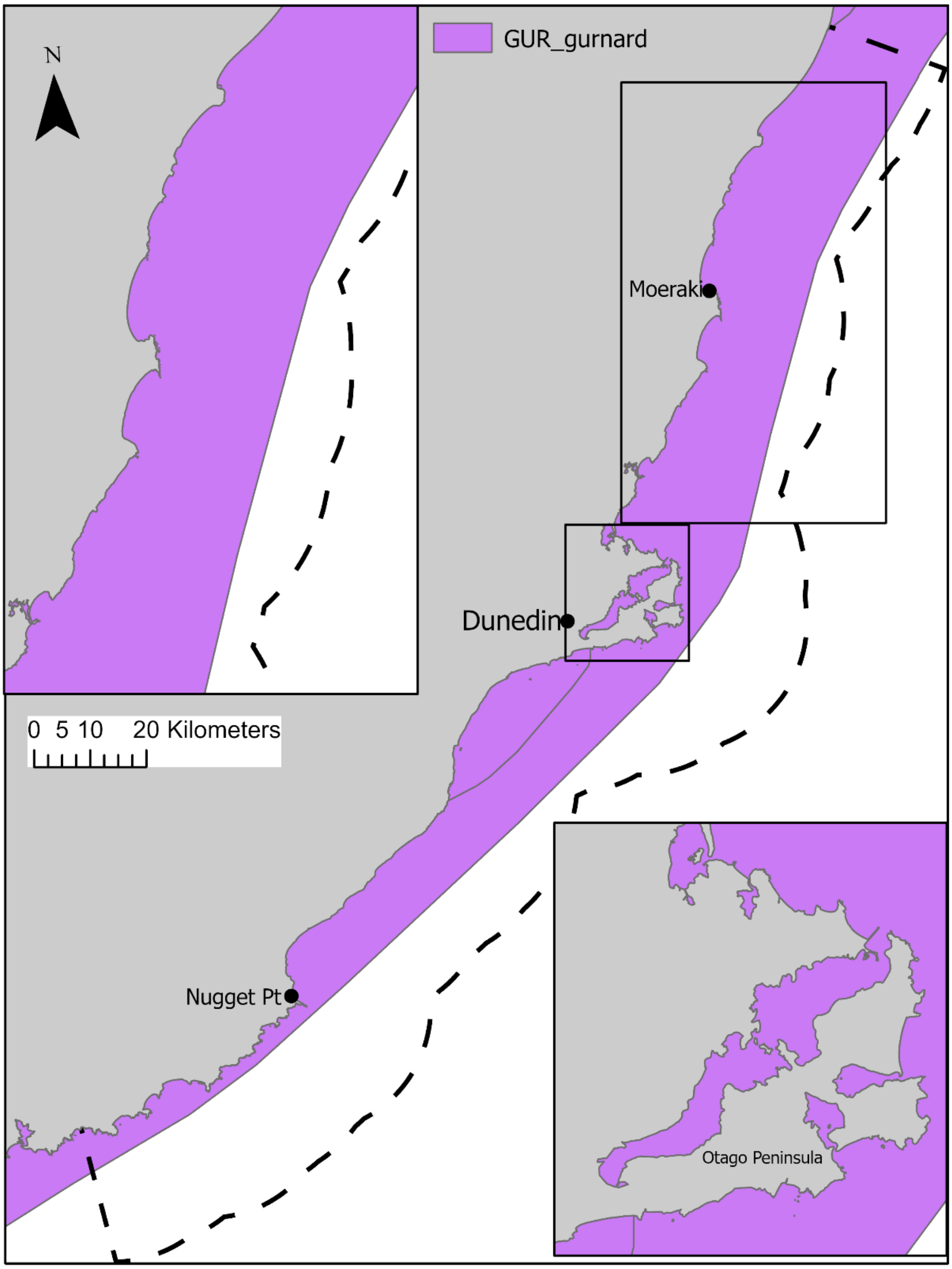


**Figure 3-20: Spawning habitat for gurnard.** Spawning habitat for gurnard (*Chelidonichthys kumu*), an example dataset for the demersal fish management class.

*Significant areas*

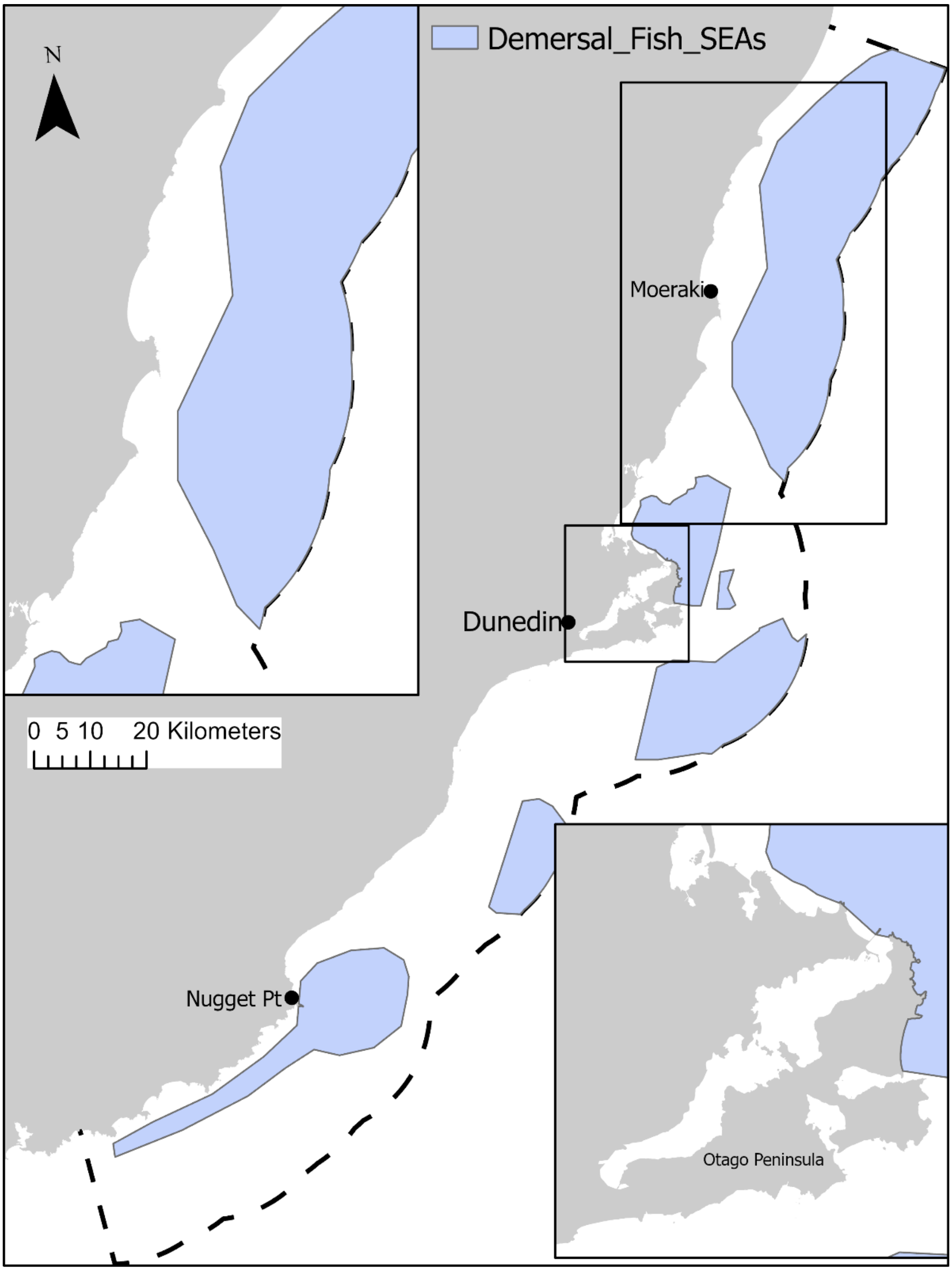


**Figure 3-21: SEAs for the demersal fish management class.**

Analysis of spatial data on important ecological features for demersal fish led to the identification of six SEAs throughout the Otago region. SEAs were located off the North Otago coast, the Otago Peninsula, the Catlins and offshore of Tokomairiro mouth. SEAs for this class consisted of areas of highly suitable habitat and spawning areas for numerous species, and occurrence of rare and threatened species.

## 3.7 Reef Fish

*Datasets*

There were two datasets that had useful information on the distribution of reef fish for the identification of SEAs. The national scale SDMs contained 42 expert-appraised species layers (Stephenson & Brough et al., submitted), and spatial data reporting the distribution (and value) of commercial harvesting for 13 reef fish species was provided by MPI.

**Table 3-8: Datasets used for the reef fish management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| 42 Reef Fish SDMs | National scale SDMs for Reef Fish. Expert appraised | Raster | KEA Database | 3 | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) |
| MPI spatial catch data - 13 species | Spatial fishing returns (catchKg) for key Otago species | Raster | MPI | 5 | 5, 6, 9 | 11 b (iv) |

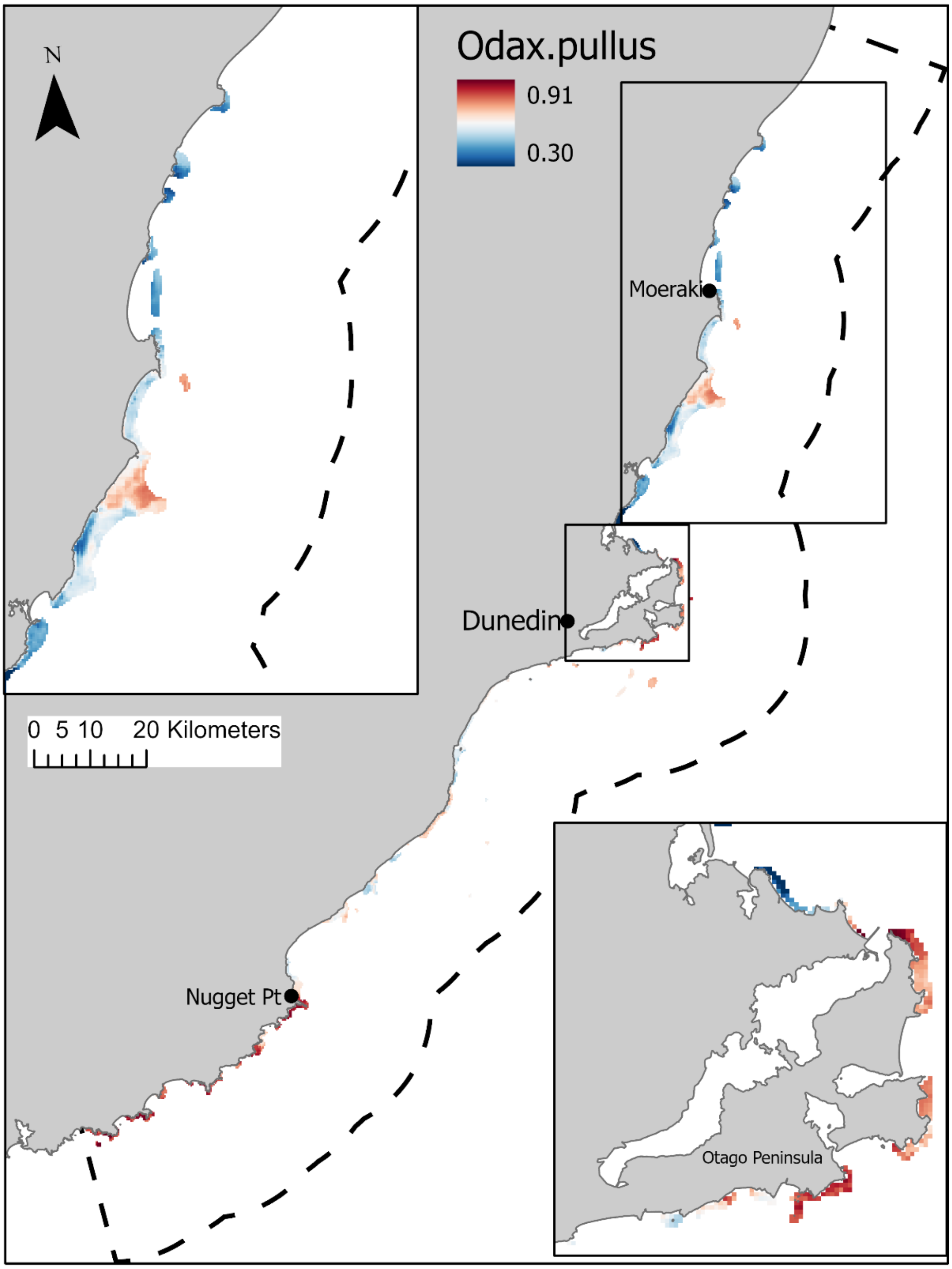


**Figure 3-22: Example dataset from the reef fish management class.** Species distribution model of butterfish (*Odax pullus*) with red indicating areas of high habitat suitability.

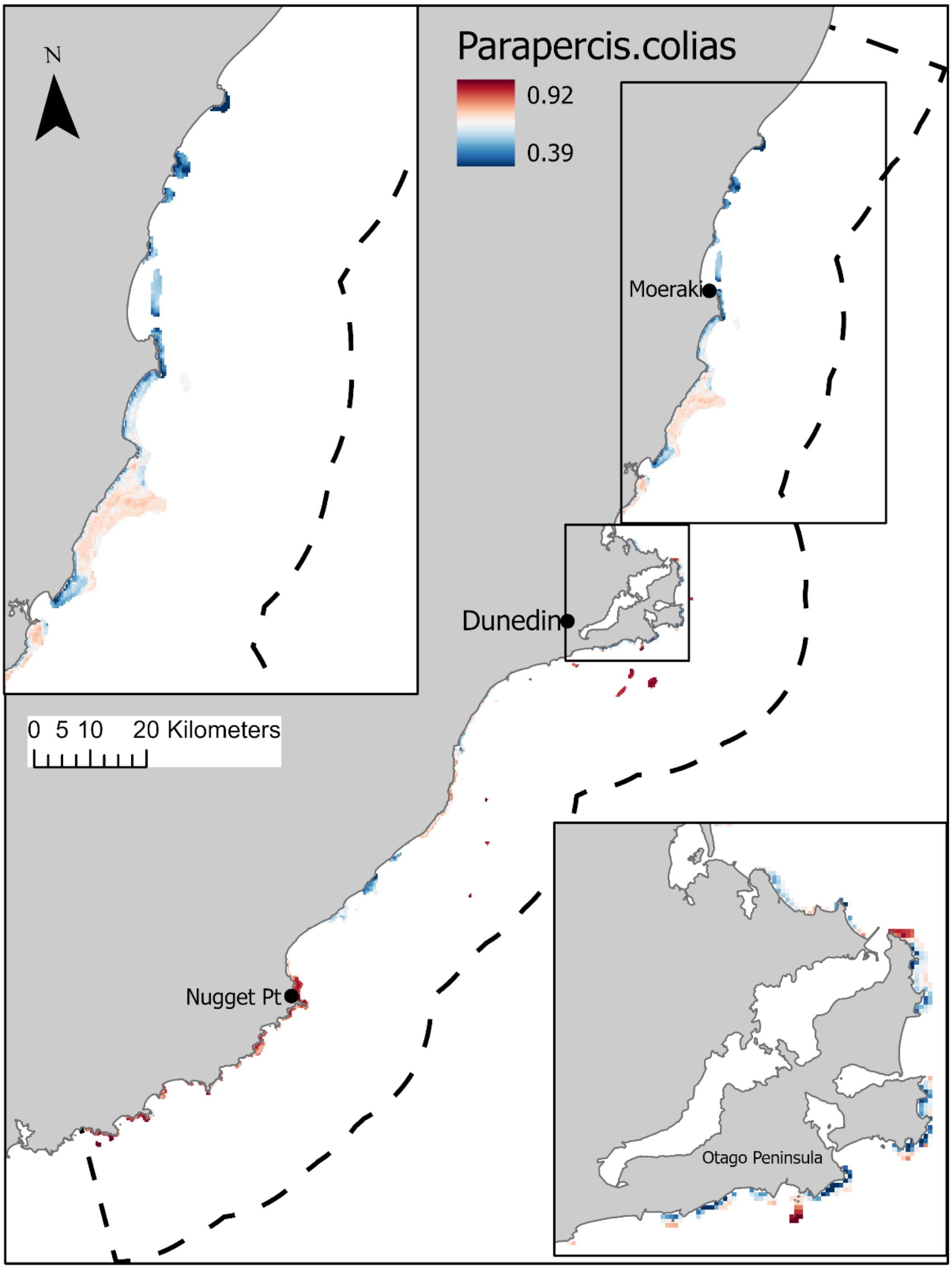


**Figure 3-23: Example dataset from the reef fish management class.** Species distribution model of blue cod (*Parapercis colias*) with red indicating areas of high habitat suitability.

*Significant areas*

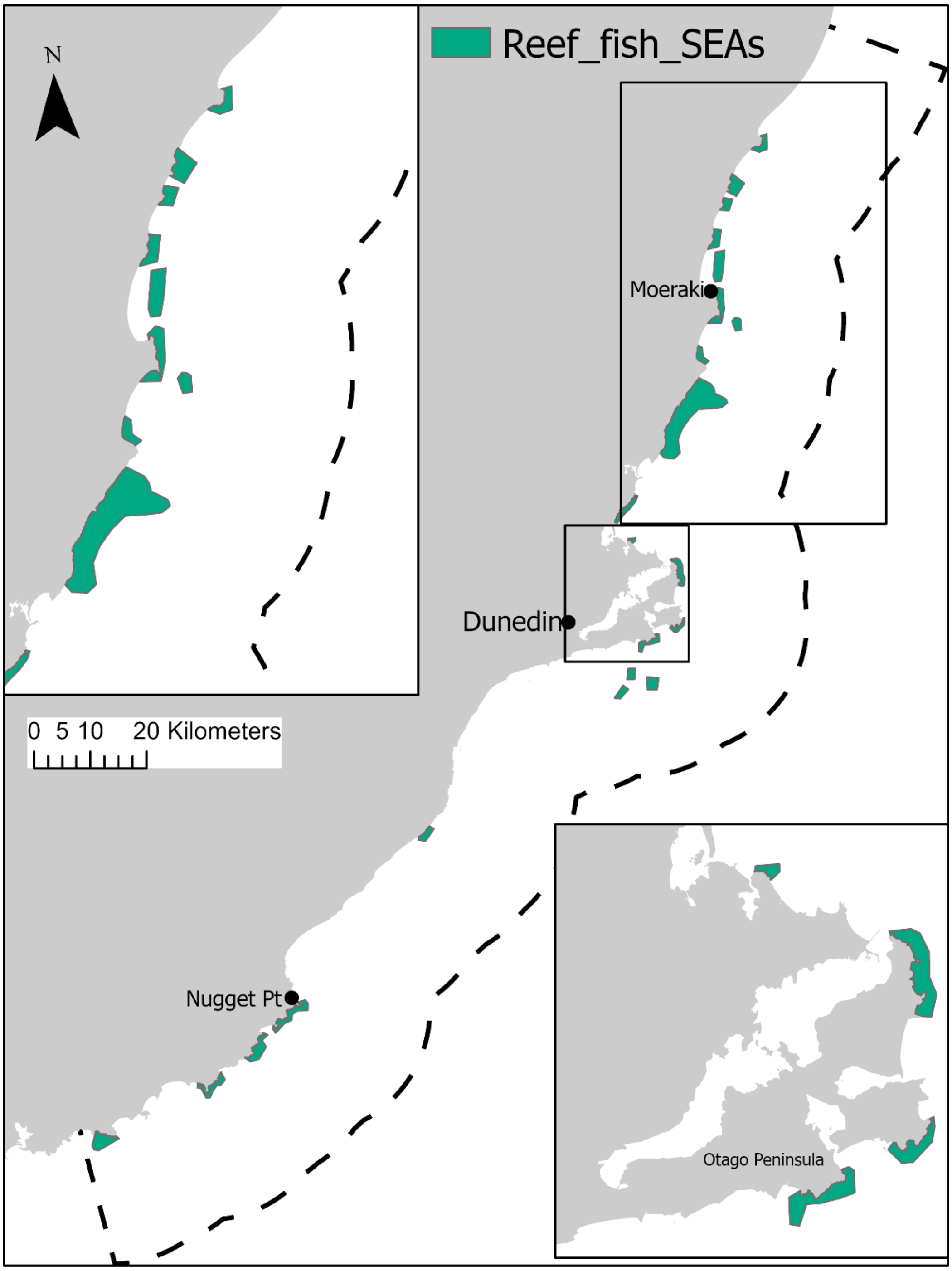


**Figure 3-24: SEAs for the reef fish management class.**

Analysis of spatial data on important ecological features for reef fish led to the identification of 22 SEAs throughout the Otago region. SEAs were located along most of the North Otago coast, the Otago Peninsula, the Catlins coast and at Tokomairiro mouth, with some offshore of Dunedin. SEAs for this class consisted of areas of highly suitable habitat for numerous reef fish species and occurrence of lobster and paua.

## 3.8 Kelp forest

*Datasets*

Five datasets contained useful information for the distribution of kelp forests for identifying SEAs. A national scale SDM provides a habitat suitability model of *Macrocystis pyrifera* (Stephenson & Brough et al., submitted). A further 12 national scale SDMs of canopy forming macroalgae were also used but down-weighted relative to the Macrocystis SDM. Port Otago provided a raster of mapped distribution of kelp forest in north Otago derived from satellite remote sensing. An ORC-held dataset maps the distribution of kelp forest north of the peninsula, and approximate distributions of kelp forest (*Macrocystis*) were obtained from the DOC SeaSketch database.

**Table 3-9: Datasets used for the kelp forest management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Macrocystis SDM | National scale SDMs for canopy forming macroalgae. Expert appraised | Raster | KEA Database | 3 | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) |
| Other Canopy-forming macroalgae SDMs x12 (down-weighted) | National scale SDMs for canopy forming macroalgae. Expert appraised | Raster | KEA Database | 3 | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) |
| KelpBeds | ORC-held database on the distribution of kelp forest - north of peninsula | Polygon | ORC Marine Sh apefiles | 5 | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) |
| Kelpforest distribution_Port Otago | Mapped distribution of kelp forest derived from satellite remote sensing - northern Otago | Raster | Port Otago | 5 | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) |
| Biogenic_macrocystis | Approximate distribution of *Macrocystis* kelp forest from Fyffe et al. 1999 | Polygon | Doc SeaSketch database | 5 | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) |

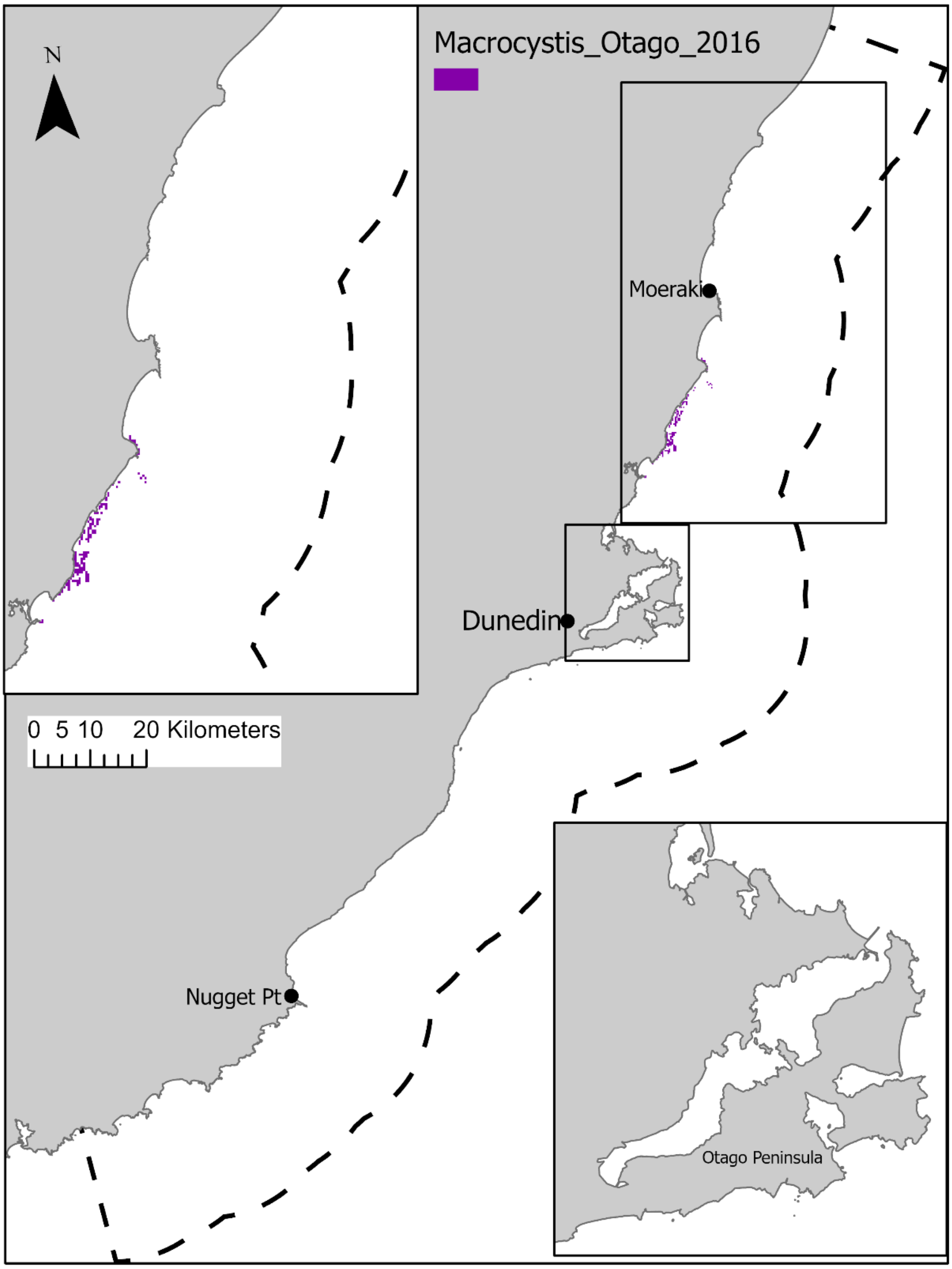


**Figure 3-25: Distribution of *Macrocystis pyrifera* on the North Otago coast.** Distribution of *Macrocystis pyrifera* derived from aerial mapping by Port Otago, an example dataset for the kelp forest management class.

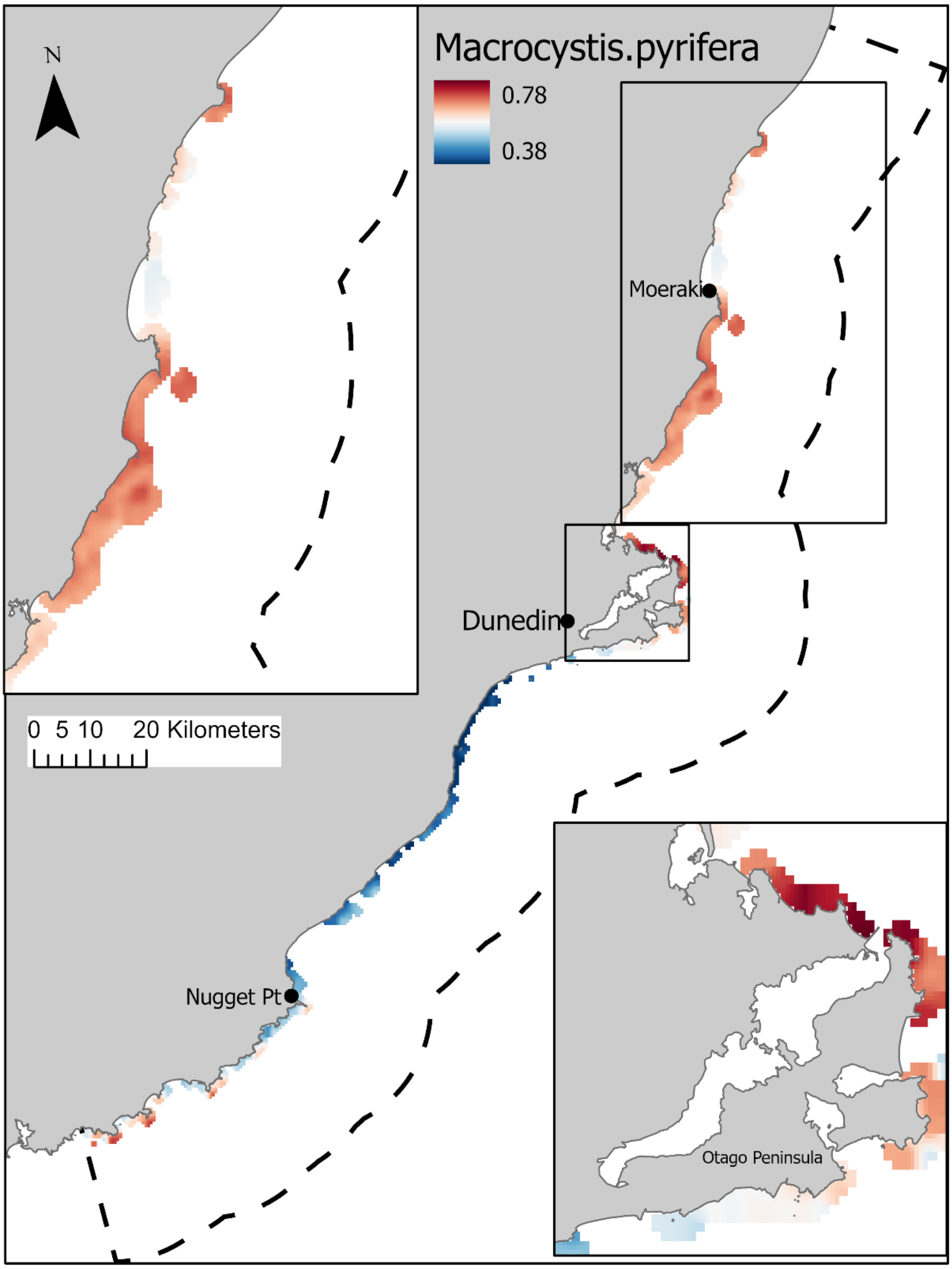


**Figure 3-26: Species distribution model of *Macrocystis pyrifera*.** Species distribution model of *Macrocystis pyrifera* with red indicating areas of high habitat suitability, and example dataset of the kelp forest management class.

*Significant areas*

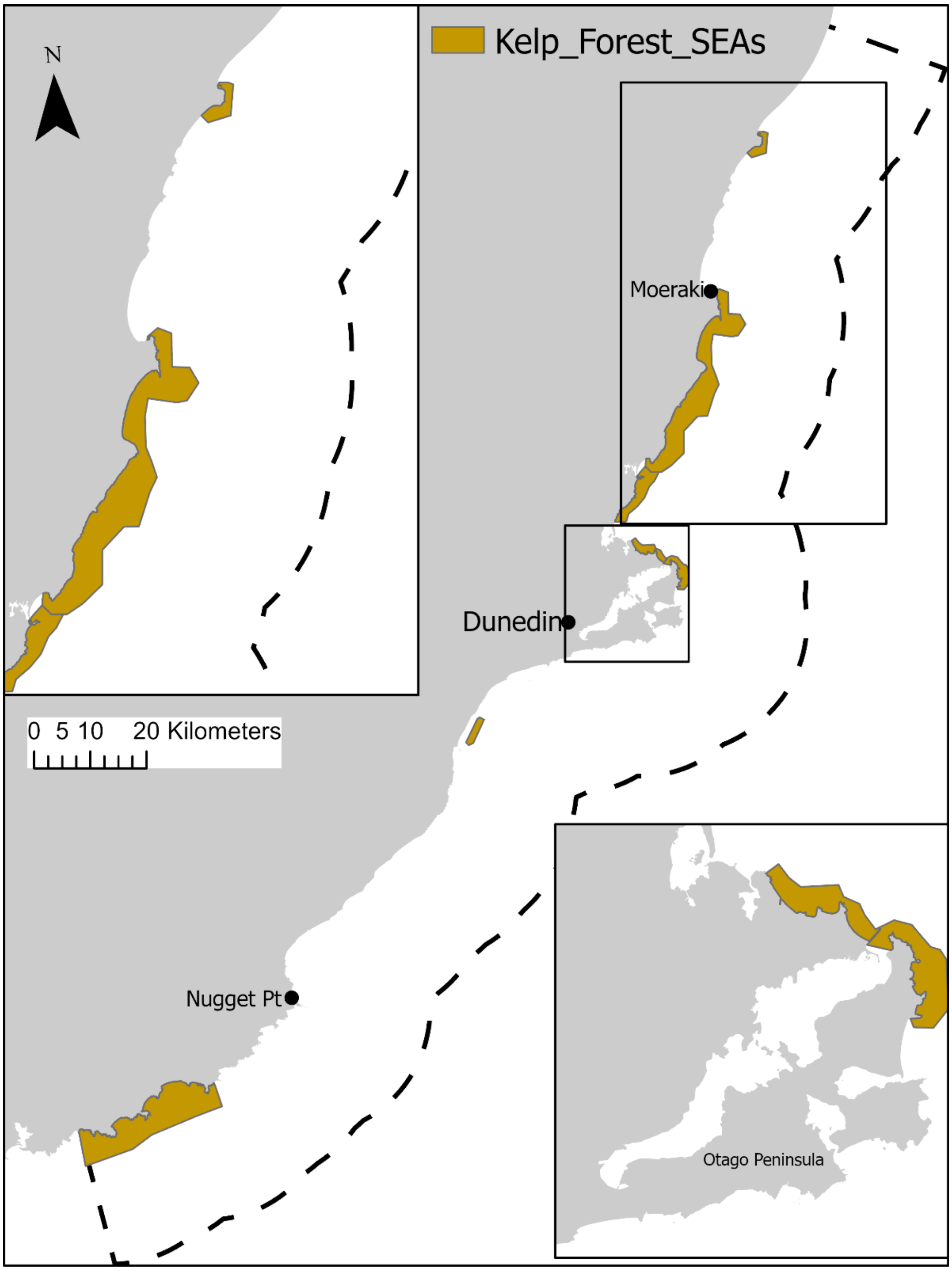


**Figure 3-27: SEAs for the kelp forest management class.**

Analysis of spatial data on important ecological features for kelp forests led to the identification of six SEAs throughout the Otago region. SEAs were located along the coast between Blueskin Bay and Moeraki, at the Otago Harbour mouth and surrounding coast, off Kuri Bush and along the south Catlins coast. SEAs for this class consisted of areas highly suitable habitat for and occurrence of *macrocystis* kelp forest and other canopy forming macroaglae.

## 3.9 Marine Flora

*Datasets*

There were 13 datasets that contained useful information for the identification of SEAs for the marine flora management class. The national scale SDM dataset had 41 expert appraised layers for canopy forming macro algae species (Stephenson & Brough et al., submitted). Nine datasets originated from ORC studies on mapping the locations of macroalgae (5) and seagrass (4) within estuarine environments. Another ORC-held dataset indicates the approximate distribution of seagrass in Otago estuaries that have not been formally mapped. The DOC SeaSketch database provided further approximate distribution of seagrass, and a point record dataset from Port Otago maps seagrass monitoring locations in Otago Harbour and Papanui Inlet.

**Table 3-10: Datasets used for the marine flora management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| 41 Marine Flora SDMs | National scale SDMs for non-canopy forming macroalgae. Expert appraised | Raster | KEA Database | 3 | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Blueskin2020_21_ Macroalgae | Mapped distribution of macroalgae within Blueskin Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 5, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Blueskin2020_21_ Seagrass | Mapped distribution of seagrass within Blueskin Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Catlins2016_ Macroalgae | Mapped distribution of macroalgae within Catlins Estuary | Polygon | ORC Otago GIS map packages, S alt Ecology | 5 | 5, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Catlins2016_Seagrass | Mapped distribution of seagrass within Catlins Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Seagrass_ORCEstuary | Approximate seagrass distribution in Otago estuaries that have not been formally mapped | Polygon | ORC Marine Shapefiles | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Shag2016_Macroalgae | Mapped distribution of macroalgae within Shag Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 5, 8 | 11 b (i), b (ii), b (iii), b (vi) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Tokomairiro2018_ Macroalgae | Mapped distribution of macroalgae within Tokomairiro Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 5, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Tokomairiro2018_ Seagrass | Mapped distribution of seagrass within Tokomairiro Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Waikouaiti2017_ Macroalgae | Mapped distribution of macroalgae within Waikouaiti Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 5, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Waikouaiti2017_ Seagrass | Mapped distribution of seagrass within Waikouaiti Estuary | Polygon | ORC Otago GIS map packages, Salt Ecology | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| E3 Scientific seagrass dataset | Seagrass monitoring locations Otago Harbour and Papanui Inlet | Point | Port Otago/E3 | 5 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |
| Seagrass_Jul2015 | Approximate distribution of seagrass in Otago Harbour | Polygon | Doc SeaSketch database | 3 | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) |

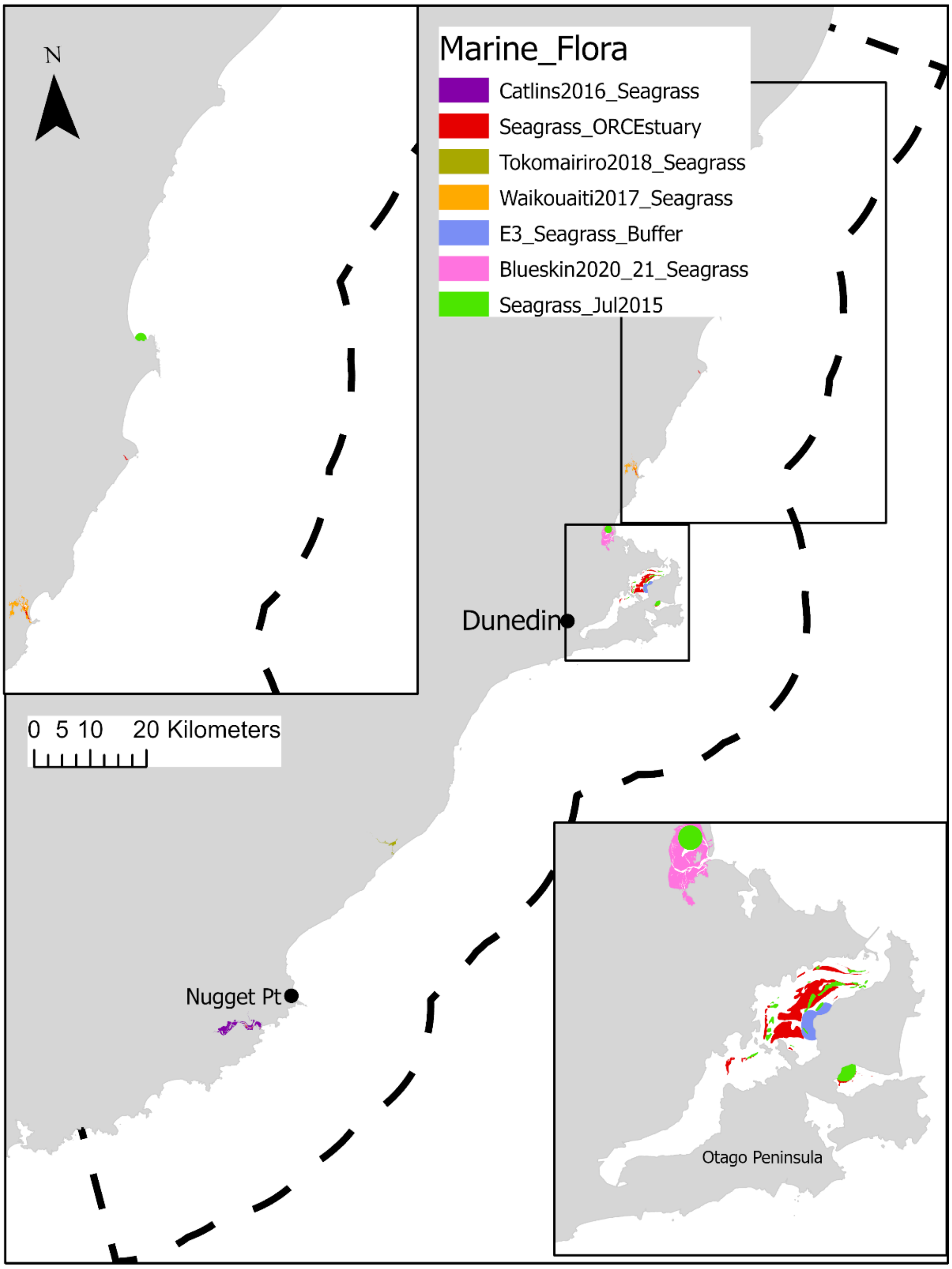


**Figure 3-28: Occurrence of seagrass.** Seagrass distribution mapped by the Otago regional council, DOC and Port Otago, example datasets for the marine flora management class.

*Significant areas*

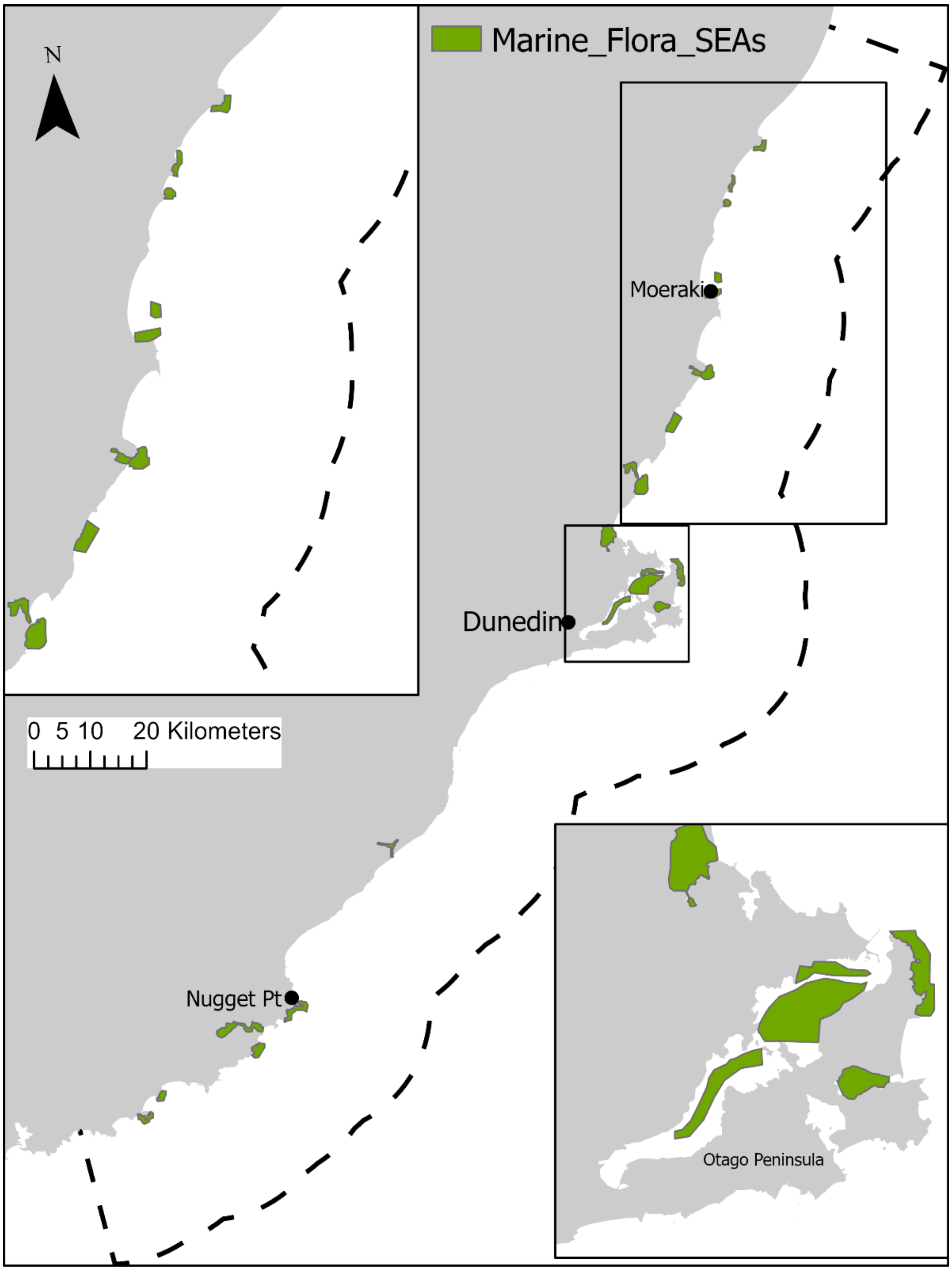


**Figure 3-29: SEAs for the marine flora management class.**

Analysis of spatial data on important ecological features for marine flora led to the identification of 22 SEAs throughout the Otago region. SEAs were located along the North Otago coast, Blueskin Bay, Otago Harbour and Peninsula, Tokomairiro and the Catlins coast. SEAs for this class consisted of areas of occurrence of seagrass and macroalgae.

## 3.10 Marine Mammal – Ocean

*Datasets*

There were eight datasets with useful information on the at-sea distribution of marine mammals for identifying SEAs. The national scale SDM dataset contained 13 expert-appraised cetacean species layers (Stephenson et al. 2020). Point records of Hector's dolphin sightings were provided by Otago university and Monarch wildlife tours (Turek et al. 2013). Approximate foraging range for fur seal and sealion were obtained from the KEA database, with mapped foraging range of female sea lions from Otago peninsula from the DOC SeaSketch database (Auge et al. 2009). Another point record dataset from Otago University maps cetacean sightings during canyon surveys.

**Table 3-11: Datasets used for the oceanic marine mammals management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Cetacean SDMs (13) | National scale SDMs for cetaceans - selected species based on occurrence in Otago | Raster | KEA Database | 3 | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), |
| HWilliams_Nemo_ HectorsDolphin_ Sightings | Sightings dataset on Hector's dolphin from Otago University | Point | Hannah Williams, Otago University | 4 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (vi), b (iv), |
| MARI429_Hectors Dolphin_Sightings | Sightings dataset on Hector's dolphin from Otago University | Point | Otago University | 4 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (vi), b (iv), |
| Monarch_Hectors Dolphin_sightings | Sightings dataset on Hector's dolphin from Monarch Wildlife tours via Otago University | Point | Monarch Wildlife Crui ses via Otago Unive rsity | 3 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (vi), b (iv), |
| NZ_FurSeal_Foraging Range | Approximate foraging range for fur seals | Polygon | KEA Database | 2 | 3, 4 | 11 a (v), a (vi) |
| NZ_SeaLion_Foraging Range | Approximate foraging range for NZ sea lions | Polygon | KEA Database | 2 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (vi), b (iv), |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| FemaleSeaLionForaging_2008to10_27_05_2015_FINAL | Mapped foraging range of female sea lions from Otago Peninsula (Auge et al. 2009) | Polygon | DOC SeaSketch database | 5 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (vi), b (iv), |
| ALLCETACEANS 20162019 | Sightings dataset on all cetaceans from surveys of the Otago Canyons | Point | Will Rayment, Otago University | 4 | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v) |

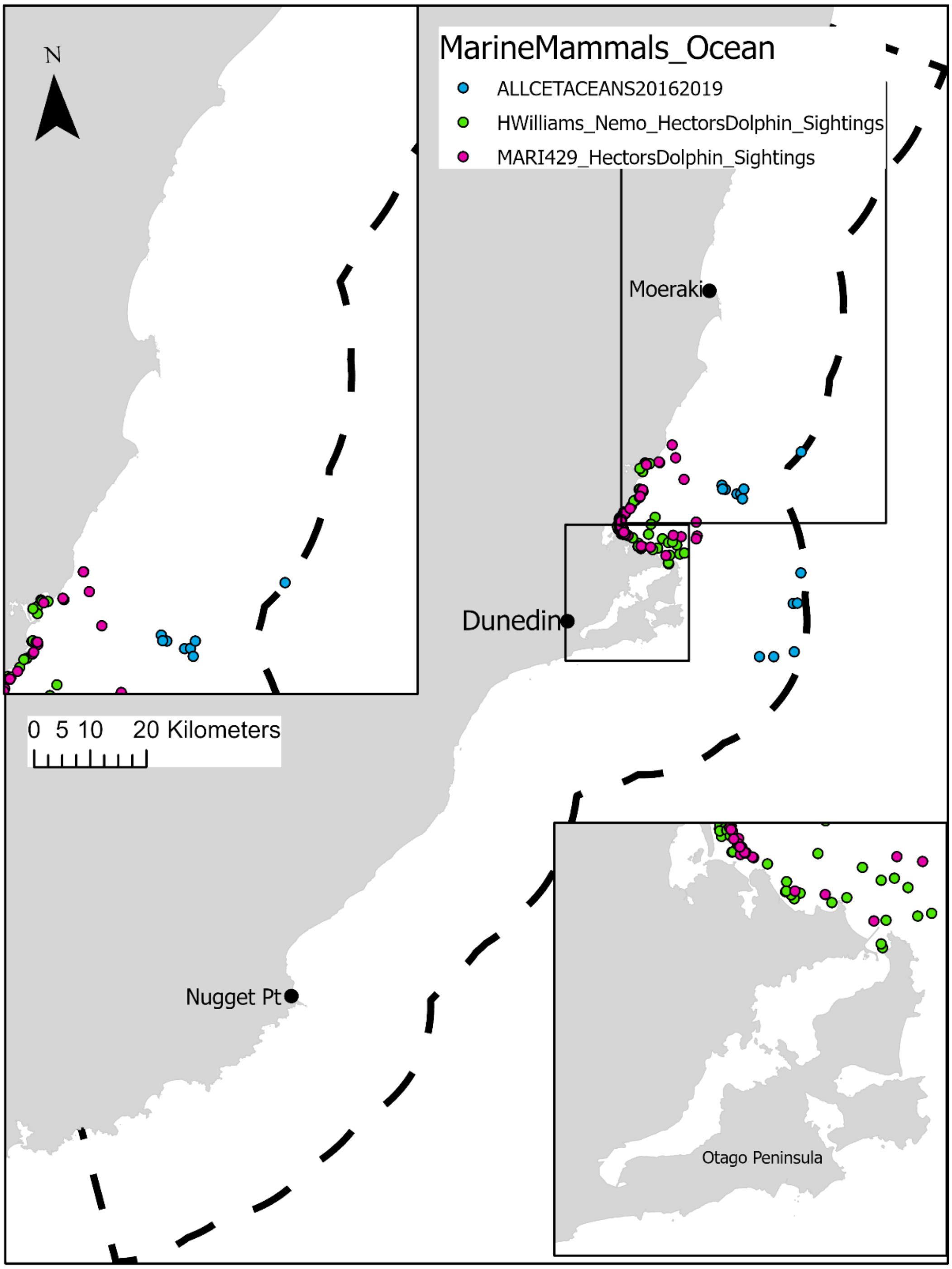


**Figure 3-30: Point records of cetacean sightings.** Sightings of various cetaceans on canyon surveys (blue) and Hector's dolphin by Otago university (green and pink), example datasets for the marine mammals - ocean management class.

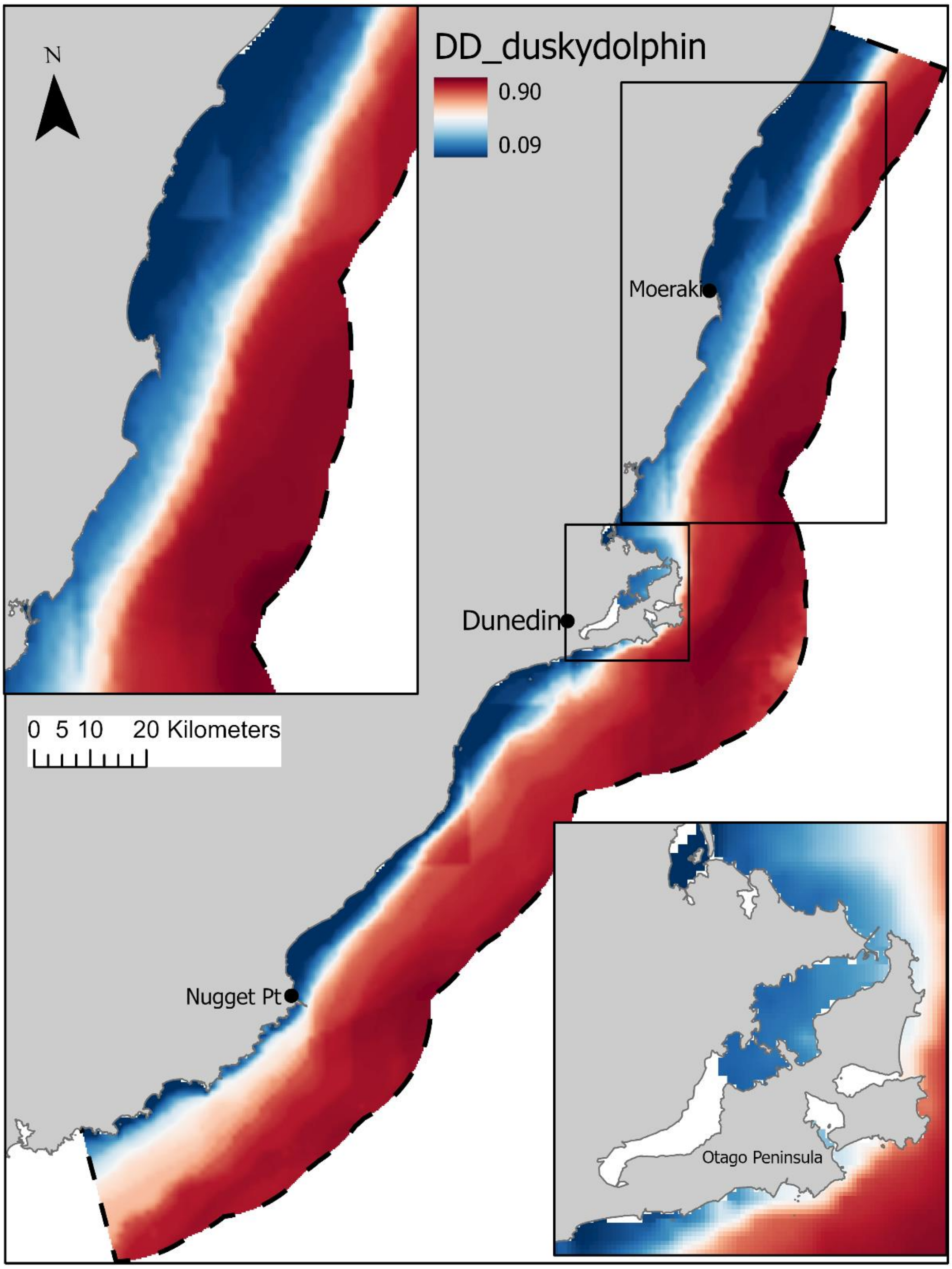


**Figure 3-31: Example dataset of the marine mammal - ocean management class.** Species distribution model of dusky dolphin (*Lagenorhynchus obscurus*) with red indicating areas of high habitat suitability.

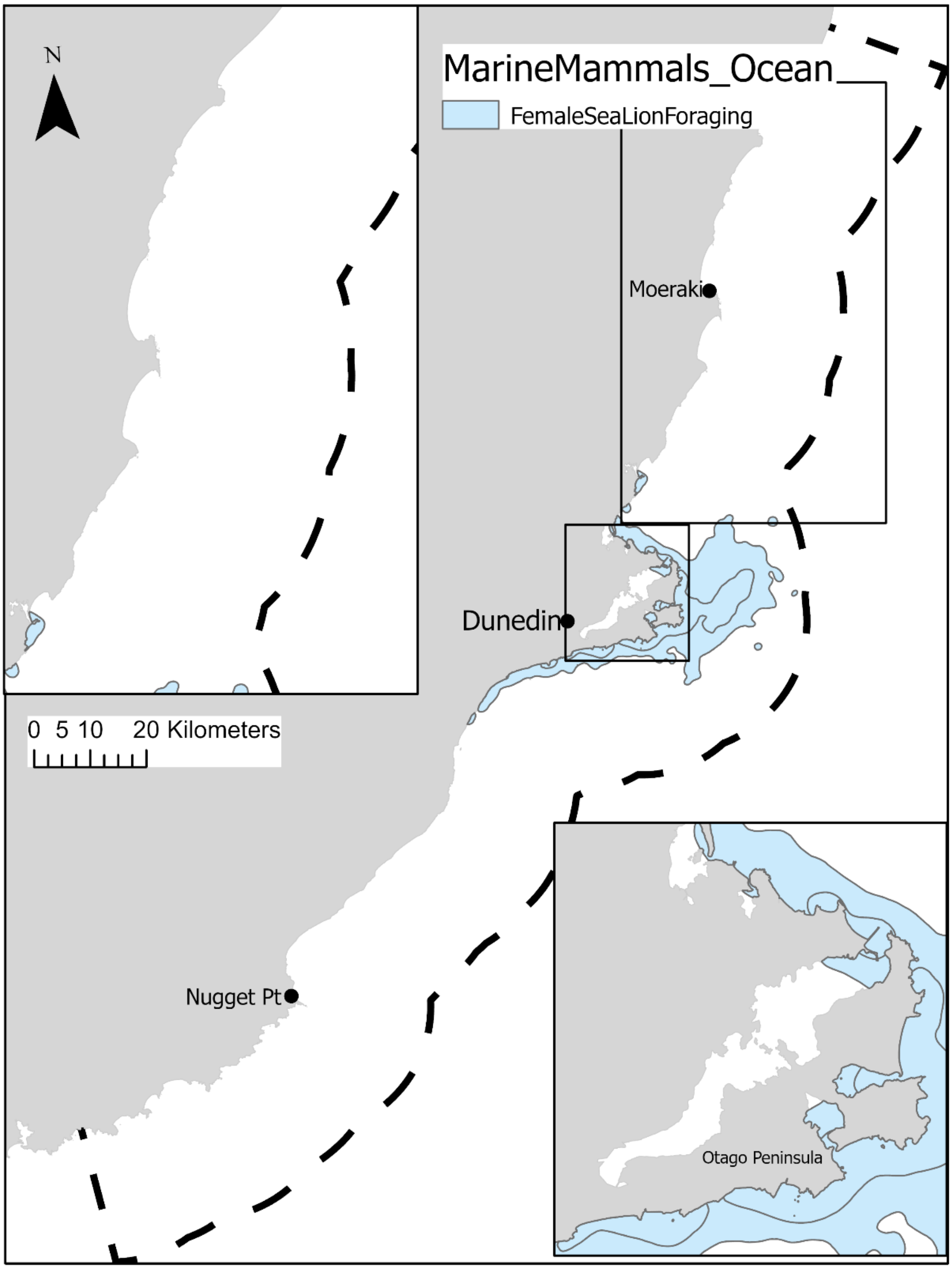


**Figure 3-32: Female sealion foraging range.** Polygons of female sealion foraging range, an example dataset for the marine mammals - ocean management class.

*Significant areas*

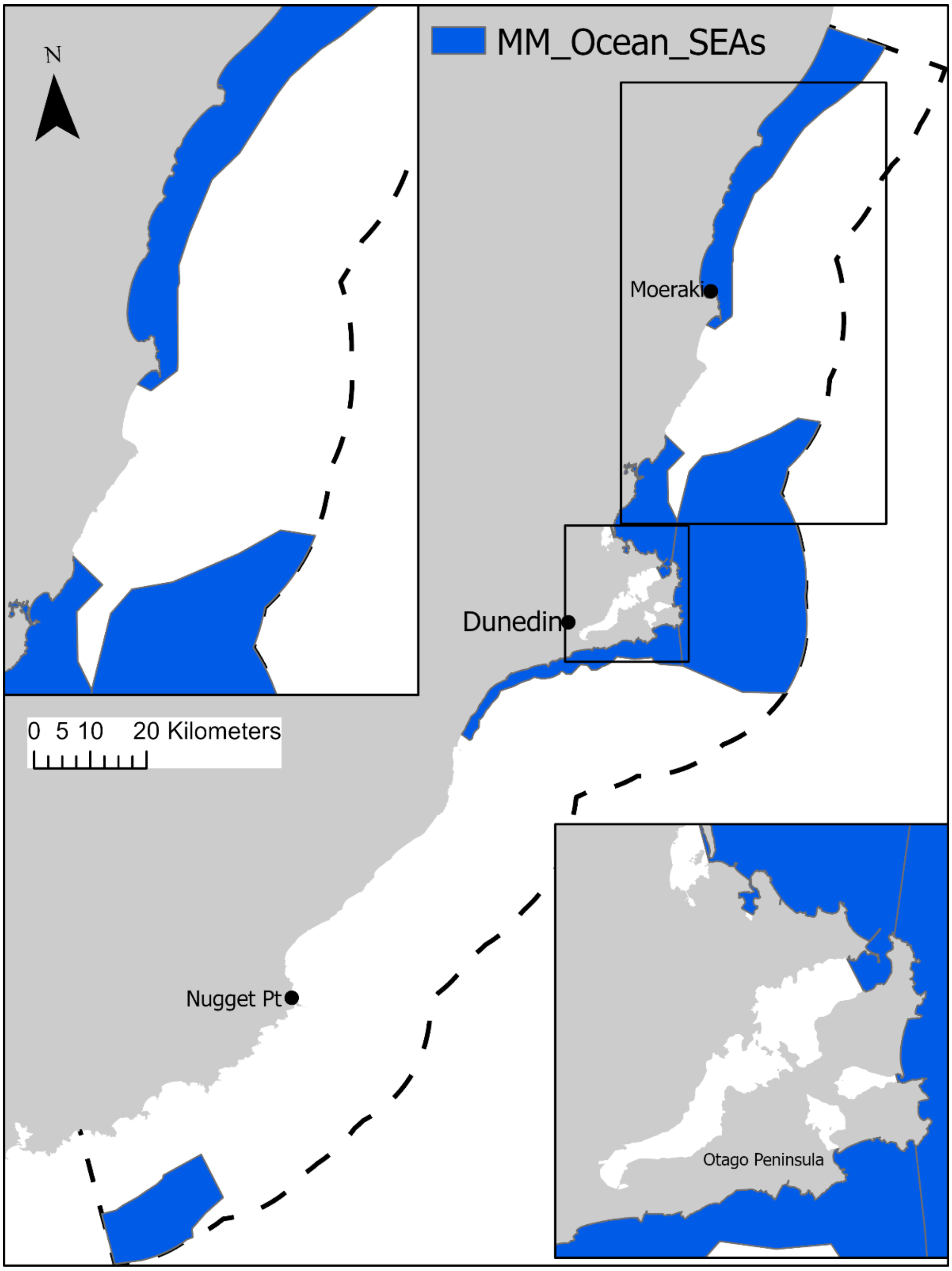


**Figure 3-33: SEAs for the marine mammals – ocean management class.**

Analysis of spatial data on important ecological features for marine mammals at sea led to the identification of five SEAs throughout the Otago region. SEAs were located along the coastline north of Moeraki, off the coast of Dunedin to the head of the Otago submarine canyons and offshore south of the Catlins. SEAs for this class consisted of areas of particular importance for sea lions and fur seals, highly suitable habitat for numerous cetacean species and occurrence of Hector's Dolphin.

## 3.11 Marine Mammal – Terrestrial

*Datasets*

There were five datasets with useful information for the identification of SEAs for the terrestrial marine mammal management class. From the KEA database we have national scale layers on the distribution of sea lion and fur seal breeding colonies as well as an extract from the Naturally Uncommon Ecosystems database maintained by Landcare Research on marine mammal haulouts (Stephenson et al. 2018; Lundquist et al. 2020). ORC also holds a database on fur seal colonies and haulouts, and the NZ Sea Lion Trust provided point records of sealion sightings from beach surveys.

**Table 3-12: Datasets used for the terrestrial marine mammal management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| New_Zealand__Hookers__Sealion___Breeding_Colonies_Distribution | National scale layer on the distribution of sea lion colonies | Polygon | KEA Database | 3 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv), |
| New_Zealand_Fur_Seal___Breeding_Colonies_Distribution | National scale layer on the distribution of fur seal colonies | Polygon | KEA Database | 3 | 3, 4 | 11 a (vi), b (ii) |
| NZSLT database sea-lions-sightings April 2022 | Database of sightings from beach surveys by NZ sea lion trust | Point | NZLT | 5 | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv), |
| ORC_Fur_seal | Database on fur seal colonies/haulouts maintained by ORC | Polygon | ORC Marine Shapefiles | 3 | 3, 4 | 11 a (vi), b (ii) |
| GEOPHYSICAL_Naturally UncommonEcosystems - Marine mammal haulouts | Extract from Naturally Uncommon Ecosystems database maintained by Landcare Research on marine mammal haulouts | Polygon | KEA Database | 3 | 3, 4 | 11 a (vi), b (ii) |

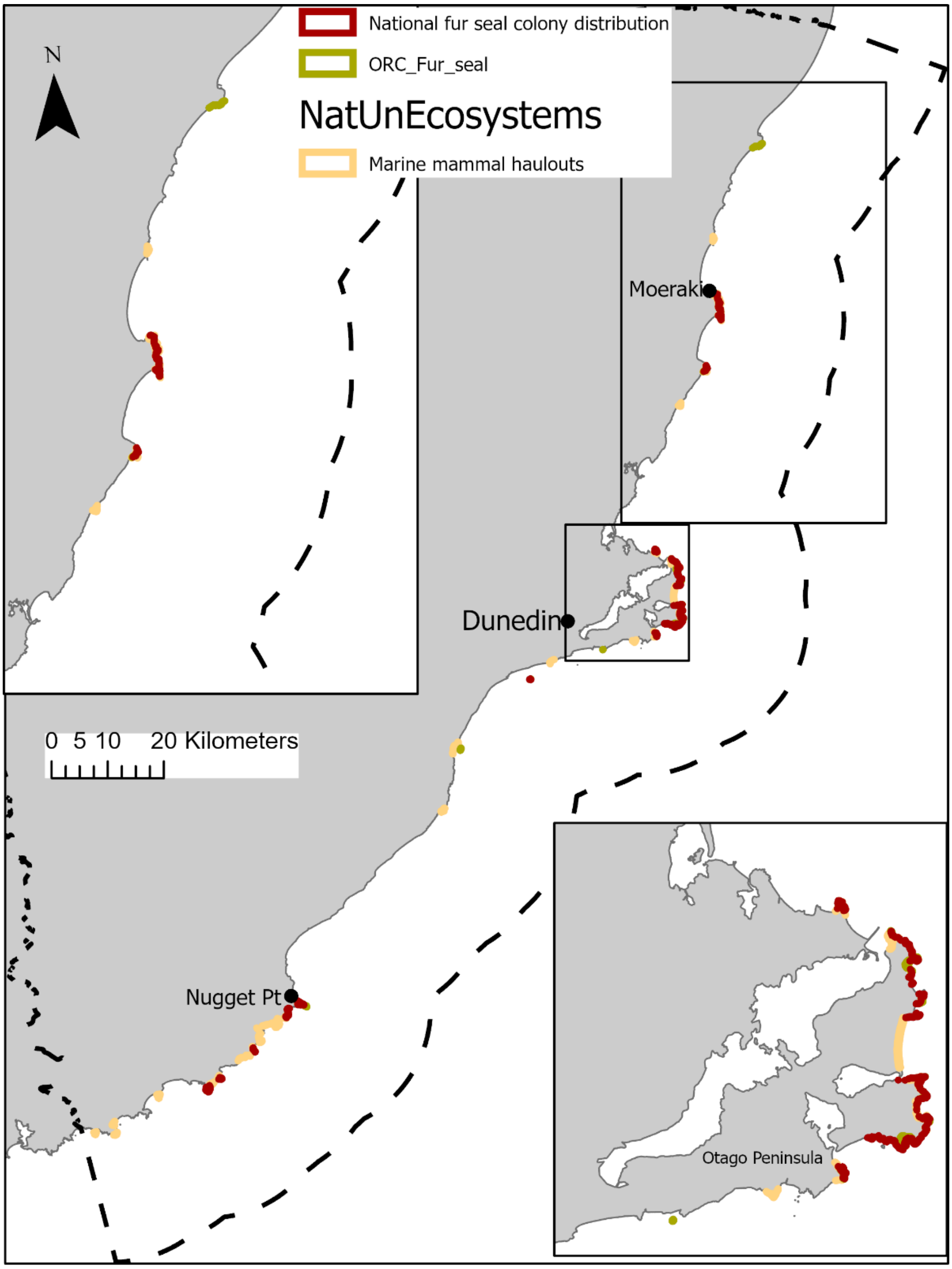


**Figure 3-34: Fur seal colonies and haulouts.** Occurrence of fur seal and sea lions from the naturally uncommon ecosystems database, locations of fur seal colonies from a national database and an ORC maintained database, example datasets for the terrestrial marine mammal management class. The outline of the features has been enlarged to help visualise smaller polygons.

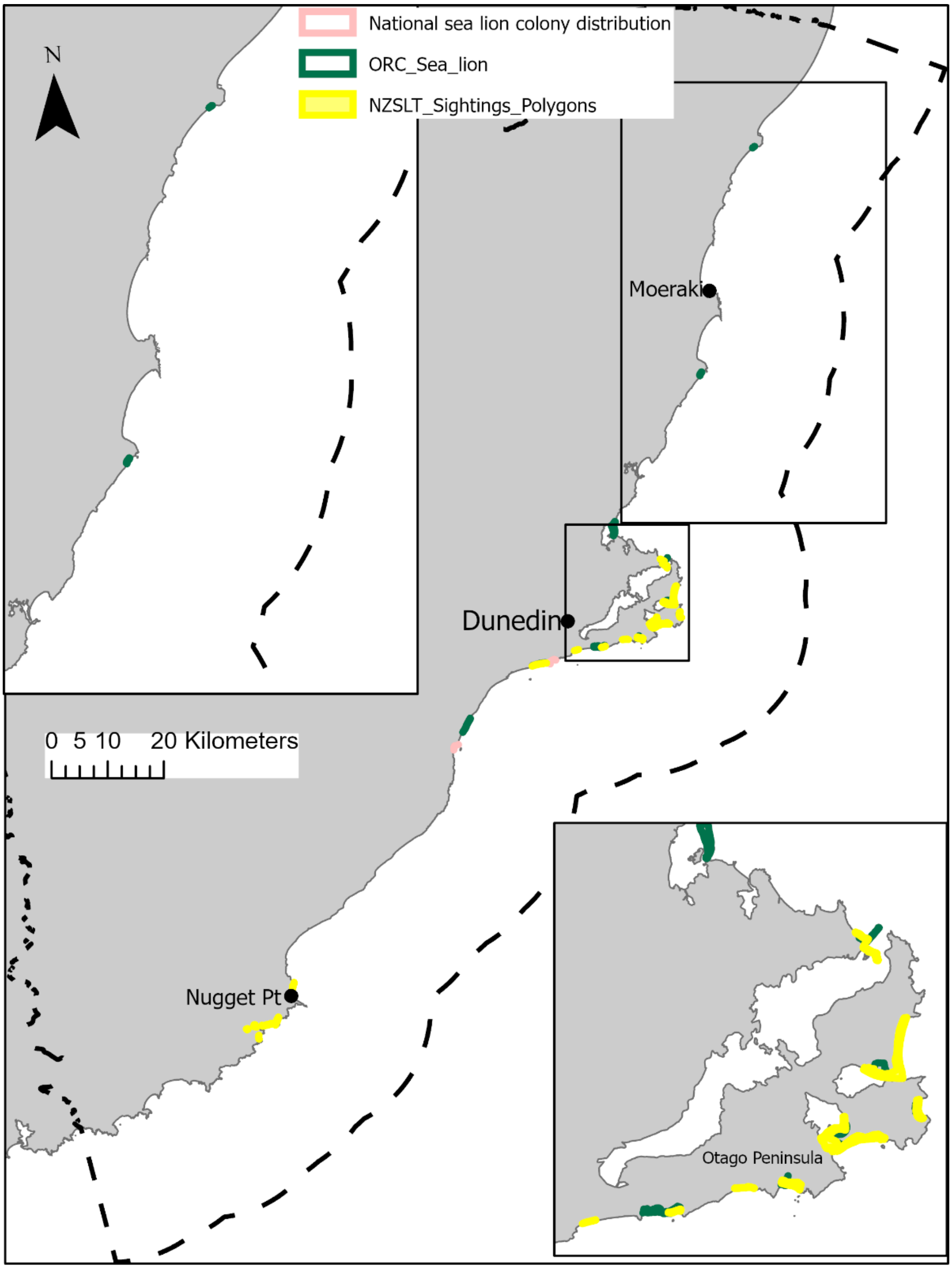


**Figure 3-35: NZ sealion distribution.** Locations of NZ sea lion haulouts/colonies from a national database and an ORC maintained database, and sightings from the NZ sea lion trust as example datasets for the terrestrial marine mammal management class. The outline of the features has been enlarged to help visualise smaller polygons.

*Significant areas*

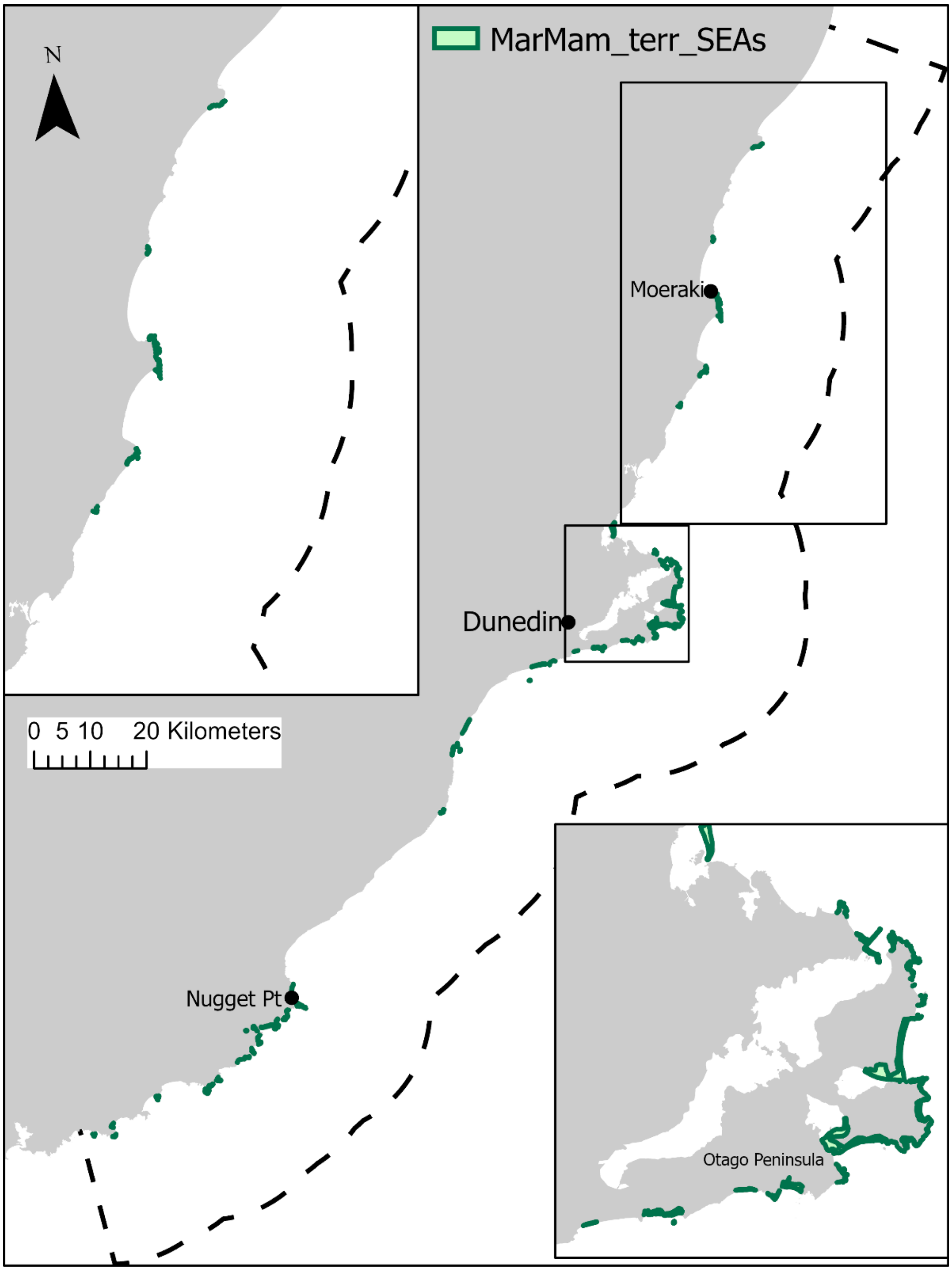


**Figure 3-36: SEAs for the terrestrial marine mammal management class.** Locations of SEAs for the terrestrial marine mammal management class. The outline of each feature has been enlarged to aid in the viewing of smaller features.

Spatial data on important ecological features for terrestrial marine mammals led to the identification of two SEAs, one for fur seals and one for sea lions, throughout the Otago region. Due to the very high numbers of individual colonies/haulouts for each species, individual SEAs were merged into one for each species for ease of reporting. Polygons can be separated and individually named by ORC if required. SEAs were located all along the Otago coast with large portions of Otago Peninsula, the Catlins and Moeraki considered important. SEAs for this class consisted of breeding colonies and haulouts for fur seals and sea lions.

## 3.12 Naturally uncommon ecosystems

*Datasets*

There is one dataset that provides useful information on the distribution of naturally uncommon ecosystems for identifying SEAs for this management class. This dataset is maintained by Landcare Research and summarise in the KEA database (Stephenson et al. 2018; Lundquist et al. 2020) and reports the occurrence and mapped extent (where undertaken) of rare coastal habitats - sand dunes, seabird burrowed soils, guano deposits, coastal cliffs and shingle beaches.

**Table 3-13: Dataset used for the naturally uncommon ecosystems management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| GEOPHYSICAL_ Naturally Uncommon Ecosystems | Naturally Uncommon Ecosystems database maintained by Landcare Research - reports the occurrence and mapped extent of rare coastal habitats - sand dunes, seabird burrowed soils, guano deposits, coastal cliffs, shingle beaches | Polygon | KEA Database | 3 | 2 | 11 a (iv), b (iii) |

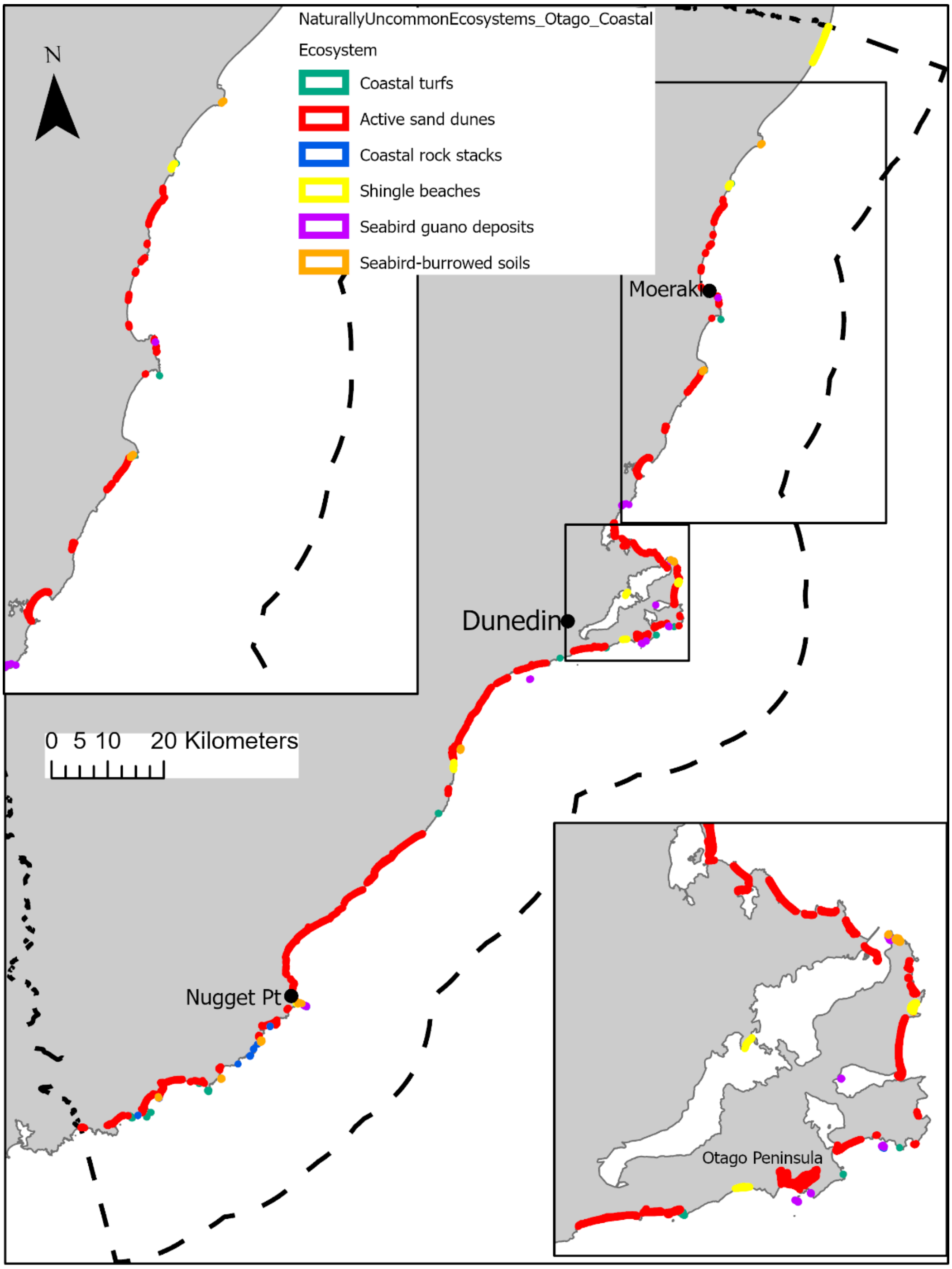


**Figure 3-37: Locations of naturally uncommon ecosystems.** Locations of the six different ecosystem types of naturally uncommon ecosystems, the dataset used for this management class. The outline of the features has been enlarged to help visualise smaller polygons.

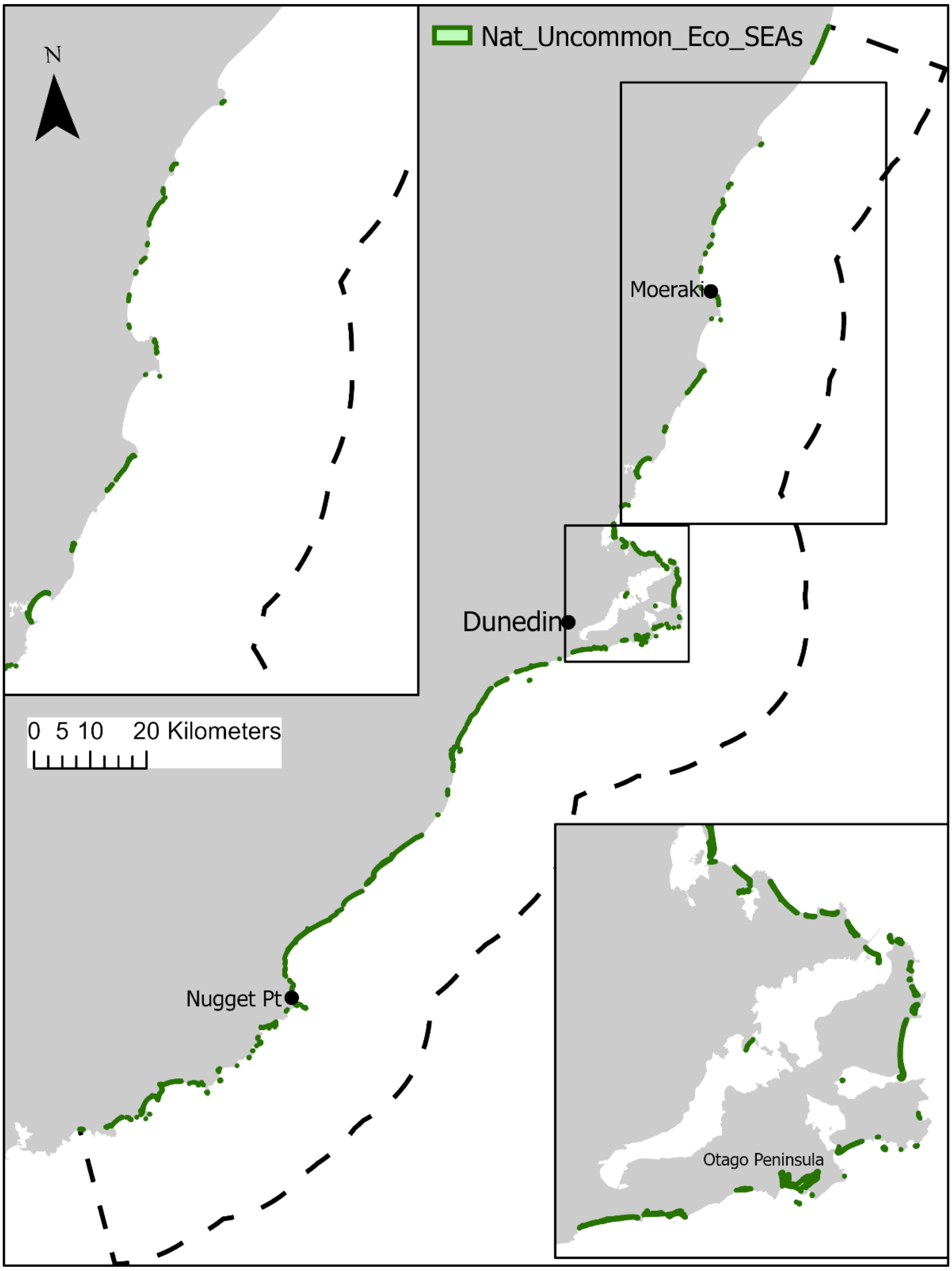


**Figure 3-38: SEAs for the naturally uncommon ecosystems management class.** Locations of SEAs for naturally uncommon ecosystems management class. The outline of each feature has been enlarged to aid in the viewing of smaller features.

Spatial data on ecological features for naturally uncommon ecosystems led to the identification of six SEAs throughout the Otago region. As for the terrestrial marine mammal management class, due to the high number of individual important areas, the SEAs were defined by all important areas belonging to a specific ecosystem category. SEAs were located along most of the Otago coast. SEAs for this class consisted of areas containing active sand dunes, coastal rock stacks, coastal turfs, shingle beaches, seabird guano deposits and seabird-burrowed soils.

## 3.13 Pelagic productivity

*Datasets*

There was one dataset that was used to identify SEAs for the pelagic productivity management class. The horizontal gradient in sea surface temperature is derived from remote sensing of sea surface temperature by satellite observation and reports average conditions over 20-years, providing a useful indication of persistent frontal features. The layer was developed as part of the seafloor community classification (Stephenson et al. 2022).

**Table 3-14: Dataset used for the pelagic productivity management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| SSTGrad | The horizontal gradient in sea surface temperature derived from remote sensing of temperature by satellite observation, 20-year average conditions. Useful indication of persistent frontal features | Raster | KEA Database | 3 | 2, 5, 8 | 11 a (v), b (vi) |

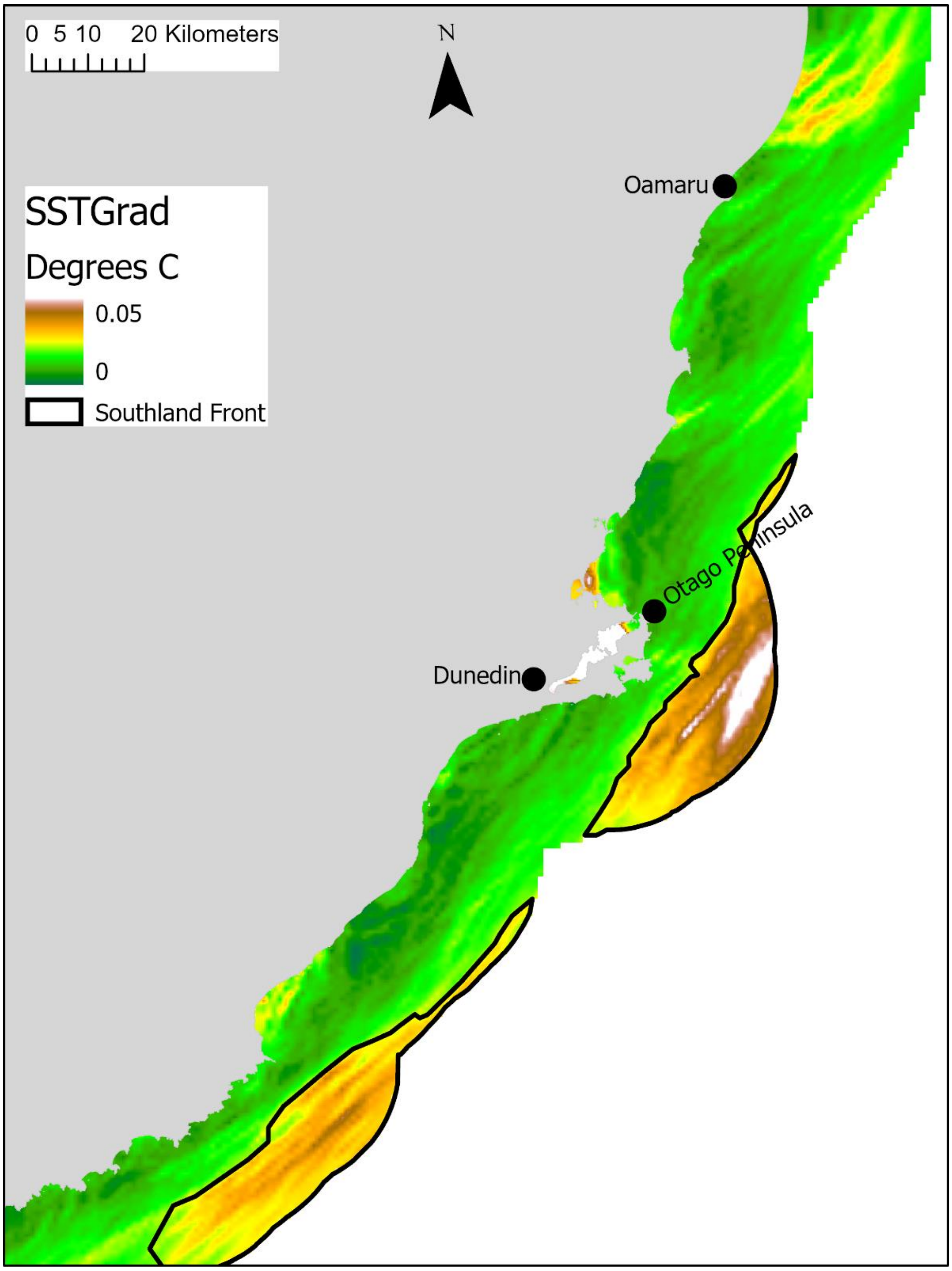


**Figure 3-39: Approximate location of the Southland front.** Sea surface temperature gradient, indicating approximate location of the Southland front, the dataset used for the pelagic productivity management class.

*Significant areas*

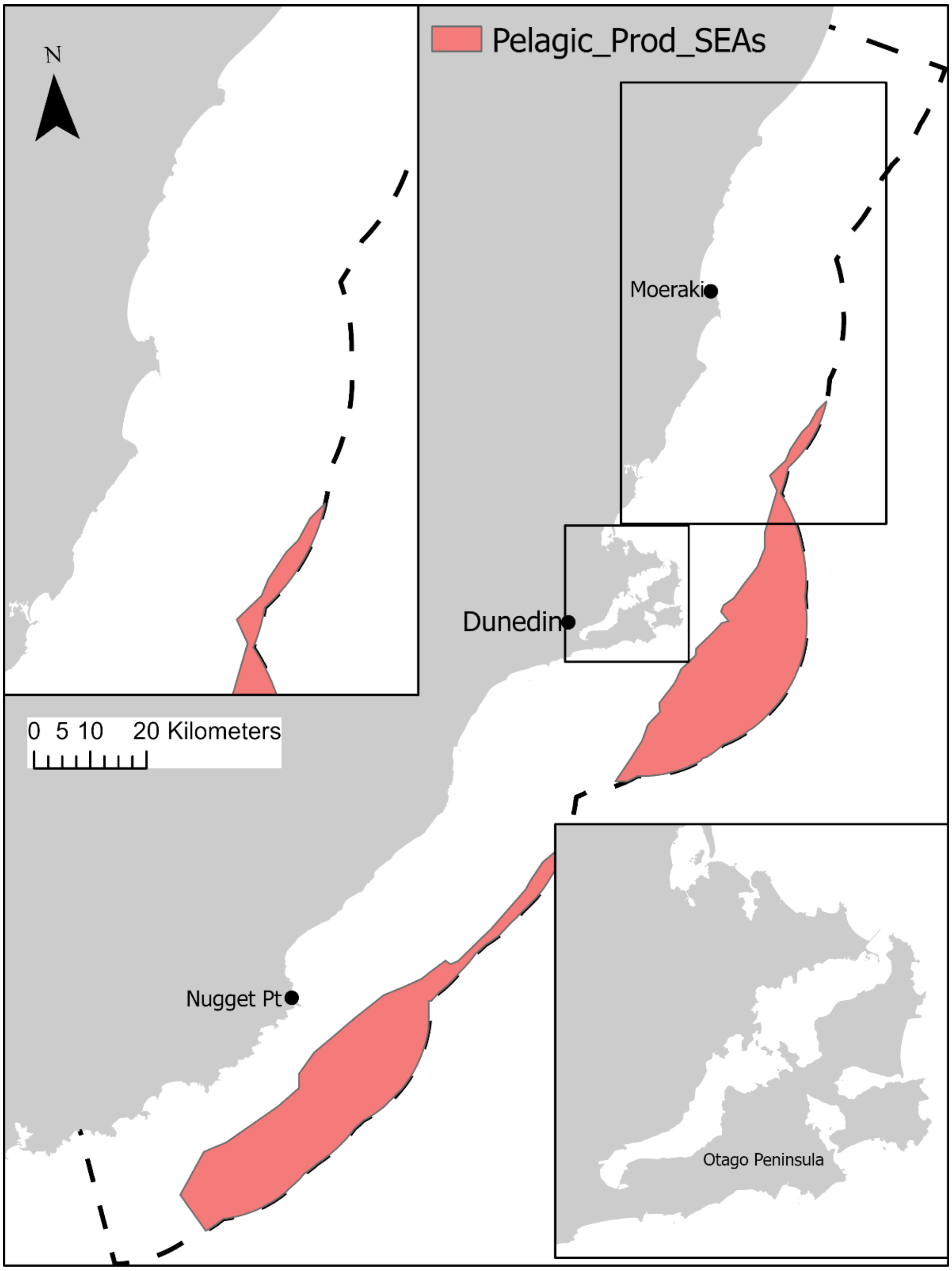


**Figure 3-40: SEAs for the pelagic productivity management class.**

Spatial data on important ecological features for pelagic productivity led to the identification of one SEA, that ranged offshore of the Catlins area through to Shag Point. The SEA for this class consists of the area containing persistent the frontal features of the Southland current.

## 3.14 Shore/seabirds – marine

*Datasets*

Ten datasets had useful information on the distribution of marine seabirds for identifying SEAs. The University of Otago provided point records of 12 GPS tracked northern royal albatross from the colony at Taiaroa head (Sugishita et al. 2015). An ORC-held dataset contains important bird areas, and iNaturalist and OBIS (Lundquist et al., 2020) provide point records of seabird sightings, with sightings around the Otago Canyons provided by the University of Otago. The national wader count survey by Birds NZ provided data on relative diversity and abundance for the survey locations in the Otago region, as well as an Otago Harbour survey of shorebirds. The foraging range of little blue penguin based on tracking data was obtained from the DOC SeaSketch database (Agnew et al. 2013) and a dataset of Hoiho tracking at sea was also provided by DOC (Mattern and Ellenberg 2018).

**Table 3-15: Datasets used for the marine seabirds management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Tracked Albatross data, 12 individuals | Point locations from GPS tracked northern royal albatross tracked from the Taiaroa Head colony | Point | Junichi Sugishita, Otago University | 4 | 3, 4 | 11 a (ii), a (iv), a (vi), b (ii), b (v) |
| Coastal_seabirds_ marine | Polygon dataset from ORC database on broad areas important for seabirds; hoiho and including Forest and Bird IBAs. | Polygon | ORC Marine Shapefiles | 2 | 3, 4 | 11 a (iv), 11 a (vi), b (v) |
| iNaturalist_Birds | Database of citizen science, opportunistic seabird observations from iNaturalist | Point | KEA Database | 3 | 2, 3, 4, 6 | 11 a (iv), 11 a (vi), b (v) |
| OBIS_Birds_4_2020_AE A_Clipped_to_EEZ | Dataset on seabird observations from diverse survey platforms stored in the OBIS database | Point | KEA Database | 3 | 2,3,4, 6 | 11 a (iv), 11 a (vi), b (v) |
| Birds NZ Otago Harbour Survey | Survey observations of shorebirds from numerous sites within Otago Harbour - pooling data spanning several decades | Polygon | OSNZ | 5 | 3, 4 | 11 a(i), a (ii), a (iv), a (vi), b (ii), b (v) |
| National Wader Count - abundance | Extract of survey data reporting relative abundance from the national wader count for the Otago region from Birds NZ. | Polygon | OSNZ | 5 | 3,4 | 11 a(i), a (ii), a (iv), a (vi), b (ii), b (v) |
| National Wader Count - diversity | Extract of survey data reporting relative diversity from the national wader count for the Otago region from Birds NZ. | Polygon | Birds NZ | 5 | 3, 4 | 11 a(i), a (ii), a (iv), a (vi), b (ii), b (v) |

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Otago_BluePenguinRange_17_10_14_FINAL | Foraging range of blue penguins from the Oamaru colony sourced from tracking data. | Polygon | Doc SeaSketch database | 4 | 3 | 11 a (i), a (vi), b (ii), |
| Seabirdsightings2019_01_canyons_Kde | Dataset of seabird observations from systematic surveys of the Otago canyons area. | Point | Will Rayment, Otago University | 4 | 2,3,4,6 | 11 a(i), a (ii), a (iv), a (vi), b (ii), b (v) |
| DOC_HoihoTracking | Dataset of Hoiho distribution at sea from tracking data - DOC/CSP funded. | Point | DOC | 4 | 2,3,4 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) |

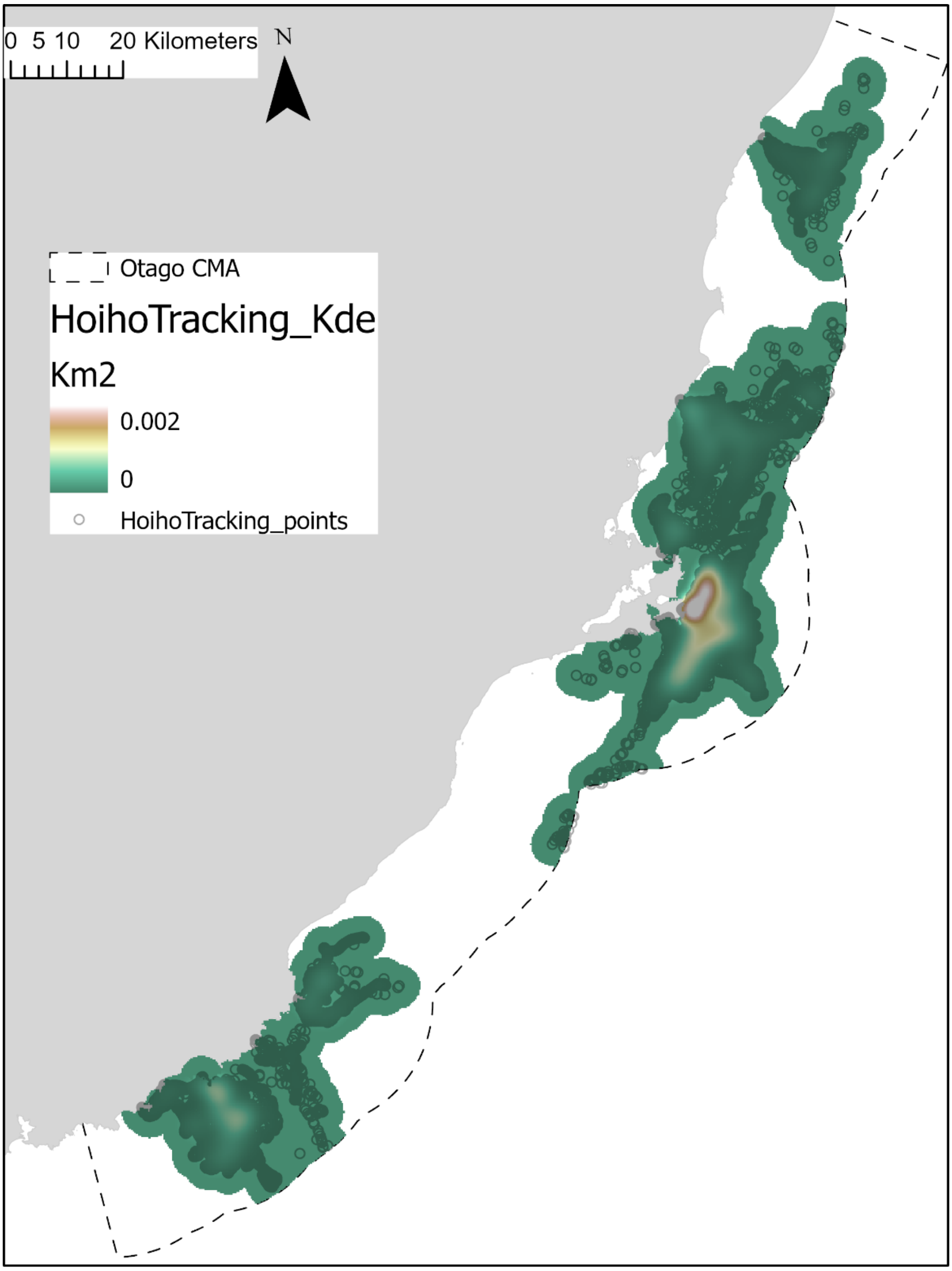


**Figure 3-41: Hoiho tracking data with kernel density.** Point layer of hoiho tracking data (hollow dots) overlaid upon kernel density raster (gradient with red indicating high density), an example dataset for the marine seabirds management class.

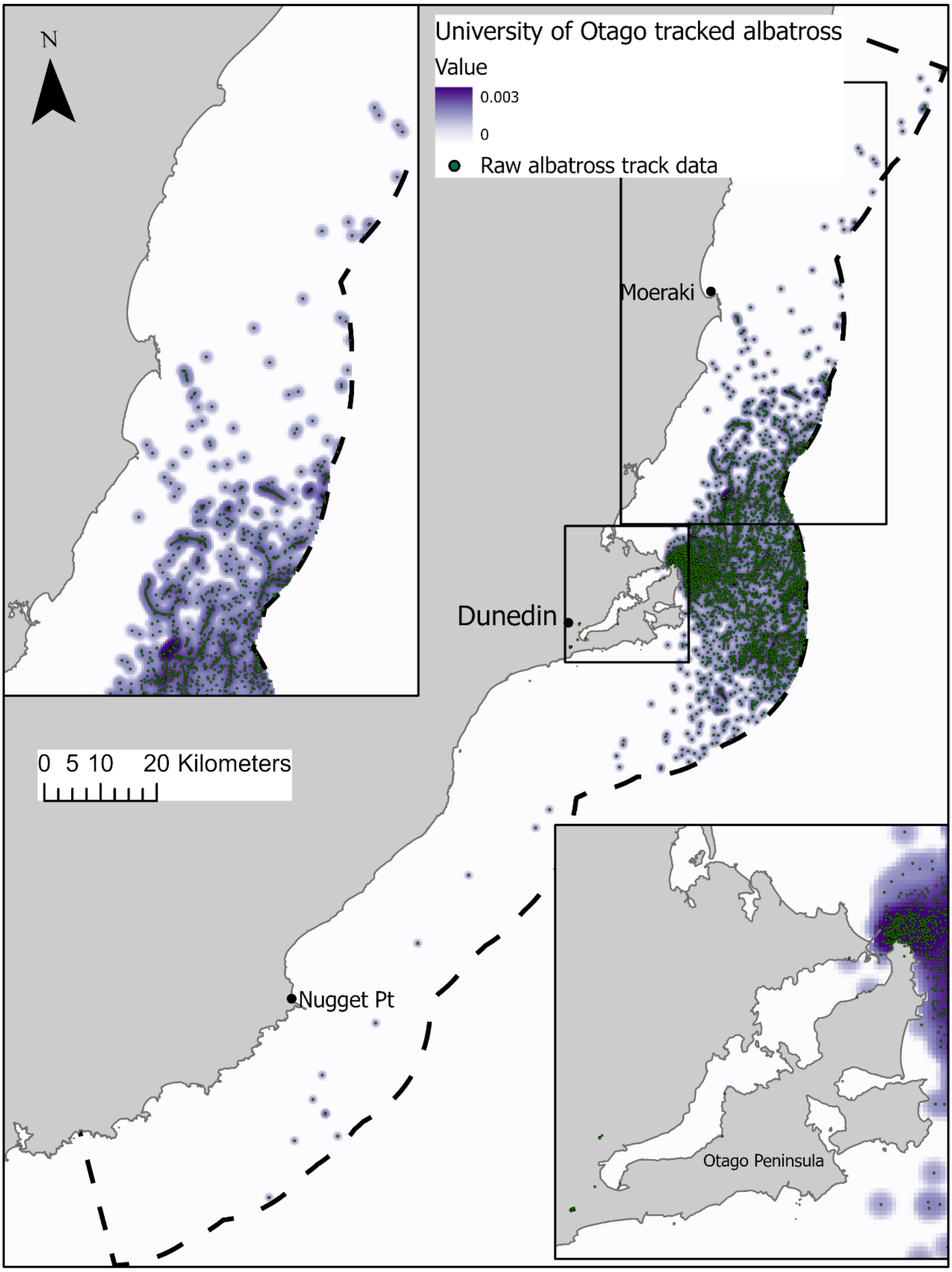


**Figure 3-42: Point records for tracked albatross and kernel density.** Tracked albatross data (green dots) overlaid upon the kernel density raster (gradient with blue indicating high density), an example dataset for the marine seabird management class.

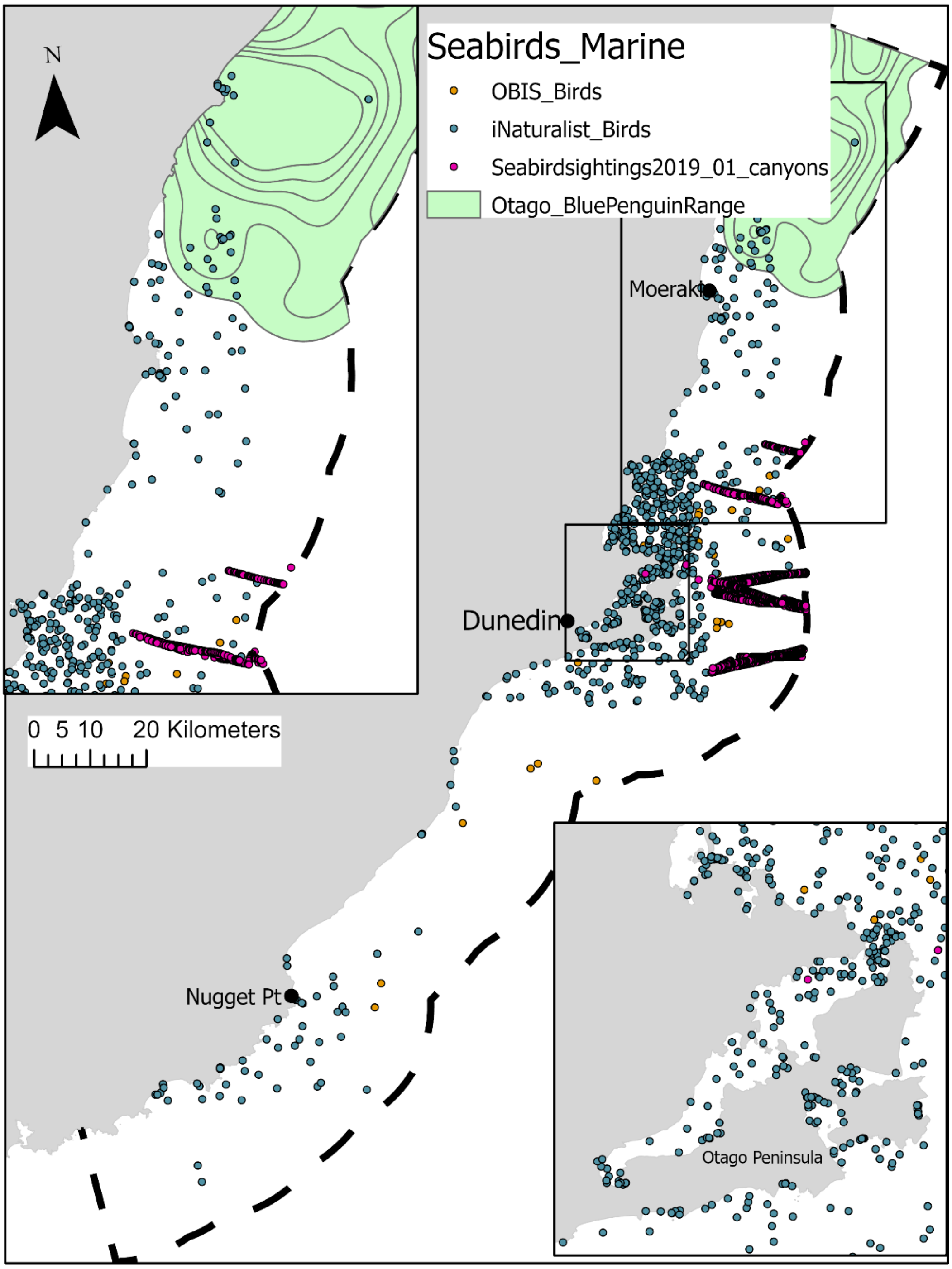


**Figure 3-43: Seabird sightings and foraging range of little blue penguins.** Points layers of seabird sightings from OBIS (orange), iNaturalist (blue) and Otago University canyon surveys (pink), and foraging range (green polygons) of little blue penguins, example datasets for the marine seabird management class.

*Significant areas*

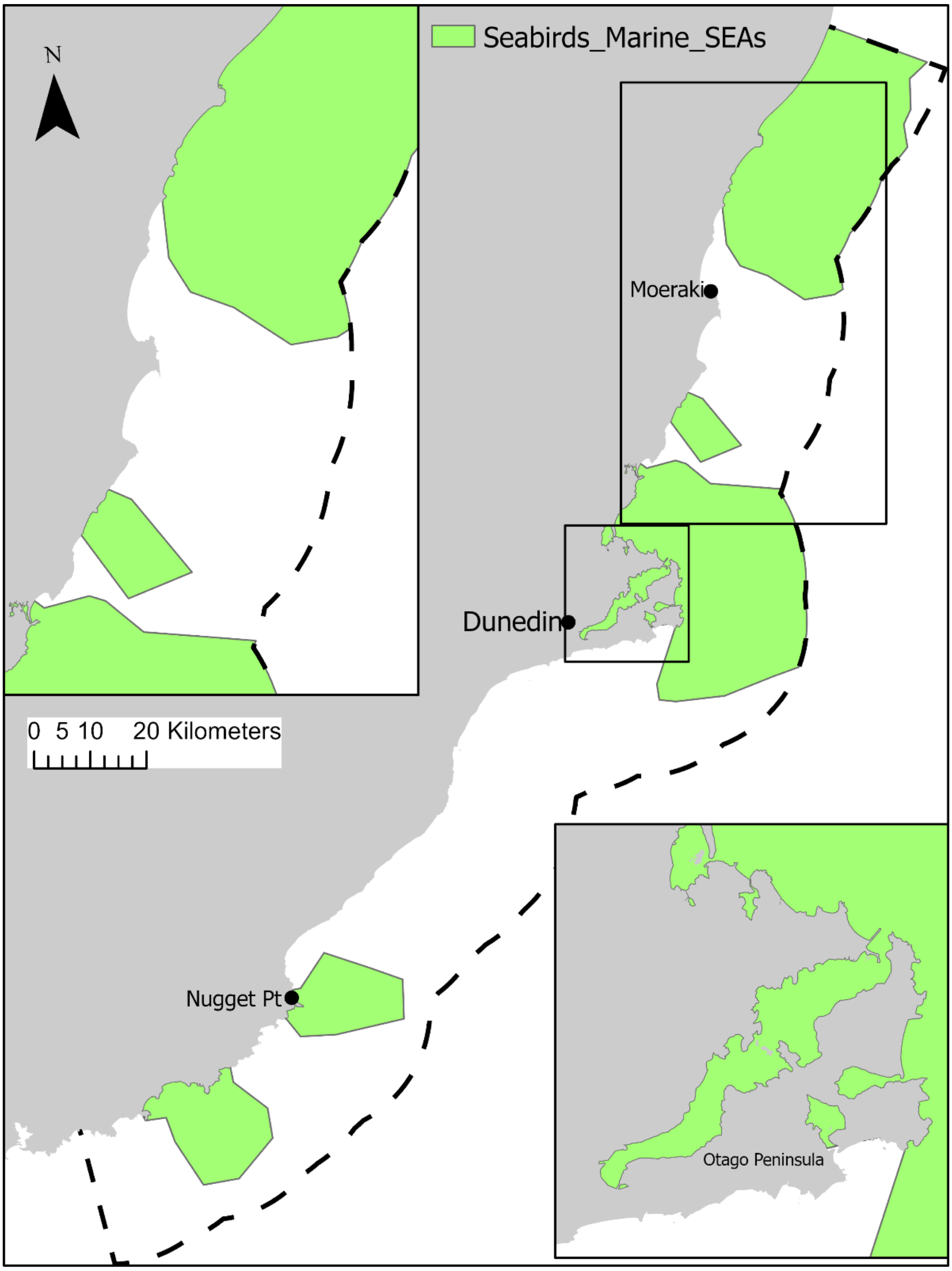


**Figure 3-44: SEAs for the marine seabirds management class.**

Analysis of spatial data on important ecological features for marine shore/seabirds led to the identification of five SEAs throughout the Otago region. SEAs were located offshore of Oamaru, off the Otago Peninsula and Blueskin Bay, at Nugget Point and further south into the Catlins – all extending into most of the width of the CMA. Another smaller SEA was identified at Bobby's Head.

SEAs for this class consisted of areas of particular importance and/or occurrence for Hoiho, albatross, little blue penguin and other seabirds.

## 3.15 Shore/seabirds – terrestrial

*Datasets*

There were four datasets with useful information for the identification of SEAs for the terrestrial seabirds management class. Locations of known Hoiho colonies and their size were provided by the Yellow-Eyed Penguin Trust. Further datasets on seabird colonies were sourced from ORC, a Forest and Bird important bird areas (IBA) dataset from the KEA database (Stephenson et al. 2018; Lundquist et al., 2020) and a dataset compiled by Otago University stored in DOC SeaSketch database (Hand 2013).

**Table 3-16: Datasets used for the terrestrial shore/seabirds management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Hoiho Colonies | Locations of known Hoiho colonies for the Otago coast with information on colonies size (n pairs) from the yellow eyed penguin trust | Point | YEPT | 5 | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) |
| ORC Bird Colonies | ORC held dataset on the location of key seabird colonies along the Otago coast | Point | KEA Database | 4 | 1,2,3,4 | 11 a (vi), b (ii), b (v) |
| NZ_IBA_Bird_Colonies | Point records from national scale layer on the distribution of seabird colonies. Sourced from forest and bird IBA dataset | Point | KEA Database | 3 | 1,2,3,4 | 11 a (vi), b (ii), b (v) |
| Otago_SeabirdColonies _21_11_14_FINAL | Point records from local dataset on the distribution of seabird colonies on the Otago coast - produced through surveys, literature review and expert knowledge (UoO - Katherine Hand) | Point | DOC SeaSketch database | 5 | 1,2,3,4 | 11 a (vi), b (ii), b (v) |

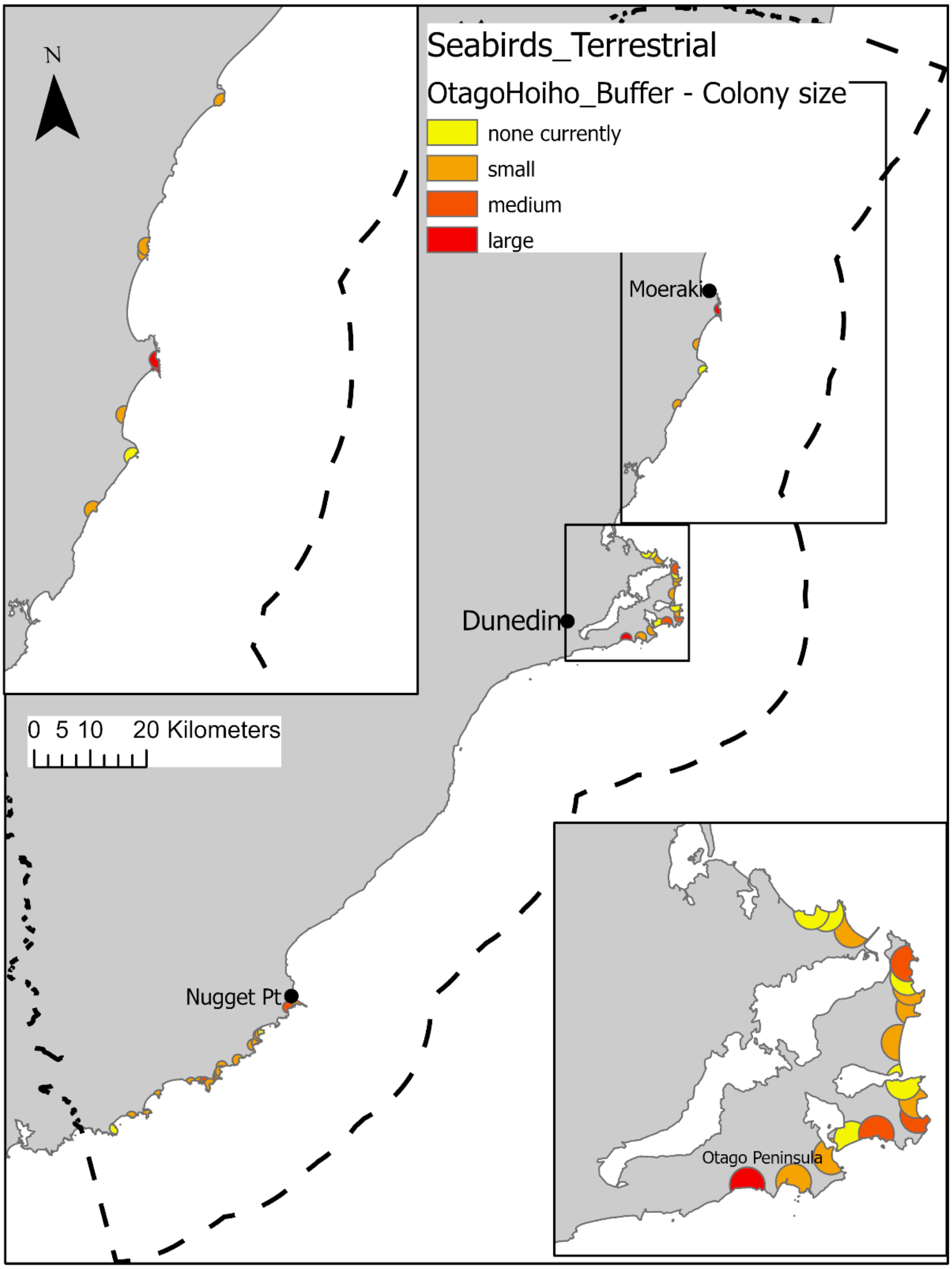


**Figure 3-45: Locations of hoiho colonies.** Approximate locations (1 km buffer) and relative size (indicated by colour) of hoiho colonies based on data provided by the Yellow-Eyed Penguin Trust, an example dataset for the terrestrial seabirds management class.

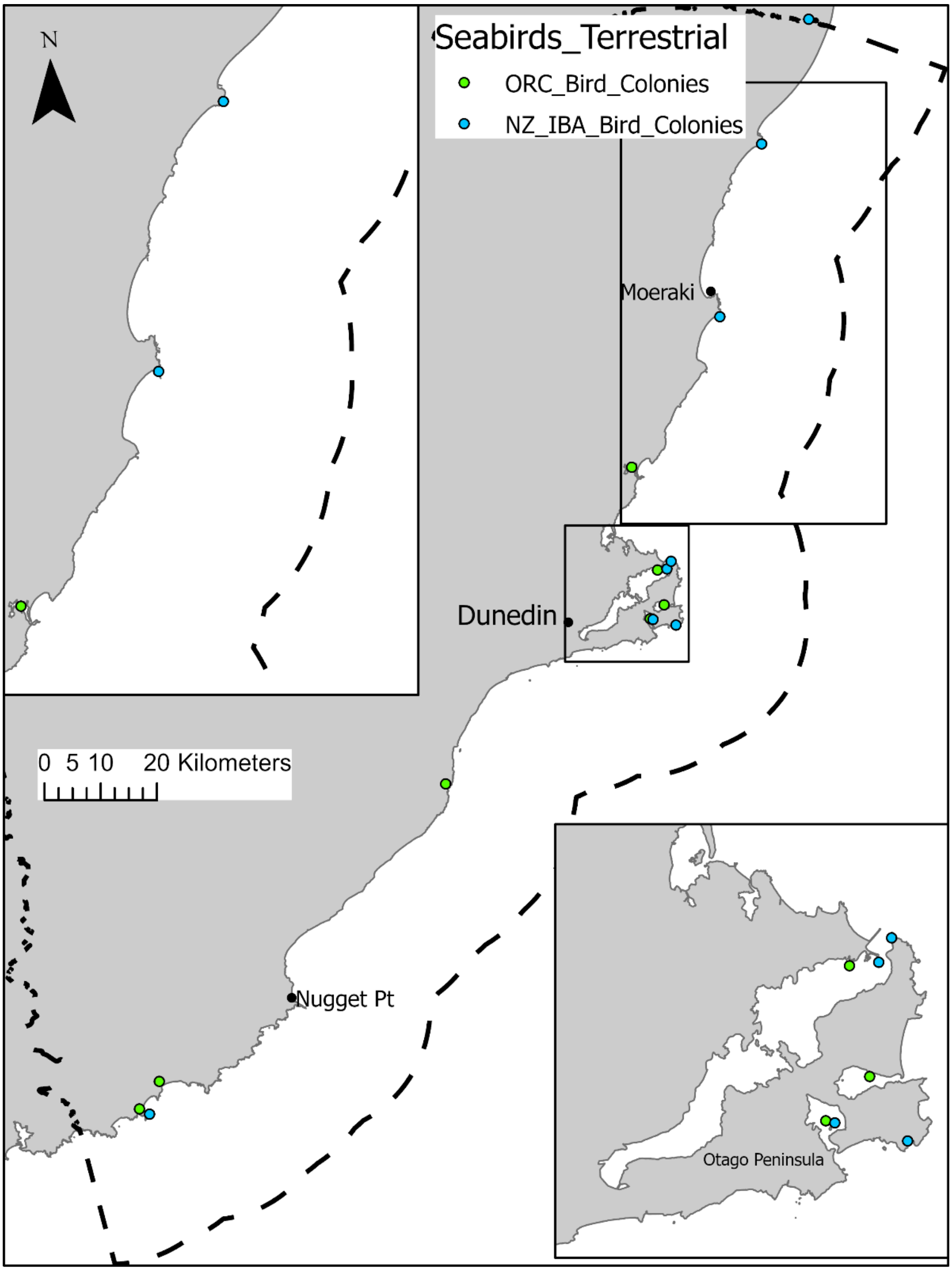


**Figure 3-46: Locations of terrestrial seabird colonies.** Point records of terrestrial seabird colonies from the Otago regional council (blue) and the forest and bird IBA dataset (green), example datasets for the terrestrial seabird management class.

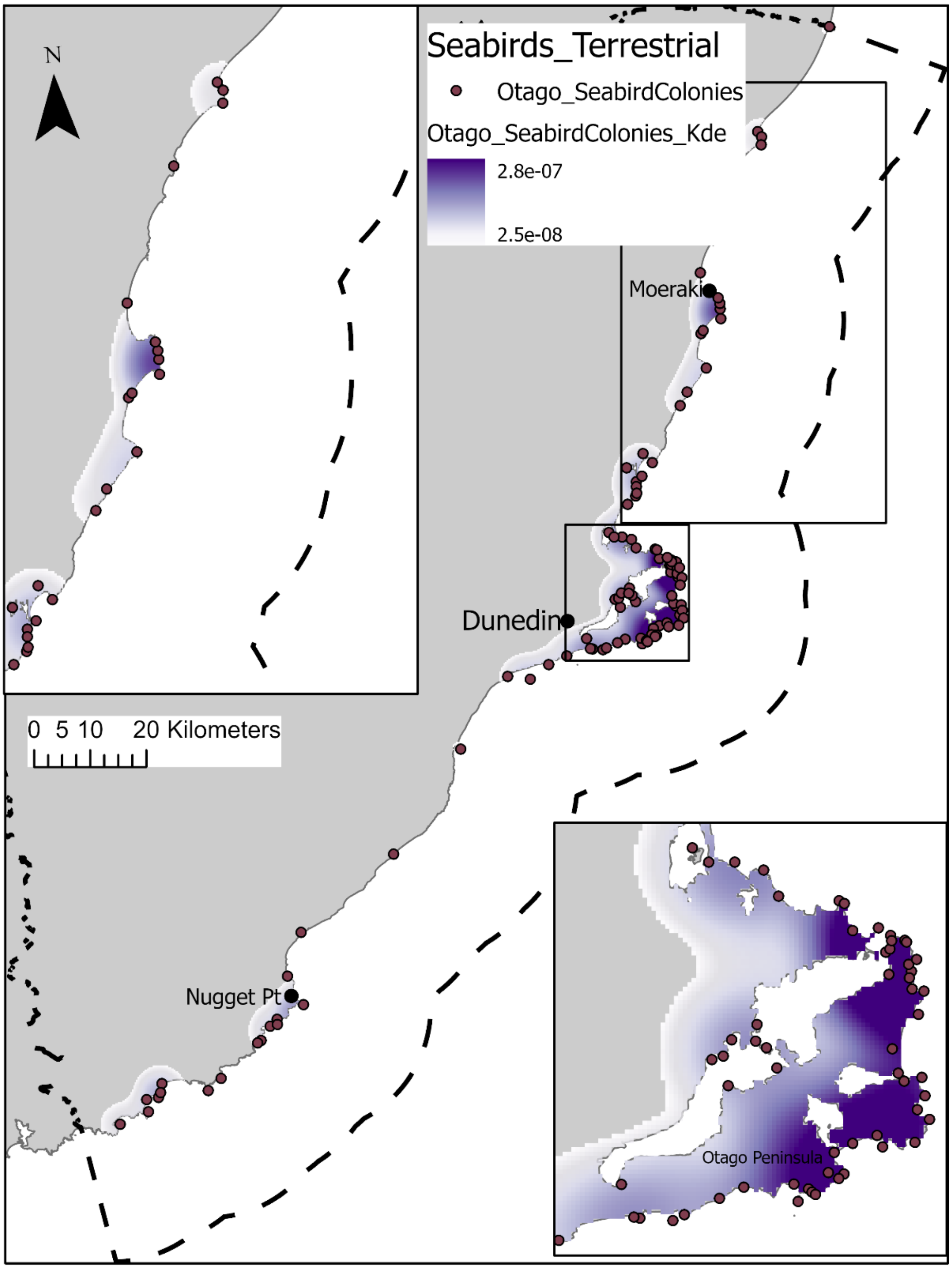


**Figure 3-47: Locations of seabird colonies and kernel density.** Point records of seabird colonies from the DOC SeaSketch database (Hand 2013) (brown dots) and generated kernel density (gradient with dark blue indicating high density), example datasets for the terrestrial seabird management class.

*Significant areas*

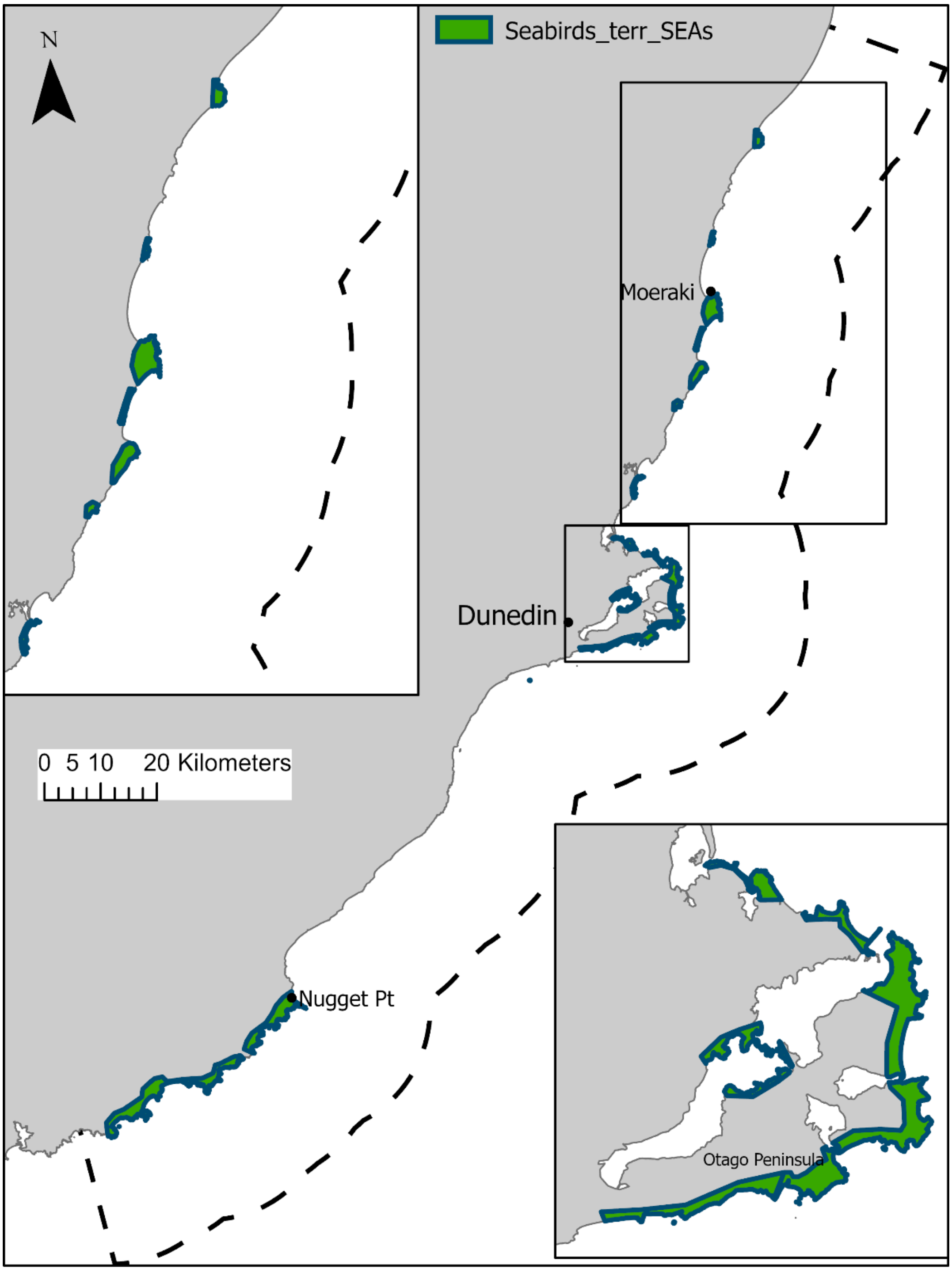


**Figure 3-48: SEAs for the terrestrial seabirds management class.**

Analysis of spatial data on important ecological features for shore/seabirds in terrestrial habitat led to the identification of fifteen SEAs throughout the Otago region. SEAs were located mostly on the Otago Peninsula and the Catlins coast, with some SEAs along the North Otago coast and on Green Island. SEAs for this class consisted of areas containing breeding colonies for hoiho and other seabirds.

## 3.16 Seafloor geomorphological features

*Datasets*

There were four datasets with useful information on seafloor geomorphological features for identifying SEAs. The national scale bathymetry layer was obtained from the KEA database (Lundquist et al. 2020). Datasets on rocky reef extent were sourced from the KEA database and ORC from DOC's MPA habitat classification. A further dataset from the DOC SeaSketch database provides bathymetry of the shipping lane along the Otago coast with a resolution of 25m.

**Table 3-17: Datasets used for the seafloor geomorphological features management class.**

| Dataset | Description | Format | Origin | Data quality score | KEA criteria | Section 11 criteria |
|---|---|---|---|---|---|---|
| Bathymetry | National scale layer on seabed bathymetry pooling data from a range of seabed surveys; 250m resolution | Raster | KEA Database | 3 | 2, 5, 6, 9 | 11 a (iv), a (v), b (v), b (vi) |
| DOC_Rocky_Reef | National rocky reef layer reporting the extent of rocky reef habitat | Polygon | KEA Database | 3 | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) |
| MPA_Habitat_Reefs | Rocky reef layer from DOCs MPA habitat classification - pools surveys observations, charting info, expert opinion | Polygon | ORC Marine Sh apefiles | 3 | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) |
| LINZ_MPPF_25mDEM | Bathymetry product from a LINZ contracted survey of the shipping lane along the Otago coast; 25m resolution | Raster | DOC SeaSketch database | 5 | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) |

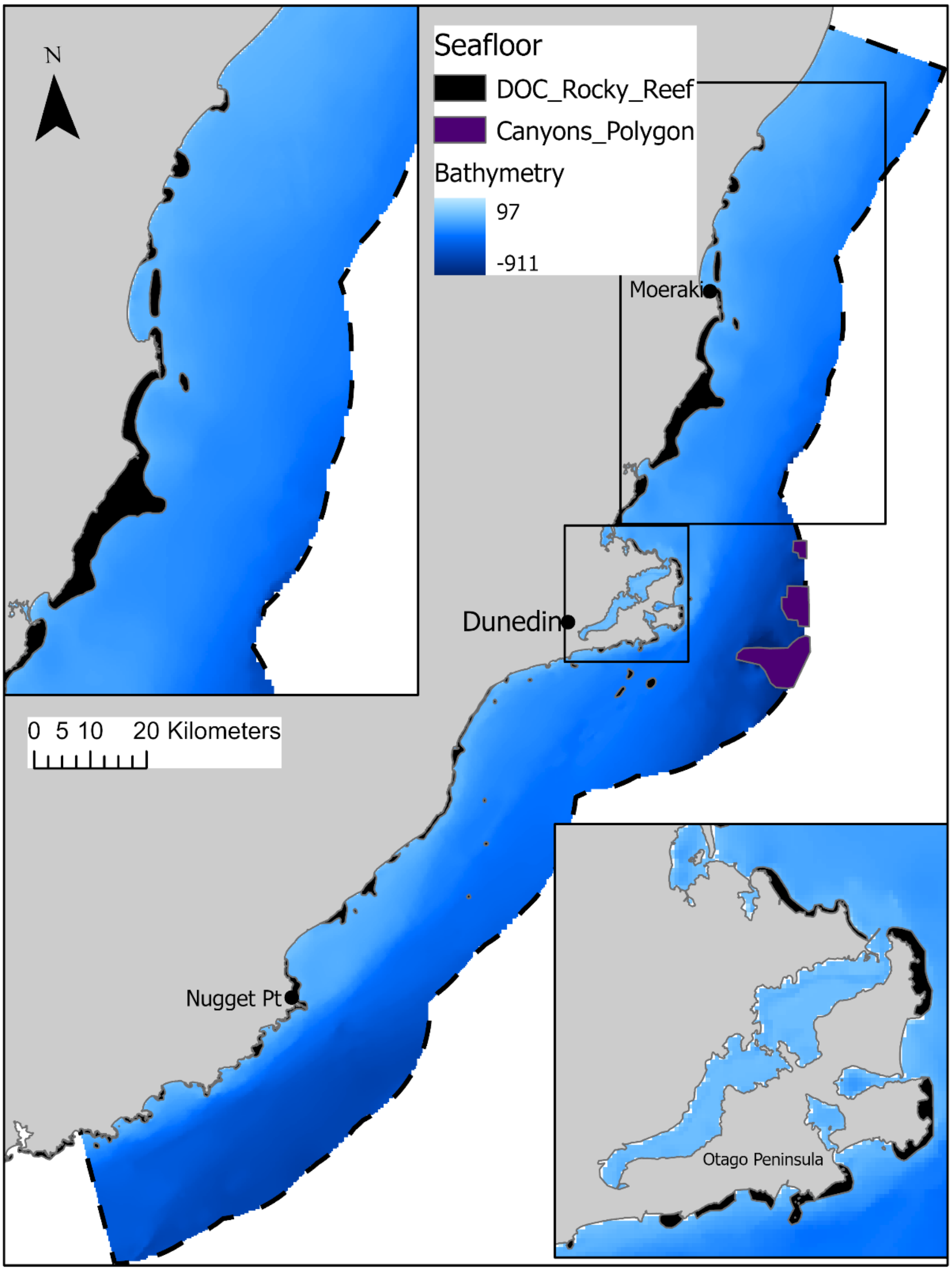


**Figure 3-49: Bathymetry and locations of rocky reef and the submarine canyons.** Bathymetry (gradient with dark blue indicating greater depth) and locations of rocky reef (black polygons) and the submarine canyons (purple polygons), example datasets for the seafloor geomorphological features management class.

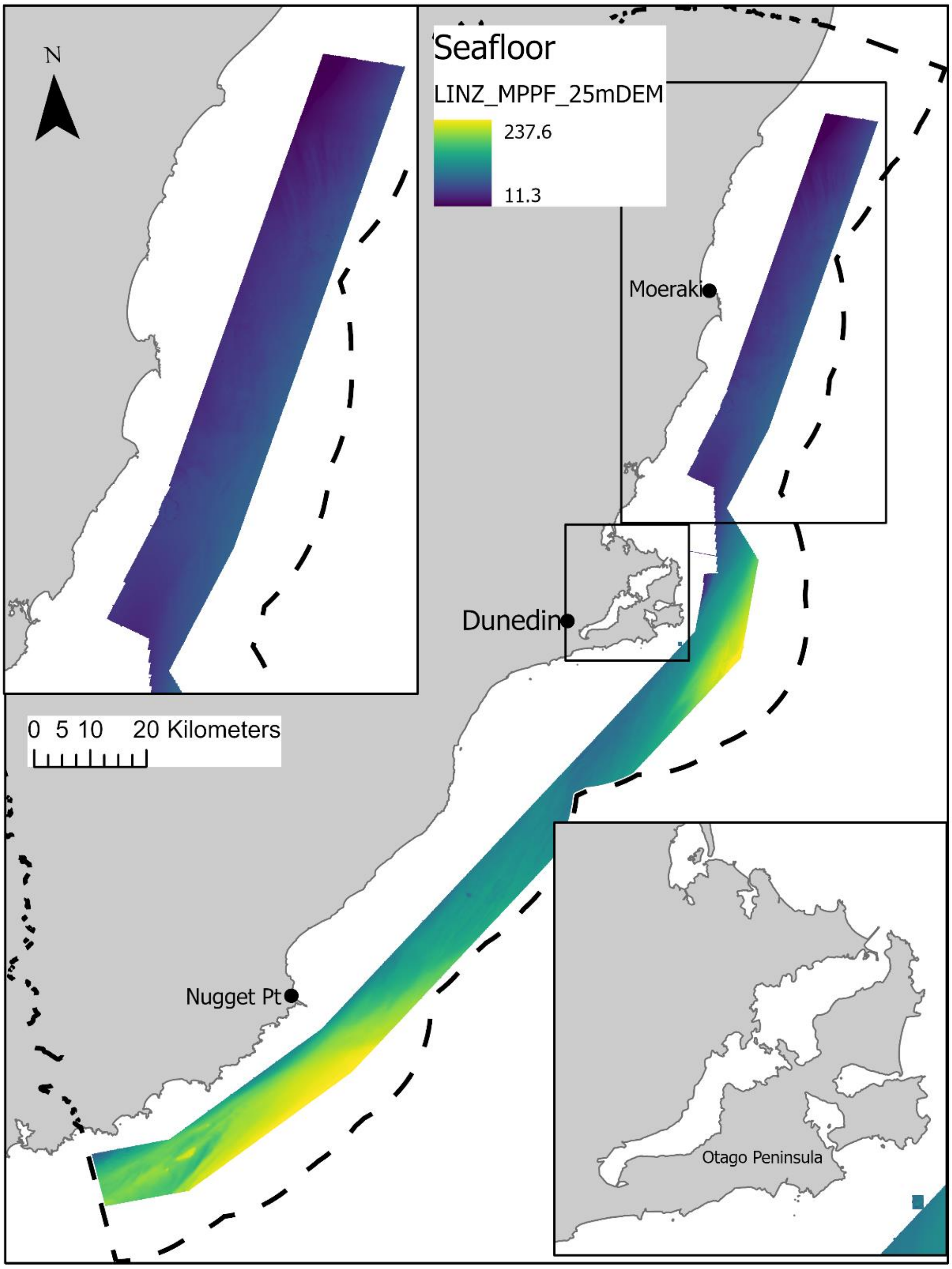


**Figure 3-50: Bathymetry within the shipping lane.** High resolution (25m) bathymetry within the shipping lane, with yellow indicating greater depth, an example dataset for the seafloor geomorphological features management class.

*Significant areas*

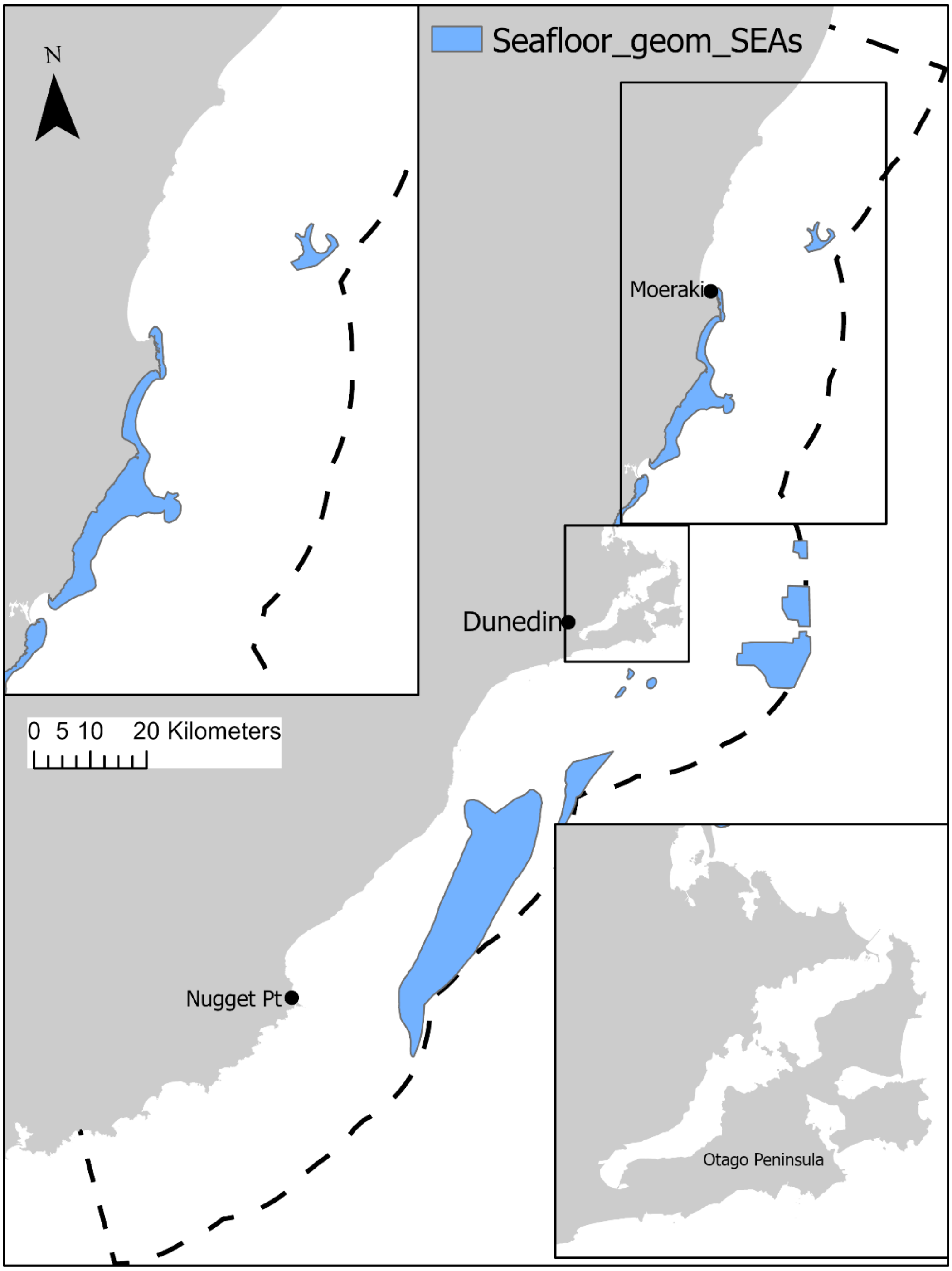


**Figure 3-51: SEAs for the seafloor geomorphological features management class.**

Spatial data on important ecological features for seafloor geomorphological features led to the identification of nine SEAs throughout the Otago region. SEAs were located offshore of Wainakarua, along the coast from Blueskin Bay to Moeraki, the head of the Saunders, Papanui and Taiaroa Canyons, offshore of Maori Head and a large offshore SEA between the Catlins and Dunedin. SEAs for this class consisted of areas containing reef systems and submarine canyons.

# 4 Threats

Based on an extensive literature review of the threats posed from anthropogenic stressors to the ecological features under each management class (McCartain et al. 2021), we have provided a matrix to guide ORC on the management of adverse impacts to the indigenous biodiversity of each class. The review, initially undertaken for a project on identifying SEAs for Environment Southland, drew on national and international studies published in the primary literature and scientific reports for government agencies. The matrix showcases the severity of adverse impacts upon each management class from a broad suite of stressors that are typically present in coastal ecosystems. The severity of stressors is indicated as high, medium, low or not applicable (when it is unlikely a stressor will have a direct impact on the features within each class). The only changes to the initial matrix provided by McCartain et al (2021) were the removal of the management class 'Fiord habitat' (not relevant in Otago).

**Table 4-1: Management class and threat matrix.** The severity of threats from anthropogenic stressors to the ecological features within each management classes. Severity is ranked as high (H), medium (M), low (L), very low (VL) and not applicable (-) based on a literature review for coastal management classes by MacCartain et al. 2021.

| Potential threat | Climate change | | Food harvesting (commercial and recreational) | | | | Pollution | | | | | | Coastal hardening and development | | Resource extraction | | Recreational access | | Other | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SEA management class** | **Sea level rise** | **Storm frequency and intensity** | **Seafloor disturbance (benthic trawling, dredging,** | **Over-fishing and exploitation** | **Bycatch (Corals, marine mammals, seabirds)** | **Pelagic fishing** | **Oil spills** | **Litter and Microplastics** | **Nutrients and Organics** | **Heavy metals and Pesticides** | **Terrigenous sediment** | **Noise** | **Habitat loss** | **Weed and pest control** | **Sand extraction, dredging and disposal** | **Freshwater abstraction and re-diversion** | **Foot and vehicle traffic** | **Boating impacts** | **Invasive species, Disease** | **Artificial structures (pipelines, Jettys etc)** | **Aquaculture** | **Grazing** |
| **Benthic invertebrates-intertidal** | L | L | VL | H | - | - | H | L | M | M | H | - | M | - | H | H | H | - | M | L | - | M |
| **Benthic invertebrates-subtidal** | - | VL | H | H | H | VL | H | L | M | L | L | - | H | - | H | - | - | - | M | - | M | - |
| **Biogenic habitats - invertebrates** | - | L | H | - | H | - | H | L | M | M | M | - | - | - | H | - | - | - | L | - | M | - |
| **Coastal vegetation** | M | M | - | - | - | - | M | L | M | M | M | - | H | H | - | L | H | - | M | H | - | H |
| **Estuaries/coastal lagoons/wetlands** | H | H | - | - | - | - | H | - | H | M | H | - | H | - | - | H | M | - | H | - | L | H |
| **Fish (Demersal/Reef)** | - | - | H | H | - | M | M | M | - | - | M | VL | - | - | H | - | - | H | - | - | M | - |
| **Kelp forests** | - | H | M | - | - | VL | H | L | M | M | H | - | L | VL | M | - | - | L | M | L | L | - |
| **Marine flora** | - | H | H | - | - | VL | H | L | H | M | H | - | L | L | H | - | M | L | L | L | M | L |

| Potential threat | Climate change | | Food harvesting (commercial and recreational) | | | | Pollution | | | | | | Coastal hardening and development | | Resource extraction | | Recreational access | | Other | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SEA management class** | **Sea level rise** | **Storm frequency and intensity** | **Seafloor disturbance (benthic trawling, dredging,** | **Over-fishing and exploitation** | **Bycatch (Corals, marine mammals, seabirds)** | **Pelagic fishing** | **Oil spills** | **Litter and Microplastics** | **Nutrients and Organics** | **Heavy metals and Pesticides** | **Terrigenous sediment** | **Noise** | **Habitat loss** | **Weed and pest control** | **Sand extraction, dredging and disposal** | **Freshwater abstraction and re-diversion** | **Foot and vehicle traffic** | **Boating impacts** | **Invasive species, Disease** | **Artificial structures (pipelines, Jettys etc)** | **Aquaculture** | **Grazing** |
| **Marine Mammals ocean** | - | - | - | M | H | M | M | M | - | - | - | M | - | - | - | - | L | H | - | M | M | - |
| **Marine Mammals terrestrial** | - | - | - | - | - | - | M | M | - | - | - | M | H | M | - | - | H | L | - | M | M | - |
| **Naturally uncommon ecosystems** | M | H | - | - | - | - | M | L | - | - | L | - | M | - | - | - | M | - | - | L | - | H |
| **Pelagic productivity** | - | M | - | - | - | - | H | L | H | - | H | - | - | L | - | - | - | - | - | - | M | - |
| **Seabirds/shorebirds ocean** | - | L | L | M | M | M | M | H | - | L | L | M | - | - | - | - | - | M | - | - | M | L |
| **Seabirds/shorebirds terrestrial** | M | L | - | - | - | - | M | M | - | L | - | M | H | M | - | - | H | L | - | M | - | M |
| **Seafloor geomorphological features** | - | - | H | - | - | VL | H | - | - | - | L | - | - | - | H | - | - | - | M | - | M | - |

# 5 Habitat classification

A deliverable for this project was the classification of the CMA using a published habitat classification. Such a classification provides ORC with information on the broader distribution of biodiversity within the CMA and provides the opportunity to investigate the representativity of SEAs (Brough et al. 2021a). There is currently no published or uniformly used thematic habitat classification for NZ, although the development of such is being prioritised (DOC, pers. comm). Thus, for this project we have used the NZ seafloor community classification (SCC) (Stephenson et al. 2022), a numerical habitat classification that describes the distribution of distinct seafloor-associated communities throughout NZ. The SCC is based on modelled rates of species turnover across environmental gradients defined by high-resolution environmental datasets and provides the best available information on the broad distribution of seafloor community assemblages (Stephenson et al. 2022). The current version of the SCC is available as 75-group classification and has been clipped to the Otago CMA for this project (Figure 5-1) and will be made available to ORC. Further, we have provided a summary of the proportion of the CMA occupied by each group as an indication of the dominant/more rare groups within the CMA (Table 5-1).

It should be noted that the use of the SCC at regional scales has not yet been fully explored, and future work to optimise the number of groups for regional scale spatial planning within the territorial sea is required.

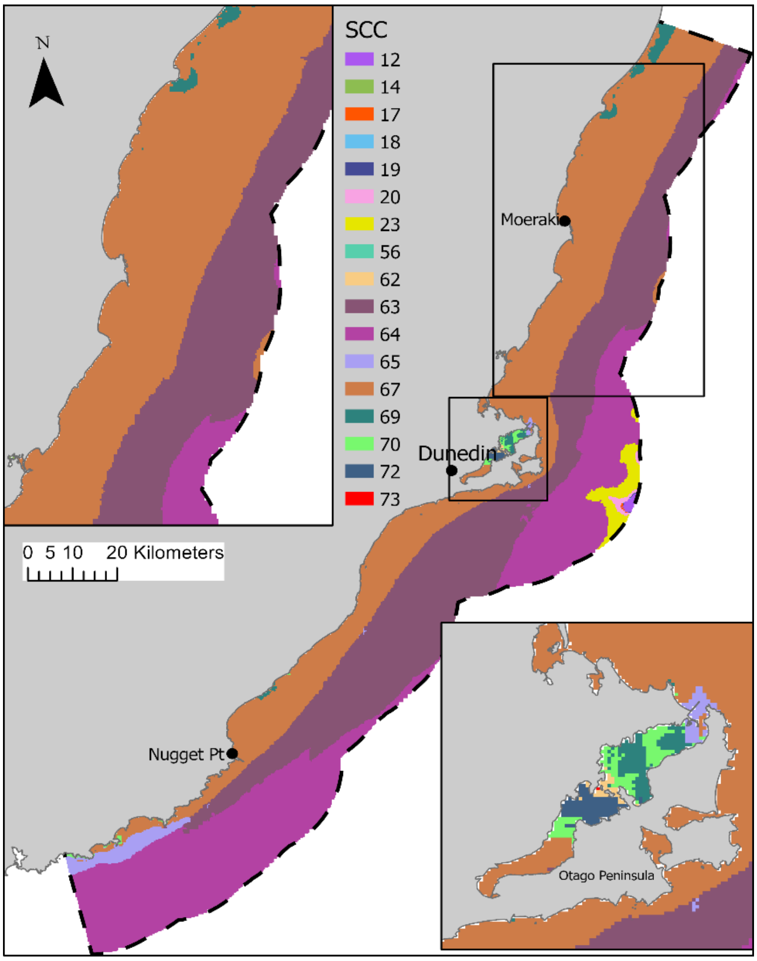


**Figure 5-1: Distribution of SCC groups.** The distribution of SCC groups within the Otago CMA.

**Table 5-1: SCC groups in Otago.** The % coverage of all SCC groups found within the Otago CMA.

| SCC group | % of CMA |
|---|---|
| 12 | 0.12 |
| 14 | <0.00 |
| 17 | 0.01 |
| 18 | <0.00 |
| 19 | 0.01 |
| 20 | 0.22 |
| 23 | 1.40 |
| 56 | <0.00 |
| 62 | 0.03 |
| 63 | 32.77 |
| 64 | 29.80 |
| 65 | 1.44 |
| 67 | 32.97 |

| SCC group | % of CMA |
|---|---|
| 69 | 0.86 |
| 70 | 0.24 |
| 72 | 0.12 |
| 73 | <0.00 |

# 6 Discussion

This project has pooled a substantial amount of information on the distribution of marine biodiversity within the Otago region. The volume of information reflects the region's richness in biodiversity and is a valuable resource for marine spatial planning. The current identification of SEAs provides the most up to date account of important areas for the various classes of biodiversity – using the best available information. However, it should be noted that substantial gaps exist in our understanding of the distribution of marine biodiversity in Otago, which means certain areas and/or management classes are not well represented. Understanding these gaps is challenged by a lack of information on where surveys/observations have occurred but did not record effort or the distribution of sampling (i.e., absence data). In this way, the majority of information collated in this report can be considered as presence data only - i.e., it contains no information on locations where surveys have occurred, but found no observations of ecological features that may inform SEAs. Thus, areas with a consistent absence of SEAs may reflect a paucity of information rather than a true absence of important ecological features. In the following section, we identify areas and ecological components within each management classes with a consistent lack of spatial data that may guide future survey effort.

## 6.1 Knowledge gaps

Data gaps on the distribution of intertidal benthic invertebrates were significant in all areas beyond the immediate surrounds of Dunedin and the Otago Peninsula. In general, there was better information for estuarine intertidal communities than for rocky reef, however such estuarine data was limited to the distribution of cockles (*Austrovenus stutchburyii*). Additional data collection should focus on characterising intertidal bivalve beds (oyster, mussel and pipi and *Macomona*), and other functionally important habitat that occur throughout the region. Further, mapping the remaining four estuaries that have not received formal habitat mapping should be a priority. Spatially, there is limited data on intertidal benthic invertebrates within the Catlins area (except Catlins estuary), both in terms of soft sediment and rocky reef communities. Further, with the exception of Kakanui, there are no data on benthic invertebrates for the North Otago region – with critical gaps at areas with significant rocky reef habitat (Shag Point and Moeraki).

Data on subtidal benthic invertebrates were available from national scale spatial models for the entire Otago CMA. However, the utility of these model predictions for regional spatial planning is uncertain. Datasets on the occurrence of important features for subtidal invertebrates are limited to the comparatively well sampled areas around Otago Peninsula. There is a paucity of data south of the Peninsula, and limited data for inshore areas north of Blueskin Bay. This data scarcity is particularly relevant for invertebrates of rare, threatened, or unique status and those with important functional traits. Other than commercial catch data, there are no datasets that report the distribution of recreationally, culturally, and commercially important subtidal invertebrates (e.g., paua, rock lobster). The offshore (> ca. 3 miles) CMA between Dunedin and Nugget Point has a particular scarcity of data for subtidal invertebrates.

A large number of datasets were pooled under the biogenic - invertebrates management class, yet several spatial gaps and absences for particular habitats were evident. Several datasets informed the well-known biogenic habitats (i.e., bryozoan thickets) offshore of Otago Peninsula. A range of datasets suggested biogenic habitat offshore of Moeraki. The southern CMA, south of Taieri Mouth, was poorly represented by the available data with the exception of likely bivalve biogenic habitat (i.e., queen scallops) offshore of the Catlins. Further, the distribution of key biogenic habitats including sponge gardens, sea tulips, rhodoliths, horse mussel and oyster beds remains poorly characterised for the majority of the region.

The distribution of saltmarsh and pingao were the major contributors to the coastal vegetation management class. While saltmarsh was relatively well-mapped in the monitored estuaries, there remains at least three estuaries where the distribution of saltmarsh remains unknown. Further, saltmarsh habitat associated with coastal lagoons and wetlands (see Estuaries/lagoons/wetlands management class) has not been characterised. The available data on pingao is likely an inaccurate representation of the current distribution of this important and threatened habitat, with observations most prevalent on Otago Peninsula. Pingao is known to occur on beaches from Warrington to North Otago and in the Catlins – further surveys should target these areas to log the occurrence and extent of pingao.

In general, the demersal fish management class was comparatively well represented. This class was populated with a large number of national scale spatial models, though local occurrence data was used to generate these models and they were supported by occurrence data on rare, threatened, unique fish, fish spawning areas and a large volume of data on commercial fisheries catch. Regional-scale species distribution models could be fit for the key species of the Otago demersal fish community, using locally sourced occurrence/abundance data which would greatly improve the confidence in our understanding of areas of importance for this management class.

A relatively limited number of datasets was used to inform the reef fish management class – with a strong reliance on the national scale species distribution models for these taxa. The data underpinning these models are sparce in Otago and thus substantial ground-truthing is required of SEAs in this class (see below). Our confidence in the understanding of SEAs for reef fish would be greatly improved by region-wide surveys of key, representative reef habitats. Significant reef systems offshore of Shag Point and Moeraki (e.g., Danger/Fish reef) remain un-surveyed and the significant coastal reef habitat between Matanaka and Shag Point is poorly represented. Further, surveys of deep, offshore reef systems south of Otago Peninsula, Taieri mouth/Akatore and the reef systems along the Catlins Coast would substantially increase of knowledge on the distribution of reef fish in Otago.

The distribution of kelp forest was well represented within important areas north of Otago Peninsula, however more accurate mapping (e.g., extent definition) is required in key locations; between Warrington and Karitane, Moeraki and Kakanui. South of the peninsula, there is no accurate data on the distribution of kelp forest. Historically, significant kelp forest was located between Taieri Island and Bruce Rocks, Akatore and between Tokomariro and the Clutha river mouth (Glover 2021). Surveys of these areas to determine the current extent and potential recovery of kelp forest should be undertaken. The extent of kelp forest around Nugget Point (Glover 2021) is also not represented by the available datasets and should be a target of future surveys along with exploration of kelp forest occurrence in suitable habitat along the Catlins coast.

The seagrass component of the marine flora management class was well characterised, particularly in the mapped estuaries and within Otago Harbour. Data on the distribution of seagrass should be acquired within the remaining four unmapped estuaries and within coastal lagoons where it is known to occur. In contrast, macroalgae (outside of the mapped estuaries) was not represented by regional data, with evidence for this component being sourced from national scale models. Otago has a rich macroalgal diversity (Neill and Nelson 2016), and surveys of both rocky reef and soft-sediment communities should be undertaken in representative habitats throughout the region.

The marine mammal – ocean management class was informed by local occurrence data within Blueskin Bay, around the peninsula and at the Otago Canyons. There have also been systematic surveys of cetaceans in coastal areas south of the peninsula to Taieri Mouth and north to Moeraki (Turek et al. 2013). Thus, the absence of data in these areas are true absences. There is a significant lack of survey effort for cetaceans, NZ sea lions and fur seals for all offshore areas (> ca 3 miles from shore) in the CMA with the exception of the Otago Canyons area (indicated by an SEA offshore of the peninsula; Figure 3-34). Foraging areas for NZ sea lions is a key contributor to this class and remains poorly represented for animals along the Catlins coast. No data on foraging distribution for fur seals was available with the exception of occurrence data from the heads of the Otago Canyons.

Terrestrial habitat for marine mammals (i.e., pinniped colonies/haulouts) was a well-represented management class, with data spanning the full extent of the region. Gaps concern the importance of each site to populations of marine mammals and may be ascertained by surveys of the number of animals using each site and determining their importance for breeding/nursing.

A single dataset on naturally uncommon ecosystems was used to inform the distribution of SEAs in this class which includes diverse ecological features originally designated ‘uncommon’ under by Landcare Research/Manaaki Whenua. Individual features (e.g., coastal turfs, rock stacks) have variable extent definition and some of the information originally used to map the features is outdated and may contain inaccuracies. Thus, features (and subsequent SEAs) in this class should be reviewed and have ground-truthing and/or extent definition applied when necessary. Targeting uncertain features may also allow ORC to prioritise certain areas with particularly outstanding features (e.g., in terms of size/quality) for management of adverse impacts.

The pelagic productivity management class was defined by a single dataset used to represent the location of the southland front. While informative, other areas of pelagic productivity are not captured by this dataset. More thorough analysis of data on primary production from phytoplankton (e.g., Chlorophyll *a* concentration), may identify other areas of importance for pelagic productivity including features such as the Blueskin Bay eddy (Murdoch et al. 1990).

The available data for the seabirds/shorebirds – marine management class spanned the entire CMA, however gaps for key species and areas are present. Additional tracking data for hoiho is required from each of the known colonies to accurately represent the extent of foraging habitat for this endangered species; data from the colony at Katiki Point is a critical gap. At sea distribution for seabirds is well represented off the Otago Peninsula and in Blueskin Bay, but is sparce in all other areas. The southland current (see pelagic productivity) is likely a nationally significant feeding area for seabirds (UoO unpublished data) and should be the focus of surveys to accurately characterize its importance. Foraging areas for shorebirds are poorly represented in all areas except those in close proximity to Dunedin city. Additional surveys for foraging shorebirds should prioritise coastal lagoons and estuaries south of Taieri Mouth and north of Karitane.

For terrestrial habitat of seabirds/shorebirds, four datasets contained information on important areas. Of these, two had high quality scores and contain the most up to date information on seabird colonies currently available. However, some SEAs are based on older information and it is important that these areas receive ground-truthing. Further, there is no information on the accurate extent of any seabird colony; this knowledge would enable more accurate management of threats to this important class. Further investigations involving historical information and/or spatial modelling approaches could also predict suitable habitats for the restoration and recovery of seabird colonies along coastal Otago.

The four datasets used to inform seafloor geomorphic features identified some clear gaps in our understanding for this class. The key information required to identify notable seafloor features are high resolution (e.g., <20m) bathymetric and backscatter data sourced from seafloor mapping surveys. Such data are unavailable for large portions of the CMA and areas with likely significant rocky reef habitat (e.g., offshore of Shag Point, Moeraki, Bobby's Head, Akatore, Taieri Island) should be prioritised. Inshore reef habitat around Otago Peninsula and the Catlins, and deeper reef to the south of the peninsula are also poorly characterised. An area of uneven seafloor topography offshore of Tautuku peninsula should also be prioritised to determine the occurrence of unique shoaling/light foul habitat (Figure 3-51)

The estuaries/wetland/lagoons management class was represented by datasets that define the extent of these important coastal features. The extent of the mapped estuaries is well known; the remaining four should have their extent mapped as a priority. Further, additional review of satellite data may reveal coastal lagoons and wetlands not included in the national or ORC layers used in this study. There are currently no data with which to distinguish between features in this class in terms of 'quality' or 'naturalness'. Should ORC wish to prioritise between the various estuaries/wetlands/lagoons, additional datasets on ecosystem health indicators will need to be acquired.

## 6.2 Ground-truthing and extent definition

While this study used the best available information to identify SEAs across the sixteen management classes, some SEAs were inevitably based on information that requires ground-truthing. Such cases occur when the best available information is either 1) older than recommended, or 2) based on modelled or highly interpolated evidence. In addition, some SEAs are based on information that may be lacking or have inaccurate spatial information that can be used to define the extent of the underlying ecological features. For example, these may include SEAs that draw heavily on point records that contain no information on the boundaries of a particular feature (e.g., records for bird colonies, rare species). Extent definition may also be required for contiguous physical features (e.g., reef systems, estuaries) that have good evidence on their occurrence but have not been accurately mapped. In these cases, we recommend targeted surveys to determine the true extent of these areas which will provide management with the best information with which to manage adverse impacts.

We have reviewed the contributing evidence for each SEA to determine those that require ground-truthing and extent definition and have provided this information in Table 6-1. Further, the attributes table of each SEA GIS layer has fields indicating whether a SEA requires ground-truthing (validation) or extent definition.

**Table 6-1: SEAs requiring validation.** The number of SEAs for each management class that require ground-truthing or extent definition to ensure their validity.

| Management class | n SEAs | Ground-truthing | Extent definition |
|---|---|---|---|
| Benthic Invertebrates Intertidal | 16 | 11 | 14 |
| Benthic Invertebrates Subtidal | 8 | 5 | 8 |
| Biogenic Habitats - Invertebrate | 8 | 5 | 8 |
| Coastal vegetation | 22 | 12 | 16 |
| Demersal Fish | 6 | 2 | 6 |
| Reef Fish | 22 | 22 | 22 |
| Kelp Forest | 6 | 4 | 6 |
| Marine Flora | 22 | 12 | 17 |
| Marine Mammal Ocean | 5 | 2 | 3 |
| Marine Mammal Terrestrial | 6 | 0 | 2* |
| Naturally Uncommon Ecosystems | 273 | 273 | 273** |
| Pelagic | 1 | 0 | 0 |
| Seabirds Marine | 5 | 0 | 0 |
| Seabirds Terrestrial | 15 | 0 | 14 |
| Seafloor geomorphic | 9 | 6 | 9 |
| Wetlands/Estuaries/Lagoons | 41 | 0 | 5 |

*Combines numerous locations for two species of pinniped. **Combines numerous locations for six distinct uncommon ecosystems.

## 6.3 Monitoring

The candidate SEAs identified in this project will require ongoing monitoring to determine they continue to meet the relevant ecological significance criteria and to ensure any mitigation of adverse impacts is effective. The additional data acquired during monitoring programmes may also help to refine the identification of SEAs that is likely to be reviewed under future iterations of the Otago coastal plan. Monitoring the highly diverse suite of SEAs that span the full extent of the Otago CMA will be a challenging undertaking and will require input and partnerships from various research providers, manawhenua and government agencies. It is recommended that, where possible, monitoring techniques that utilise state-of-the-art and emerging technology be used to monitor SEAs in an efficient and cost-effective manner.

*Satellite remote sensing*

Satellite remote sensing methods have been adapted for surveys of a range of biological, geophysical and oceanographic applications. Within the Otago SEA context, remote sensing methods may yield particularly productive results for monitoring coastal water quality and habitat condition, kelp forest and macroalgal communities, coastal vegetation, marine mammals, and seabird colonies. The opportunities afforded by satellite derived sensing for consistent, long-term monitoring at high temporal frequencies makes the technique ideally suited to cost-effective monitoring.

*Remote operated vehicles*

Remotely operated vehicles (ROVs) include diverse platforms designed to survey a broad range of marine ecosystem components. Platforms include; gliders that yield information on physical oceanography, acoustics and water column biodiversity, drones that provide high-resolution aerial imagery on a range of coastal invertebrate and algal species, marine mammal and seabird colonies, autonomous surface vehicles that can sample a broad range of biological and physical components such as fish and algal distribution, and seafloor habitat. Traditional, piloted ROVs are regularly used to capture information on the distribution of benthic habitats and associated species (fish, macroalgae, invertebrates). All classes of ROV greatly improve the cost-effectiveness of sampling due to minimisation of the number of field personnel required and increased operational capacity.

*Artificial intelligence*

Technological advancements in artificial intelligence are often applied to field datasets to greatly improve the efficiency and cost-effectiveness of processing/analysing large datasets. For monitoring in the Otago region, such technology may include image/footage classification of raw datasets on fish, macroalgae and invertebrates and seafloor features that may greatly improve the cost effectiveness of monitoring.

*Advanced spatial modelling*

Sampling across the range of management classes in a holistic monitoring and ground-truthing programme will provide high quality data with which to construct accurate, regional-scale spatial models. Such models will provide opportunities accurately represent the distribution of biodiversity in the Otago region, the impact of stressors and explore the effectiveness of management scenarios that limit those stressors.

## 6.4 Conclusions

This project has brought together a substantial amount of information on marine biodiversity within the Otago region and has made important contributions to the identification of SEAs in this area with very high biodiversity values. With ongoing validation and monitoring, the work presented here will provide significant opportunities for both ORC and other stakeholders to implement meaningful management of adverse impacts to biodiversity in this unique region.

# 7 Acknowledgements

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# Appendix A Agenda for workshop 1

Workshop title: Identification of significant marine ecological areas on the Otago Coast.

| | |
|---|---|
| When | **Tuesday 7 December 2021. 1230pm – 4:00pm** |
| Where | Otago Regional Council Chambers. Level 2, Philip Laing House, 2/144 Rattray Street, Dunedin.<br><br>Zoom link provided for video-conferencing below |
| Attendees | Korako Edwards, Greig Funnell, Kat Manno, Marine Richarson, Bruce McKinlay, Mark Geytenbeek, Gaya Gnanalingam, Tom McCowan, Brendan Flack, Carolyn Lundquist, Kate Hesson, Rebecca McGrouther, Sarah Cumming, Mike Bentjes, Trudi Webster, Sam Thomas, Tom Brough, others tbc |
| Apologies | tbc |

Significant Marine Ecological Areas (SEAs) are required to be identified and implemented under the national coastal policy statement and form an important component of regional coastal plans. The aim of this workshop is to begin a dialogue on the identification of significant marine ecological areas (SEAs) on the Otago Coast, that may be implemented during the review of Otago's coastal plan in 2024. The workshop will engage stakeholders with significant interest and experience on the biodiversity of Otago's coastal environment to discuss the process of SEA identification. We will also explore opportunities for the pooling of spatial datasets that can be used to identify SEAs using systematic spatial planning methodologies. Policy-based discussion on the management options for SEAs will not be part of this workshop, and will be incorporated into the review process of Otago's coastal plan in 2024.

Agenda

1. 12:35pm – Welcome and Introductions
2. 12:45pm – Introduction to project and ORC requirements – Sam Thomas (ORC)
3. 1:00pm – Project methodology and spatial mapping – Tom Brough (NIWA)
4. 1:30pm – Introduction to spatial management tools – Carolyn Lundquist (NIWA
5. 2:00pm – Break
6. 2:15pm – Identification and discussion of spatial datasets to aid identification of significant ecological areas (All)
7. 3:50pm - Wrap up and next steps – Sam Thomas (ORC)

# Appendix B Significant ecological areas - metadata

Benthic invertebrates – intertidal

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Otago Harbour invertebrate SEA | BiInt_001 | Occurrence of significant cockle habitat | Cockles_ORCEstuary, MPI spatial catch data - clams, E3_scientific_cockles | 1, 2, 8, 9 | 11 a (v), 11 b (iii), b (iv) | No | Yes |
| Papanui Inlet invertebrate SEA | BiInt_002 | Occurrence of cockle habitat | Cockles_ORCEstuary | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | Yes |
| Purakaunui invertebrate SEA | BiInt_003 | Occurrence of significant cockle habitat | Cockles_ORCEstuary | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | Yes |
| Blueskin Bay invertebrate SEA | BiInt_004 | Occurrence of significant cockle habitat | Cockles_ORCEstuary, Blueskin2020_21_Substrate, MPI spatial catch data - clams | 1, 2, 8, 9 | 11 a (v), 11 b (iii), b (iv) | Yes | Yes |
| Puddingstone invertebrate SEA | BiInt_005 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Cape Saunders invertebrate SEA | BiInt_006 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Sandymount invertebrate SEA | BiInt_007 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Tomahawk invertebrate SEA | BiInt_008 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Tunnel beach invertebrate SEA | BiInt_009 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Kuri bush invertebrate SEA | BiInt_010 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Hays gap invertebrate SEA | BiInt_011 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Warrington invertebrate SEA | BiInt_012 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Huriawa invertebrate SEA | BiInt_013 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Kakaho invertebrate SEA | BiInt_014 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Cape Wanbrow invertebrate SEA | BiInt_015 | Occurrence of green-lipped mussel | Perna_presence | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | No |
| Catlins River Invertebrate SEA | BiInt_016 | Occurrence of cockle habitat | Catlins2016_Substrate_Biogenic, Cockles_ORCEstuary | 1, 2, 8, 9 | 11 b (iii), b (iv) | No | Yes |

Benthic invertebrates – subtidal

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Otago Peninsula offshore subtidal benthic invertebrate SEA | BiSub_001 | Important habitat for rare, threatened, unique species. Highly suitable habitat for numerous benthic invertebrate species. Importance for benthic invertebrate functional groups | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset. Benthic invertebrate function groups. | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | Yes |
| Catlins subtidal benthic invertebrate SEA | BiSub_002 | Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | No |
| Otago Harbour subtidal benthic invertebrate SEA | BiSub_003 | Occurrence of rare, threatened, unique species. Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | No |
| Blueskin Bay subtidal benthic invertebrate SEA | BiSub_004 | Occurrence of rare, threatened, unique taxa. Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | No |
| Shag Point offshore subtidal benthic invertebrate SEA | BiSub_005 | Important habitat for rare, threatened, unique species. Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | Yes |
| North Otago coastal subtidal benthic invertebrate SEA | BiSub_006 | Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | No |
| Waianakarua offshore subtidal benthic invertebrate SEA | BiSub_007 | Highly suitable habitat for numerous benthic invertebrate species | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | No |
| Cape Saunders subtidal benthic invertebrate SEA | BiSub_008 | Important habitat for rare, threatened, unique species. Highly suitable habitat for numerous benthic invertebrate species. Importance for benthic invertebrate functional groups | Species distribution models for benthic invertebrate species. Rare/threatened/ unique/endemic dataset. Benthic invertebrate function groups. | 1, 2, 4, 6, 8 | 11 a (i), a (v), b (ii), b (iii), b (vi) | No | Yes |

Biogenic Habitats – invertebrates

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Otago Peninsula biogenic SEA | Biog_ 001 | Occurrence of biogenic habitat formers - bryozoans, bivalves, sponges. Highly suitable habitat for numerous biogenic habitat and threatened deepwater corals | biogenic_bryozoan. Habitat suitability models for biogenic habitat forming species and protected coral species. Bryozoans_AMSmith_merged tsp. Obis_clip_keybiv2. Wood_Biogenic_habitats_ review. obis_clip_keybryo. specify_clip_keyspg. tepapa_clip_keybiv. | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | Yes |
| Waikouaiti offshore biogenic SEA | Biog_ 002 | Occurrence of biogenic habitat formers - bryozoans, bivalves, sponges. Highly suitable habitat for numerous biogenic habitat and threatened deepwater corals | biogenic_bryozoan. Habitat suitability models for biogenic habitat forming species and protected coral species. Bryozoans_AMSmith_merged tsp. Obis_clip_keybiv2. specify_clip_keyspg. obis_clip_keyspg | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | Yes |
| Moeraki biogenic SEA | Biog_ 003 | Occurrence of biogenic habitat forming species - sponges. Highly suitable habitat for numerous biogenic habitat-forming species and protected corals | Habitat suitability models for biogenic habitat forming species and protected coral species. specify_clip_keyspg. obis_clip_keyspg | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |
| Cape Wanbrow biogenic SEA | Biog_ 004 | Highly suitable habitat for numerous biogenic habitat-forming species and threatened deepwater corals | Habitat suitability models for biogenic habitat forming species and protected coral species | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |
| Southern Catlins biogenic SEA | Biog_ 005 | Highly suitable habitat for numerous biogenic habitat-forming species and protected coral species | Habitat suitability models for biogenic habitat forming species and protected coral species | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |
| Waitaki biogenic SEA | Biog_ 006 | Highly suitable habitat for numerous biogenic habitat-forming species and protected coral species | Habitat suitability models for biogenic habitat forming species and protected coral species | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |
| Tokomairaro offshore biogenic SEA | Biog_ 007 | Occurrence of biogenic habitat forming species - bivalves, bryozoans. Highly suitable habitat for numerous biogenic habitat-forming species and protected corals | Obis_clip_keybiv2. Bryozoans_AMSmith_merged tsp. Habitat suitability models for biogenic habitat forming species and protected coral species | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Northern Catlins biogenic SEA | Biog_ 008 | Highly suitable habitat for numerous biogenic habitat-forming species and protected coral species | Habitat suitability models for biogenic habitat forming species and protected coral species | 1, 2, 4, 6, 7, 8 | 11 a (ii), a (iii), b (ii), b (iii), b (vi) | No | No |

## Coastal vegetation

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Shag River coastal vegetation SEA | CoVeg_ 001 | Contains areas of saltmarsh | Shag2016_SaltMarsh. MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Bobby's Head coastal vegetation SEA | CoVeg_ 002 | Occurrence of pingao habitat | iNaturalistPingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Pleasant River Estuary coastal vegetation SEA | CoVeg_ 003 | Contains areas of saltmarsh | Saltmash_ORCWetlands. MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Waikouaiti Beach coastal vegetation SEA | CoVeg_ 004 | Occurrence of pingao habitat | iNaturalistPingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Waikouaiti Estuary coastal vegetation SEA | CoVeg_ 005 | Contains areas of saltmarsh | Waikouaiti2017_ SaltMarsh. Saltmash_ORCWetlands. MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Blueskin Bay coastal vegetation SEA | CoVeg_ 006 | Contains areas of saltmarsh | Blueskin2020_21_ SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Aramoana coastal vegetation SEA | CoVeg_ 007 | Contains areas of saltmarsh | Saltmash_ORCWetlands. MPA_Habitat_SaltMarsh. E3_Saltmarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Te Rauone Beach coastal vegetation SEA | CoVeg_ 008 | Historical pingao occurrence | Otago Peninsula Pingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Pipikaretu Beach coastal vegetation SEA | CoVeg_ 009 | Historical pingao occurrence | Otago Peninsula Pingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Ryans Beach coastal vegetation SEA | CoVeg_ 010 | Historical pingao occurrence | Otago Peninsula Pingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Victory Beach coastal vegetation SEA | CoVeg_ 011 | Historical pingao occurrence | Otago Peninsula Pingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Papanui Inlet coastal vegetation SEA | CoVeg_ 012 | Contains areas of saltmarsh | Saltmarsh_ORC_ Wetlands | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Allans Beach coastal vegetation SEA | CoVeg_ 013 | Occurrence of pingao habitat | Otago Peninsula Pingao. iNaturalistPingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Hoopers Inlet coastal vegetation SEA | CoVeg_ 014 | Contains pingao and areas of saltmarsh | iNaturalistPingao. MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Sandfly Bay coastal vegetation SEA | CoVeg_ 015 | Occurrence of pingao habitat | Otago Peninsula Pingao. iNaturalistPingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Smaills Beach coastal vegetation SEA | CoVeg_ 016 | Historical pingao occurrence | Otago Peninsula Pingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| St Kilda coastal vegetation SEA | CoVeg_ 017 | Occurrence of pingao habitat | Otago Peninsula Pingao. iNaturalistPingao | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | Yes |
| Kaikorai Lagoon coastal vegetation SEA | CoVeg_ 018 | Contains areas of saltmarsh | Kaikorai2018_SaltMarsh. MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Tokomairaro coastal vegetation SEA | CoVeg_ 019 | Contains areas of saltmarsh | Tokomairiro2018 _SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Catlins River coastal vegetation SEA | CoVeg_ 020 | Contains areas of saltmarsh | Catlins2016_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | Yes | Yes |
| Tahakopa coastal vegetation SEA | CoVeg_ 021 | Contains areas of saltmarsh | MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |
| Tautuku coastal vegetation SEA | CoVeg_ 022 | Contains areas of saltmarsh | MPA_Habitat_SaltMarsh | 1, 2, 4, 8 | 11 a (iii), b(i), b (ii), b (iii), b (v), b (vi) | No | No |

## Estuaries/Coastal Lagoons and Wetlands

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Hawksbury coastal lagoon | EstLagWet_ 001 | Hawksbury coastal lagoon | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | No | Yes |
| Wangaloa coastal lagoon | EstLagWet_ 002 | Wangaloa coastal lagoon | nz-lake-polygons-topo_LINZ | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | No | Yes |
| Washpool coastal lagoon | EstLagWet_ 003 | Washpool coastal lagoon | nz-lake-polygons-topo_LINZ | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | No | Yes |
| Tomahawk coastal lagoon | EstLagWet_ 004 | Tomahawk coastal lagoon | nz-lake-polygons-topo_LINZ | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | No | Yes |
| All Day Bay Lagoon | EstLagWet_ 005 | All Day Bay Lagoon | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Clutha Matau Wetlands | EstLagWet_ 006 | Clutha Matau Wetlands | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Clutha River Mouth Lagoon | EstLagWet_ 007 | Clutha River Mouth Lagoon | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| False Islet Wetland Management Area | EstLagWet_ 008 | False Islet Wetland Management Area | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Hoopers Inlet Swamp | EstLagWet_ 009 | Hoopers Inlet Swampe | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Hukihuki Swamp | EstLagWet_ 010 | Hukihuki Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Jennings Creek Marsh | EstLagWet_ 011 | Jennings Creek Marsh | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Kaikorai Lagoon Swamp | EstLagWet_ 012 | Kaikorai Lagoon Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Kakaho Creek Swamp | EstLagWet_ 013 | Kakaho Creek Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Kemp Road Lagoon | EstLagWet_ 014 | Kemp Road Lagoon | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Lake Wilkie Swamp | EstLagWet_ 015 | Lake Wilkie Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Lenz Reserve Wetlands | EstLagWet_ 016 | Lenz Reserve Wetlands | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Coutts Gully Swamp | EstLagWet_ 017 | Coutts Gully Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Lower Otokia Creek Marsh | EstLagWet_ 018 | Lower Otokia Creek Marsh | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Maclennan River Podocarp Swamp Complex | EstLagWet_ 019 | Maclennan River Podocarp Swamp Complex | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| McGregor Swamp | EstLagWet_ 020 | McGregor Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| McLachlan Road Marsh | EstLagWet_ 021 | McLachlan Road Marsh | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Measly Beach Wetland Complex | EstLagWet_ 022 | Measly Beach Wetland Complex | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Molyneux Bay Swamp | EstLagWet_ 023 | Molyneux Bay Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Okia Flat Wetland Management Area | EstLagWet_ 024 | Okia Flat Wetland Management Area | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Shag Point Dam Margins | EstLagWet_ 025 | Shag Point Dam Margins | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Tahakopa Bay Podocarp Swamp | EstLagWet_ 026 | Tahakopa Bay Podocarp Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Tautuku River Mouth Marsh | EstLagWet_ 027 | Tautuku River Mouth Marsh | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Te Matai Marsh Complex | EstLagWet_ 028 | Te Matai Marsh Complex | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Tokomairiro River Swamp | EstLagWet_ 029 | Tokomairiro River Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Waianakarua River Estuary Swamp | EstLagWet_ 030 | Waianakarua River Estuary Swamp | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Waikouaiti River Estuary Wetland Complex | EstLagWet_ 031 | Waikouaiti River Estuary Wetland Complex | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Whareakeake Marsh | EstLagWet_ 032 | Whareakeake Marsh | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Tavora Wetland | EstLagWet_ 033 | Tavora Wetland | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Pleasant River Estuary | EstLagWet_ 034 | Pleasant River Estuary | ORC wetlands dataset | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | No | Yes |
| Waikouaiti Estuary | EstLagWet_ 035 | Waikouaiti Estuary - subtidal & intertidal | Waikouaiti2017_ Estuary_ORC mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Tokomairiro Estuary | EstLagWet_ 036 | Tokomairiro Estuary - subtidal & intertidal | Tokomairiro2018 _Estuary_ORC mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Kakanui Estuary | EstLagWet_ 037 | Kakanui Estuary - subtidal & intertidal | Kakanui2021_ Estuary_ORC_ mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Shag Estuary | EstLagWet_ 038 | Shag Estuary - subtidal & intertidal | Shag2016_ Estuary_ORC_ mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Kaikorai Estuary | EstLagWet_039 | Kaikorai Estuary - subtidal & intertidal | Kaikorai2018_Estuary_ORC_mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Catlins Estuary | EstLagWet_040 | Catlins Estuary - subtidal & intertidal | Catlins2016_Estuary_ORC_mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |
| Blueskin Estuary | EstLagWet_041 | Blueskin Estuary - subtidal & intertidal | Blueskin2020_21_Estuary_ORC_mapping | 1, 3, 4, 5, 8, 9 | 11 a (iii), b (ii), b (iii), b (iv), b (v), b (vi) | Yes | Yes |

## Demersal Fish

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Taiaroa Head demersal fish SEA | FishDF_001 | Occurrence of rare and threatened species, highly suitable habitat and spawning areas for numerous demersal fish species | NZ_fish_point_records_rarity. Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 1, 2, 3, 4, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | No | Yes |
| Wickliffe Bay offshore demersal fish SEA | FishDF_002 | High abundance, highly suitable habitat and spawning areas for numerous demersal fish species | Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 3, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | No | No |
| Cape Saunders offshore demersal fish SEA | FishDF_003 | Occurrence of rare and threatened species, high abundance, highly suitable habitat and spawning areas for numerous demersal fish species | NZ_fish_point_records_rarity. Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 1, 2, 3, 4, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | No | Yes |
| Catlins demersal fish SEA | FishDF_004 | Occurrence of rare and threatened species, high abundance and highly suitable habitat and spawning areas for numerous demersal fish species | NZ_fish_point_records_rarity. Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 1, 2, 3, 4, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | No | Yes |
| North Otago demersal fish SEA | FishDF_005 | Important location for rare and threatened species, high abundance and highly suitable habitat and spawning areas for numerous demersal fish species | NZ_fish_point_records_rarity. Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 1, 2, 3, 4, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | Yes | Yes |
| Tokomairiro offshore demersal fish SEA | FishDF_006 | Occurrence of rare and threatened species, high abundance, highly suitable habitat and spawning areas for numerous demersal fish species | NZ_fish_point_records_rarity. Demersal fish species distribution models. MPI spatial catch data. Finfish Spawning areas. | 1, 2, 3, 4, 5, 6, 9 | 11 a (iii), b (ii), b (iv), b (v) | No | No |

Reef Fish

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Lookout bluff reef fish SEA | FishRF_ 001 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Cape Wanbrow reef fish SEA | FishRF_ 002 | High abundance of reef fish, lobster and paua, high habitat suitability for numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Orore Point reef fish SEA | FishRF_ 003 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Kakanui reef fish SEA | FishRF_ 004 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Hampden reef fish SEA | FishRF_ 005 | High abundance of reef fish and lobster, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Taki-a-Maru reef fish SEA | FishRF_ 006 | High abundance of reef fish and lobster, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Shag point reef fish SEA | FishRF_ 007 | High abundance of reef fish, lobster and paua, high habitat suitability for numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Moeraki reef fish SEA | FishRF_ 008 | High abundance of reef fish, lobster and paua, high habitat suitability for numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Bobby's Head reef fish SEA | FishRF_ 009 | High abundance of reef fish, lobster and paua, high habitat suitability for numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Omimi reef fish SEA | FishRF_ 010 | High abundance of reef fish and lobster, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Potato Point reef fish SEA | FishRF_ 011 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Taiaroa Head reef fish SEA | FishRF_ 012 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Cape Saunders reef fish SEA | FishRF_ 013 | High abundance of reef fish and lobster, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Harakeke Point reef fish SEA | FishRF_014 | High abundance of reef fish and lobster, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Dunedin offshore south reef fish SEA | FishRF_015 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Dunedin offshore east reef fish SEA | FishRF_016 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Dunedin offshore north reef fish SEA | FishRF_017 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Bull Creek reef fish SEA | FishRF_018 | highly suitable habitat for numerous reef fish | Reef fish species distribution models | 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Nuggets reef fish SEA | FishRF_019 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Jack's Bay reef fish SEA | FishRF_020 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Long Point reef fish SEA | FishRF_021 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |
| Makati reef fish SEA | FishRF_022 | High abundance of reef fish and paua, high habitat suitability of numerous reef fish | Reef fish species distribution models. MPI spatial catch data | 5, 6, 9 | 11 b (iii), b (ii), b (iv), b (v) | No | No |

## Kelp Forest

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Cape Wanbrow kelp forest SEA | Kelp_001 | Occurrence of kelp forest habitat | biogenic_macrocystis. KelpBeds. Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | No |
| North Otago coast kelp forest SEA | Kelp_002 | Occurrence of kelp forest habitat | Kelp forest distribution_Port Otago. biogenic_macrocystis. KelpBeds. Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | Yes |
| Puketeraki kelp forest SEA | Kelp_003 | Occurrence of kelp forest habitat | Kelp forest distribution_Port Otago. biogenic_macrocystis. KelpBeds. Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Otago Harbour kelp forest SEA | Kelp_004 | Highly suitable habitat for canopy-forming macroalgae | Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | No |
| Kuri Bush kelp forest SEA | Kelp_005 | Occurrence of kelp forest habitat | KelpBeds. Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | No |
| Catlins kelp forest SEA | Kelp_006 | Occurrence of kelp forest habitat | KelpBeds. Species distribution models for canopy-forming macroalgae | 1, 2, 3, 4, 5, 6, 8 | 11 a (v), b (i), b (ii), b (iii), b (iv), b (vi) | No | No |

## Marine Flora

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Cape Wanbrow marine flora SEA | MarFlor_001 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Kakanui marine flora SEA | MarFlor_002 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Orore Point marine flora SEA | MarFlor_003 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Hampden marine flora SEA | MarFlor_004 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Moeraki marine flora SEA | MarFlor_005 | Occurrence of seagrass habitat | Seagrass_Jul2015. Macroalgae species distribution models | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | Yes |
| Shag River Estuary marine flora SEA | MarFlor_006 | Occurrence of seagrass habitat | Shag2016_Macroalgae. Seagrass_ORCEstuary. Macroalgae species distribution models | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | Yes | Yes |
| Shag Point marine flora SEA | MarFlor_007 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Goodwood coast marine flora SEA | MarFlor_008 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Waikouiaiti Estuary marine flora SEA | MarFlor_009 | Occurrence of seagrass and macroalgae | Seagrass_ORCEstuary. Waikouaiti2017_Macroalgae Waikouaiti2017_Seagrass. Macroalgae species distribution models | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | Yes | Yes |
| Puketeraki marine flora SEA | MarFlor_010 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Blueskin Bay marine flora SEA | MarFlor_011 | Occurrence of seagrass and macroalgae | Blueskin2020_21_Macroalgae. Blueskin2020_21_Seagrass. Macroalgae species distribution models. Seagrass_Jul2015. MPA_Habitat_BiogenicSeagrass. | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | Yes | Yes |
| Otakou marine flora SEA | MarFlor_012 | Occurrence of seagrass habitat | Seagrass_Jul2015. E3 Scientific seagrass dataset. MPA_Habitat_BiogenicSeagrass. Seagrass_ORCEstuary. Macroalgae species distribution models. | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | Yes |
| Lower Otago Harbour marine flora SEA | MarFlor_013 | Occurrence of seagrass habitat | Seagrass_Jul2015. MPA_Habitat_BiogenicSeagrass. Seagrass_ORCEstuary. Macroalgae species distribution models. | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | Yes |
| Upper Otago Harbour marine flora SEA | MarFlor_014 | Occurrence of seagrass habitat | Seagrass_Jul2015. MPA_Habitat_BiogenicSeagrass. Seagrass_ORCEstuary. Macroalgae species distribution models. | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | Yes |
| Taiaroa Head marine flora SEA | MarFlor_015 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Papanui inlet marine flora SEA | MarFlor_016 | Occurrence of seagrass habitat | Seagrass_Jul2015. E3 Scientific seagrass dataset. MPA_Habitat_BiogenicSeagrass. Seagrass_ORCEstuary. Macroalgae species distribution models. | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | Yes |
| Tokomairiro marine flora SEA | MarFlor_017 | Occurrence of seagrass and macroalgae | Tokomairiro2018_Macroalgae. Tokomairiro2018_Seagrass. Macroalgae species distribution models | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | Yes | Yes |
| Catlins River marine flora SEA | MarFlor_018 | Occurrence of seagrass and macroalgae | Catlins2016_Macroalgae. Catlins2016_Seagrass. Seagrass_ORCEstuary. MPA_Habitat_BiogenicSeagrass. Macroalgae species distribution models | 1, 3, 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | Yes | Yes |
| Penguin Bay marine flora SEA | MarFlor_019 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Nugget Point marine flora SEA | MarFlor_020 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Tautuku marine flora SEA | MarFlor_021 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |
| Skeleton Point marine flora SEA | MarFlor_022 | Highly suitable habitat for numerous macroalgae species | Macroalgae species distribution models | 5, 6, 8 | 11 b (i), b (ii), b (iii), b (vi) | No | No |

## Marine Mammal – Ocean

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Blueskin Bay marine mammal ocean SEA | MMOcean_ 001 | Occurrence and highly suitable habitat for Hector's dolphin and other cetaceans, important areas for sea lion foraging | Cetacean species distribution models. NZ_FurSeal_ForagingRange. HWilliams_Nemo_HectorsDolphin _Sightings. MARI429_HectorsDolphin_Sightin gs. Monarch_HectorsDolphin_ sightings. NZ_SeaLion_Foraging Range. FemaleSeaLionForaging _2008to10_27_05_2015_FINAL. | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), | Yes | Yes |
| North coast marine mammal ocean SEA | MMOcean_ 002 | Highly suitable habitat for numerous cetaceans, fur seal foraging | Cetacean species distribution models. NZ_FurSeal_ForagingRange | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), | No | No |
| South Dunedin coast marine mammal ocean SEA | MMOcean_ 003 | Highly suitable habitat for numerous cetaceans, important sea lion and fur seal foraging | Cetacean species distribution models. NZ_FurSeal_ForagingRange. FemaleSeaLionForaging_2008to10 _27_05_2015_FINAL | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), | No | No |
| Catlins marine mammal ocean SEA | MMOcean_ 004 | Highly suitable habitat for numerous cetaceans, fur seal foraging | Cetacean species distribution models. NZ_FurSeal_ForagingRange | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), | No | No |
| Otago Peninsula marine mammal ocean SEA | MMOcean_ 005 | Occurrence and highly suitable habitat for Hector's dolphin and other cetaceans, Important sea lion and fur seal foraging habitat | Cetacean species distribution models. NZ_FurSeal_ForagingRange. HWilliams_HectorsDolphin. MARI429_HectorsDolphin. Monarch_HectorsDolphin_sightin gs. NZ_SeaLion_ForagingRange. FemaleSeaLionForaging. ALLCETACEANS20162019. | 3, 4, 6, 8 | 11 a (i), a (ii), a (iv), a (vi), b (iv), b (v), | Yes | Yes |

## Marine Mammal – Terrestrial

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Fur Seal SEAs | MMTerr_001 | Haulouts and breeding colonies for fur seals | New_Zealand_Fur_Seal___Breeding_Colonies_Distribution. ORC_Fur_seal. GEOPHYSICAL_NaturallyUncommon Ecosystems - Marine mammal haulouts. | 3, 4 | 11 a (vi), b (ii) | Yes | Yes |
| Sea Lion SEAs | MMTerr_002 | Haulouts and breeding colonies for sea lions | New_Zealand_Hookers_Sealion_Breeding_Colonies_Distribution. NZSLT database sea-lions-sightings April 2022. GEOPHYSICAL_NaturallyUncommon Ecosystems - Marine mammal haulouts. ORC_Sea_lion. | 2, 3, 4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv), | Yes | Yes |

## Naturally Uncommon Ecosystems

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Active sand dunes - Otago wide SEA | NatUnc_001 | Occurrence of active sand dunes | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |
| Coastal rock stacks - Otago wide SEA | NatUnc_002 | Occurrence of coastal rock stacks | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |
| Coastal turfs - Otago wide SEA | NatUnc_003 | Occurrence of coastal turfs | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |
| Shingle beaches - Otago wide SEA | NatUnc_004 | Occurrence of shingle beaches | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |
| Seabird guano deposits - Otago wide SEA | NatUnc_005 | Occurrence of seabird guano deposits | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |
| Seabird-burrowed soils - Otago wide SEA | NatUnc_006 | Occurrence of seabird-burrowed soils | GEOPHYSICAL_NaturallyUncommon Ecosystems | 2 | 11 a (iv), b (iii) | No | No |

## Pelagic Productivity

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Southland front pelagic SEA | PelProd_001 | Indication of persistent frontal features (Southland current) based on gradient in sea surface temperature | SSTGrad | 2, 5, 8 | 11 a (v), b (vi) | Yes | Yes |

## Shore/seabirds - Marine

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Oamaru seabird marine SEA | BirdMar_001 | Important habitat for foraging Hoiho, albatross, Little Blue Penguin and other seabirds | Tracked Albatross data. Coastal_seabirds_marine. iNaturalist_Birds. DOC_HoihoTracking. Otago_BluePenguinRange_17_10_14_FINAL | 2, 3, 4, 6 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) | Yes | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Dunedin seabird marine SEA | BirdMar_002 | Important habitat for foraging Hoiho, albatross, Little Blue Penguin, wading birds and other seabirds | Tracked Albatross data. Coastal_seabirds_marine. iNaturalist_Birds. DOC_HoihoTracking. Otago_BluePenguinRange. Birds NZ Otago Harbour Survey. National Wader Count - abundance & biodiversity. Seabirds_canyons. OBIS_Birds | 2, 3, 4, 6 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) | Yes | Yes |
| Tirohanga seabird marine SEA | BirdMar_003 | Important habitat for foraging Hoiho and other seabirds | Coastal_seabirds_marine. iNaturalist_Birds. DOC_HoihoTracking. | 2, 3, 4, 6 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) | Yes | Yes |
| Catlins seabird marine SEA | BirdMar_004 | Important habitat for foraging Hoiho and other seabirds | Coastal_seabirds_marine. iNaturalist_Birds. DOC_HoihoTracking. | 2, 3, 4, 6 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) | Yes | Yes |
| Bobby's Head seabird marine SEA | BirdMar_005 | Important habitat for foraging Hoiho, albatross and other seabirds | Tracked Albatross data. Coastal_seabirds_marine. iNaturalist_Birds. DOC_HoihoTracking. | 2, 3, 4, 6 | 11 a (i), a (ii), a (iv), a (vi), b (ii), b (iv) | Yes | Yes |

## Shore/seabirds - Terrestrial

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Cape Wanbrow terrestrial seabird SEA | BirdTerr_001 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. NZ_IBA_Bird_Colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Lookout Bluff terrestrial seabird SEA | BirdTerr_002 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Moeraki terrestrial seabird SEA | BirdTerr_003 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. NZ_IBA_Bird_Colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Katiki Beach terrestrial seabird SEA | BirdTerr_004 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Shag Point terrestrial seabird SEA | BirdTerr_005 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Bobby’s Head terrestrial seabird SEA | BirdTerr_006 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Puketeraki terrestrial seabird SEA | BirdTerr_007 | Contains seabird breeding colonies | Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), b (ii), b (iv) | No | Yes |
| Purakaunui terrestrial seabird SEA | BirdTerr_008 | Contains seabird breeding colonies | Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), b (ii), b (iv) | No | Yes |
| Otago Peninsula terrestrial seabird SEA | BirdTerr_009 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. NZ_IBA_Bird_Colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Otago Harbour terrestrial seabird SEA | BirdTerr_010 | Contains seabird breeding colonies | Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), b (ii), b (iv) | No | Yes |
| South Dunedin terrestrial seabird SEA | BirdTerr_011 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Green Island terrestrial seabird SEA | BirdTerr_012 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | Yes | Yes |
| Northern Catlins terrestrial seabird SEA | BirdTerr_013 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Southern Catlins terrestrial seabird SEA | BirdTerr_014 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. NZ_IBA_Bird_Colonies. Otago_SeabirdColonies_21_11_14_FINAL. ORC Bird Colonies | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |
| Aramoana terrestrial seabird SEA | BirdTerr_015 | Contains Hoiho and other seabird breeding colonies | YEPT Hoiho colonies. Otago_SeabirdColonies_21_11_14_FINAL | 1,2,3,4 | 11 a (i), a (ii), a (iv), a (v), a (vi), b (ii), b (iv) | No | Yes |

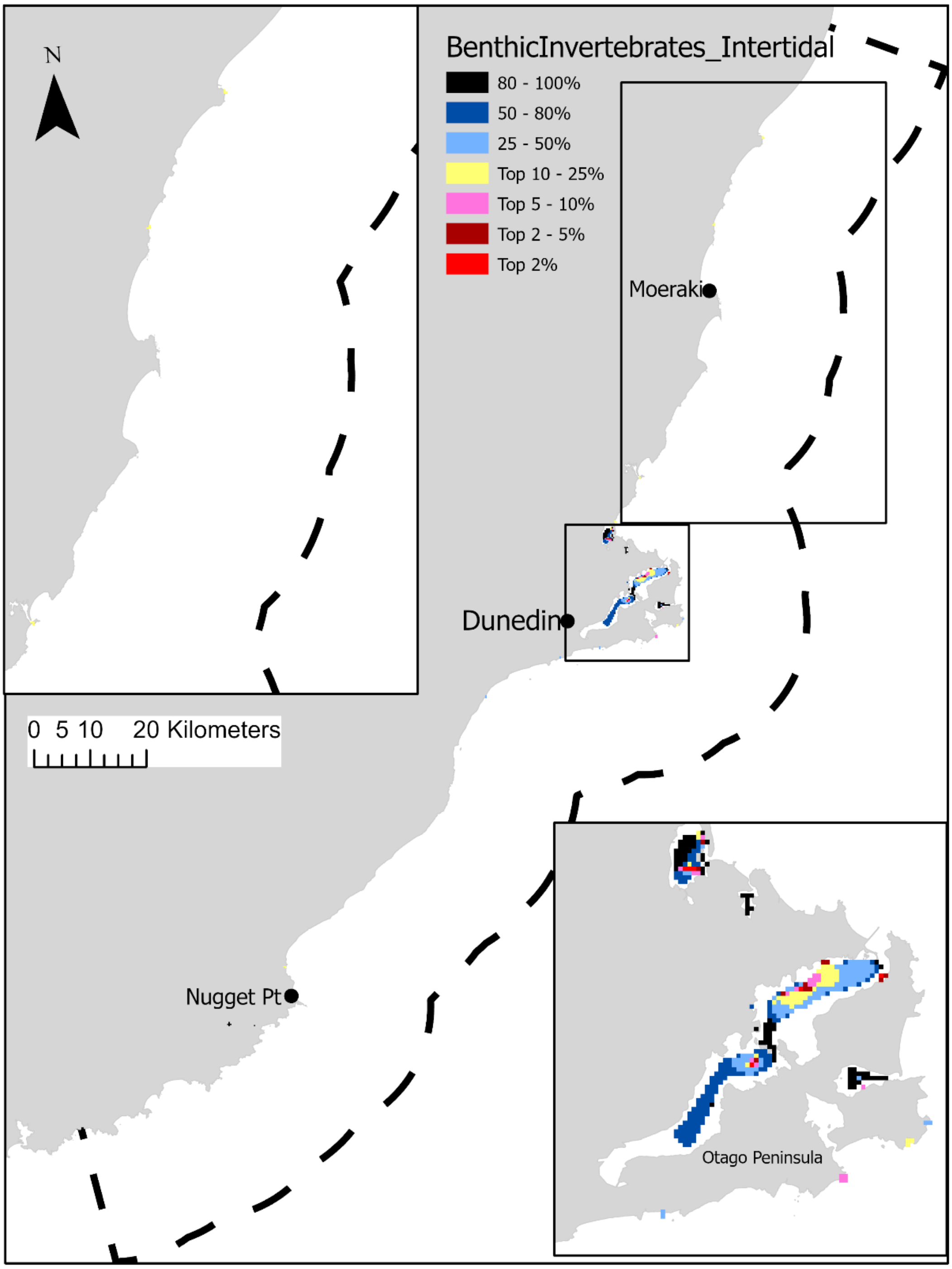
## Seafloor geomorphological features

| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| Head of Saunders Canyon seafloor SEA | SeaFlr_001 | Head of Saunders Canyon | NIWA Bathymetry | 2, 5, 6, 9 | 11 a (iv), a (v), b (v), b (vi) | No | Yes |
| Head of Papanui Canyon seafloor SEA | SeaFlr_002 | Head of Papanui Canyon | NIWA Bathymetry | 2, 5, 6, 9 | 11 a (iv), a (v), b (v), b (vi) | No | Yes |
| Head of Taiaroa Canyon seafloor SEA | SeaFlr_003 | Head of Taiaroa Canyon | NIWA Bathymetry | 2, 5, 6, 9 | 11 a (iv), a (v), b (v), b (vi) | No | Yes |
| Taieri reef system seafloor SEA | SeaFlr_004 | Highly variable bathymetry - possible reef system | LINZ_MPPF_25mDEM | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |

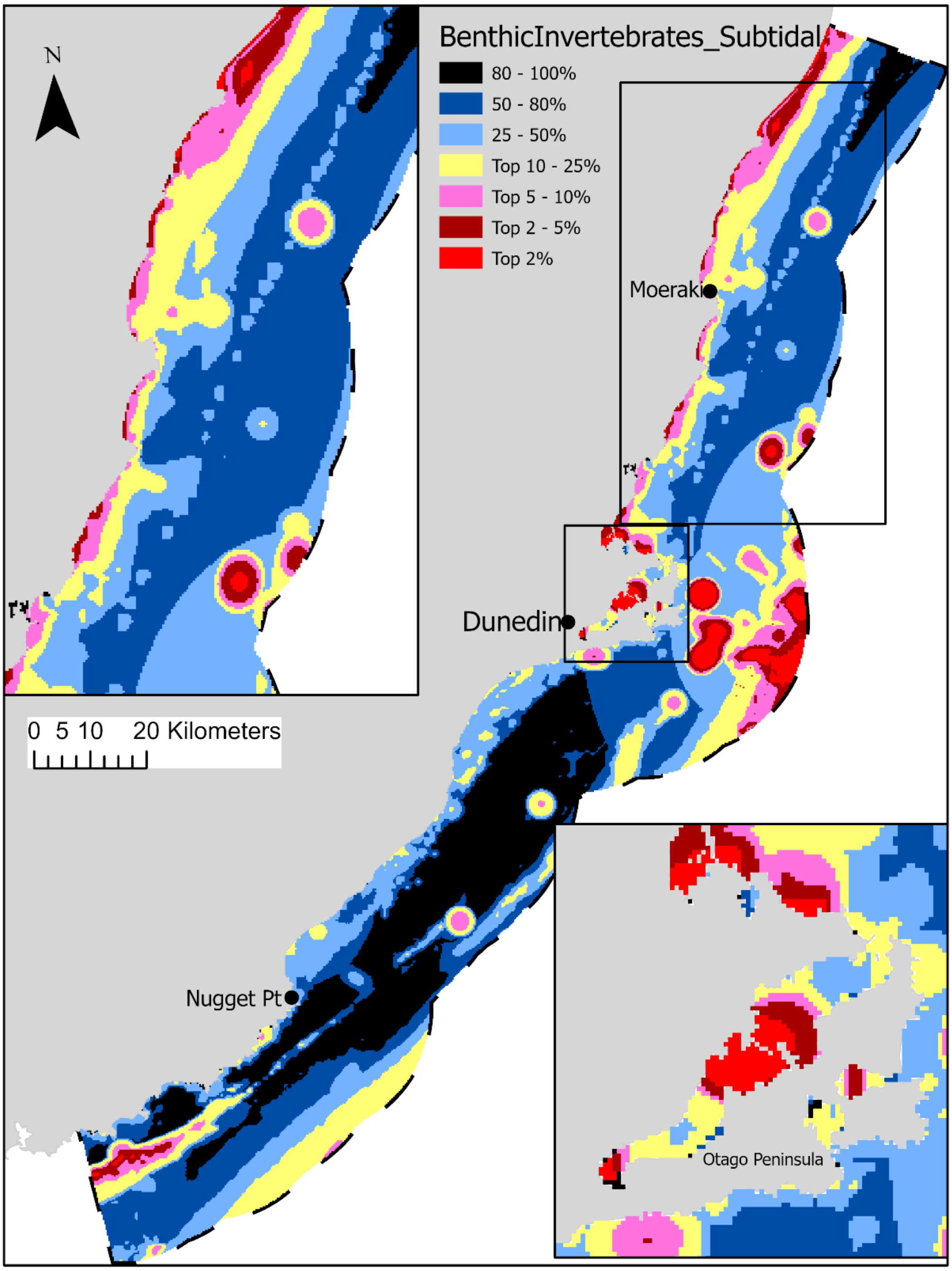
| Name | Code | Features | Evidence | KEA criteria | Policy11 criteria | Extent defined | Validated |
|---|---|---|---|---|---|---|---|
| North Coast reef platform seafloor SEA | SeaFlr_005 | Significant contiguous coastal reef platform | DOC Rocky Reef. LINZ_MPPF_25mDEM | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |
| Waianakarua offshore deep reef seafloor SEA | SeaFlr_006 | Rare offshore deep reef | LINZ_MPPF_25mDEM | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |
| Maori Head offshore deep reef seafloor SEA | SeaFlr_007 | Rare offshore deep reef | DOC_Rocky_Reef. LINZ_MPPF_25mDEM | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |
| Puketeraki coastal reef platform seafloor SEA | SeaFlr_008 | Significant contiguous coastal reef platform | DOC Rocky Reef | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |
| South Coast offshore seafloor SEA | SeaFlr_009 | Areas of foul and papa rock | MPA_Habitat_Rocky Reef | 2,5,6 | 11 b (ii), b (iii), b (iv), b (vi) | No | No |

# Appendix C Zonation prioritisation outputs

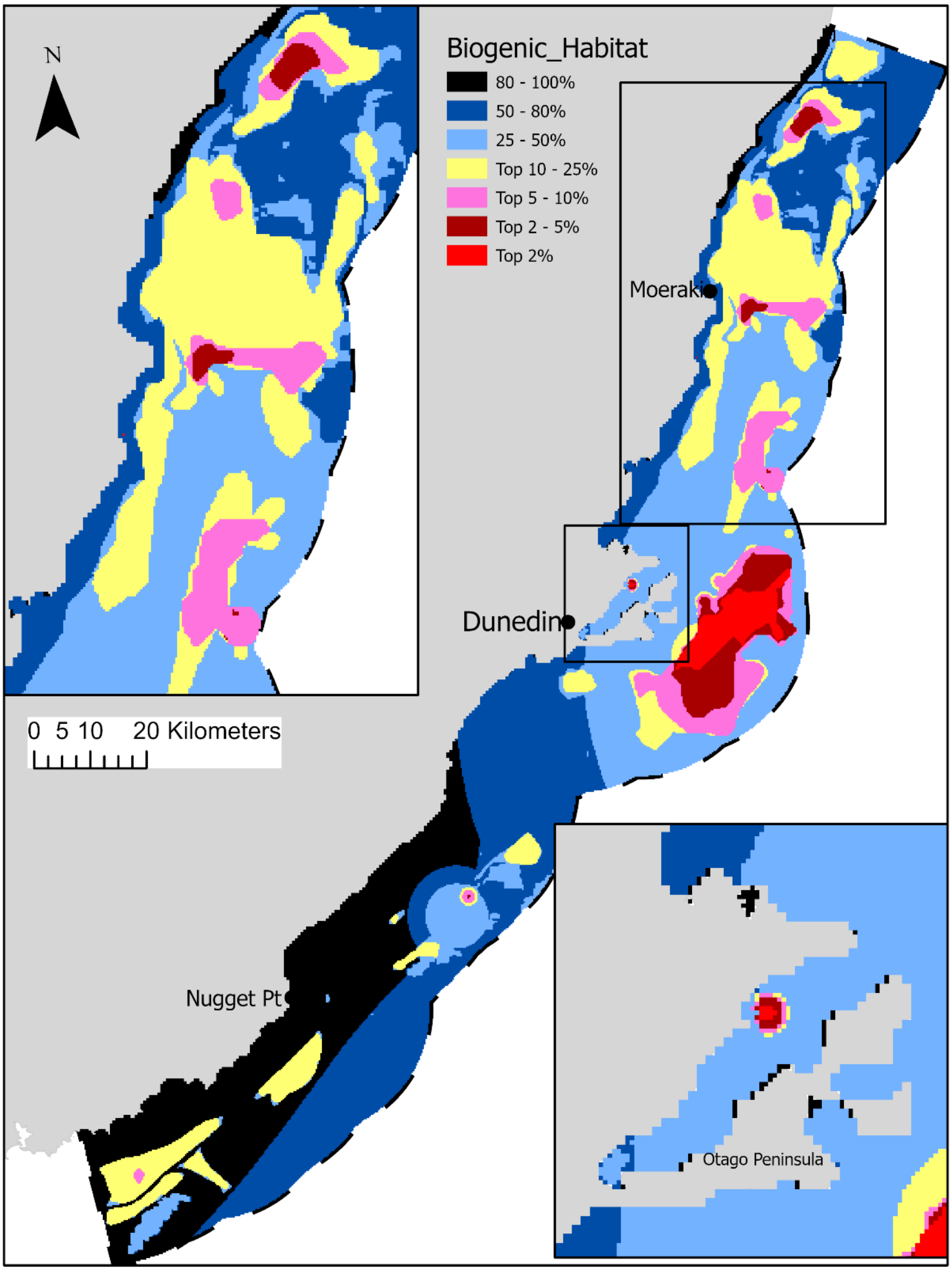
Benthic Invertebrates - Intertidal



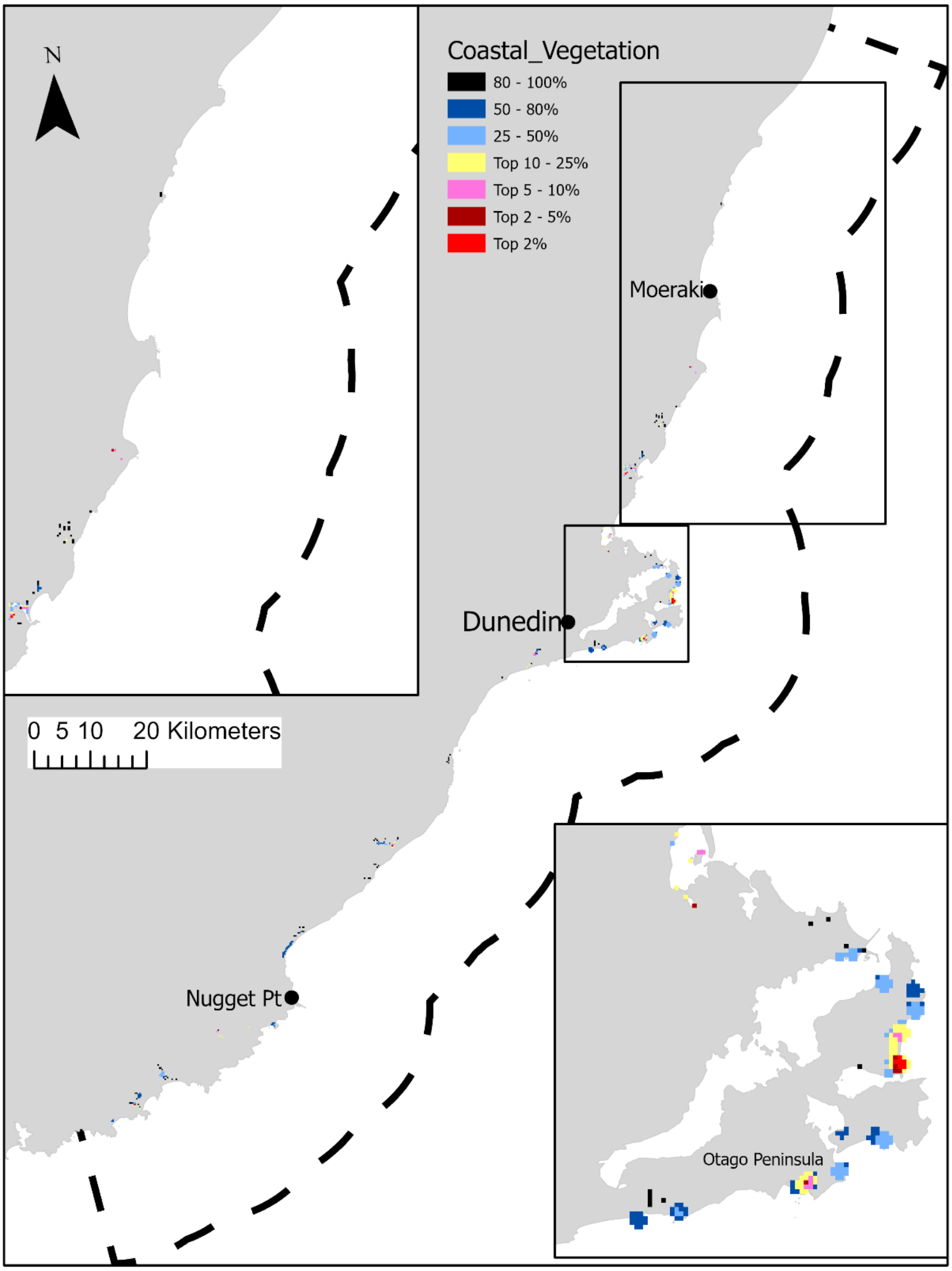
Benthic Invertebrates - Subtidal



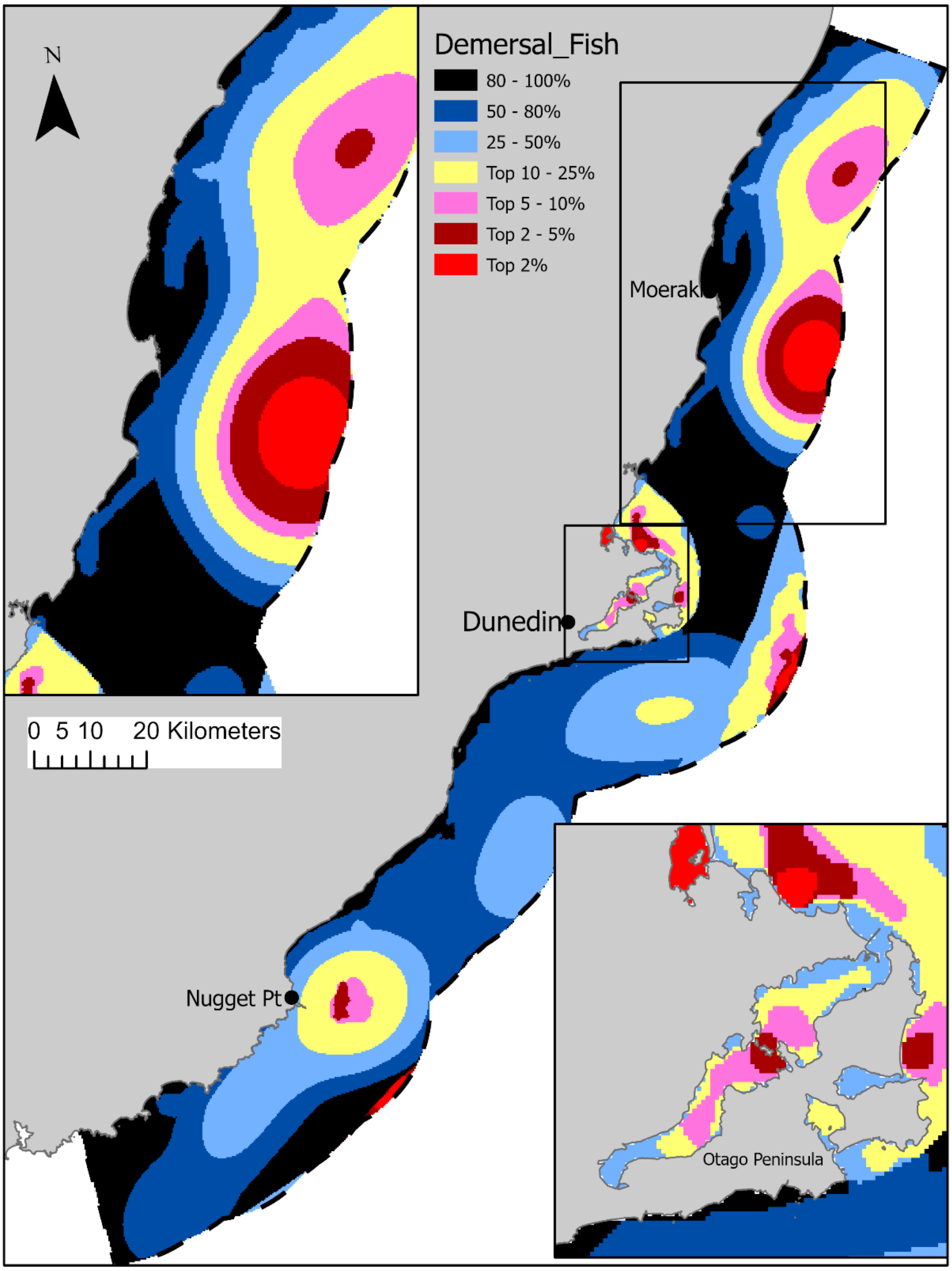
Biogenic Habitats – Invertebrates



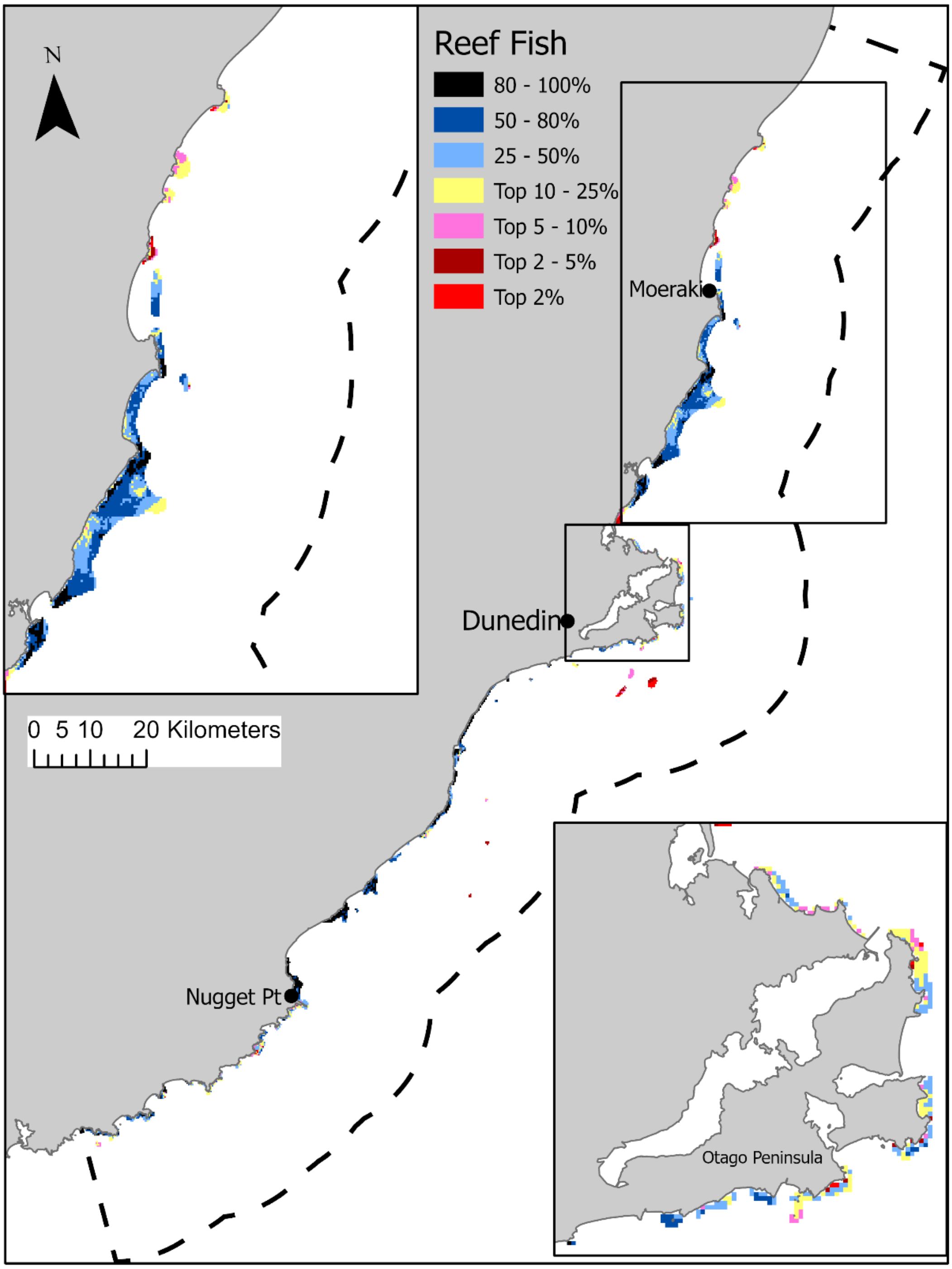
Coastal Vegetation



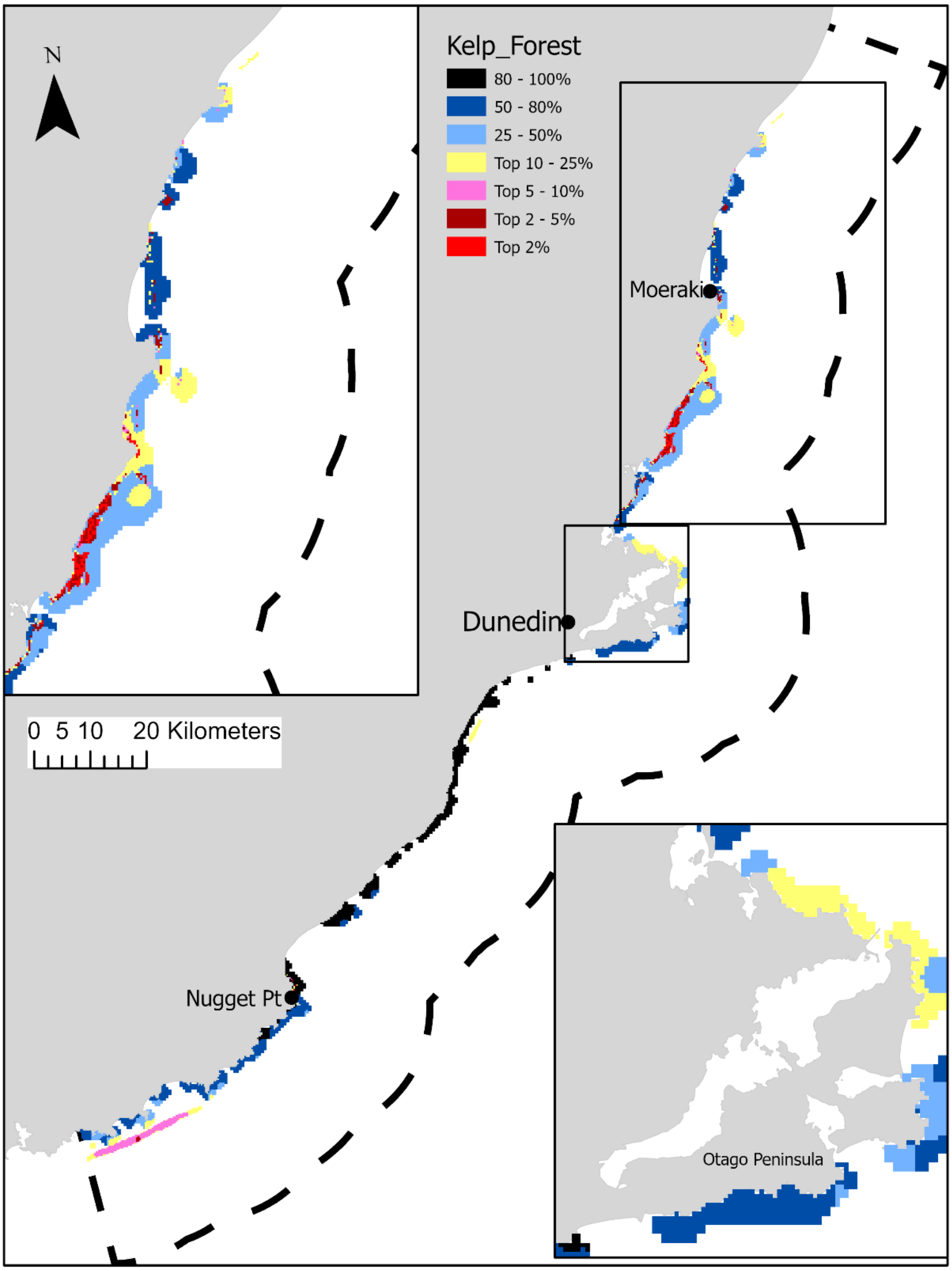
Demersal Fish



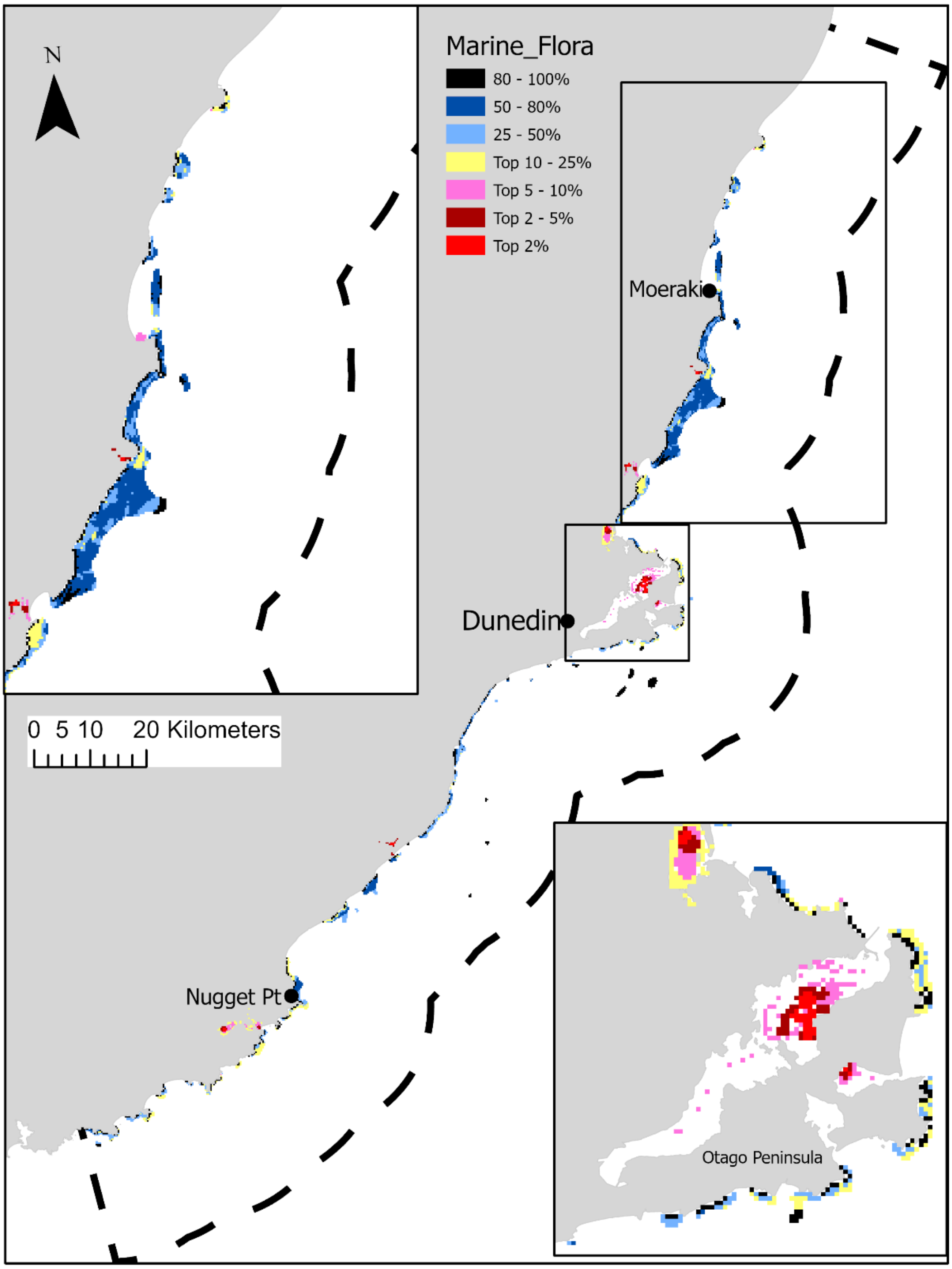
Reef Fish


N
Reef Fish
80 - 100%
50 - 80%
25 - 50%
Top 10 - 25%
Top 5 - 10%
Top 2 - 5%
Top 2%
Moeraki
Dunedin
0 5 10 20 Kilometers
Nugget Pt
Otago Peninsula

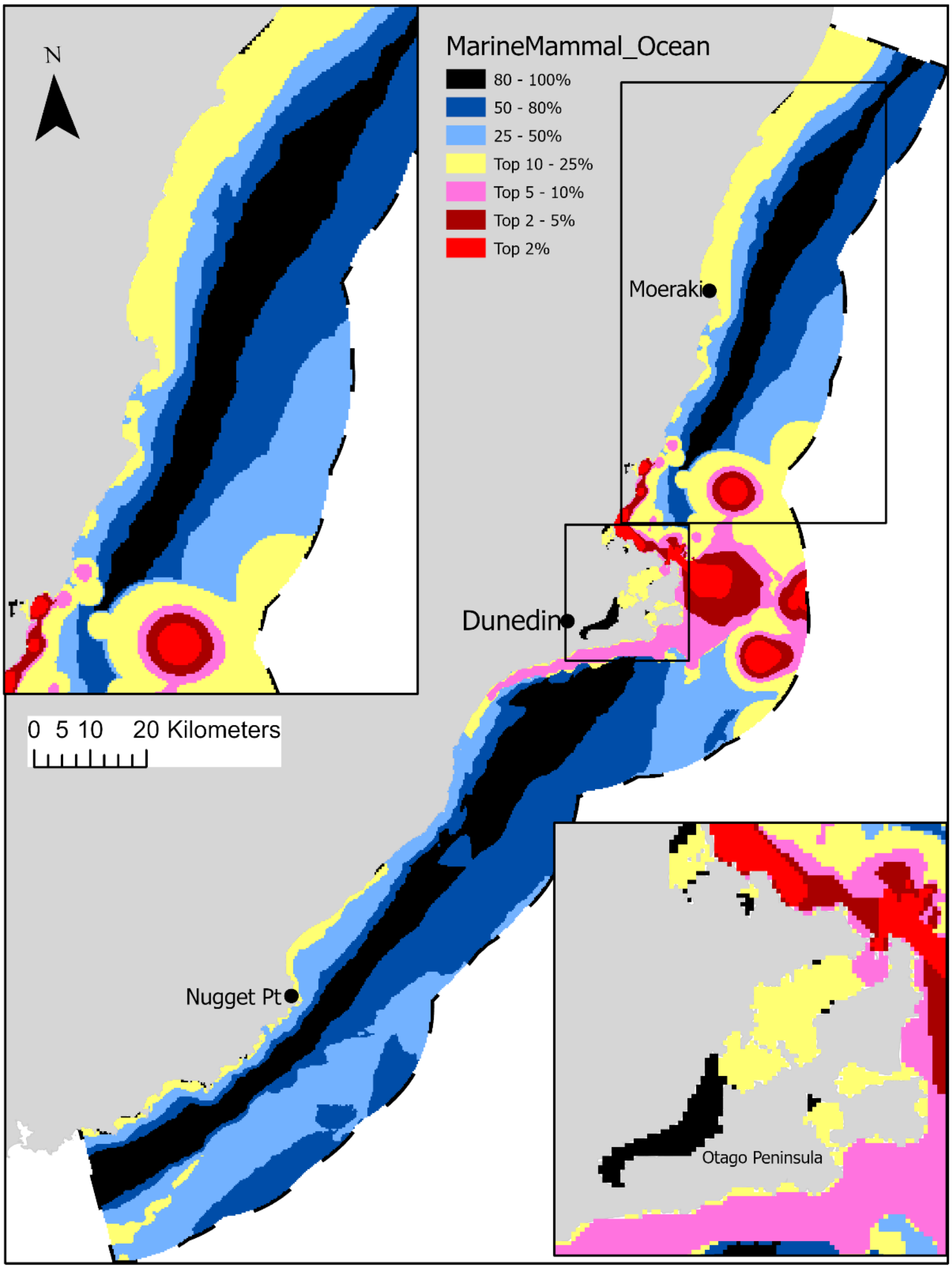
Kelp Forest


N
Kelp_Forest
80 - 100%
50 - 80%
25 - 50%
Top 10 - 25%
Top 5 - 10%
Top 2 - 5%
Top 2%
Moeraki
Dunedin
0 5 10 20 Kilometers
Nugget Pt
Otago Peninsula

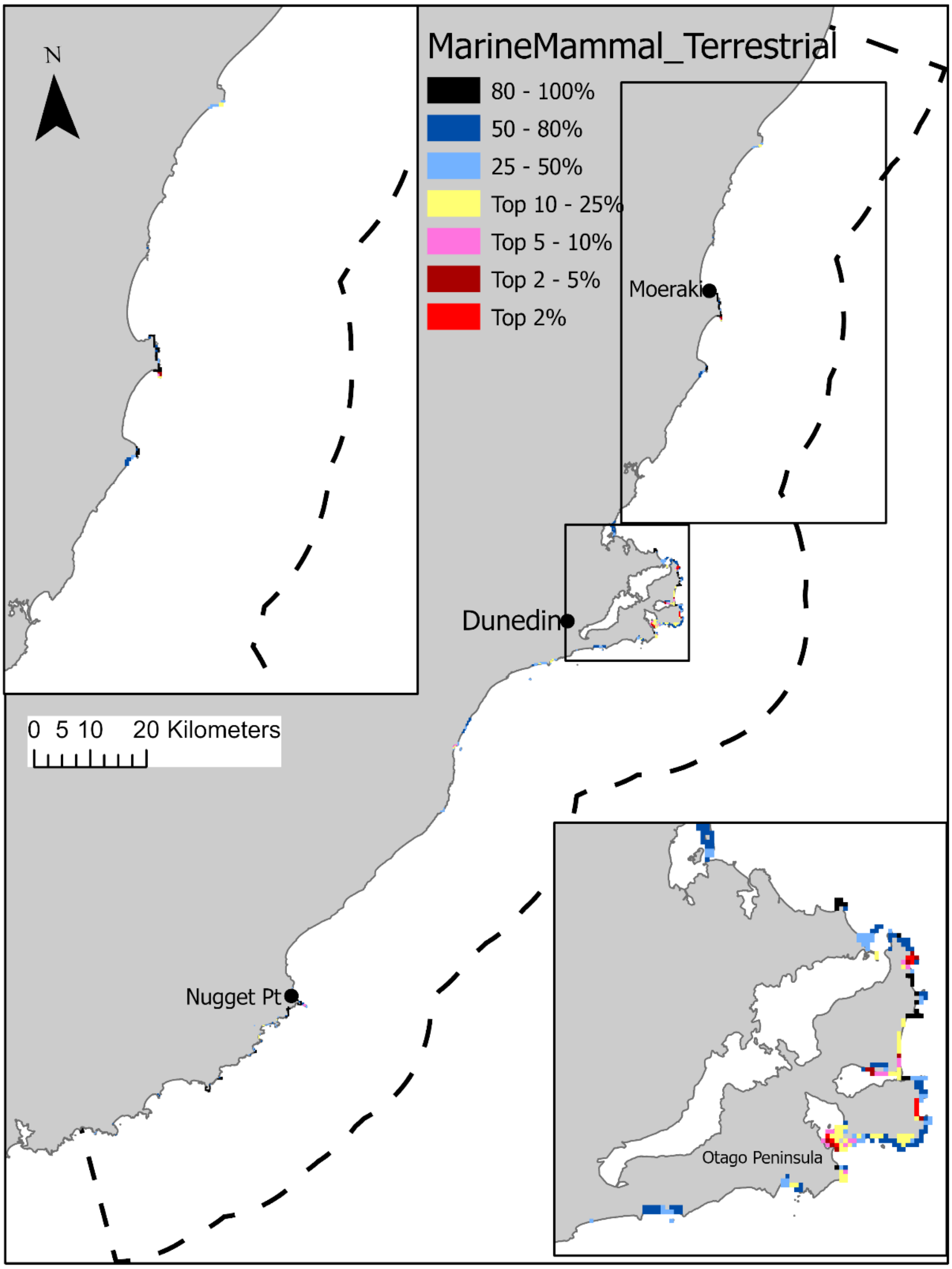
Marine Flora



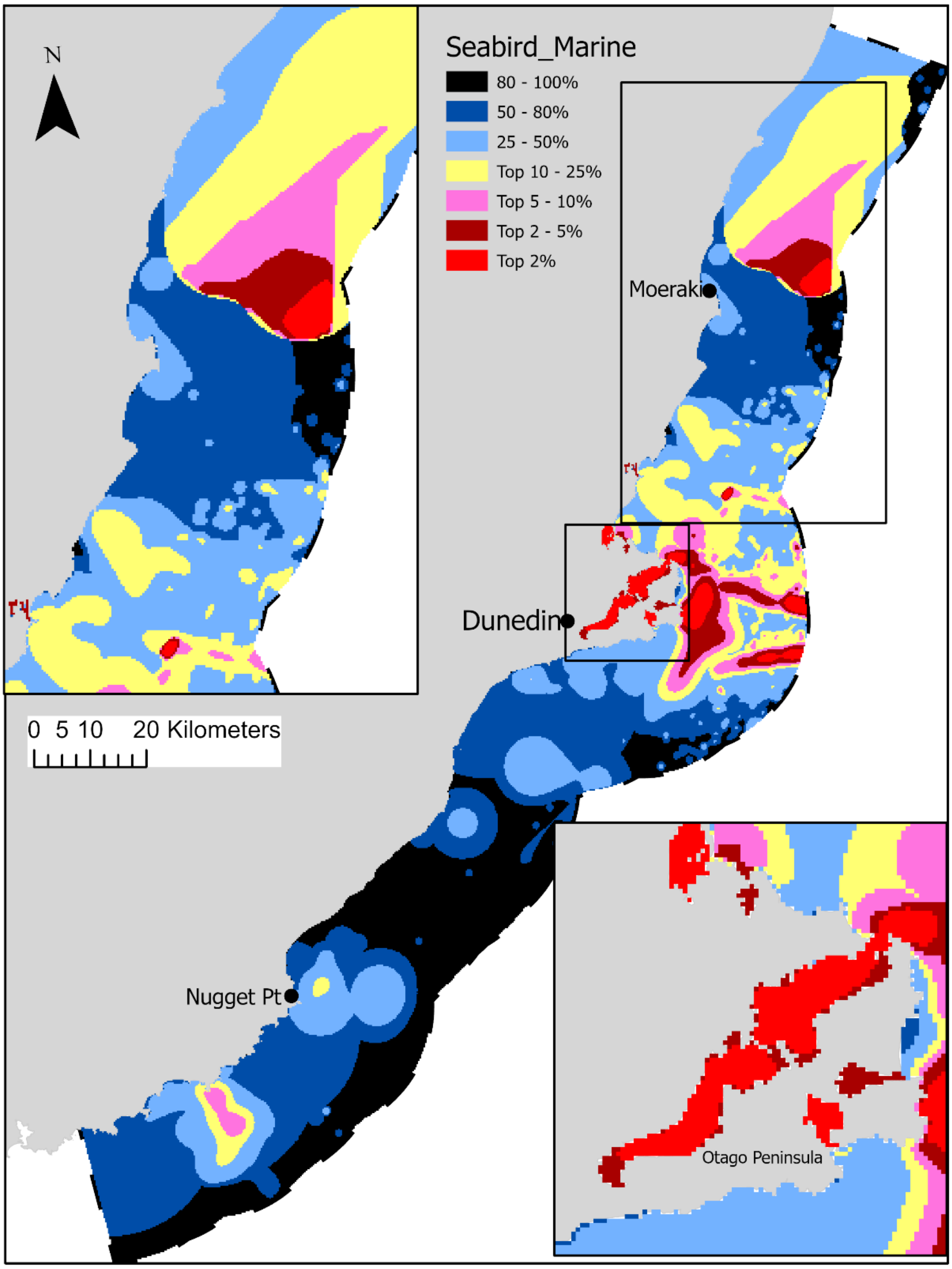
Marine Mammal – Ocean



Marine Mammal – Terrestrial



Shore/seabird – Marine



Shore/seabirds – Terrestrial