Appendix O Seabird (coastal and marine avifauna) effects assessment

Ngāi Tahu Seafood Resources Limited

Hananui Aquaculture Project

Coastal & Marine Avifauna Assessment

Evidence of Dr Leigh Bull regarding '*Hananui Aquaculture Project: Coastal & Marine Avifauna Assessment – Fast Track Approvals*' and Proposed Conditions 38-44

Dr Leigh Bull
11-8-2025

Introduction

My name is Leigh Sandra Bull.

My role in relation to the Hananui Aquaculture Project (“**HAP**”) has been to provide expert evidence in relation to coastal and marine avifauna. I wrote the Hananui Aquaculture Project Coastal & Marine Avifauna Assessment which is provided within **Appendix O** of the application.

This evidence has been prepared to accompany the application by Ngāi Tahu Seafood Resources Limited (“**NTS**”) for approvals required for the HAP under the Fast-track Approvals Act 2024 (“**FTAA**”). It has been prepared on the understanding that the process for determining applications under the FTAA does not require a hearing to be held, and accordingly the purpose of this evidence is to confirm that, relative to my area of expertise, the Hananui Aquaculture Project Coastal & Marine Avifauna Assessment provides an appropriate description of the relevant environment, the proposed activities comprising the effects of the HAP on that environment, and the way those effects are proposed to be managed.

My findings are set out in full in the Hananui Aquaculture Project Coastal & Marine Avifauna Assessment included within **Appendix O** of the application.

While this application is not being considered by the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing this evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Qualifications and Experience

I am a Director and Senior Ecologist with BlueGreen Ecology Limited (BlueGreen).

I hold the qualifications of Bachelor of Science (Zoology), Masters of Science with Honours (Ecology) and PhD (Ecology) from Victoria University of Wellington. The topics of my MSc and PhD theses were kororā / little penguins and shearwaters respectively.

I have worked as a professional ecologist for 20 years (not including 11 years tertiary study). My area of specialisation is ornithology, particularly oceanic and coastal avifauna.

I currently hold 11 DOC Wildlife Act Authorisations to capture, handle and relocate kororā for various coastal projects around New Zealand.

I have significant experience conducting surveys and monitoring of seabirds, coastal and wading birds in New Zealand (mainland, offshore and sub-Antarctic islands), New Caledonia, Tonga and France.

Overall, I have authored (and co-authored) over 20 publications in scientific peer reviewed journals, primarily relating to seabirds.

Before joining BlueGreen in 2023, I was a Partner at Boffa Miskell Ltd (BML), where I worked as a consulting ecologist for 16 years. Prior to joining BML, I held positions at the Department of Conservation (DOC), Université Paris Sud XI, and as an independent contractor to NIWA.

While working for DOC my positions were as a Species Protection Officer in the Biodiversity Recovery Unit, and as a Senior Technical Support Officer in the Marine Conservation Unit. Of note, I undertook a major review of the effectiveness of mitigation measures for seabird bycatch used in New Zealand fisheries (including long line, trawling and set netting). The results of that review were published in two articles (2007 and 2009) in the scientific journal Fish & Fisheries.

Since becoming a consultant ecologist in 2007, I have prepared numerous ecological assessments for major infrastructure projects, and have extensive experience working on the coastal and seabird aspects of a range of projects in the marine and coastal environments including numerous windfarms (onshore and offshore), reclamations, port activities (Whangarei, Wellington and Lyttelton), marina construction, aquaculture and dredging. In preparing my ecological assessments a, I apply the method for undertaking ecological impact assessments as set out in the EIANZ (2018) guidelines.

I have appeared as an expert witness before Council hearings, Environment Court hearings, Board of Inquiry hearings and at a Decision-Making Committee hearing for marine consents associated with Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012, and the Resource Management (Natural and Built Environment and Spatial Planning and Repeal Interim Fast-Track Consenting) Act 2023.

My professional memberships include the New Zealand Ornithological Society and the Environment Institute of Australia and New Zealand (EIANZ). I am a Certified Environmental Practitioner (Ecology Specialist) with the EIANZ and am bound by the Institute's code of ethics.

I served in a voluntary role as the Editor of Notornis, the Ornithological Society of New Zealand's peer-reviewed scientific journal, from 2016 to 2018.

I currently serve in a voluntary role as a subject matter expert to the Shorebirds Trust, a registered charitable trust that invests in scientific research, and funds and co-ordinates conservation efforts aimed to improve coastal biodiversity.

In providing this evidence in relation to coastal and marine avifauna, I have considered the following matters as relevant to that topic:

- The project description provided by NTS as set out in *section 6 of the substantive application*;
- The description of the existing environment, the effects of the HAP on that environment and their significance, and the proposed management and mitigation measures to manage

those effects all as set out in the assessment of environmental effects accompanying the application;

- The following technical assessments have been used in the preparation of my report:
  - Clement (2025). '*Effects of Hananui Aquaculture Project on marine mammals*'. Cawthron Report No. 4171 prepared by Cawthron Institute for Ngāi Tahu Seafood Resources.
  - SLR (2025). '*Water Column Assessment Hananui Aquaculture Project*'. Report prepared by SLR Consulting New Zealand Limited for Ngāi Tahu Seafood.
  - Bennett et al. (2025). '*Assessment of seabed effects associated with farming salmon offshore of northern Stewart Island / Rakiura'*. Report prepared by Cawthron Institute for Ngāi Tahu Seafood Resources.
  - Taylor & Dempster (2021). '*A discussion on the effects of salmon farming on the wild fish fauna of an area in Foveaux Strait and management options for avoiding, remedying, and mitigating any adverse effects including proposed methods for monitoring and investigating the impact of deploying a sea pen salmon farm in the area*'. Report prepared for Ngāi Tahu Seafood Resources.
  - Navigatus (2025). '*Hananui Aquaculture Porject Navigational Risk Assessment*'. Prepared by Navigatus Consulting for Ngāi Tahu Seafood Limited.
  - Bermingham (2025). '*Hananui Proposed Aids to Navigation*'. Report prepared by Navigatus Consulting for Ngāi Tahu Seafood Limited.
  - Gibbs (2025). *'Hananui aquaculture project: Characterisation and assessment of potential impacts on commercial fishing*'. Report prepared by Fathom Consulting Ltd for Ngāi Tahu Seafood Resources Ltd.
  - Isthmus (2025). '*Hananui Aquaculture Project Te Ara a Kiwa, Rakiura: Natural Character, Landscape and Visual Assessment Report*'. Prepared by Isthmus for Ngāi Tahu Seafood Resources Ltd.
  - DSA Ocean (2025). '*Hananui Aquaculture Site – Front-End Engineering Design Report'*. Report prepared by DSA Ocean for Ngāi Tahu Seafood Ltd.

- A wide range of data sources were used to inform my assessment (both habitat and species), including:
  - Published and unpublished material regarding coastal and marine bird species known to occur within the surrounding coastal habitats, as well as information relating to their population estimates, breeding and feeding ecology.
  - Relevant databases (e.g. MPI protected species bycatch records, fisheries seabird observer data, eBird, seabird tracking).

- Records of seabird interactions at existing aquaculture facilities in New Zealand and Australia.
- Species' threat status according to the New Zealand Threat Classification System and IUCN redlist.
- Discussions with and information provided by the Department of Conservation.
- Observations made during my site visit.

Confirmation of Contents of Report and Proposed Conditions

I confirm that in my opinion the Hananui Aquaculture Project Coastal & Marine Avifauna Assessment contain an accurate and appropriate description of the environment, the actual and potential effects of the HAP, and the recommended actions to manage those effects within my area of expertise.

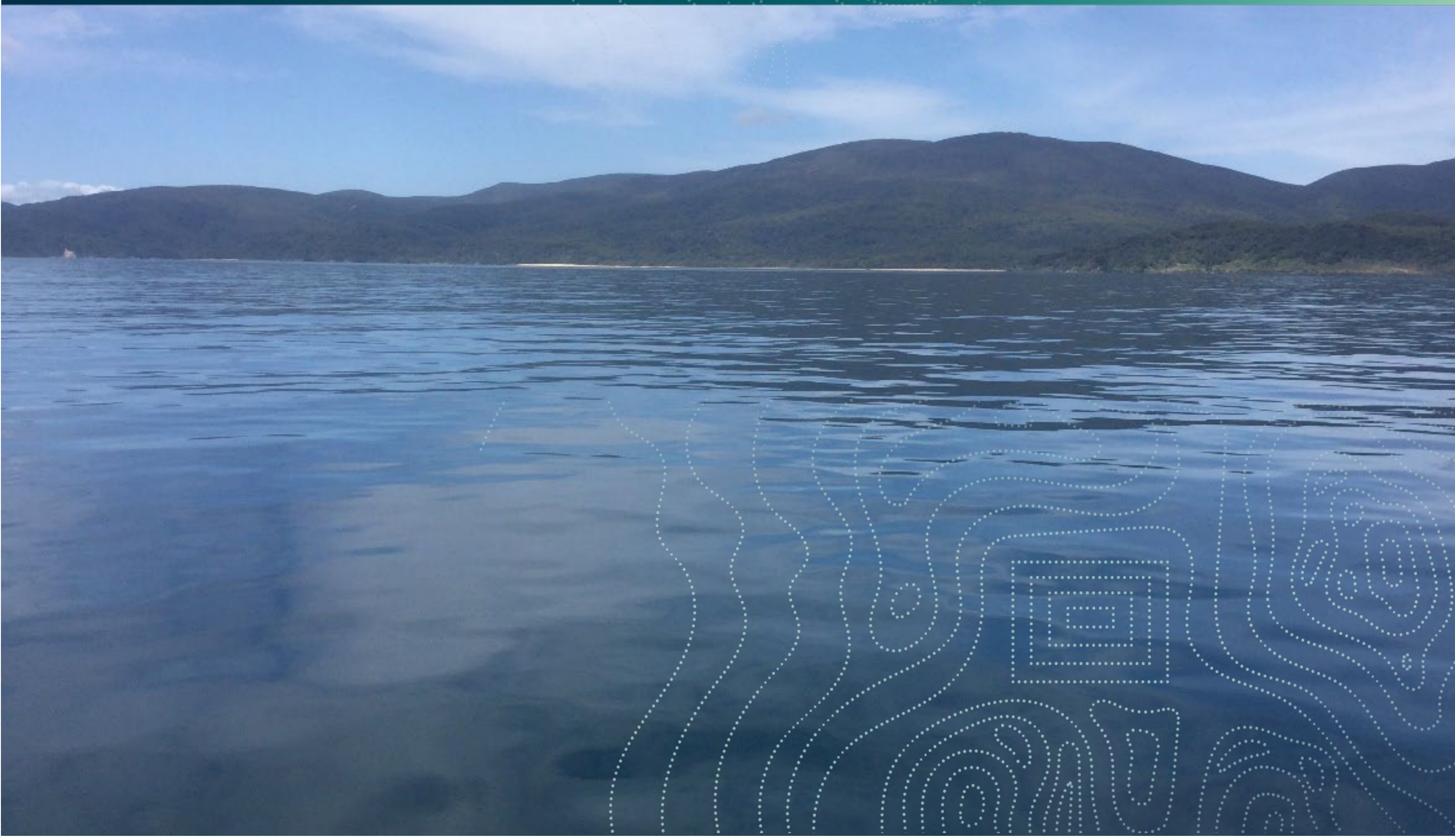
I confirm that in my opinion the contents of the Hananui Aquaculture Project Coastal & Marine Avifauna Assessment may be relied on in making a decision on the approvals sought for the HAP and confirm that provided effects within my area of expertise are managed as proposed in the application those effects will not be unacceptable and will be managed to a standard that I consider meets good practice.

I confirm that I have reviewed the conditions that NTS proposes for the approvals being sought as they relate to my area of expertise. I confirm that in my opinion, those proposed conditions are appropriate.

[redacted]

Dr Leigh Bull
8 November 2025

BlueGreen



Hananui Aquaculture Project

Coastal & Marine Avifauna Assessment – Fast Track Approvals

Prepared for Ngāi Tahu Seafood Resources
8 November 2025

BG2319_Hananui_Aquaculture_project_marine_avifauna_assessment_FastTrack_RevE_20251107

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Prepared by:	Dr Leigh Bull Senior Ecologist / Director BlueGreen Ecology Ltd	[redacted]
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BG2319_Hananui_Aquaculture_project_marine_avifauna_assessment_FastTrack_RevE_20251107

Cover photograph: View over the proposed salmon farm site towards Murray Beach, Rakiura / Stewart Island

Executive Summary

Project Details

- Ngāi Tahu Seafood (NTSR) is proposing to occupy an approximately 1,285 ha area of coastal marine area located 2-6 km off the northern coast of Rakiura / Stewart Island for the Hananui aquaculture project.
- The two-staged exposed coastal water salmon farming project involves the following:
  - Stage 1 - Feed discharge of 15,000 tonnes per annum and the establishment of a block of 10 sea pens (arranged in a 5x2 configuration) at each of the four marine farm sites.
  - Stage 2 - Overall feed discharge rise to 25,000 tonnes per annum with the introduction of a second block of 10 sea pens at each of the four marine farm sites.
- The sea pens will be 168 m circumference polar circle type pens, set at atmaximum net depth of 22 m below the sea surface and a minimum clearance of 5 m between the bottom of the pen and the seabed.
- Single net systems will be used, which are anticipated to be dark coloured, have an underwater mesh size ≤40mm and made of predator resistant materials.
- Bird netting on the surface will be installed using as small a mesh size as possible, and ≤60 mm (knot to knot). Poles (65mm diameter and 5.9 m tall) will be used to maintain the bird netting in place.
- The Hananui Aquaculture Project has adhered to measures, including by minimising and / or mitigating for potential interactions through site selection, design, and operation of farm infrastructure as recommended in Fisheries New Zealand Seabird Guidelines for Open Aquaculture (Gaskin et al., 2021).
- these guidelines having undergone an extensive amount of project shaping over an extended period of time, both in regards to its location, design and operation, in order to seek ways to minimise the potential effects not only on seabirds, but on the environment and all associated ecology.

Methods

- Information was gathered on the ecological values (habitat and species) present at the project site and within the wider area through a combined desktop and field approach.
- The methodology used to undertake this assessment is consistent with the EIANZ guidelines for undertaking ecological impact assessment whereby a matrix combining the magnitude of the

effect and ecological value are used to determine the overall level of ecological effect.

- For this assessment, a species (rather than habitat) approach was taken and we determined the magnitude of effect at the local scale, including Foveaux Strait, Rakiura (and associated offshore islands), Whenua Hou, Ruapuke Island, Solander and Little Solander islands.

Existing Environment

- The Project site forms part of an existing environment (Fovueax Strait and surrounding waters) that has been identified for its marine values, including for seabirds. However, the site itself has not been singled out for its ecological importance relative to elsewhere in this wider environment.
- A total of 97 marine and coastal avifauna species have been recorded utilising the waters surrounding northern Rakiura / Foveaux Strait and the nearby coastlines. Fifty of those 97 species were recorded by multiple data sources, are range restricted in the area, and / or from groups that are considered vulnerable to aquaculture projects. Department of Conservation requested that one further species (not identified in the 50) be included in this assessment based on data obtained from recent tracking studies.
- Fourteen of the 51 species either recorded or potentially occurring in close proximity to the project site have been identified as key species in terms of potentially being impacted by the proposed Hananaui project. These 14 key species include *Threatened* or *At Risk* penguins (hoiho, southern little penguin and Fiordland crested), sooty shearwater / titi, Cook's petrel, diving petrel (southern and Whenua Hou), white-fronted tern, shag (Foveaux, spotted, pied, little and black) and red-billed gull.

Assessment of Effects

- The potential level of effect on the key seabird species was assessed for the following: Entanglement in structures, habitat exclusion, providing roost sites closer to foraging areas, changes to food supply, disturbance, marine litter, vessel / propeller strike, and artificial lighting.
- For most key species the potential negative effects are considered to be Low to Very Low, the exception being a potential Moderate level of effect on Foveaux shag and spotted shag from entanglement and on Whenua Hou diving petrel from attraction to the artificial lighting.

Summary

- The Hananui Aquaculture Project has adhered to measures, including by minimising and / or mitigating for potential interactions through site selection, design, and operation of farm infrastructure as recommended in Fisheries New Zealand Seabird Guidelines for Open Aquaculture (Gaskin et al., 2021).

- The assessment of effects was undertaken on the basis of the implementation of all those measures which are critical to achieving the level of effects identified.
- In line with the EIANZ guidelines for undertaking ecological impact assessments, the overall level of effect has been assessed based on ecological value and magnitude of effect. While the risks of incidents with seabirds will be low and managed by the proposed management programme, many of the seabird species assessed have high or very high ecological. Thus should an incident occur involving species such as hoiho which have a declining population, the consequences would be high.
- Operational monitoring of nets and lighting for potential interactions, especially for Foveaux shag and Whenua Hou diving petrel, will be an important part of the management programme and should be undertaken on a regular basis. Importantly, the Seabird Management Plan will include feedback loops that will make it possible to try to address causes and reduce risks of further incidences should interactions occur.

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Appendix 1: Representative site photos (taken 31 January 2019)
Appendix 2: Rakiura avifauna associated with the marine environment

1.0 Introduction

Ngāi Tahu Seafood (NTSR) is proposing to occupy an approximately 1,285 ha area of coastal marine area located 2-6 km off the northern coast of Rakiura / Stewart Island (refer to Map 1) for the Hananui aquaculture project.

Rakiura is the third largest island of New Zealand and lies approximately 30 km south of the South Island. The proposal site is in Foveaux Strait, which separates Rakiura from the South Island. The strait is about 130 km long (from Ruapuke Island to Little Solander Island), and it widens (from 14 km at Ruapuke Island to 50 km at Te Waewae Bay) and deepens (from 20 to 120 m) from east to west. The strait lies within the continental shelf area of New Zealand.

NTSR engaged BlueGreen Ecology Ltd to undertake an assessment of effects on coastal and marine avifauna for the proposed fin fish farm. This report begins by providing a summary of the project proposal (Section 2.0). The methods used to collect information on which to base the assessment are then outlined (Section 3.0). A description of the existing coastal and marine avifauna environment is then provided (Section 4.0), followed by a summary of the key species that have been identified (Section 5.0). Measures that have been incorporated in to the Project to avoid, minimise and mitigate potential effects on seabirds are described (Section 6.0), followed an assessment of effects of the proposal on the key species identified (Section 7.0).

2.0 Proposal

Fisheries New Zealand published guidelines (‘*Seabird Guidelines*’) for minimising and mitigating the interactions between finfish open ocean aquaculture and seabirds state that the focus is on “*mitigation of interactions through site selection, design, and operation of farm infrastructure*” (Gaskin et al., 2021). The Hananui Aquaculture Project has adhered to these guidelines having undergone an extensive amount of project shaping over an extended period of time, both in regards to its location, design and operation, in order to seek ways to minimise the potential effects not only on seabirds, but on the environment and all associated ecology (e.g. marine mammals, fish, benthic ecology etc.).

2.1 Staged Development & Farm Stocking

The proposed Hananui Aquaculture Project location and layout is shown in Figure 1 below. The Project will comprise four farms (1-4 as shown in Figure 1). The two-stage exposed coastal water salmon farming project involves the following:

- Stage 1 - Feed discharge of 15,000 tonnes per annum and the establishment of a block of 10 sea pens (arranged in a 5x2 configuration) at each of the four marine farm sites.
- Stage 2 - Overall feed discharge rise to 25,000 tonnes per annum with the introduction of a second block of 10 sea pens at each of the four marine farm sites.

Moving to Stage 2 would be subject to environmental monitoring over two production cycles at the Stage 1 feed input.

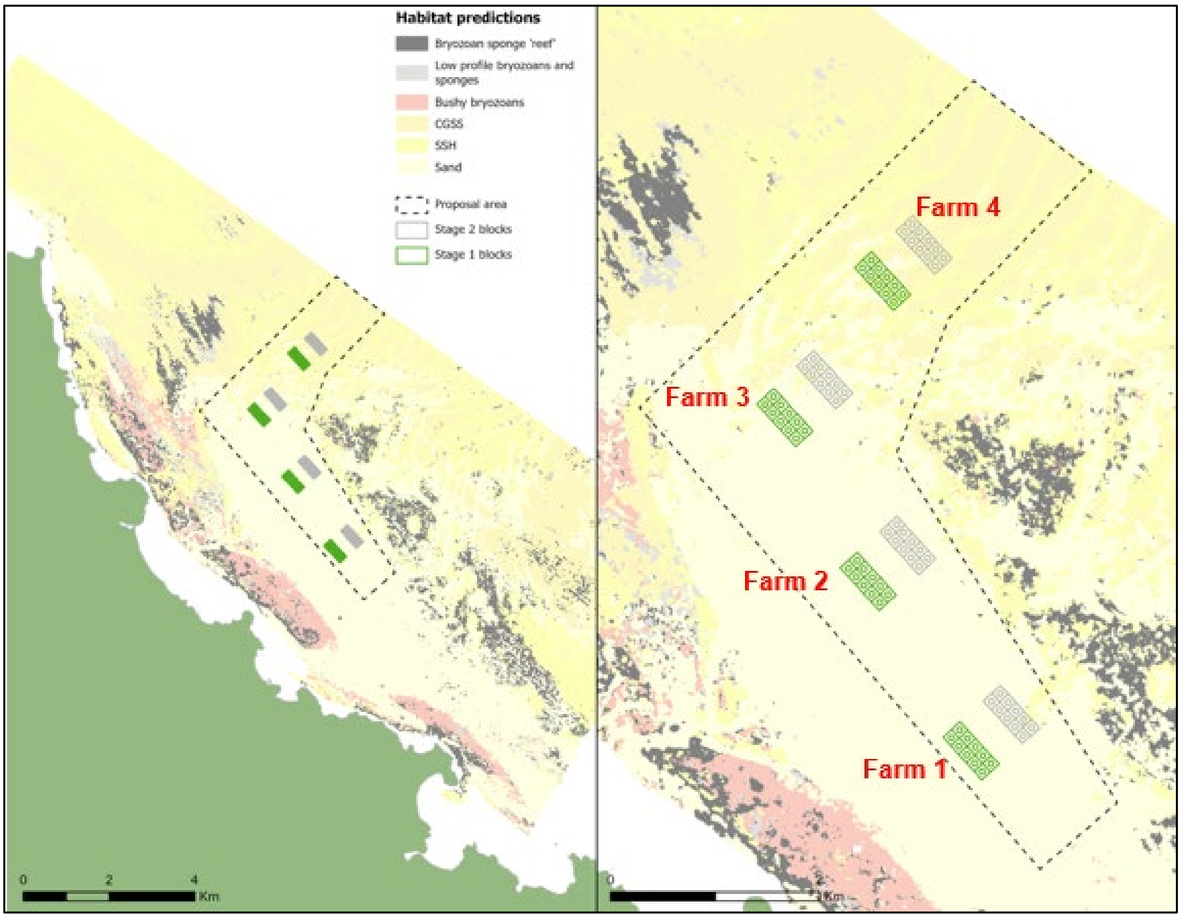

Figure 1: Proposed location and layout of the Hananui Aquaculture Project

Farm stocking is proposed to be on a single year class rotational basis so that in general:

- One farm has stock introduced;
- One farm is at grading;
- One farm is at harvest; and
- One farm is fallow

2.2 Sea Pens

Sea pens are proposed to be installed in blocks of 10 pens (arranged in a 5x2 configuration; refer to Figure 1 above), using 168 m circumference polar circle type pens (e.g. ScaleAQ 168 m circumference Midgard Predator Solution (MPS)). Each marine farm would consist of two blocks of pens, located at least 300 m apart.

The maximum net depth will be 22 m below the sea surface, with a minimum clearance of 5 m between the bottom of the pen and the seabed, the net depth will be adjusted based on site depth to allow for the minimum clearance at each site, and are anticipated to be dark coloured. NTS intend to use a single net system, with an underwater mesh size ≤40mm (knot-to-knot), using predator resistant materials in the construction of nets. Each net would also have a 'false' bottom separated from the outer net to catch dead fish or a mortality collection system that would hold/contain them away from access to marine species swimming underneath the pens. Bird netting on the surface will be installed using as small a mesh size as possible[1], and ≤60 mm (knot to knot). Poles (65 mm diameter and 5.9 m tall) will be used to maintain the bird netting in place.

2.3 Feed Barges & Vessel Traffic

There will be one feed barge associated with each marine farm, moored equidistant between the two blocks of sea pens at each farm.

Up to two of the barges may be used for onsite accommodation, and human sewage generated on board will be retained and removed to shore for disposal.

Feed barges provide feed to each sea pen by feed blowers that blow feed/pellets through floating pipes to a rotor spreader that distributes feed throughout the pen. Real-time camera monitoring of the water column within the pens allows the feeding response to be monitored, and feed provision adjusted to minimise wastage.

In addition to feed barges, other vessels associated with the salmon farm, and which will transit across the strait, are listed in Table 1 below.

Table 1: Summary of vessels that will be transiting between port and salmon farm

VESSEL No. & LENGTH	VESSEL FUNCTION	FREQUENCY TRANSITING THE STRAIT
4 x <18m	Net cleaning etc	As required for maintenance
1 X 30m	Harvest	Daily
1 X 30m	Support	Daily
1 X 86m	Feed	Daily

2.4 Anchoring System

Indicative mooring designs are included in DSA Ocean (2025) and associated drawing set. In summary:

- Each 10-pen grid will be secured to a submerged mooring grid (110 m × 110 m spacing) set at 6 m depth, which is itself moored to the seabed with an array of moorings and anchors
- 26 mooring lines and anchors are required for each block of sea pens;
- Grid lines, bridles and buoy lines are also required to hold the sea pens in configuration. The mooring grid consists of a combination of anchor chain and mooring line, rising to a node plate on the mooring line grid for the pens. Each of the net pens is then connected to the mooring grid at the node plates. Node plates are connected to each other by grid lines. Each node plate is maintained in position in the water column by compensator buoys on the sea surface, attached to the node plate by buoy lines;
- Feed barges would be moored using 8 anchor chains.

[1] The ideal mesh size should: maintaain visibility for diving birds, reduce engineering loading and wind resistance, minimise the risk of entanglement, and limit the surface area available for perching birds , thereby reducing the risk of net sagging.

Some minor disturbance of the seabed is likely to occur as part of the installation of the anchoring systems, although any disturbance will be temporary in nature and restricted to the immediate area of each anchor and anchor block (where required).

2.5 Sea pen Lighting

Submerged artificial lighting is used in marine farming of salmon to delay the maturation of the fish by removing the trigger provided by shortening daylight hours in nature. For sea pens of the size proposed by Ngāi Tahu Seafood, current advice from marine farming structure providers is that up to eight, 680W LED lights may be required for each pen. Lights are generally installed at a depth of approximately 5 m below the water surface and designed to direct light downwards to the maximum extent possible. Lights will run from around 3pm – 9am for salmon between 50g – 3kg, with the use of underwater lighting across the site varying as single year classes are grown at each farm.

Recent studies at New Zealand King Salmon's Kopaua salmon farm in Pelorus Sound (which has six 640W LED lights installed in each pen) found the illuminated footprint of each light was approximately 3 m wide, with measurable light confined to within the pens and a 'slight glow' visible from 10 m beyond the pens. Light levels were too low at the surface to be measured by a light meter, both within the pen and at a distance of 10 m away from the pen.

2.6 Aids to Navigation

Seabirds can be attracted to artificial lights. As such, the following outlines the proposed aids for navigations for the Hananui Project (Bermingham, 2025; Navigatus, 2025), subject to approval from the Environment Southland Harbour Master, as follows:

- Four black and yellow cardinal markers, as identified by the yellow dots in Figure 2. The southern cardinal mark should be placed on or just south of Newton Rock so as to mark the general southern extremity of the proposed marine farming area whilst also indicating the hazard that is Newton Rock;
- The cardinal markers will each have a white light with different sequences (detailed in Table 2).
- Special marks on the four corners of each 5x2 block of pens with two of the four being lit. The lit special marks shall be the northernmost and southernmost corners. This lighting will need to be changed between stages 1 and 2 where the special marks will be altered to mark each pair of 5x2 marine farms collectively.

Table 2: Lighting characteristics for proposed cardinal marks (Source: Bermingham (2025))

POSITION	LIGHT COLOUR & SEQUENCE	NOMINAL LIGHT RANGE (nm)
North	White light, Very Quick (VQ) or Quick (Q) flash.	6
East	White light, VQ(3) every 5 seconds or Q(3) every 10 seconds.	3
South	White light, VQ(6) + long flash every 10 seconds or Q(6) + long flash every 15 seconds.	3

POSITION	LIGHT COLOUR & SEQUENCE	NOMINAL LIGHT RANGE (nm)
West	White light, VQ(9) every 10 seconds or Q(9) every 15 seconds.	3

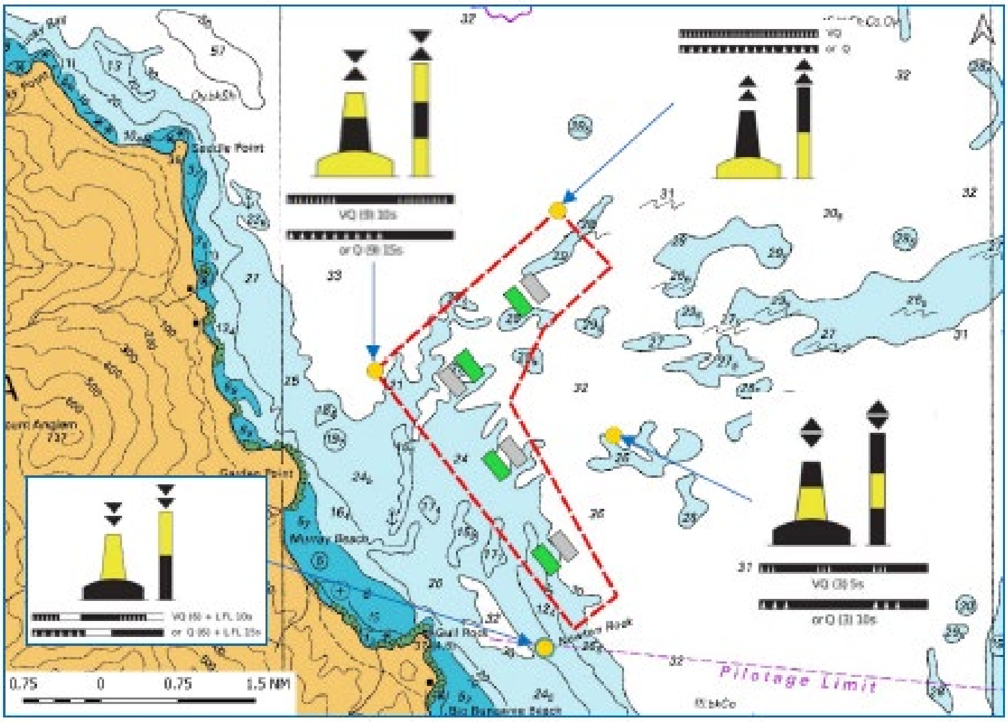

Figure 2: Proposed aids to navigation around proposed site (Source: Bermingham (2025))

3.0 Methods

In order to conduct an assessment of the potential effects of the proposal on coastal and marine avifauna, information was gathered on the ecological values (habitat and species) present at the project site and within the wider area through a combined desktop and field approach as described below.

3.1 Desktop Investigation

The desktop data sources that were accessed included:

- LITERATURE SEARCH: Both published and unpublished material was sourced to obtain additional information regarding coastal and marine bird species known to occur within the surrounding coastal habitats, as well as information relating to their population estimates, breeding and feeding ecology.

- PROTECTED SPECIES BYCATCH: Records collected by Ministry for Primary Industries (MPI) of protected species bycatch[2] in New Zealand commercial fishing operations, including FMA5 (Southland).
- FISHERIES SEABIRD OBSERVER DATA: At-sea data regarding seabird distribution and abundance collected by government Fisheries Observers on board fishing vessels around NZ between 2007-08 to 2018-19 (Richard et al., 2020) (refer to Map 2 for NZ fisheries observer data points).
- eBIRD:[3] Data were downloaded from the eBird website (refer to Map 2 for eBird data location points).
- SEABIRD TRACKING DATABASE: Tracking data (GPS, PPT or GLS) for a number of seabird species collected by various researchers from around the globe.
- HUON AQUACULTURE: Records of seabird interactions with Huon aquaculture farms between July 2019 and April 2024.
- NEW ZEALAND KING SALMON MARINE WILDLIFE INTERACTIONS: Reported[4] seabird interactions at inshore salmon farms between January 2019 and March 2025.
- Species' threat status according to the New Zealand Threat Classification System (H. A. Robertson et al., 2021).
- Forest & Bird Important Bird Areas (IBAs).

As such, we have explored all the relevant data sources that we are aware of in order to obtain as much information as possible regarding seabird species abundance, distribution and utilisation of and adjacent to the project site.

3.2 Field Investigation

A site visit to the project site and adjacent shoreline was undertaken by the report author on 31 January 2019. The vessel departed Bluff Port at 09:15 hr and took approximately two hours to reach Murray Bay. A zodiac was taken ashore to Murray Beach (northern end) at 12:45 hr and an active search for nesting seabirds (particularly penguins) was undertaken behind the dunes along the length of the Bay. The zodiac was then driven close to the shoreline from Murray Bay to Port William/ Potirepo at a low speed so that species and habitat observations could be made along that entire coastline. Representative site photos are provided in Appendix 1.

Conditions for the field survey were ideal, being warm and calm, scattered cloud cover and a slight northerly breeze.

The objective of the survey was to identify the coastal and marine avifauna habitat (including terrestrial nesting habitat), compile a species list and make behavioural observations. Any species identified during this trip were recorded, including a note relating to the bird's location, activity (i.e. roosting, traversing, foraging, nesting) and approximate numbers present.

[2] https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/managing-the-impact-of-fishing-on-protected-species/seabirds-and-protected-marine-species-caught-by-commercial-fishers/

[3] https://ebird.org/home

[4] https://www.kingsalmon.co.nz/our-environment/

3.3 Data Constraints

Marine avifauna are inherently difficult to study due to the remote locations in which they inhabit both on land and at sea. However, the data sources we have interrogated span the period 1999-2025 and are therefore likely to provide a realistic base list of avifauna species utilising the wider Foveaux Strait area and therefore potentially present at or near the project site.

Nevertheless, the following data constraints have been identified and taken into consideration for this assessment:

- POPULATION ESTIMATES: There is no single source for obtaining seabird population estimates, both local and national. Furthermore, population estimates aren't available for some species, or in other cases only historic estimates are available. The population estimates reported here have been obtained from a number of resources which will have used a variety of survey techniques (including effort, time of year, count method etc). As such, these estimates should be viewed in the context of the order of magnitude, not exact numbers.
- FISHERIES OBSERVER DATA: Richard et al. (2011) note that species identification in the data set should be treated with caution and that *"All the data were collected from fishing vessels and the counts will depend on the distribution of the seabird taxa, how attracted they are to fishing vessels, the visibility of the birds, how readily they may be identified, and the distribution of observed fishing effort. In general, inshore species will be underrepresented as observer coverage on inshore fishing vessels has been relatively low…Seabirds were identified to the most accurate taxonomic level possible. Because of the inherent difficulties of counting seabirds around vessels, the variation in the experience of observers, and changes in the protocol with time, the counts should be regarded as indicative only. The data will inevitably contain misidentified birds, and errors in transcribing the raw counts*."
- PROTECTED SPECIES BYCATCH: Like fisheries observer data, bycatch data can be biased by species that are attracted to vessels.
- eBIRD: A citizen science, global, on-line checklist database programme. Observations of single birds through to checklists of all birds seen at a location are submitted to the website. As such, data is collected by a number of people with varying levels of species identification skills and there is no standardised method in terms of survey effort or coverage. Observation locations are also biased towards more accessible sites. Therefore, the absence of a species in a certain area may not be considered as a true absence of the species.
- SEABIRD TRACKING DATABASE: The data shown in the mapping tool is raw data (filtered to remove erroneous locations in case of PTT and GLS data), corresponding to a small sample of the species' overall populations. Therefore, the absence of a species in a certain area may not be considered as a true absence of the species. Furthermore, the frequency with which data points are set to be collected differs between studies; those set to record more frequently will record more accurate paths due to the greater number of fixes.

- SITE VISIT (2019): The data collected during the January 2019 site visit represents a snapshot of the species and habitat utilisation of the area at that time and does not account for temporal and seasonal variability that is likely to occur. However, the survey was conducted near the end of the seabird breeding season, when marine birds may still be making trips between nesting and foraging habitats.

3.4 Supporting Information

In addition to the information collected through a site visit and desktop investigation of relevant literature and databases (refer to Appendix 2), this assessment has been based on the information provided in the following supporting documents and plans:

- Clement (2025). '*Effects of Hananui Aquaculture Project on marine mammals*'. Cawthron Report No. 4171 prepared by Cawthron Institute for Ngāi Tahu Seafood Resources.
- SLR (2025). '*Water Column Assessment Hananui Aquaculture Project*'. Report prepared by SLR Consulting New Zealand Limited for Ngāi Tahu Seafood.
- Bennett et al. (2025). '*Assessment of seabed effects associated with farming salmon offshore of northern Stewart Island / Rakiura'.* Report prepared by Cawthron Institute for Ngāi Tahu Seafood Resources.
- Taylor & Dempster (2021). '*A discussion on the effects of salmon farming on the wild fish fauna of an area in Foveaux Strait and management options for avoiding, remedying, and mitigating any adverse effects including proposed methods for monitoring and investigating the impact of deploying a sea pen salmon farm in the area*'. Report prepared for Ngāi Tahu Seafood Resources.
- Navigatus (2025). '*Hananui Aquaculture Porject Navigational Risk Assessment*'. Prepared by Navigatus Consulting for Ngāi Tahu Seafood Limited.
- Bermingham (2025). '*Hananui Proposed Aids to Navigation*'. Report prepared by Navigatus Consulting for Ngāi Tahu Seafood Limited.
- Gibbs (2025). *'Hananui aquaculture project: Characterisation and assessment of potential impacts on commercial fishing*'. Report prepared by Fathom Consulting Ltd for Ngāi Tahu Seafood Resources Ltd.
- Isthmus (2025). '*Hananui Aquaculture Project Te Ara a Kiwa, Rakiura: Natural Character, Landscape and Visual Assessment Report*'. Prepared by Isthmus for Ngāi Tahu Seafood Resources Ltd.
- DSA Ocean (2025). '*Hananui Aquaculture Site – Front-End Engineering Design Report'*. Report prepared by DSA Ocean for Ngāi Tahu Seafood Ltd.
- DSA Ocean Drawing set DSA-NAGI-25FEED-REVC.0:
  - Sheet 1 'Site Arrangement', dated 2025-08-25;
  - Sheet 2 'Site Arrangement Alternative Farm Positions', dated 2025-08-25;
  - Sheet 3 'Grid Hardware', dated 2025-08-25;
  - Sheet 4 'Lead Mooring Anchoring Elevation', dated 2025-08-25;

    - Sheet 5 'Non-lead Mooring Anchoring Elevation', dated 2025-08-25;
    - Sheet 6 'Grow-out Cage Navigation Elevation', dated 2025-08-25;
    - Sheet 7 'Feed Barge Hardware', dated 2025-08-25;
    - Sheet 8 'Feed Barge Anchoring Elevation', dated 2025-08-25;
- Steinsvik Orbit LED product sheet[5]
- Regional Coastal Plan for Southland (Environment Southland, 2013).

3.5 Ecological Assessment Methodology

The potential direct and indirect ecological effects considered for this ecological assessment include:

- Entanglement in structures;
- Habitat exclusion;
- Providing roost sites closer to foraging areas;
- Changes to food supply;
- Disturbance;
- Marine litter;
- Vessel / propeller strike; and
- Artificial lighting.

The methodology used to undertake this assessment is consistent with the EIANZ guidelines for undertaking ecological impact assessments. Given both the 1st and 2nd editions of the EIANZ guidelines (EIANZ, 2015; Roper-Lindsay et al., 2018b) were for use in New Zealand terrestrial and freshwater ecosystems, an addendum to the guidelines was recently published for the purpose of assigning ecological value to marine benthic habitats (EIANZ, 2024).

The EIANZ approach uses a matrix to determine the overall level of ecological effect (Table 3) by combining the magnitude of the effect in association with the ecological values.

Table 3: Criteria for describing the level of effect (Roper-Lindsay et al., 2018b)

LEVEL OF EFFECT		ECOLOGICAL VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

[5] https://www.steinsvik.no/en/products/e/seaculture/seaculture-equipment/lights

The EIANZ guidelines allow either a species or habitat approach to be applied to impact assessments; on that basis, for the current assessment, a species (coastal and marine avifauna) approach has been applied in order to capture the potential impacts on individual species rather than the habitat as a whole. Given the diversity and high conservation values of the coastal and marine avifauna inhabiting Foveaux Strait, and potential the Project site, a species, rather than a habitat focus was considered to be a more conservative approach. Furthermore, it would be enable teasing out of individual difference in risk profile.

In terms of ecological value, as noted in Section 5.1.4 of the EIANZ guidelines, this is assigned for any given site, at all or some of the following levels of organisational scale:

- Species;
- Assemblage or communities;
- Habitats fof fauna.

As noted in the EIANZ guidelines, the focus of assigning value to species is usually 'conservation concern', and the system for classifying threats to New Zealand species, by assessing risk of extinction, is the New Zealand Threat Classification System. Table 5 in the EIANZ guidelines (replicated in Table 4 below) outlines the factors that can be used to assign ecological values, which includes the New Zealand threat classification. Robertson et al. (2021) provides the most recent threat classifications for avifauna and as such has been used when assigning values to individual species. We note that the species identified in the New Zealand Coastal Policy Statement (Department of Conservation, 2010) Policy 11a(i), that is, *Threatened* or *At Risk* species in the New Zealand Threat Classifications System lists are captured under the EIANZ Very High, High or Moderate ecological value criteria.

Table 4: Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018b).

ECOLOGICAL VALUE	DETERMINING FACTORS
Very High	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI[6] either permanently or seasonally.
High	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
Moderate	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the ZOI either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
Low	Nationally and locally common indigenous species.
Negligible	Exotic species, including pests, species having recreational value.

Table 5 lists the criteria and descriptions for determinising the magnitude of effect as described in the EIANZ guidelines (Roper-Lindsay et al., 2018b). As noted above, this assessment has taken a species rather than habitat focus, and as such the population criteria (text italicised and bolded in for Table 5) has been applied for the assessment of effects. For the purpose of this assessment, we have determined the magnitude of effect at the local scale, including Foveaux

[6] Roper-Lindsay et al. (2018b) define the Zone of Influence (ZOI) as "*the areas/resources that may be affected by the biophysical changes caused by the proposed project and associated activities.*"

Strait, Rakiura (and associated offshore islands), Whenua Hou, Ruapuke Island, Solander and Little Solander islands. However, we note that the EIANZ guidelines state that generally, "*the magnitude of effects will be assessed at the same scale as the value assessment*" (e.g. feature / site, Ecological District, national etc). However, this is very rarely possible as there are very few New Zealand regions for which species regional threat classifications have been determined. As such we have used a national value classification in combination with a local magnitude of effect. The population proportion thresholds that have been applied to each magnitude level are as follows:

- Very High: >50% of the population affected;
- High: 20-50% of the population affected;
- Moderate: 10-20% of the population affected;
- Low: 1-10% of the population affected;
- Negligible: <1% of the population affected.

Table 5: Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018b)

MAGNITUDE	DESCRIPTION
Very High	Total loss of, or very major alteration, to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR ***Loss of a very high proportion of the known population*** or range of the element / feature.
High	Major loss or major alteration to key elements/ features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR ***Loss of a high proportion of the known population*** or range of the element / feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR ***Loss of a moderate proportion of the known population*** or range of the element / feature.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR ***Having a minor effect on the known population*** or range of the element / feature.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the "no change" situation; AND/OR ***Having a negligible effect on the known population*** or range of the element / feature.

4.0 Existing Environment – Coastal & Marine Avifauna

All of the coast of Rakiura, its offshore islands, and all the waters within 5 km of the mean high water mark (except Big Glory Bay in Paterson Inlet) have been identified by the Department of Conservation as areas containing significant values (ACSVs) (Environment Southland, 2013). The project site is located within ACSV 14-15 which includes "*3 km seawards from land (MHWS) and encompassing all offshore stacks and rocks around the northern coast of Stewart Island, between Mason Head and northern shore of Horseshoe Bay*" (Environment Southland, 2013).

The waters around Rakiura, some 7,811 km^2, have also been identified as an Important Bird Area (IBA) (Forest & Bird, 2014) with regards to providing foraging and passage for a number of marine birds. Similarly, the following areas on land have been identified as coastal and island IBAs: Raratoka Centre Island (NZ113), Ruapuke (NZ114),Fife Rock (NZ115), Solander Islands (NZ116), Whenua Hou Codfish Island (NZ117), Northern Titi Muttonbird Islands (NZ118), North Coast Rakiura (NZ119), Paterson Inlet The Neck (NZ120), Port Adventure (NZ121), Port Pegasus (NZ122) and Southern Titi Muttonbird Islands (NZ123) (Forest & Bird, 2015). A number of breeding and resident coastal and marine birds inhabit these areas.

Thus, the Project site forms part of an existing environment that has been identified for its marine values, including for seabirds. However, the site itself has not been identified in by either Environemtnal Southland or Forest & Bird for its ecological importance relative to elsewhere in this wider environment.

A total of 97 marine and coastal avifauna species have been recorded utilising the waters surrounding northern Rakiura / Foveaux Strait and the nearby coastlines (refer to Appendix 2 for species list and Map 2 for survey / data source locations). The Fisheries Observer data recorded 42 species around Rakiura (refer to Appendix 2 for species list, and Map 3 for distribution). Species diversity was greatest in the spring and summer periods (refer to Map 4). With respect to overall bird abundance, the highest numbers were recorded to the south-east and north-west of Rakiura (refer to Map 5). As was the case for species diversity, bird abundance was generally higher in the spring and summer months (refer to Map 6). This pattern of higher species diversity and bird abundance during the spring and summer months is to be expected as it coincides with the breeding season when birds are likely to remain closer to their breeding colonies (i.e. Rakiura and offshore islands).

Sections 4.1-4.7 below provide details of 50 species which have been recorded by multiple data sources, are range restricted in the area, and / or from groups that are considered vulnerable to aquaculture projects. In addition, the the Department of Conservation requested that one further species be included in this assessment. An overview of each the 51 species' breeding and feeding ecology relevant to this assessment is provided in order to better identify the level of risk posed to individual species by the proposal.

4.1 Penguins

In terms of foraging distribution and technique, Shealer (2002) classifies the Spheniscidae family, which penguin belong to, as coastal-inshore pursuit divers.

4.1.1 Hoiho / yellow-eyed penguin

Approximately 20 obsevations of hoiho / yellow-eyed penguin (*Megadyptes antipodes*) were made at sea during the boat trip from Bluff to Rakiura in 2019, some of which were within the project site. Distribution records of hoiho from the GIS databases are shown on Map 7.

Hoiho is a New Zealand endemic species which is classified as *Threatened – Nationally Endangered* (H. A. Robertson et al., 2021). There are estimated to be around 1,260 breeding pairs, with the majority of these in the subantarctic on Auckland and Campbell islands.[7] Hoiho breed in coastal forest and scrub (Chilvers et al., 2014).

[7] Estimated population size provided by Depaartment of Conservation to NTS

King et al. (2012) estimated 107-123 breeding pairs on Rakiura and its outliers. Nesting locations historically recorded adjacent to the project site include Rollers, Murray Beach, Golden Beach, Big Bungaree Beach and Sawyers Beach (Darby, 2003; Massaro & Blair, 2003; Moore, 1991) (refer to Map 7). King et al. (2012) reported a decline in the number of breeding pairs on the northern coast of Rakiura by 27% between 1999 and 2008. A survey of hoiho nests along the Anglem Coast during the 2019/20 season recorded a further decline (King et al. (2020); refer to Figure 3 below). During that survey, a total of 20 eggs were found in 11 nests at Rollers and Golden Beaches. While 15 chicks hatched, only one chick fledged; this equates to productivity rate of 0.09 for the Anglem Coast. No nests were observed during the January 2019 site visit to Murray Beach.

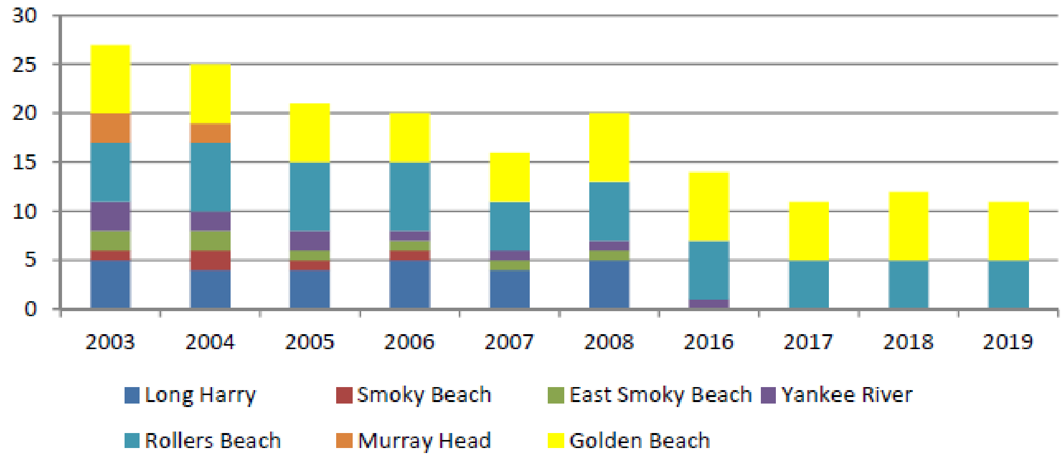

Figure 3: Number of hoiho nests recorded during surveys at Anglem coast sites between 2003 and 2019 (Source: Figure 4 in King et al. (2020))

A subsequent hoiho survey undertaken during the 2020/21 breeding season along the northern coast reported a further decrease in numbers, with only two nests recorded along the Anglem coast; both nests were at Rollers Beach, with none recorded at Golden Beach (YEPT, 2021b, 2021a).

A survey during the most recent breeding season (2024/25) recorded nests on Rakiura (n=20) and Whenua Hou (n=6). On Rakiura the majority of nests (n=13) were in Paterson Inlet, with a small numbers of nests along the south east and north east coasts. The following results were recorded[8] for the Anglem Coast:

- Rollers Beach was searched in October, during the nesting period. Two nests were found, and additional evidence of non-nesting adult birds.
- Long Harry Bay was searched in early December. Evidence of hoiho activity was found, but no active nest.
- Golden Beach was visited in mid-December. No indication of hoiho presence was found.

Based on the most recent (2024/25) nest counts across coastal Otago, Southland, and Rakiura, show that this northern hoiho population has experienced a decline of approximately 80% since

[8] pers. comm. S. Lancombe, DOC, 18 June 2025.

2008/09[9]. The declining numbers have been attributed to a number of factors including human disturbance, introduced predators, habitat quality, malnutrition (likely driven by increasing sea temperatures), bycatch in set nets and disease[10].

Hoiho breeding sites in close proximity to the existing Big Glory Bay salmon farm include Ulva Island (approximately 5 km), Tommy Island (approximately 3 km) and Bravo Island (approximately 1.3 km) (Darby, 2003).

Egg laying takes place between mid-September and mid-October; chicks hatch in early November and leave for sea in mid-late February (Dilks & Grindell, 1990). Adults undertake only short (1-32 days) foraging trips away from the breeding area (Marchant et al., 1990), thereby returning regularly to land.

In general, hoiho forage from the inshore to mid-shelf region. At least two studies have been undertaken over the past 20 years tracking hoiho from Golden and Rollers beaches (Mattern, 2006; Seed, 2018). Mattern (2006) deployed GPS loggers on 3 and 5 adults at Golden Beach in January 2005 and November 2005 respectively, and on 2 birds at Rollers Beach in November 2005. Mattern (2006) reported that the birds generally remained in shallow water (<20 m) within 8 km of the coast; one bird was recorded undertaking two foraging trips on consecutive days, during which the bird foraged very close to its breeding site (maximum distance from colony was 2.3 km) and very close inshore. Seed (2018) deployed video loggers on four breeding birds from Golden Beach and four from Rollers Beach in 2016; however GPS data was only attained for three birds from Golden Beach. That data showed that foraging effort was contained to the inshore waters off the Anglem Coast, including offshore from Murray Beach.

Tracking studies of six birds from the Bravo Group during November – December 2019 reported three birds foraging exclusively within Big Glory Bay (Mattern & Ellenberg, 2021; Mattern & Young, 2019), which is the site of existing aquaculture activities (including mussel and salmon farming). Interestingly, the three birds foraged in the vicinity of mussel farms, but no birds foraged under the salmon farms (refer to Figure 4 below).

Elley et al. (2022) fitted 19 adult breeding yellow-eyed penguins from Port Pegasus (Pigeon House Bay), Paterson Inlet (Groper Island within the Bravo Group), and Whenua Hou (Sealers Bay) with GPS-TDR dive loggers during the 2020/21 breeding season to track their movements and diving behaviours. Penguins from each site exhibited intra-site and inter-annual consistency in preferred foraging locations (Elley et al., 2022; Mattern & Ellenberg, 2022). Thus, as noted by Elley et al. (2022), these results show that foraging locations at one site cannot be used to assess habitat use by penguins at other sites.

Dive depths of 40-120 m indicate that they feed predominantly near the seafloor (benthic), obtaining bottom-dwelling fish species such as sprat, spotty, red cod, opalfish, ahuru, silversides and blue cod, plus cephalopods and crustaceans (Mattern et al., 2007, 2013; Mattern & Ellenberg, 2022; Moore, 1999; Moore & Wakelin, 1997; Seddon & van Heezik, 1990; van Heezik, 1990). Mattern & Ellenberg (2022) noted that hoiho do engage in pelagic foraging when the opportunity arises. Chilvers et al. (2014) study of diving behaviour of hoiho from Rakiura reported birds foraging predominantly in the late afternoon with a mean dive depth of 61 m, and with the majority of dives concentrated between 3-20 m (63%) and 80-100 m (16%).

[9] https://www.doc.govt.nz/news/media-releases/2025-media-releases/hoihoyellow-eyed-penguin-nest-numbers-down/#:~:text=Nest%20numbers%20are%20only%20part%20of%20the,low%20reproductive%20rate%20and%20low%20juvenile%20survival.

[10] https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/penguins/yellow-eyed-penguin-hoiho/

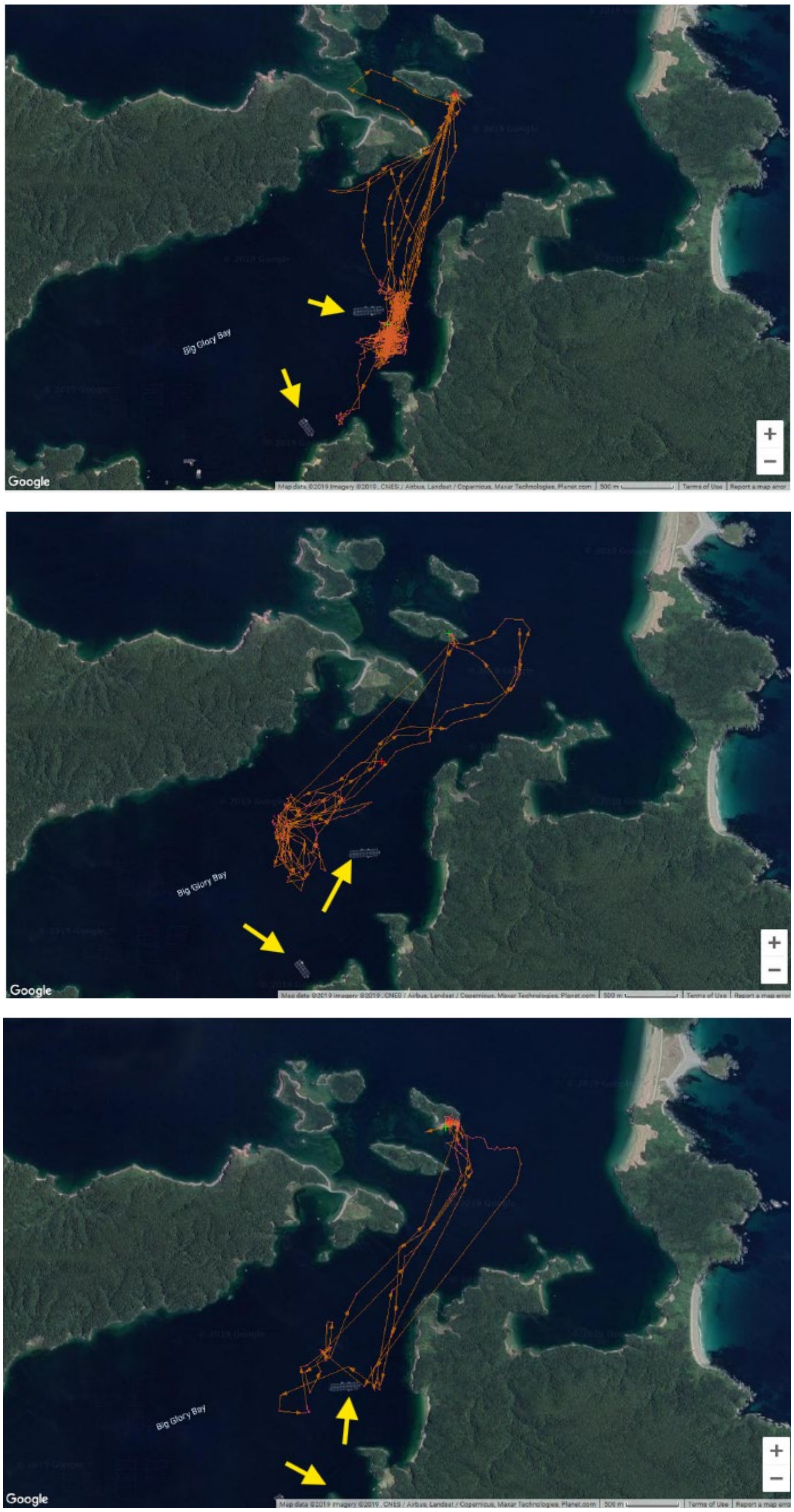

Figure 4: Foraging tracks (orange) of three hoiho within Big Glory Bay around the existing salmon farms (identified by the yellow arrows). Source: Mattern & Young (2019)

4.1.2 Kororā / little penguin

Approximately 40 kororā / little penguin (*Eudyptula minor*) were observed at sea during the boat trip from Bluff to Rakiura in 2019, including within the project site. No nests were observed during the January 2019 site visit to Murray Beach. Distribution records of kororā from the GIS databases are shown on Map 7.

Kororā are native to New Zealand and Australia; in New Zealand they are widely distributed along the coastlines of the North, South, Rakiura and Chatham islands and their offshore islands (Cooper, 1991; Heather & Robertson, 2005; Marchant et al., 1990). The New Zealand population of kororā is estimated to be c. 50,000-100,000, with approximately 5,000 –10,000 breeding pairs of the southern form (C. J. R. Robertson & Bell, 1984). Robertson et al. (2021) have assigned an *At Risk – Declining* classification to the southern little penguin (*Eudyptula minor minor).*

Nests are situated close to the sea in burrows excavated by the birds or other species, or in caves, rock crevices, under logs or in or under a variety of man-made structures including nest boxes, pipes, stacks of wood or timber, and buildings.[11] Adults are present at colonies throughout the year, though numbers are lowest between completion of moult (April) and start of breeding (August) (Marchant et al., 1990). For most colonies in New Zealand the breeding season begins around August and continues until January when chicks fledge (Davis & Renner, 2010).

During the breeding season, kororā are near shore foragers, restricted to foraging areas close to their nest. Numerous studies have found that kororā generally travel no further than 20 km from the colony while feeding chicks (Cannell, 2016; Chiaradia & Kerry, 1999; Collins et al., 1999; Hoskins et al., 2008; Klomp & Wooller, 1988; Preston et al., 2008; Weavers, 1992).

Kororā are visual feeders foraging by pursuit diving; consequently diving is exclusively diurnal, with a midday peak (Cannell & Cullen, 1998; Preston et al., 2008; Ropert-Coudert et al., 2003, 2006).

Numerous studies investigating dive depth of kororā have recorded most birds foraging in shallow waters within 15 m of the surface, with maximum dive depths up to 27 m (Bethge et al., 1997; Gales et al., 1990; Preston et al., 2008; Ropert-Coudert et al., 2003, 2006).

In New Zealand, kororā are generalist feeders of small inshore species, able to switch between a number of prey species, probably in response to temporal variation in availability (Flemming et al., 2013). At Rakiura, Flemming et al. (2013) reported that arrow squid (*Nototodarus sloanii*) occurred most frequently (91.3%) and contributed most to kororā meal mass (73.1%).

4.1.3 Tawaki / Fiordland crested penguin

Tawaki / Fiordland crested penguin (*Eudyptes pachyrhynchus*) have been recorded within 10 km of the Project site (refer to Map 7 for distribution records). This *At Risk – Declining* species breeds in small colonies on inaccessible headlands and islets along the shores of south-western South Island and Rakiura.[12]

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[11] Flemming, S.A. 2013. Little penguin. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[12] Ellenberg, U. 2013 [updated 2017]. Fiordland crested penguin. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

A survey conducted in the early 1990's recorded 5 birds on or near Codfish / Whenua Hou Island, 32 birds around southern Rakiura, and 115 nests and 263 birds on Solander Island (Studholme et al., 1994). Fiordland crested penguin have also been recorded on the western side of Rakiura (P. C. Bull et al., 1985; C. J. R. Robertson et al., 2007). A more recent survey of tawaki along Rakiura's northeast coast in 2019 found 128 nests between Lee Bay in the south and Yankee River in the north; a gross estimate of entire tawaki population on Rakiura is around 880 breeding pairs (Long & Litchwark, 2021). During that survey, 22 nests were found between Sawyers and Little Bungaree beaches, while 23 nests were found between Little Bungaree and Murray beaches (Long & Litchwark, 2021). Mattern & Ellenberg (2015) also reported tawaki breeding in groups on the cliffs by Golden Beach. These areas of coastline are adjacent to the project site.

Tawaki undertake long migrations during both their pre-moult and winter dispersal south of the subtropical front to sub-Antarctic waters (Mattern et al., 2018; Mattern & Ellenberg, 2018, 2019). For instance, during the pre-moult dispersal phase, Mattern et al. (2018) tracked 17 adult tawaki over an 8-10 week period and reported birds travelling in a general south-west direction up to 6,800 km from their West Coast mainland breeding colony.

Eudyptes[13] penguins characteristically feed offshore on small shoaling species of euphausiids, cephalpods and small fish. Van Heezik (1989, 1990) found that prey composition of tawaki on Codfish / Whenua Hou Island consisted of cephalopods, crustaceans and fish during the post-guard phase of chick growth. This prey species composition indicated that penguins were foraging exclusively pelagically and mainly over the continental shelf, which extends no more than 10-15 km from the shore (van Heezik, 1989, 1990).

Wood's (1997) study of food fed to tawaki chicks during the guard and postguard phase at Jackson Head (West Coast) and Whenua Hou Island, reported that fish appeared to be the most important prey type at both study sites. Cephalopods were present in constant but low amounts and crustaceans varied widely in terms of numbers and weight, between breeding season, phase and study site. Wood (1997) also concluded that tawaki were probably foraging over the continental shelf as prey types identified were mainly components of the continental shelf macrozooplankton.

Poupart et al.'s (2019) study of Fiordland crested penguin from Taumaka/Open Bay Island also reported extensive use of continental shelf slope (200−1000 m) habitat within 42 ± 5 km of the colony. Individuals were also recorded mostly foraging during daylight in the epi-pelagic zone (mean modal depth 22 ± 2 m; maximum dive depth of 154 m) (Poupart et al., 2019).

In summary, past studies have demonstrated differences in tawaki diet and foraging behaviour across their breeding range (Hornblow, 2022; Mattern & Ellenberg, 2015, 2019; Otis, 2021; Poupart et al., 2019; van Heezik, 1989, 1990; J. W. White, 2020). Thus, tawaki appear to be able to apply a great degree of foraging plasticity by exploiting local resources and differences in marine habitats in the vicinity of their breeding sites (Hornblow, 2022).

4.1.4 Snares crested penguin

Snares crested penguin (*Eudyptes robustus*) breeds only at the Snares Islands, with an estimated 30,000 breeding pairs (Hiscock & Chilvers, 2016). This species is classified as *At Risk – Naturally*

[13] A genus of penguins commonly known as "crested penguins":

Uncommon (H. A. Robertson et al., 2021). Birds have been recorded off the eastern coast of Rakiura, including within 10 km of the project site (refer to Map 7).

During the breeding season, Snares penguins seem to remain within 200-300 km of the Snares Islands while eggs are incubated, with foraging ranges further restricted to 50-80 km to the north of the Island during the chick guard stage (Mattern, 2006). Birds tracked through the winter mainly headed west to waters south of Tasmania, with a few birds travelling as far as south of the Australian Bight, north to waters off Westland, and into the southern Tasman Sea (Mattern, 2006).

Chicks are reared predominantly on small crustaceans, fish and squid, while adults feed primarily on pelagic fish and squid species (Guímaro et al., 2021; Mattern, 2006; Mattern et al., 2009). Food is obtained by pursuit diving at depths up to 120 m (typically 15-80 m) (Mattern, 2006).

4.2 Petrels

In terms of foraging distribution, Shealer (2002) classifies the Procellariidae family (medium-sized petrels) as inshore pelagic[14] feeders. There is considerable variability within this family in terms of foraging technique exhibited by the different species, and includes pursuit divers, surface seizers, dipping, pattering, kleptoparatism (stealing) and scavenging.

In terms of foraging distribution, Shealer (2002) classifies the Oceanitidae family (storm petrels) as inshore pelagic feeders with species that use the surface seizing, dipping or pattering foraging technique.

Shealer (2002) classifies the Pelecanoididae family (diving petrels) as inshore pursuit divers.

4.2.1 Sooty shearwater / Tītī

Approximately 50 sooty shearwater (*Puffinus griseus,* tītī) were observed at sea during the boat trip from Bluff to Rakiura in 2019, including several rafts of birds on the water within the project site. The distribution of sooty shearwater records from the GIS databases are shown in Map 8. Sooty shearwater was the most abundant and widespread of the shearwater species recorded in the fisheries observer and eBird data.

Sooty shearwater have an estimated population of 21.3 million birds in the New Zealand region (Newman et al., 2009). Due to recent decline in numbers, the sooty shearwater currently has a New Zealand threat classification of *At Risk – Declining* (H. A. Robertson et al., 2021). Breeding birds are concentrated primarily around the southern islands of New Zealand, with 53% breeding on the Tītī Islands surrounding Rakiura (Newman et al., 2009). A number of these colonies are subject to a customary harvesting program managed by Rakiura Māori. The Tītī Islands are located approximately 9 km from the closest of the proposed farms, and approximately 13 km from Big Glory Bay Salmon Farm (refer to Map 1).

New Zealand sooty shearwater breed in the summer and migrate to the north Pacific during winter (Shaffer et al., 2006; Spear & Ainley, 1999). Between September and mid-May, breeding and pre-breeding birds disperse widely throughout New Zealand seas, mainly over continental-

[14] Pelagic = Any water in a sea or lake that is neither close to the bottom nor near the shore. The pelagic zone can be contrasted with benthic and demersal zones at the bottom of the sea (Lincoln et al., 1998).

shelf and deeper waters off southern New Zealand, although some move south to the pack ice. Birds have been shown to travel mean distances of 1970 km and 515 km from the colony on long and short trips respectively during the breeding season (Shaffer et al., 2009). Thus, the nearby proposal site is not regarded as a major foraging site for this species. After the breeding season most adults depart on migration to the northern Pacific between late March and early May.

Birds frequently plunge or dive for food to depths averaging 16 m, and have been recorded swimming to depths up to 90 m (Shaffer et al., 2009; G. A. Taylor, 2008; Weimerskirch & Sagar, 1996). Kitson et al. (2000) recorded the following six major prey categories in the diet of sooty shearwater: decapod, fish, squid, euphausiid, salp and amphipod.

4.2.2 Buller's shearwater

Buller's shearwater (*Puffinus bulleri*), classified as *At Risk – Declining* (H. A. Robertson et al., 2021) breeds solely on the Poor Knights Island, northern New Zealand. Based on burrow counts and breeding activity surveys, a recent study estimated around 78,645 active burrows, broadly representing breeding pairs (Friesen et al., 2021).

While this species was not observed during the January 2019 site visit, it has been recorded within 10 km of the project site by other data sources (refer to Map 8). Most of the Buller's shearwater records are in deeper waters (refer to Map 8).

At sea, Buller's shearwaters range widely away from the breeding colonies, foraging over the continental shelf around both the North and South Islands, but also regularly flying east towards the Chatham Islands and beyond (Jenkins, 1974, 1988; Tennyson & Taylor, 1989). Buller's shearwaters are trans-equatorial migrants, flying north to the seas between Hawaii and Japan during the austral winter, and back to New Zealand via the west coast of North America and the central Pacific Ocean (Wahl, 1985).

The diet of Buller's shearwaters is still poorly known, but likely to include small krill (9-17 mm), fish, jellyfish and squid (Heather & Robertson, 2005; Kozmian-Ledward et al., 2020). Birds rarely plunge into the sea or dive underwater; rather, when searching for food they glide along with head and neck just under the water (Heather & Robertson, 2005; Kozmian-Ledward et al., 2020).

4.2.3 Flesh-footed shearwater

Flesh-footed shearwater (*Puffinus carneipes*), classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), breeds around New Zealand and Australia. While not observed during the January 2019 site visit, the fisheries observer data recorded low numbers of flesh-footed shearwater in the Foveaux Strait (refer to Map 8).

The total New Zealand population is approximately 10,000-15,000 pairs located on 15 breeding colonies around northern New Zealand and in Cook Strait (Waugh et al., 2013). New Zealand birds forage over continental shelves north of the sub-tropical convergence during the summer and are mostly absent from the New Zealand region between May and September (Rayner et al., 2011; G. A. Taylor, 2000b).

Flesh-footed shearwaters appear to be most active during the day, with Crowe (2018) recording 78% of all foraging activity between 07:00 and 20:00.

Taylor (2008) reported flesh-footed shearwater diving to depths of 28 m, with a mean maximum dive depth of 13.6 m. Rayner et al. (2011) reported shallower diving depths during migration (2.5 m), and in the western North Pacific (2.4 m) dives were shallower than during the onset of breeding (4.8 m).

Flesh-footed shearwaters specialise on small fish caught by shallow dives into shoals, or occasional deeper dives reaching 30 m in depth. They sometimes eat small squid.[15]

4.2.4 Fluttering shearwater

Fluttering shearwater (*Puffinus gavia*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breeds only in New Zealand and is widespread on approximately 90 discrete islands throughout northern New Zealand and Cook Strait (Waugh et al., 2013). The estimated national population is thought to be approximately 100,000 breeding pairs (C. J. R. Robertson & Bell, 1984; Waugh et al., 2013).

While not observed during the January 2019 site visit, fluttering shearwater have been recorded within 10 km of the Project site, with the majority of records in the wider area associated with ferry route between Bluff and Rakiura (refer to Map 8).

This species is commonly observed in large feeding flocks during summer within inshore and harbour waters. A tracking study of birds from Burgess Island (Hauraki Gulf) reported birds frequently foraging over pelagic shelf waters, but the majority of tracking locations were found over shallow waters close to the coast (Berg et al., 2019).

A significant proportion of the population remains in local waters during the non-breeding period, but with at least partial migration to eastern Australia (Berg et al., 2019; Gaskin & Rayner, 2017; G. A. Taylor, 2000b).

Berg et al. (2019) recorded birds predominantly foraging in daylight. Diet includes small fish (e.g. pilchards, sprats) caught by pursuit diving and pelagic crustacea (e.g. the small euphausiid *Nyctiphanes australis*) caught while moving forward, head often submerged to look underwater, sometimes with wings raised, and partially spread.[16] Taylor (2008) reported a single fluttering shearwater diving to a depth of 29 m.

4.2.5 Hutton's shearwater

Hutton's shearwater, classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), is one of the few New Zealand seabirds which breeds solely on the mainland; with two colonies occurring naturally in alpine zone of the Seaward Kaikōura mountains, and a third colony recently established on the Kaikōura Peninsula through a programme of translocations (beginning in 2005). Rowe et al. (2018) estimate the Hutton's shearwater total population to be approximately 590,000 individuals (including breeding and non-breeding birds).

While not observed during the January 2019 site visit, the distribution of a low number of Hutton's shearwater (*Puffinus huttoni*) records from the GIS databases (eBird and Fisheries Observer data) around Rakiura are shown in Map 8.

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[15] Taylor, G.A. 2013. Flesh-footed shearwater. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

[16] Gaskin, C.P. 2013. Fluttering shearwater. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

From September through to March, Hutton's shearwaters are present over the inshore waters off Kaikoura. Outside the breeding season Hutton's shearwaters mostly are absent from New Zealand waters as they migrate to Australian waters, where young birds stay for 4-5 years before returning to visit breeding colonies.[17]

Tracking of 26 adults during the chick-rearing recorded most individuals foraging in coastal and oceanic areas 125–365 km south and near Banks Peninsula (Bennet, 2018; Bennet et al., 2019, 2022). Although some diving occurred in near-shore waters near the breeding colony, most foraging was concentrated in four regions south of Kaikōura. Dive durations averaged 23.2 s (range 8.1 to 71.3 s) and dive depths averaged 7.1 m (range 1.5 to 35 m) (Bennet et al., 2020, 2022). Birds did not feed at night, but tended to raft in areas with deeper water than foraging locations. Hutton's shearwaters consume a variety of crustaceans, small fish and squid (West & Imber, 1985).

4.2.6 Broad-billed prion

In New Zealand, breeding colonies of the broad-billed prion (*Pachyptila vittata*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), span from the Chatham Islands to the Snares.[18]Local breeding colonies include on the islands in Foveaux Strait and around Stewart Island, Solander and Codfish / Whenua Hou islands. Jamieson (2016) report that the number of birds in the Stewart Island / Rakiura region is poorly known, though 1000–2000 burrows were recorded on the Sealers Bay stacks off Codfish Island / Whenua Hou in 1991 (Taylor & Tennyson in O'Donnell & West (1998)).

While this species was not recorded the site visit in January 2019, the distribution records of broad-billed prion from the GIS databases (Map 9) show birds have been recorded in the wider area, including within 10 km of the Project site.

This species is not attracted to boats, and food items are mainly captured while sitting on the sea surface or hydroplaning. Birds mainly eat zooplankton, especially copepods, obtained from filtering seawater through the comb-like lamellae that fringe the upper mandible. Other prey items include euphausiid krill, amphipods, stalked barnacles and small fish.

4.2.7 Fairy prion

Four fairy prion (*Pachyptila turtur*) were observed at sea during the boat trip from Bluff to Rakiura; none were observed within the project site. The distribution records of fairy prion from the GIS databases (Map 9) show birds have been recorded in the wider area, including within 10 km of the Project site.

Fairy prion, classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breed on islands in Foveaux Strait and around Rakiura (Heather & Robertson, 2005; Jamieson et al., 2016; Johnson, 1976; Watt, 1975). While very few recent estimates are available, thousands of birds were recorded on Kundy Island in 2011 (Jamieson et al., 2016). Jamieson et al. (2016) also reported on the substantial decline on Green Island (northeast of Rakiura), where an estimated 1.5 million pairs

[17] Gaze, P.D. 2013 [updated 2022]. Hutton's shearwater | Kaikōura tītī. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[18] Miskelly, C.M. 2013 [updated 2019]. Broad-billed prion. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

were nesting in November 1941, yet in December 2012 there was very little sign of any nesting prions.

During the winter there are many birds in Foveaux Strait, but some disperse further north to subtropical waters as far as the Coral Sea and the Kermadecs (Heather & Robertson, 2005).

Fairy prions mainly eat small pelagic crustaceans, along with small fish and squid; most prey is taken by surface-seizing, dipping or surface plunging (Harper, 1987; Kozmian-Ledward et al., 2020).

4.2.8 Snares Cape petrel

Snares Cape petrel (*Daption capense australe*), classified as *At Risk – Naturally Uncommon* (H. A. Robertson et al., 2021), breed on the Snares, Bounty, Antipodes, Auckland and Chatham islands. They frequent New Zealand coastal waters, especially south from Cook Strait, including Foveaux Strait (Dawson, 1951; C. J. R. Robertson et al., 2007).

Snares Cape petrels mainly eat krill and amphipods, plus small fish and squid, and offal from fishing vessels taken from the surface; they rarely plunge or dive for food.[19]

No Snares Cape petrel were observed during the January 2019 site visit, however the distribution records of Snares Cape petrel from the GIS databases (Map 9) show birds have been recorded around much of Rakiura, including within 10 km of the project site.

4.2.9 Cook's petrel

Cook's petrels (*Pterodroma cookii*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breed on Little Barrier and Great Barrier Islands, off north-eastern North Island, and Codfish / Whenua Hou Island, near Rakiura. Rayner *et al.* (2008) estimated the Codfish / Whenua Hou population to be approximately 5,000 breeding pairs.

While Cook's petrel were not observed during the January 2019 site visit, distribution records from the GIS databases (Map 9) show birds have been recorded around the west, north and east of Rakiura, including within 10 km of the Project site.

Cook's petrels are specialist deep water (pelagic) foragers. Rayner *et al*. (2008) reported that during the breeding season birds from Codfish / Whenua Hou foraged west of the South Island in the south Tasman Sea in association with the subtropical convergence zone; maximum foraging ranges for breeding birds was 800-900 km. After breeding, Codfish /Whenua Hou birds migrate to the Humboldt Current off Peru and Chile.[20]

Rayner *et al*. (2008) suggest that Cook's petrel is a highly active nocturnal forager. They feed on small crustaceans, squid and fish, mostly picked off the ocean surface (M. Brooke & Cox, 2004; Warham, 1990), though dive depths of 3-21 m has been recorded for Codfish / Whenua Hou birds (Rayner, Hauber, et al., 2008).

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[19] Sagar, P.M. 2013. Cape petrel. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[20] Taylor, G.A.; Rayner, M.J. 2013 [updated 2017]. Cook's petrel. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

4.2.10 Grey petrel

Grey petrel (*Procellaria cinerea*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breed on Antipodes Island (53,000 breeding pairs) and Campbell Island (100 pairs) in the subantarctic. This species is a winter breeder, and during the breeding season birds occur in waters east of New Zealand; during the non-breeding season, birds migrate to the Humboldt Current off Peru.[21] While no birds were observed during the site visit, there are several records of grey petrel around Rakiura / Stewart Island (refer to Map 9).

Grey petrels are often solitary at sea but sometimes form flocks around fishing vessels or in association with cetaceans. They typically feed on squid and fish by surface feeding or shallow diving, and readily take offal and discards from fishing vessels.[21] A study of the diving behaviour of grey petrels breeding on Gough Island (South Atlantic Ocean) recorded a maximum dive depth of 22m (average maximum dive-depth of 3.2±2.2 m); most dives were <5 m (85%) and 95% of dives <7 m deep (Rollinson et al., 2016).

4.2.11 Mottled petrel

Mottled petrel (*Pterodroma inexpectata*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breeds only in southern New Zealand, primarily on the Snares (>10,000 breeding pairs), Codfish Island / Whenua Hou (>10,000 breeding pairs) and Big South Cape Island (>10,000 breeding pairs), with small colonies on other islands around Stewart Island and in Fiordland.[22] While no birds were observed during the site visit, there are records of mottled petrel around Rakiura / Stewart Island, including within 10 km of the Project site (refer to Map 9).

During the breeding season (October-May) mottled petrel occur throughout New Zealand subantarctic waters, and make trips of about 2000 km each way to forage in the vicinity of the Polar Front at about 65°S. After breeding, birds from New Zealand migrate to the North Pacific Ocean and Bering Sea before returning to New Zealand for the following breeding season.[22]

Most prey are taken from near the surface of the sea whilst the bird is in flight, but they will land on the water to feed on prey at or near the surface. Mottled petrel mainly eat lantern fish, squid, and krill.[22]

4.2.12 Westland petrel

Westland petrel (*Procellaria westlandica*), classified as *At Risk – Naturally Uncommon* (H. A. Robertson et al., 2021), are confined to a single breeding location (Punakaiki, South Island west coast), where an estimated 4,000 pairs breed annually.[23] While no birds were observed during the 2019 site visit, there are records of Westland petrel around Rakiura / Stewart Island (refer to Map 9).

During the breeding season (March to November), birds range over shelf waters (<800 m water depth) of the South Island, Cook Strait, and on the Chatham Rise and south to seas around Stewart Island and Fiordland.

[21] Bell, E.A. 2013 [updated 2018]. Grey petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

[22] Sagar, P.M. 2013. Mottled petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

[23] Waugh, S.M.; Bartle J.A. 2013. Westland petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

Breeding Westland petrels consume mainly fish (especially lantern fishes), with a strong component of fisheries waste (A. N. D. Freeman, 1997b, 1997a). Birds feed by surface-seizing and shallow diving (Nicholls et al., 1997; Poupart et al., 2020).

4.2.13 Black petrel

Black petrel (*Procellaria parkinsoni*), classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), is an endemic species that breeds solely on Aotea/Great Barrier (2,500 breeding pairs; Bell et al. (2018)) and Hauturu / Little Barrier (620 breeding pairs; Bell et al. (2015)). While no birds were observed during the 2019 site visit, there are several records of black petrel around Rakiura / Stewart Island (refer to Map 9).

Black petrel forage predominantly along the continental shelf break and beyond in deeper oceanic waters during the breeding season (Bell et al., 2013; R. Freeman et al., 2010), and birds migrate to the eastern Pacific Ocean during the non-breeding season (Bell et al., 2018; Cabezas et al., 2012; Imber et al., 2003; Pitman & Ballance, 1992).

Bell (2016) collected dive data from 22 black petrel breeding on Aotea/Great Barrier Island. Maximum dive depths varied considerably among individuals and ranged from 0.8 m to 34.3 m. The majority (86.8%) of all dives were <5 m, with birds only rarely diving to depths of >10 m. The majority (92.7%) of dives were during the day, and only males were recorded diving at night.

Bell (2016) describes the following two feeding strategies by black petrel. The main foraging method occurs during daylight when targeting fish or other prey species that the birds observe from the air or from the surface (i.e. dives >1 m). Birds could also be scavenging scraps or dead prey on or just below the surface, or possibly following fishing vessels during the day. It is likely that black petrels also forage on the surface during the day in association with dolphins and whales targeting surface scraps from these feeding events (Pitman & Ballance, 1992). The second strategy is night feeding when they probably capture bioluminescent squid on and just below the surface (Imber, 1976).

Black petrels have been caught by commercial and recreational fishers both in New Zealand and overseas and are recognised as the most at-risk seabird in New Zealand from commercial fishing (Bell, 2016).

4.2.14 White-chinned petrel

White-chinned petrels (*Procellaria aequinoctialis*), classified as *Not Threatened* (H. A. Robertson et al., 2021), in New Zealand breed on Auckland, Antipodes and Campbell islands.

During the breeding season, white-chinned petrels occur in waters south and east of New Zealand, feeding over continental-shelf waters up to Cook Strait. During the non-breeding season, white-chinned petrels move northwards into subtropical waters as far as North Cape.

The main food items of white-chinned petrels are squid, salps, fish and crustaceans, although numbers and types of prey items alter during the breeding and non-breeding periods. Most food is taken from the surface, by shallow diving from on or just above the surface of the water. White-chinned petrels readily take offal and discards from fishing vessels.[24]

[24] Bell, E.A. 2013 [updated 2017]. White-chinned petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

No white-chinned petrel were observed during the January 2019 site visit. As noted above, white-chinned petrels are widely known to follow fishing vessels and there are extensive records of this species in the Fisheries Observer data in the waters around Rakiura, including near the project site (refer to Map 9).

4.2.15 Grey-faced petrel

Grey-faced petrel (*Pterodroma macroptera gouldi*), classified as *Not Threatened* (H. A. Robertson et al., 2021), is a widespread endemic subspecies that breeds on numerous islands and some North Island mainland locations. Taylor (2000b) estimated a total population in excess of a million birds, however more recently Peat et al. (2023) have estimated 200,00 to 300,000 pairs.

Gaskin & Rayner (2017) report that this species forages offshore in deep sub-tropical and temperate waters of the Tasman Sea and Pacific Ocean, and that recent dietary and tracking studies indicate the species to be an obligate deep-water specialist with > 80% of food, predominantly diurnally migrating species, predated or scavenged at night.

Taylor (2008) report grey-faced petrels diving to depths of up to 23 m, with males diving deeper on average than females during the incubation period. Breeding birds dived significantly deeper on average than non-breeders, and breeding males dived significantly deeper on average than non-breeding males.

Grey-faced petrel are away from their colonies during the non-breeding season and disperse widely within the subtropical and temperate waters (Gaskin & Rayner, 2017).

While no birds were observed during the 2019 site visit, there are several records of grey-faced petrel around Rakiura / Stewart Island (refer to Map 9).

4.2.16 White-headed petrel

The white-headed petrel (*Pterodroma lessonii*) is classified as *Not Threatened* (H. A. Robertson et al., 2021). In the New Zealand region this species breeds in colonies on subantarctic Auckland and Antipodes Islands, where there are estimated to be hundreds of thousands of pairs (G. A. Taylor, 2000b; G. A. Taylor et al., 2020). While no birds were observed during the 2019 site visit, there are a low number of white-headed petrel records around Rakiura / Stewart Island (refer to Map 9).

Tracking data from Adams Island (Auckland Islands) birds revealed the maximum foraging range during incubation to be 5,230 km from the colony (G. A. Taylor et al., 2020). After eggs hatched, some birds foraged off Antarctica. Birds spent the inter-breeding period in disjunct areas (off South Africa, south of Australia, Tasman Sea, and South Pacific Ocean). While they can dive to depths of up to 14.5 m and speeds of 2.0 m/s, most dives are shallow and short.

Analysis of stomach contents indicated chicks from Kerguelen Island were fed primarily on fish and cephalopods, whilst crustaceans were minor dietary components (Cherel et al., 2022).

4.2.17 Giant petrel

The southern giant petrel (*Macronectes giganteus*) breed in subantarctic and Antarctic waters and is classified as *Migrant* to New Zealand waters (H. A. Robertson et al., 2021). The northern giant petrel (*Macronectes halli*) is classified as *At Risk – Recovering* and in New Zealand breed at the Auckland, Campbell, Antipodes and Chatham Islands.

Both species of giant petrel are main scavengers, eating corpses of birds and mammals (e.g. penguin, albatross, seal and whale) on beaches and at sea, as well as ship offal and kelp. They also take fish and squid by surface-seizing, surface-diving and pursuit plunging down to 2m.[25,26]

While no birds were observed during the 2019 site visit, there are several records of both northern and southern giant petrel around Rakiura / Stewart Island, including within 10 km of the Project site (refer to Map 9).

4.2.18 Whenua Hou diving petrel

Whenua Hou diving petrel (*Pelecanoides whenuahouensis*) is a recently described nocturnal Procellariiform seabird species that was previously considered conspecific to the South Georgian diving petrel (*P. georgicus*) (J. H. Fischer et al., 2018). Once a widespread and abundant breeder in the coastal dune systems throughout southern New Zealand, today only one breeding colony remains, which is restricted to a small (0.018 km^2) dune system on Codfish Island / Whenua Hou, with 210 birds recently confirmed[27] in 2021/22 (J. Fischer, 2020; Tocker, 2021). This new species has a New Zealand threat classification of *Threatened - Nationally Critical* (H. A. Robertson et al., 2021).

During the breeding period, Fischer et al. (2020) reported that birds did not range very far from Whenua Hou, and GPS tracks have been recorded over the project site. The core offshore breeding distribution for this species was some 159,497 km^2 and ranged from the Tasman Sea west and south off the South Island to the Auckland Islands, and appeared to be concentrated around the Subtropical Front and the Snares Islands shelf. The total breeding distribution (890,632 km^2) extended further northwards in the Tasman Sea and further south towards Campbell Island. The total non-breeding distribution (6,069,461 km^2) ranged from the Polar Front south of Macquarie Island to seas north of the Subantarctic Front west of Western Australia (J. Fischer, 2020).

Fischer et al. (2020) note that Pelecanoides species are wing-propelled pursuit-divers and largely planktivorous. In terms of diet, two specimens collected during the breeding season had eusphausiids, small fish, and small squids in their stomachs (Imber & Nilsson, 1980).

4.2.19 Southern diving petrel

Southern diving petrel (*Pelecanoides urinatrix chathamensis*), a subspecies of the common diving petrel, is classified as *At Risk – Relict* (H. A. Robertson et al., 2021) and breeds on islands around Foveaux Strait and Rakiura including Little Solander, Big Solander, Codfish / Whenua Hou and adjacent stacks, North, Womens, and Big South Cape (Marchant et al., 1990; G. A. Taylor, 2000b; Watt, 1975). The estimated New Zealand population is more than one million pairs.[28] No southern diving petrel were observed during the January 2019 site visit. The distribution of common diving petrel records from the GIS databases are shown in Map 10, which shows this

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[25] Szabo, M.J. 2013 [updated 2022]. Southern giant petrel | pāngurunguru. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[26] Szabo, M.J. 2013 [updated 2022]. Northern giant petrel | pāngurunguru. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[27] https://www.rnz.co.nz/news/national/462708/critically-endangered-diving-petrel-population-soars

[28] Miskelly, C.M. 2013 [updated 2017]. Common diving petrel. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online.* www.nzbirdsonline.org.nz

species has been recorded in much of the waters around Rakiura, including within 10 km of the Project site.

This species mainly eat small pelagic crustaceans, especially the krill *Nyctiphanes australis* and copepods.[28] Taylor (2008) reported mean maximum dives of 10.9 ± 6.1 m (range 6.9-22.2 m) by common diving petrels from New Zealand colonies; Bocher *et al.* (2000) reported mean maximum dive depths of 31 ± 6 m for Kerguelen Island birds.

4.2.20 White-faced storm petrel

White-faced storm petrel (*Pelagodroma marina*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), breed around the mainland of New Zealand and at the Chatham and Auckland islands (Heather & Robertson, 2005; Watt, 1975). A single white-faced storm petrel was observed outside of the project site on the water in Foveaux Strait on the voyage from Bluff to Rakiura during the January 2019 site visit. This species has been recorded in the waters elsewhere around Rakiura, particularly to the west (refer to map 10).

White-faced storm petrels are pelagic birds usually found near the edge of the continental shelf and over upwellings in the very deep water beyond. They are only found in the seas around New Zealand for the duration of the breeding season (August to April) migrating to the tropical eastern Pacific for the off season. White-faced storm petrels mainly eat planktonic crustaceans and some small fish, picked up from the surface of the water.[29]

4.2.21 Grey-backed storm petrel

Grey-backed storm petrel (*Garrodia nereis*), classified as *At Risk – Relict* (H. A. Robertson et al., 2021), New Zealand breeding populations are located on the Chatham, Antipodes, Campbell and Auckland islands (Heather & Robertson, 2005). While no grey-backed storm petrel were observed during the January 2019 site visit, the distribution records for this species from the GIS databases (Map 10) show birds have been recorded scattered around the waters off Rakiura.

At sea, they forage over deep water near the shelf edge and beyond in subantarctic waters as far north as the subtropical convergence, dispersing further away from the breeding islands after the season has ended. Some birds regularly feed in southern New Zealand waters, and in winter they may occur anywhere around the coast.[30] The diet of the grey-backed storm petrel consists mainly of barnacle larvae but with a variety of other small crustaceans and fish.[30]

4.2.22 Black-bellied storm petrel

Black-bellied storm petrels (*Fregetta tropica*) are found throughout the Southern Ocean. In the New Zealand region it breeds on the Auckland and Antipodes Islands and is classified as Not Threatened (H. A. Robertson et al., 2021).

Black-bellied storm petrels are highly pelagic seabirds that feed close to or beyond the continental shelf and in very deep water. In summer during the breeding season the birds feed in the Southern Ocean, spread between the Ross Sea in the south and as far north as the

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[29] Southey, I. 2013. White-faced storm petrel. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[30] Southey, I. 2013 [updated 2017]. Grey-backed storm petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

southern coasts of New Zealand. After breeding they migrate to tropical seas south of the equator.[31]

The diet of black-bellied storm petrel is poorly known, but includes crustaceans, small fish and squid taken from the surface of the water.[31]

While no black-bellied storm petrel were observed during the January 2019 site visit, the distribution records of for this species from the GIS databases (Map 10) show birds have been recorded scattered around the waters off Rakiura, particularly to the east.

4.3 Albatross & Mollymawk

The Diomedeidae family, which includes albatross and mollymawk, are classified by Shealer (2002) as pelagic feeders which use surface seizing or kleptoparatism as their main foraging techniques.

4.3.1 Northern royal albatross

The breeding range of the Northern royal albatross (*Diomedea sanfordi*), classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), is restricted to the Chatham Islands (~6,500-7,000 pairs) and Taiaroa Head (~30 pairs) on the Otago Peninsula.[32] Northern royal albatross were not observed during the January 2019 site visit, but there are GIS records of this species, primarily to the east of Rakiura, and within 10 km of the Project site (refer to Map 11).

Birds forage predominantly over continental shelves to shelf edges. While breeding, they generally forage over the Chatham Rise, and are less common farther north than East Cape, North Island. The majority of the population spends their non-breeding period off both coasts of southern South America.[32]

Most of their food is thought to be obtained by seizing dead or dying prey from the surface and also by scavenging discards and offal from fishing boats. They can dip the head and neck to one metre depth. Mainly feed on squid and other cephalopods, along with fish, crustaceans, and salps.[32]

4.3.2 Southern royal albatross

Southern royal albatross (*Diomedea epomorpha*), classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), breed on the Campbell (approximately 8,500 pairs) and Auckland (<100 pairs) islands. While no birds were observed during the January 2019 site visit, there are records of Southern royal albatross around Rakiura / Stewart Island, including within 10 km of the Project site (refer to Map 11).

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[31] Southey, I. 2013 [updated 2022]. Black-bellied storm petrel | takahikare-rangi. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[32] Sugishita, J. 2013 [updated 2017]. Northern royal albatross. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

Birds forage over the continental shelf and inner slope of southern New Zealand and the Campbell plateau, southern Chile, Uruguay and Argentina where they scavenge for squid and fish; food is mainly seized from the water's surface, or by shallow plunges beneath the surface.[33]

4.3.3 Antipodean albatross

Two subspecies of Antipodean albatross breed on New Zealand's subantarctic islands: Gibson's wandering albatross (*Diomedea antipodensis gibsoni*) on the Auckland Islands and Antipodean wandering albatross (*D. a. antipodensis)* mainly on Antipodes Island, with a few on Campbell, Pitt and Chatham Islands. Both subspecies are classified as Threatened – Nationally Critical (H. A. Robertson et al., 2021). Antipodean albatross were not observed during the January 2019 site visit, however there are records of birds around Rakiura / Stewart Island (refer to Map 11).

Tracking of Antipodes Island birds found they mainly forage over the shelf edge and deep water around the Chatham Rise, but it range as far east as South America and a few birds visit the Tasman Sea and the great Australian Bight (Bose & Debski, 2021; Walker et al., 2006; Walker & Elliott, 2022). They forages as far north as 27°S, and as far south as 72°S (Bose & Debski, 2021; Walker & Elliott, 2022). Antipodean albatrosses come close to shore only at its breeding islands and where deep water occurs close to land. They eat squid and fish and follow boats to take discards and bait from hooks. [34]

4.3.4 Wandering albatross

Wandering albatross (*Diomedea exulans*) breed on islands in the Southern Ocean, with the closest being Macquarie Island. The species is classified as a *Migrant* in New Zealand waters (H. A. Robertson et al., 2021). Non-breeding birds from the Crozet Islands may spend extensive periods in the deep waters in both the Tasman Sea and the eastern waters of New Zealand from the subantarctic to latitudes around East Cape (Weimerskirch et al., 2006, 2015).

Wandering albatrosses are solitary at sea, though may feed in flocks in association with fishing vessels. The wandering albatross is essentially a scavenger, feeding on squid (especially) and marine fishes, and mainly within a few metres of the surface. Most prey is captured by surface seizing. [35]

Wandering albatross were not observed during the January 2019 site visit, however there are records of birds around Rakiura / Stewart Island (refer to Map 11).

4.3.5 Southern Buller's mollymawk

Southern Buller's mollymawk is classified as *At Risk – Declining* (H. A. Robertson et al., 2021), and breeds on the Solander Islands from December to September, where there are an estimated 4,912 breeding pairs. Two southern Buller's mollymawk (*Thalassarche bulleri bulleri*) were

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[33] Moore, P.J. 2013 [updated 2017]. Southern royal albatross. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

[34] Elliott. G.P.; Walker, K.J. 2013 [updated 2022]. Antipodean albatross | Toroa. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[35] Waugh, S.M. 2013 [updated 2022]. Wandering albatross | Toroa. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. https://www.nzbirdsonline.org.nz/

observed at sea during the boat trip from Bluff to Rakiura in 2019, and there are extensive tracking records of and this species in the area (refer to Map 11).

Stahl & Sagar's (2000) foraging study of southern Buller's mollymawk breeding on Solander Island reported that during incubation, birds made long trips to the Tasman Sea (1417 km), west coast (533 km) or east coast of the South Island (656 km); whereas during chick-rearing, foraging trips ranged from 69 to 571 km. Buller' mollymawk mainly eat fish, squid, krill, salps and offal from fishing vessels taken from the surface. They rarely plunge or dive for food.

4.3.6 NZ white-capped albatross

The NZ white-capped albatross (*Thalassarche cauta steadi*), classified as *At Risk – Declining* (H. A. Robertson et al., 2021), breeds on the Auckland, Antipodes and Chatham Islands.[36] Six birds were observed at sea during the boat trip from Bluff to Rakiura in 2019, including two birds sitting on the water within the project site. This species was one of the most abundant albatross / mollymawk species recorded in the Fisheries Observer data (refer to Map 11), with birds recorded around much of the Rakiura coastline (including within 10 km of the Project site); the greatest concentration of birds was recorded off to the east of Rakiura (refer to Map 11).

During the breeding season (November-June), birds occur throughout coastal New Zealand, especially from Cook Strait south, and across the Tasman Sea to south-east Australian waters.[36] They mainly eat fish, squid, krill, salps and offal from fishing vessels taken from the surface, and rarely plunge or dive for food.[36]

4.3.7 Black-browed albatross

Black-browed albatross (*Thalassarche melanophris*) are circumpolar colonial annual breeders at subantarctic islands including Antipodes Islands (approx. 120 pairs), Campbell Island (approx. 20 pairs) and Snares Western Chain (1 pair) in New Zealand.[37] In New Zealand this species is classified as a *Coloniser* (H. A. Robertson et al., 2021). Black-browed albatross were not observed during the January 2019 site visit, however there are a number of records of this species around Rakiura / Stewart Island, including within 10 km of the project site (refer to Map 11).

After breeding, they disperse widely around the Southern Ocean and into temperate seas in the South Pacific, South Atlantic and Indian Oceans. They are often seen off the New Zealand coast, particularly in Cook Strait and off Kaikoura Peninsula, or following fishing boats, especially in winter.[37]

Black-browed mollymawks mostly feed on fish, squid and krill caught at the sea surface or during shallow dives (Prince, 1980). Other prey items, such as seabirds (e.g. small petrels and terns), are taken occasionally either alive or as carrion found floating on the sea surface. Black-browed mollymawks also scavenge long-line baits and discarded fish offal while following fishing vessels, and at marine mammal carcasses found floating at sea.

[36] Sagar, P.M. 2013 [updated 2017]. White-capped mollymawk. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[37] Szabo, M.J. 2013 [updated 2022]. Black-browed mollymawk | toroa. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

4.3.8 Campbell Island albatross

Campbell Island albatross *(Thalassarche impavida),* classified as At Risk – Naturally Uncommon (H. A. Robertson et al., 2021) nest only at Campbell Island and offshore Isle de Jeanette Marie, with an estimated 21,000 breeding pairs.[38]

Tracking studies have recorded this species over the seas east of the South Island and off Rakiura (Thompson et al., 2021). As such, it is likely that birds may be present around the Hananui site, at least during the non-breeding season.

Campbell Island albatross are found throughout the continental shelf area of southern New Zealand waters, and feed on small fish, squid and crustaceans, mainly in water depths less than 200 m (Cherel & Waugh, 2023). They also scavenge actively for fish waste or offal released from vessels.[38]

4.3.9 Light-mantled sooty albatross

Light-mantled sooty albatross (*Phoebetria palpebrata*), classified as At Risk – Declining (H. A. Robertson et al., 2021), are found around the Southern Ocean, with a circumpolar breeding distribution. In the New Zealand region, there are breeding populations on the Antipodes (250 pairs), Auckland (5000 pairs) and Campbell (1600 pairs) Islands.[39] Light-mantled sooty albatross were not observed during the January 2019 site visit, and there are only scattered records for this species around Rakiura / Stewart Island (refer to Map 11).

Birds breeding on sub-Antarctic islands have been recorded foraging in the waters of the high Antarctic (Phillips et al., 2005; Weimerskirch & Robertson, 1994). Light-mantled sooty albatross feeds mainly on squid, followed by fish and crustaceans (Cherel et al., 2023; Green et al., 1998; Thomas & Friend, 1982).

4.3.10 Salvin's mollymawk

Salvin's mollymawk (*Thalassarche salvini*), classified as *Threatened – Nationally Critical* (H. A. Robertson et al., 2021), breed on the Bounty Islands and the Snares Western Chain, plus breeding attempts have been made by isolated pairs and individuals in the Chatham Islands (G. A. Taylor, 2000a). While no birds were observed during the January 2019 site visit, Salvin's mollymawk have been recorded around much of Rakiura, including within 10 km of the Project site (refer to Map 11).

Salvin's mollymawks mainly eat fish, squid, krill, salps and offal from fishing vessels taken from the surface; they rarely plunge or dive for food.[40]

[38] Waugh, S.M. 2013 [updated 2022]. Campbell black-browed mollymawk | toroa. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[39] Waugh, S.M. 2013 [updated 2022]. Light-mantled sooty albatross | toroa pango. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[40] Sagar, P.M. 2013 [updated 2017]. Salvin's mollymawk. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

4.3.11 Chatham Island mollymawk

Chatham Island mollymawk (*Thalassarche eremita)*, classified as At Risk – Naturally Uncommon (H. A. Robertson et al., 2021), breeds on The Pyramid (approx. 5300 nests[41]), located at the southern end of the Chatham Islands. While no birds were not observed during the January 2019 site visit, and there are scattered records of Chatham Island mollymawk around Rakiura / Stewart Island, including within 10 km of the Project site (refer to Map 11).

During the breeding season, Chatham Island mollymawks are commonly seen at sea around The Pyramid and the southern Chatham Islands and occasionally at sea around the eastern New Zealand coastline. They migrate to coastal waters off Chile and Peru outside their breeding season.[41]

Chatham Island mollymawks are generally surface feeders, but will shallow dive for food. They are known to feed on fish, squid and krill.[41]

4.3.12 Grey-headed mollymawk

Grey-headed mollymawk (*Thalassarche chrysostoma)*, classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021) are found around the Southern Ocean, with a circumpolar breeding distribution. In the New Zealand region, they nest on Campbell Island (approx. 7800 nests) (Moore, 2004). While no birds were not observed during the January 2019 site visit, tracking data shows this species utilises the waters around Rakiura / Stewart Island (refer to Map 11).

Their feeding habitat tends to be oceanic (>2000 m water depth) rather than over continental shelves and they occur in the New Zealand region mainly well offshore and south of Cook Strait, but may be found around East Cape, particularly during the austral autumn.[42]

The diet of grey-headed mollymawks on Campbell Island consists mainly of squid, in particular species associated with the Polar Front. Fish (e.g. southern blue whiting) are also consumed.[42]

4.4 Tern & Gannet

Shealer (2002) classifies terns belonging to the Laridae family as inshore-pelagic foragers, with species exhibiting dipping, plunge diving or klepotparasitic foraging techniques.

4.4.1 White-fronted tern

Approximately 100 white-fronted tern (*Sterna striata striata*) were observed during the January 2019 site visit; most were roosting on coastal rock outcrops (Figure 5). This species has been recorded around much of Rakiura / Stewart Island coastline (refer to Map 12), including within 10 km of the Project site (refer to Map 12).

The white-fronted tern, while common all around New Zealand coasts, is classified as *At Risk – Declining* (H. A. Robertson et al., 2021). The national population is estimated to be 15,000-20,000

[41] Fraser, M.J. 2013 [updated 2022]. Chatham Island mollymawk | Toroa. *In* Miskelly, C.M. (ed.). *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[42] Waugh, S.M. 2013 [updated 2022]. Grey-headed mollymawk | toroa. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. https://www.nzbirdsonline.org.nz

pairs, and includes birds breeding around the coast of Rakiura (Heather & Robertson, 2005; Higgins & Davies, 1996).

White-fronted tern feed on shoaling fish such as smelt and pilchard in coastal waters (Heather & Robertson, 2005). They catch small fish and crustaceans by plunging into the water from 5-10 m above the surface.

Figure 5: White-fronted tern roosting on coastal rock outcrops (January 2019).

4.4.2 Australasian gannet

Australasian gannet (*Morus serrator*), classified as *Not Threatened* (H. A. Robertson et al., 2021), breeds on coastal islands and on cliffs and beaches of some headlands of the New Zealand mainland. Wodzicki et al. (1984) estimated the New Zealand breeding population to be approximately 46,600 pairs, including a small breeding colony of 62 pairs on Little Solander Island.

Australasian gannets primarily feed over the continental shelf and inshore waters, diving straight down from up to 30 m high (Heather & Robertson, 2005); mainly feeding on fish and also squid.[43] Gannets belong to the Sulidae family, which Shealer (2002) also classifies as inshore-pelagic foragers, with species exhibiting pursuit or plunge diving foraging techniques.

No Australasian gannet were observed during the January 2019 site visit, however there are records of this species around Rakiura in the GIS databases, including with 10 km of the project site (refer to Map 13). These birds are likely being from the Little Solander Island population.

4.5 Shags

Shags belong to the Phalacrocoracidae family which Shealer (2002) classifies as coastal-inshore pursuit divers.

[43] Ismar, S.M.H. 2013. Australasian gannet. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

4.5.1 Foveaux shag

Foveaux shag (*Leucocarbo stewarti*), classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021), occurs around Rakiura and in Foveaux Strait (Rawlence et al., 2014, 2016). Lalas & Perriman (2009) reported populations breeding at six locations on islands in and bordering Foveaux Strait. The Foveaux shag population was estimated to be at least 1007 breeding pairs at the start of the 2022 breeding season (Rexer-Huber & Parker, 2023).

This species is a colonial breeder that build closely-spaced nest mounds on bare-rock coastal plateaus and slopes that overlook the sea (Lalas & Perriman, 2009). Of note, is a well recorded phenomenon whereby Foveaux and Otago shag abandon of breeding sites that have been active for long periods of times (i.e. decades) and establish new breeding sites (Lalas, 1983, 1993; Parker & Huber, 2021; Watt, 1975).

This species roosts on headlands, small islands and on man-made structures. Approximately 20 adult and juvenile Foveaux shag were observed on the rock outcrops and coastal cliffs adjacent to the project site during the January 2019 site visit (Figure 6). Young birds were also observed on the coastal cliffs of Golden beach (north of Gull Rock Point), indicating a potential breeding colony at this location. There are records of Foveaux shag at various locations around the Rakiura coastline and in Foveaux Strait, including within 5km of the Project site (refer to Map 13).

In a study of Foveaux and Otago shag response to drones, Parker & Huber (2021) reported Whero Rock Foveaux shags as showing no response to drone launch and ascent, while on Kanetetoe Island the shags showed no sign that they were concerned by the drone at 20 m above. This suggests that birds accepting of some level of disturbance.

Foveaux shags forage in groups in water up to 30 m, and are able to successfully forage in murky water.[44] The diet is mainly seabed-dwelling fish such as flounder and bullies.

Figure 6: Foveaux shag on coastal rock outcrops (January 2019).

[44] McKinlay, B.; Rawlence, N.J. 2022. Foveaux shag. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

4.5.2 Spotted shag

Several spotted shag (*Stictocarbo punctatus*) were observed on the coastal cliffs south of Big Bungaree Bay during the January 2019 site visit. There are records of spotted shag at various locations around the Rakiura coastline and in Foveaux Strait, including within 10 Km of the Project site (refer to Map 13).

The spotted shag is endemic to New Zealand and classified as *Threatened – Nationally Vulnerable* (H. A. Robertson et al., 2021). The total breeding population is estimated[45] to be less than 18,000 pairs and includes breeding populations on the islands in Foveaux Strait and around Rakiura (Cooper, 1991; Heather & Robertson, 2005).

Timing of breeding varies year-to-year and in different parts of the range, depending on food availability.[46] Spotted shag are concentrated around nesting sites when breeding, dispersing to other coastal areas in winter (Owen & Sell, 1985), but with most birds remaining within 200 km of their breeding grounds (Heather & Robertson, 2005).

Spotted shag feed in deep water up to 15 km from the shore, and they sometimes feed in harbours (Heather & Robertson, 2005). Their diet is mainly small fish less than 15 cm long, and marine invertebrates (Heather & Robertson, 2005).

4.5.3 Pied shag

Pied shag (*Phalacrocorax varius*) nest in trees (particularly large conifers) along coastal cliffs. During the January 2019 site visit pied shag were observed roosting in large coastal cliff trees. There are also records of pied shag at various locations around the Rakiura coastline and in Foveaux Strait, including within 10 km of the Project site (refer to Map 13).

The national population of pied shag, classified as *At Risk – Recovering* (H. A. Robertson et al., 2021), is widespread and estimated to be approximately 6,400 breeding pairs, with breeding colonies also located in Rakiura (WMIL, 2013). Pied shag clutches are laid in all months, with peaks during February-April and August-October.[47] They generally forage close to shore in shallow water less than 10 m deep and their diet is mainly 6-15 cm long fish (Heather & Robertson, 2005; Lalas, 1983).

4.5.4 Little shag

Little shag (*Phalacrocorax melanoleucos*), with a national population of 5,000-10,000 breeding pairs, are classified as *At Risk - Relict* (Heather & Robertson, 2005; H. A. Robertson et al., 2021). Peak breeding activity for little shag occurs in October to December. Diet varies greatly with habitat but is mainly small fish (<13 cm long). Little shag generally feed close to shore in waters less than 3 m deep (Heather & Robertson, 2005; Lalas, 1983).

Little shag nest in trees along coastal cliffs. This species was observed roosting in large coastal cliff trees during the January 2019 site visit, and has been recorded within 5 km of the Project as well as further out in Foveaux Strait (refer to Map 13).

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[45] Estimate provided by Department of Conservation

[46] Szabo, M.J. 2013 [updated 2015]. Spotted shag. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[47] Powlesland, R.G. 2013. Pied shag. *In* Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

4.5.5 Black shag

Black shag (*Phalocrocorax carbo novaehollandiae*), classified as *At Risk –Relict* , is sparsely widespread from Northland to Stewart Island and is found in a variety of habitats including coastal and freshwater systems (Heather & Robertson, 2005). Heather & Robertson (2005) estimate the national population to be 5,000-10,000 pairs, with most nesting in small colonies of 5-20 pairs. Black shag nests are typically located in trees or shrubs, often in colonies near water.

Birds generally forage alone and the diet is mainly small and medium sized fish (<35 cm long), and may include (depending on habitat) mullet, wrasse, red cod, spotties, smelt, eels, bullies, galaxiids, trout and perch (Heather & Robertson, 2005; McKinnon et al., 2004). They sometimes forage in highly turbid waters. Heather & Robertson (2005) report that black shags stay close inshore, mainly in water <3 m deep, but have been caught in crayfish pots set at 12 m deep.

Black shag were not observed during the January 2019 site visit, however there are records of birds around Rakiura / Stewart Island, including within 10 km of the Project site (refer to Map 13).

4.6 Gulls

Shealer (2002) classifies gulls belonging to the Laridae family as coastal-inshore foragers, with species exhibiting surface-seizing, dipping, klepotparasitic or scavenging foraging techniques.

4.6.1 Red-billed gull

Approximately 50 red-billed gull (also called silver gull; *Larus novaehollandiae*) were observed during the January 2019 site visit. There are widespread records of this species around the coastline of Rakiura and the surrounding waters, including within 10 km of the Project site (refer to Map 12).

The red-billed gull is a very abundant species, but has been afforded a classification of *At Risk – Declining* due to the recent large declines at its three main breeding colonies (Three Kings Islands, Mokohinau Islands and Kaikoura Peninsula) (H. A. Robertson et al., 2021). This species nests in dense colonies, including on Rakiura and islands in Foveaux Strait (Cooper, 1991; Frost & Taylor, 2018).

During the breeding season, red-billed gull feed mainly in inshore waters on the planktonic euphausiid *Nyctiphanes australis,* although some other marine invertebrates and small fish are taken (Heather & Robertson, 2005). Birds disperse during the non-breeding season (Higgins & Davies, 1996).

4.6.2 Southern black-backed gull

Approximately 12 black-backed gull (*Larus dominicanus*) were observed during the January 2019 site visit. There are widespread records of this species around the coastline of Rakiura and the surrounding waters (refer to Map 12).

The black-backed gull is classified as *Not Threatened* (H. A. Robertson et al., 2021) and common throughout New Zealand in most habitats; particularly abundant anywhere food scraps, offal and other organic waste can be obtained.[48]

4.7 Shorebirds

4.7.1 White-faced heron

White-faced heron (*Egretta novaehollandiae*) were observed foraging along the coast adjacent to the project site during the January 2019 site visit, and they have been recorded along other sections of the Rakiura coastline (refer to Map 14). This widespread and common species is classified as *Not Threatened* (H. A. Robertson et al., 2021). It is a tree-top dweller, favouring the tops of large pine trees or macrocarpa growing near water.[49]

Both saline and freshwater habitats are used for foraging, as indicated by the wide range of prey they consume: small fish, crabs, worms, insects, spiders, mice, lizards, tadpoles and frogs (Marchant et al., 1990). The white-faced heron is a predator that depends on vision and captures prey with a variety of methods; when foraging, they are essentially searchers, usually wading and walking, but occasionally standing and waiting for prey (Moore, 1984). Thus, they are coastal edge shallow-water foragers.

4.7.2 Variable oystercatcher

Variable oystercatcher (*Haematopus unicolor*), classified as *At Risk – Recovering* (H. A. Robertson et al., 2021), are almost exclusively a coastal wader, favouring sandy and rocky shorelines around the North, South and Stewart Islands and their offshore islands (Crossland, 2001; Dowding & Moore, 2006). Two pairs of variable oystercatcher were observed on Murray Beach during the January 2019 site visit. Based on the habitat available, it is likely that Murray Beach provides breeding habitat for this *At Risk – Recovering* species. There are records of this species along other sections of the Rakiura coastline (refer to Map 15). Dowding & Moore (2006) report at least 20 pairs of variable oystercatcher in Paterson Inlet (Rakiura).

Their diet includes a wide range of littoral[50] invertebrates, including molluscs, crustaceans, and annelids; foraging patterns are influenced by tidal cycles (Heather & Robertson, 2005).

4.8 Species Summary

Table 6 provides a summary of species threat classification, breeding biology and feeding ecology for those species recorded in the vicinity of the proposed salmon farm site.

[48] Miskelly, C.M. 2013. Southern black-backed gull. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
[49] Adams, R. 2013 [updated 2015]. White-faced heron. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
[50] Pertaining to the shore (Lincoln et al., 1998).

Table 6: Summary of foraging and dietary information for marine avifauna breeding or foraging within the wider area and which may be impacted by the proposal.

SPECIES	CLASSIFICATION	RAKIURA / FOVEAUX BREEDING POPULATION	EST. LOCAL POPULATION	EST. NATIONAL POPULATION	FORAGING HABITAT / RANGE	FORAGING BEHAVIOUR
Penguins						
Hoiho	Threatened – Nationally Endangered	Patterson Inlet, south east and north east coasts	~30 pairs	~1,260 pairs	Near shore to mid-shelf (2-25 km off-shore)	Pursuit diver with mean dive depth of 61 m
Southern little penguin	At Risk - Declining	Rakiura / Foveaux Strait islands	>500 pairs	~10,000 pairs	Near shore (<20 km from colony during breeding season; up to 150 km during non-breeding season)	Pursuit diver with most foraging within 15 m of the surface (maximum dive depths up to 27 m)
Fiordland crested penguin	At Risk - Declining	Southern Rakiura and Codfish / Whenua Hou Island	~880 pairs	~2,500 – 3,000 pairs	Pelagic (10-15 km from shore)	Pursuit diver
Snares crested penguin	At Risk – Naturally Uncommon	No	-	~30,000 pairs	Pelagic (subtropical front)	Pursuit diver
Petrels						
Sooty shearwater	At Risk - Declining	Rakiura / Foveaux Strait islands	>1,000,000 pairs	~21,300,000 birds	Pelagic (up to 1970 km from shore)	Diver - depths averaging 16 m, depths of up to 90 m recorded
Buller's shearwater	At Risk - Declining	No	-	~79,000 pairs	Pelagic (off-shore)	Rarely plunge into sear or dive underwater
Flesh-footed shearwater	Threatened – Nationally Vulnerable	No	-	~10,000 – 15,000 pairs	Near and offshore	Diver – depths up to 28 m recorded
Fluttering shearwater	At Risk – Relict	No	-	~100,000 pairs	Near and offshore	Diver – depths up to 29 m recorded
Hutton's shearwater	Threatened – Nationally Vulnerable	No	-	~590,000 birds	Near and offshore	Diver – depths up to 35 m recorded
Broad-billed prion	At Risk – Relict	Rakiura / Foveaux Strait islands and Codfish / Whenua Hou Island	~5,000 birds	>600,000 pairs	Pelagic (off-shore)	Surface feeder
Fairy prion	At Risk – Relict	Rakiura / Foveaux Strait islands	>2,000 birds	~4,000,000 pairs	Pelagic	Surface-seizing, dipping or surface plunging
Snares Cape petrel	At Risk – Naturally Uncommon	No	-	~10,000 pairs	Pelagic	Rarely plunge or dive

SPECIES	CLASSIFICATION	RAKIURA / FOVEAUX BREEDING POPULATION	EST. LOCAL POPULATION	EST. NATIONAL POPULATION	FORAGING HABITAT / RANGE	FORAGING BEHAVIOUR
Cook's petrel	At Risk – Relict	Codfish / Whenua Hou	~5,000 pairs	~300,000 pairs	Pelagic (approx. 800 km foraging range during breeding season)	Surface feeder, but dive depths up to 21 m
Grey petrel	At Risk – Relict	No	-	~53,000 pairs	Pelagic	Surface feeder or shallow-dive
Mottled petrel	At Risk – Relict	Rakiura / Foveaux Strait islands, Codfish Island / Whenua Hou, Big South Cape Island	>20,000 breeding pairs	>30,000 pairs	Pelagic (approx. 2000 km foraging range during breeding season)	Surface feeder
Westland petrel	At Risk – Naturally Uncommon	No	-	~4,000 pairs	Pelagic (over shelf waters <800 m water depth)	Surface seizing or shallow-dive
Black petrel	Threatened – Nationally Vulnerable	No	-	~38,000 birds	Pelagic (over continental-shelf waters)	Surface seizing or shallow-dive
White-chinned petrel	Not Threatened	No	-	>200,000 pairs	Pelagic (over continental-shelf waters)	Surface feeder or shallow-dive
Grey-faced petrel	Not Threatened	No	-	~200,000 pairs	Deep water specialist	Surface feeder or shallow-dive
White-headed petrel	Not Threatened	No	-	>100,000 pairs	Pelagic (over convergence zones)	Surface feeder or shallow-dive
Southern giant petrel	Migrant	No	-	-	Offshore	Scavenge, surface-seize, surface-diving and pursuit plunging
Northern giant petrel	At Risk – Recovering	No	-	~2,570 pairs	Near shore	Scavenge
Whenua Hou diving petrel	Threatened – Nationally Critical	Codfish / Whenua Hou	~200 birds	~200 birds	Pelagic (over continental shelf)	Pursuit-diver
Southern diving petrel	At Risk – Relict	Rakiura / Foveaux Strait islands / Solander	>1,000 pairs	>1,000,000 pairs	Near shore	Pursuit diver
White-faced storm petrel	At Risk – Relict	No	-	>1,000,000 pairs	Pelagic (near the edge of the continental-shelf)	Surface feeder
Grey-backed storm petrel	At Risk – Relict	No	-	>30,000 pairs	Pelagic (near the edge of the continental-shelf)	Surface feeder
Black-bellied storm petrel	Not Threatened	No	-	50,000 - 100,000 pairs	Offshore	Surface feeder

SPECIES	CLASSIFICATION	RAKIURA / FOVEAUX BREEDING POPULATION	EST. LOCAL POPULATION	EST. NATIONAL POPULATION	FORAGING HABITAT / RANGE	FORAGING BEHAVIOUR
Albatross & mollymawk						
Northern royal albatross	Threatened – Nationally Vulnerable	No	-	~7,000 pairs	Pelagic (over continental shelf)	Surface feeders and scavenger
Southern royal albatross	Threatened – Nationally Vulnerable	No	-	~8,500 pairs	Pelagic (over continental shelf)	Surface seizer or shallow plunges
Gibson's wandering albatross	Threatened – Nationally Critical	No	-	~3200 pairs	Pelagic (over shelf and deep water)	Surface seizer
Antipodes wandering albatross	Threatened – Nationally Critical	No	-	~3700 pairs	Pelagic (over continental shelf)	Surface seizer
Wandering albatross	Migrant	No	-	-	Pelagic (over continental shelf)	Surface seizer
Southern Buller's albatross	At Risk – Declining	Solander Island	~5,000 pairs	~13,500 pairs	Pelagic (69-1417 km from colony)	Surface seizer, rarely plunge or dive
NZ white-capped albatross	At Risk – Declining	No	-	>120,000 pairs	Pelagic	Surface seizer, rarely plunge or dive
Black-browed albatross	Coloniser	No	-	~150 pairs	Near and offshore	Surface seizer or shallow dives
Campbell Island albatross	At Risk – Naturally Uncommon	No	-	~21,000 pairs	Pelagic (deep waters)	Surface seizer or shallow dives
Light-mantled sooty albatross	At Risk – Declining	No	-	~7000 pairs	Pelagic	Surface seizer or shallow dives / plunges
Salvin's mollymawk	Threatened – Nationally Critical	No	-	~41,000 pairs	Pelagic	Surface seizer, rarely plunge or dive
Chatham Island mollymawk	At Risk – Naturally Uncommon	No	-	~5,300 pairs	Pelagic	Surface seizer or shallow dives
Grey-headed mollymawk	Threatened - Nationally Vulnerable	No	-	~7,800 pairs	Pelagic	Surface seizer or shallow dives
Tern & gannet						
White-fronted tern	At Risk – Declining	Rakiura / Foveaux Strait islands	<200 pairs	~20,000 pairs	Inshore – pelagic	Plunger
Australasian gannet	Not Threatened	Little Solander Island	~60 pairs	~46,000 pairs	Continental shelf and inshore waters	Diver
Shag						

SPECIES	CLASSIFICATION	RAKIURA / FOVEAUX BREEDING POPULATION	EST. LOCAL POPULATION	EST. NATIONAL POPULATION	FORAGING HABITAT / RANGE	FORAGING BEHAVIOUR
Foveaux shag	Threatened – Nationally Vulnerable	Rakiura / Foveaux Strait islands	~1,000 pairs	<5,000 pairs	Coastal inshore	Pursuit diver in water up to 30 m
Spotted shag	Threatened – Nationally Vulnerable	Rakiura / Foveaux Strait islands	~1,000 pairs	~18,000 pairs	Coastal inshore (up to 15 km from shore)	Pursuit diver feeding in deep water
Pied shag	At Risk - Recovering	Rakiura / Foveaux Strait islands	~1,000 pairs	~6,400 pairs	Coastal inshore	Pursuit diver in water up to 10 m
Little shag	At Risk - Relict	Rakiura / Foveaux Strait islands	>200 pairs	~10,000 pairs	Coastal inshore	Pursuit diver in water up to 3 m
Black shag	At Risk - Relict	Rakiura / Foveaux Strait islands	<200 pairs	50,000 - 100,000 pairs	Shallow waters	Detect prey visually at very short distances
Gulls						
Red-billed gull	At Risk - Declining	Rakiura / Foveaux Strait islands	>500 pairs	~28,000 pairs	Inshore pelagic	Surface seizer
Black-backed gull	Not Threatened	Rakiura / Foveaux Strait islands	>1,000 pairs	>1,000,000 birds	Inshore pelagic	Surface seizer
Shorebirds						
White-faced heron	Not Threatened	Rakiura / Foveaux Strait islands	>100 pairs	Abundant	Coastal edge shallow water wader	Coastal wader
Variable oystercatcher	At Risk - Recovering	Murray Beach	>100 pairs	~4,000 birds	Sandy and rocky coastal margin wader	Coastal wader

5.0 Key Species

Marine avifauna species are not equally susceptible or exposed to the potential impacts of aquaculture activities. For instance, factors which may contribute to the likelihood of species interacting with the proposed salmon farm include location of breeding populations (and therefore frequency of movements across the site) as well as feeding habits (i.e. prey species, foraging zones and behaviour).

Fourteen of the 51 species either recorded or potentially occurring in close proximity to the project site have been identified as key species in terms of potentially being impacted by the proposed Hananaui project (Table 7). The rationale for the identification of these 14 species is based on a combination of factors they exhibit, including their threat status, local breeding population(s), records within 10 km of the Project site, and diving behaviours.

Table 7: Identification of key species for which potential interactions with the salmon farm may occur.

SPECIES	NZ THREATENED / AT RISK[51]	IUCN THREATENED[52]	LOCAL BREEDING POPULATION	RECORDED WITHIN 10KM	DIVING BEHAVIOUR	NEARSHORE FORAGER[53]	KEY SPP
Hoiho	✓	✓	✓	✓	✓	✓	Yes
Southern little penguin	✓		✓	✓	✓	✓	Yes
Fiordland crested penguin	✓		✓	✓	✓	✓	Yes
Snares crested penguin	✓	✓		✓	✓		No
Sooty shearwater	✓		✓	✓	✓		Yes
Buller's shearwater	✓	✓		✓			No
Flesh-footed shearwater	✓				✓	✓	No
Fluttering shearwater	✓			✓	✓	✓	No
Hutton's shearwater	✓	✓			✓	✓	No
Broad-billed prion	✓		✓	✓			No
Fairy prion	✓		✓	✓			No
Cape petrel	✓			✓			No
Cook's petrel	✓	✓	✓	✓	✓		Yes
Grey petrel	✓						No
Mottled petrel	✓		✓	✓			No
Westland petrel	✓	✓					No
Black petrel	✓	✓			✓		No
White-chinned petrel		✓		✓			No
Grey-faced petrel					✓		No
White-headed petrel							No

[51] Robertson et al. (2021)

[52] https://www.iucnredlist.org/ Threatened = Vulnerable, Endangered or Critically Endangered

[53] Schreiber & Burger (2002)

SPECIES	NZ THREATENED / AT RISK[51]	IUCN THREATENED[52]	LOCAL BREEDING POPULATION	RECORDED WITHIN 10KM	DIVING BEHAVIOUR	NEARSHORE FORAGER[53]	KEY SPP
Southern giant petrel				✓			No
Northern giant petrel	✓			✓		✓	No
Whenua Hou diving petrel	✓	✓	✓		✓	✓	Yes
Southern diving petrel	✓		✓	✓	✓	✓	Yes
White-faced storm petrel	✓						No
Grey-backed storm petrel	✓						No
Black-bellied storm petrel							No
Northern royal albatross	✓	✓		✓			No
Southern royal albatross	✓	✓		✓			No
Gibson's wandering albatross	✓	✓					No
Antipodes wandering albatross	✓	✓					No
Wandering albatross		✓					No
Southern Buller's albatross	✓		✓	✓			No
NZ white-capped albatross	✓			✓			No
Black-browed albatross				✓			No
Campbell Island albatross	✓	✓		✓			No
Light-mantled sooty albatross	✓						No
Salvin's mollymawk	✓	✓		✓			No
Chatham Island mollymawk	✓	✓		✓			No
Grey-headed mollymawk	✓	✓					No
White-fronted tern	✓		✓	✓	✓	✓	Yes
Australasian gannet			✓	✓	✓		No
Foveaux shag	✓	✓	✓	✓	✓	✓	Yes
Spotted shag	✓		✓	✓	✓	✓	Yes
Pied shag	✓		✓	✓	✓	✓	Yes
Little shag	✓		✓	✓	✓	✓	Yes
Black shag	✓		✓	✓	✓	✓	Yes
Red-billed gull	✓		✓	✓		✓	Yes
Black-backed gull			✓	✓		✓	No
White-faced heron			✓	✓			No
Variable oystercatcher	✓		✓	✓			No

6.0 Measures to avoid, minimise and mitigate

Through a process of project design and shaping, a number of measures were identified to avoid, minimise and mitigate potential effects on seabirds. These measures are outlined below, and will be incorporated into the proposed Hananui Project

- Nets:
    - Good management of underwater nets (e.g. keeping nets taut and well maintained).
    - Use of top nets, preventing birds gaining access to the fish from above.
    - The use of a single net system with the use of predator resistant materials in the construction of nets.
    - Using small mesh sizes (≤40 mm underwater and ≤60 mm above water).
- Farm feed
    - Smart feeders to minimise excess feed.
    - Minimising the waste accumulating on the seabed beneath cages.
- Waste management:
    - Preparation and implementation of a Waste Management Plan to ensure waste material and debris are collected and disposed of correctly.
- Boat traffic
    - Minimise boat traffic near the coastline (i.e. within 200 m) associated with the salmon farming for daily operations.
    - In terms of land access to the adjacent coastline, farm staff should only be permitted to access via existing landing sites (e.g. those current used by tourism & charter operators), unless under specific circumstances (e.g. i.e. search and rescue, clean up, recovery of equipment, pest control, safety and procedures etc).
    - DOC has developed guidelines[54] relating to vessel behaviour around marine mammals, and Part 3 of the Marine Mammals Protection Regulations 1992 list the conditions governing behaviour of all vessels and aircraft around marine mammals. These requirements will be implemented at the Hananui farms and as such will also act to minimise disturbance to birds that may be present in the vicinity of the farm.
- Lighting
    - Minimal non-navigational lighting at night (not white light).
    - Minimise underwater lighting, particularly skyward illumination.
- Monitoring
    - A full-time role dedicated to wildlife monitoring, management and reporting.
    - Preparation and implementation of a Seabird Management Plan.
    - Monitoring and reporting of negative interactions of seabirds with any structures associated with the salmon farming activities should be

[54] https://www.doc.govt.nz/nature/native-animals/marine-mammals/sharing-our-coasts-with-marine-mammals/

undertaken, and species-specific management strategies should be implemented if required.

We note that the above measures incorporate all those recommended by Gaskin et al. (2021) in the Seabird Guidelines.

7.0 Assessment of Potential Effects on Key Species

The potential level of effect on the key seabird species (identified in Table 7) is assessed in the following sections for the following:

- Entanglement in structures;
- Habitat exclusion;
- Providing roost sites closer to foraging areas;
- Changes to food supply;
- Disturbance;
- Marine litter;
- Vessel / propeller strike; and
- Artificial lighting.

We note that the assessment takes into account impact management developed during project shaping (i.e. meausures to avoid, minimise or mitigate potential effects), as outlined in Section 6.0 above.

For clarity, definitions for a number of terms frequently used in this assessment are provided in Table 8 below.

Table 8: Terminology used in the assessment

TERM	DEFINTION
Mitigation	Any action that alleviates or moderates the severity of an impact caused by something. Actions that mitigate impacts may also minimise those effects.
Interaction	Any physical contact made between a seabird and a part or structure of the farm itself, which may or may not result in an incident (as defined below).
Incident	An interaction that results in an injury (e.g. rope cut, abrasion), entrapment (e.g. live animal within farm pen), or entanglement (live or fatal) of a seabird.

7.1 Entanglement

7.1.1 Potential effect

Entanglement of seabirds with commercial fisheries equipment has been recorded for a number of species, including sooty shearwater and hoiho (Bell, 2014; Crawford et al., 2017; Darby & Dawson, 2000; Thompson, 2010); however, these reports all relate to fishing methods such as trawling, gill and set netting. Seabirds interact differently with fisheries depending on the type of fishery and the gear used (L. S. Bull, 2007; Løkkeborg, 2011). For example, with respect to trawl fisheries, seabirds often collide with the net monitoring (net sonde) cable and trawl warps, or birds become tangled in the net (whilst attempting to feed) when it is at the surface during setting and hauling (Barton, 2002; Hooper et al., 2003; Weimerskirch et al., 2000; Wienecke & Robertson, 2002). In gillnet fisheries, seabirds are most often caught in the nets when diving for prey; the fine transparent monofilament used results in reduced net visibility and therefore increased risk of seabird entanglement (Melvin et al., 1999; Žydelis et al., 2013).

The potential exists for **diving birds,** attracted to the fish and fish feed pellets, to be drowned as a result of becoming entangled in underwater nets used to contain the farmed fish and predator nets both above and below the cages (Sagar, 2013; SAMS Research Services Ltd, 2018). With regards to aquaculture projects, physical factors that may influence the potential for seabird interactions include mesh size (knot-to-knot) and material (e.g. colour and rigidity), as well as net tension.

Entanglement records were found for several Australian offshore farms. Based on the first two years of a five year offshore seacage trial in New South Wales, one incident of bird entanglement was recorded (NSW Department of Primary Industries, 2017, 2018). Huon Aquaculture farms in Tasmania reported on bird interactions; a total of 115 seabird incidents were recorded[55] at four Tasmanian farms[56] (Huon River (5 sites), Lower D'Entrecasteaux (1 site), Storm Bay (2 sites) and Macquarie Harbour (3 sites)) over the period July 2019 to November 2022 (Figure 7). Shags (n=65) and gulls (n=47) were the only groups recorded caught (Figure 8). Further information was requested[57] from Huon to obtain an understanding of the circumstances surrounding the 24 black-faced shag[58] incidents that were recorded in August 2019. These mortalities occurred on a single day and black-faced shag were the only species recorded. All bird netting on the pens was correctly rigged and the pens weren't being fed on that day. The birds were not entrapped inside the pens, but rather were entangled from the outside. Huon undertook an internal investigation[59] and determined that the shags had likely been spooked by a predator flying above them. Unlike Australia, New Zealand does not have coastal aerial predators such as the white-bellied sea eagle (*Haliaeetus leucogaster*) which forages over the water for aquatic animals, such as fish, turtles and sea snakes, and birds. As such, the circumstances surrounding the reported entanglement of 24 black-faced shag are unlikely to occur in New Zealand waters.

In New Zealand, the New Zealand King Salmon Company report[60] on the wildlife incidents recorded at their salmon farms[61] (none of which are open ocean like the proposed Hananui project). A total of 193 seabird interactions have been recorded over the period January 2019 to May 2025 (Figure 9), the majority of which were red-billed gull (n = 64), pied shag (n = 61) and black-backed gull (n = 51) and (Figure 10). However it is important to note that the NZ King Salmon farms used a larger mesh size that that proposed for the current project (refer to Section 2.2 above).

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[55] Source https://dashboard.huonaqua.com.au/environment/wildlife accessed 12 July 2022.

[56] We note that of these sites, only the 2 Storm Bay sites can be considered open ocean, and even they are tucked in beside Bruny Island.

[57] Personal communications between Huon Aquaculture and Thomas Hilderbrand, email dated 7 April 2020.

[58] Black-faced shag (*Phalacrocorax fuscescens*), a coastal native Australian species, is not found in New Zealand.

[59] The results of this investigation were provided to the State Government.

[60] https://www.kingsalmon.co.nz/our-environment/

[61] Clay Point, Kopaua, Ngamahau, Ruakaka, Te Pangu, Waihinau, Waitata, Forsyth and Otanerau.

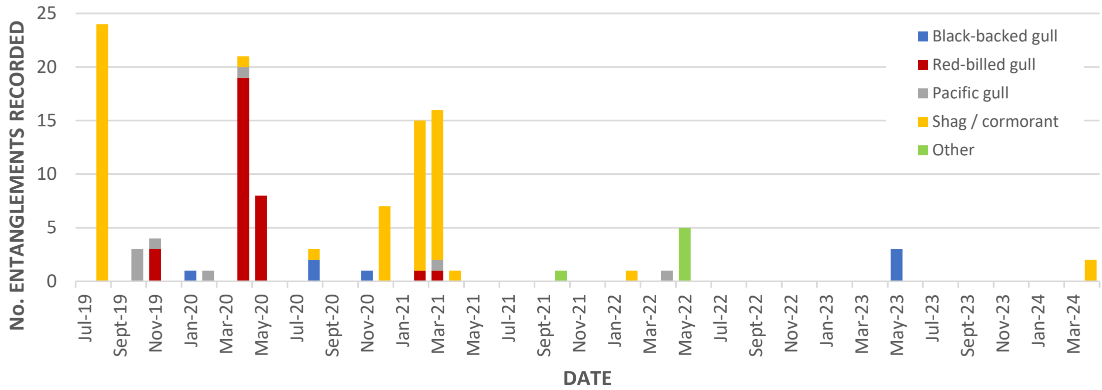

Figure 7: Monthly reported seabird incidents at three Huon Tasmanian salmon farms (comprising 11 sites) from July 2019 – April 2024

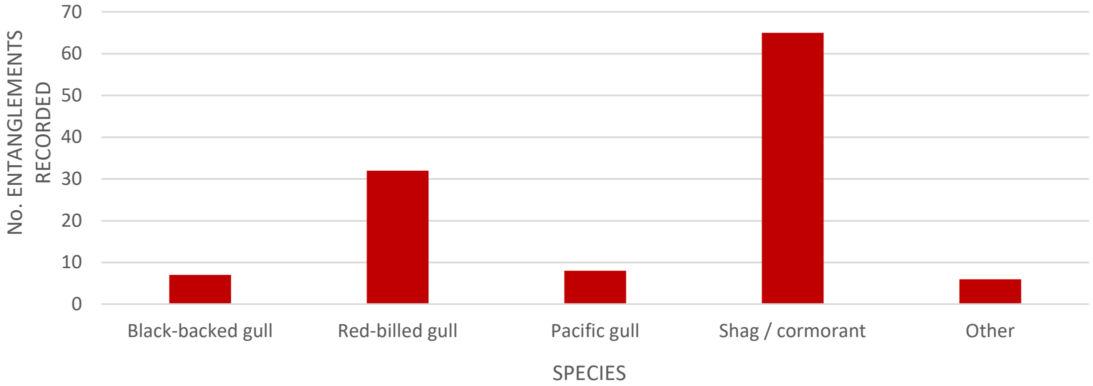

Figure 8: Total seabird incidents at three Huon Tasmanian salmon farms (comprising 11 sites) from July 2019 – April 2024

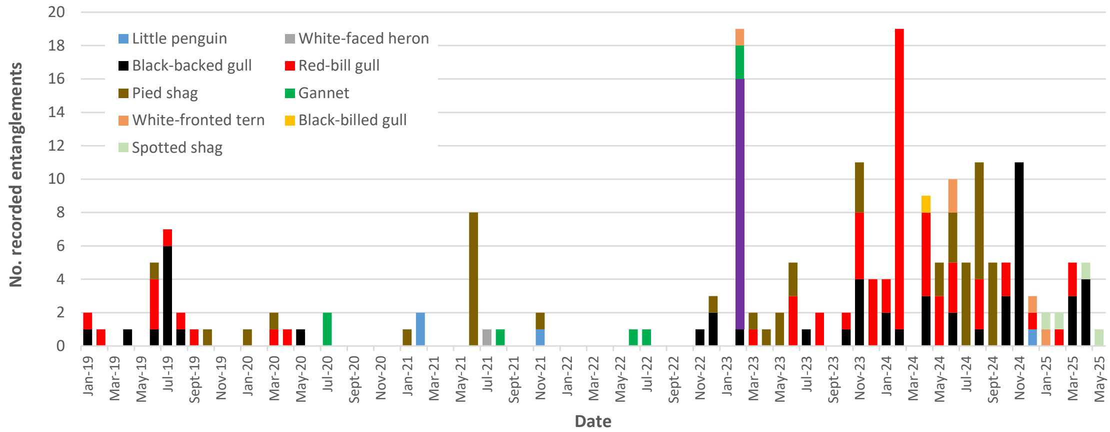

Figure 9: Monthly seabird incidents reported at eight[61] NZ King Salmon farms from January 2019 – May 2025

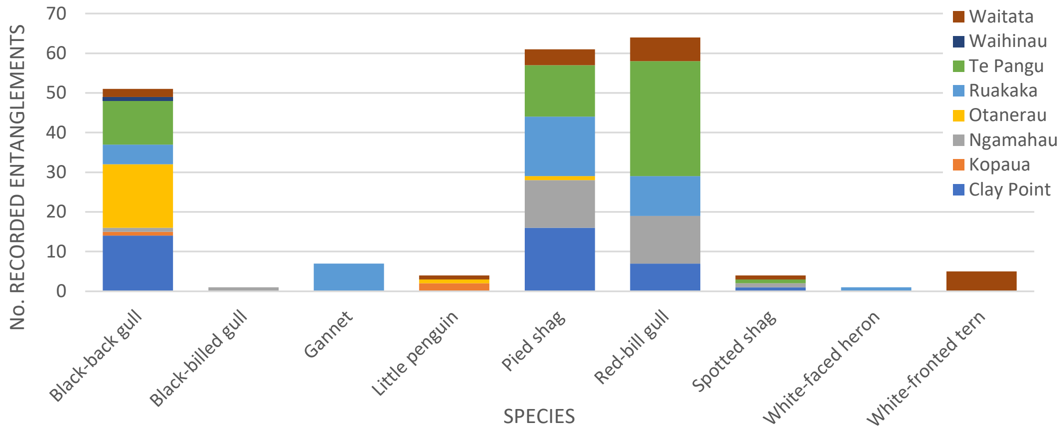

Figure 10: Total seabird incidents reported at eight[61] NZ King Salmon farms from January 2019 – May 2025

Based on the above data sets, the incident rates for shags (species combined), red-billed gull and penguin at the Huon and New Zealand King Salmon farms are provided in Table 9 below. The average incident rates for red-billed were similar, being 1.6 and 1.3 birds per farm per year at Huon and New Zealand King Salmon sites respectively. In comparison, higher average rates of shag incidents were recorded at Huon sites (3.25 birds per farm per year) compared to New Zealand King Salmon sites (1.4 birds per farm per year). While no tern were recorded at the Huon farms, the NZ King Salmon white-fronted tern incident data equates to average of 0.1 bird per farm per year.

Table 9: Incident rates at Huon and New Zealand King Salmon (NZKS) sites.

PARAMETERS	HUON	NZKS
Number of farms	4	8
Number of years	5	6
Total penguin incidents	0	4
Average penguins per year	-	0.7
Average penguins per farm per year	-	0.1
Total shag incidents	65	65
Average shags per year	13	10.8
Average shags per farm per year	3.25	1.4
Total red-billed gull incidents	32	64
Average red-billed gull per year	6.4	10.7
Average red-billed gull per farm per year	1.6	1.3
Total tern incidents	-	5
Average tern per year	-	0.8
Average tern per farm per year	-	0.1

Fisheries New Zealand releases quarterly information reported by commercial fishers about accidental catches of marine mammals, seabirds, reptiles, protected fish, and corals, sponges, and bryozoans. Between the period October 2019/20 to December 2024/25, a total of 176 seabird interactions were reported, the majority (n=104) of which were unidentified shags (refer to Figure 11). In terms of FMA5 (Southland), in which the Hananui Project is located, a total of 19 bird interactions were recorded for the same period (refer to Table 6); unfortunately, the method of capture was reported as unknown in all 19 reported interactions not . These incidents included all three penguin species, sooty shearwater and unidentified shags. In FMA5 (Southland), the minimum set net mesh size is 100 mm for most species – this is more than twice the mesh size (knot-to-knot) proposed for the Hananui project. While this larger mesh size may allow undersized fish to escape, it is large enough to entangle birds.

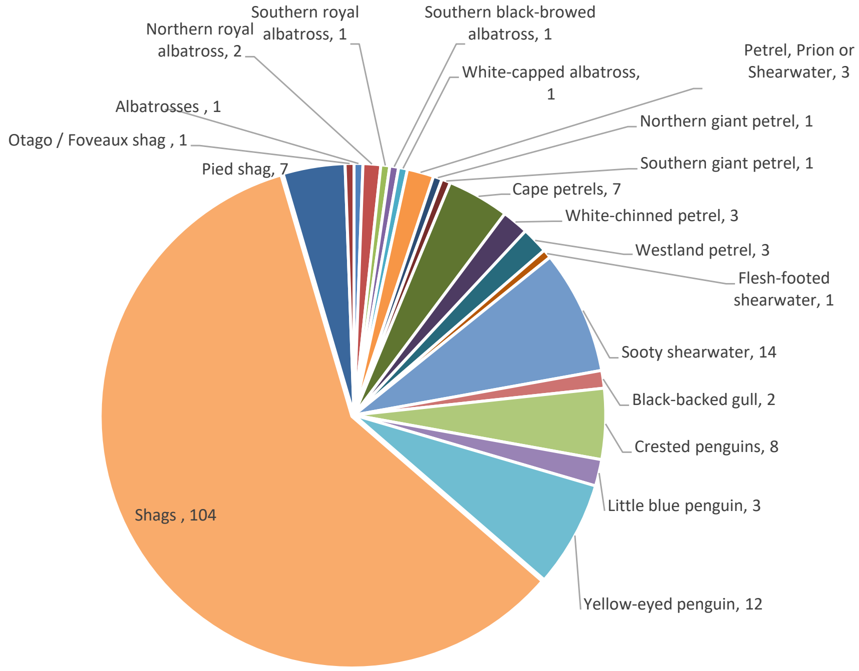

Figure 11: Total reported seabird catch data for set netting between October 2019/20 to December 2024/25

Table 10: Reported seabird catch data as a result of set netting in FMA5 (Southland) between October 2019/20 to December 2024/25

SPECIES	ALIVE INJURED	ALIVE UNINJURED	DEAD	TOTAL BIRDS	AVERAGE BIRDS PER YEAR
Little penguin	0	3	0	3	0.6
Crested penguins	1	0	7	8	1.6
Hoiho	0	0	3	3	0.6
Sooty shearwater	0	0	1	1	0.2
Shags (unidentified)	0	0	4	4	0.8

We note that no diving petrel interactions were identified in all three data sets (Huon (Figure 7), NZ King Salmon (Figure 9) and Fisheries New Zealand (Figure 11)), however a low number of penguins and shearwaters have been recorded. Thus it appears from the available data sets that shags and gulls are the main species for which incidents have been reported (Figure 8 and Figure 10), but other species of interest being reported less. However, as noted previously, there are several charactistics about these fisheries which are likely to significantly increase the chances of seabird entanglements compared to the current proposal, including:

- Considerably larger mesh sizes; and
- In the case of set netting, net material that is finer and not as visible.

Thus it is expected that the incident rates reported above will not occur at the Hananui farms, but rather serve as example of e minimisng risk of interactions through the proposed net design, as well as the importance of net maintenance and tensioning.

7.1.2 Key species assessed

We have considered the potential for entanglement for all key species. Based on known feeding behaviours, diving seabirds (shag, penguins, shearwaters and diving petrels) are likely exposed to potential entanglements, but gulls and terns have also been recorded entangled.

7.1.3 Assessment of proposal

The different sizes of mesh are likely to have different entanglement risks for birds; the larger the mesh the greater the risk of entanglement.

The following design features of the proposed project will reduce the likelihood of seabird entanglements:

- Top nets over sea cages exclude birds and prevents physical interactions with net pens (NOAA, 2005; Sagar, 2013).
- Single underwater net with mesh size of <40 mm (knot-to-knot).

An average entanglement rate of 0.1 little penguin per farm per year was recorded at the New Zealand King Salmon farms (Table 9). All three species of penguins have been recorded in set nets in FMA5, with average entanglement rates being 0.6 birds per year for hoiho and kororā, and 1.6 birds pe year for crested penguins (Table 10). However, as noted previously, all these records are from nets with greater mesh size, as well as in the case of set netting, a different fishing method. Head width measurements taken from six hoiho specimens held at Te Papa ranged from 47.2-53.9 mm, with a mean of 50.9 mm. Thus, the proposed <40 mm mesh size proposed for the Hananui underwater nets will not pose a risk of entanglement to hoiho. Furthermore, hoiho have been shown to forage successfully around, but not under, the existing salmon farms in Big Glory Bay (refer to Figure 4 on page 15).

As such, we do not consider the Hananui Project will pose the same level of risk for entanglement to these species, and that the magnitude of effect on the local populations of penguins will be Negligible (as defined by the criteria in Table 5) on that basis.

With regards to shearwater, there was only a single record of a sooty shearwater in the FMA5 set net records (refer to Table 10 above). Furthermore, the only other shearwater recorded in the Fisheries New Zealand set net data for all areas was a single flesh-footed shearwater (refer to Figure 11 above) recorded in FMA8 (Central - Egmont). As such, we consider the magnitude of effect on the sooty shearwater will be Negligible (as defined by the criteria in Table 5).

There were no records of diving petrel entanglements in the Huon, NZ King Salmon or Fisheries New Zealand datasets. As such, we consider the magnitude of effect on the local populations of southern and Whenua Hou diving petrel will be Negligible (as defined by the criteria in Table 5).

There are no records of Cook's petrel in the Fisheries New Zealand set net (refer to Figure 11 above). As such we consider the magnitude of effect related to entanglement on this species will be Negligible (as defined by the criteria in Table 5).

The average rates for shag entanglements were 3.25 and 1.4 birds per farm per year at the Huon and New Zealand King Salmon sites respectively (refer to Table 9 above). Four unidentified shags were recorded in the Fisheries New Zealand FMA5 set net data over a 5-year period, and a single Foveaux shag was recorded in FMA3 (South-East coast) set net data. As noted above, a smaller mesh size will be used for the current project, rather than a larger mesh as is used at these other sites. Thus, we would expect lower rates of entanglement for the Hananui project. Nevertheless, we have determined the magnitude of effect on the local populations of Foveaux, spotted and pied shag to be Low, and Negligible for little and black shag (as defined by the criteria in Table 5).

The average rates for red-billed gull entanglements were 1.6 and 1.3 birds per farm per year at the Huon and New Zealand King Salmon sites respectively (refer to Table 9 above). Again, we would expect lower rates of entanglement for the Hananui project based on the nets that will be used. Based on that level of interaction, we have determined that the magnitude of effect on the local population of red-billed gull to be Low (as defined by the criteria in Table 5).

Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) of entanglements on the local coastal avifauna populations as outlined in Table 11.

Table 11: Assessment of potential effects of entanglement on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook's petrel	~5,000 pairs	High	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Negligible	Low
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Low	Moderate
Spotted shag	~1,000 pairs	Very High	Low	Moderate
Pied shag	~1,000 pairs	Moderate	Low	Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low
Red-billed gull	>500 pairs	High	Low	Low

[62] Refer to Table 2

[63] Refer to Table 3

[64] Refer to Table 1

7.2 Habitat Exclusion

7.2.1 Potential effect

The habitat available for **surface feeding** seabirds becomes reduced because of the physical presence of farm structures (Sagar, 2013). Benthic-feeding seabirds, such as penguins and some shags, may still be able to feed under the farm. Sagar (2013) considers that the effect of habitat exclusion would be at a local scale, that being including and within 50 m of the farm; we concur that this is likely to be the extent and scale of effect at the project site.

7.2.2 Key species assessed

We have considered the potential for habitat exclusion for all key species; however, based on known feeding behaviours, surface feeders are the most likely to be impacted by habitat exclusion. Nevertheless, while most diving species will likely still be able to forage under the nets, we have considered the impact of habitat exclusion on all key species.

7.2.3 Assessment of proposal

The magnitude of effect relating to habitat exclusion will be Negligible (as defined by the criteria in Table 5) on the local populations of the key species identified above (Section 7.2.2) given the small area[65] occupied by the proposed salmon farm in relation to the large total area of suitable foraging habitat available for foraging birds (refer to Maps 7-13), and the reduction in farm density that has been achieved through the project design process.

Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) of habitat exclusion on the local coastal avifauna populations as outlined in Table 12.

Table 12: Assessment of potential effects of habitat exclusion on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook's petrel	~5,000 pairs	Moderate	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Negligible	Low
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Negligible	Low
Spotted shag	~1,000 pairs	Very High	Negligible	Low

[65] As outlined by Isthmus (2025) "*Foveaux Strait, the 1,250ha site boundary occupies approximately 0.5% or one two hundredth of the 2,640km² area of the strait. Within the 1,250ha site area, the salmon farm blocks of pens occupy approximately 96.8ha of water space*".

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Pied shag	~1,000 pairs	Moderate	Negligible	Very Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low
Red-billed gull	>500 pairs	High	Negligible	Very Low

7.3 Providing Roost Sites Closer to Foraging Areas

7.3.1 Potential effect

Aquaculture facilities provide new roosting sites, including buoys and other above water structures.

7.3.2 Key species assessed

We have considered the potential for providing roost sites closer to foraging areas for all key species. Shags, gulls and terns are the groups of birds known to readily roost on structures. As such, the key species identified (Table 7) in these groups, and therefore assessed below, are as follows: red-billed gull, white-fronted tern and Foveaux shag, spotted shag and pied shag.

7.3.3 Assessment of proposal

The presence of the above-water components of the aquaculture facilities, and associated navigational aids, may benefit species such as shags, gulls and terns, by providing roosting sites close to their foraging areas (thereby reducing energy expenditure) and away from terrestrial predators (Sagar, 2013).

The magnitude of effect relating to the provision of roost sites closer to foraging areas will be positive for the local populations of shag, white-fronted tern and red-billed gull. Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations through the provision of roosting sites closer to foraging areas as outlined in Table 13.

Table 13: Assessment of potential effects of providing roosting sites closer to foraging areas on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
White-fronted tern	<200 pairs	High	Positive	Net gain
Foveaux shag	~1,000 pairs	Very High	Positive	Net gain
Spotted shag	~1,000 pairs	Very High	Positive	Net gain
Pied shag	~1,000 pairs	Moderate	Positive	Net gain
Little shag	>200 pairs	Moderate	Positive	Net gain
Black shag	>200 pairs	Moderate	Positive	Net gain

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Red-billed gull	>500 pairs	High	Positive	Net gain

7.4 Changes to Food Supply

7.4.1 Potential effect

Fin fish farms have the potential to change the food supply for seabirds through:

1. Provision of a food supply through farm feed waste (P. Taylor & Dempster, 2021);
2. Small fish may be attracted to the farm to feed on food residue and to shelter under the farm structures (P. Taylor & Dempster, 2021). Sagar (2013) considers that the effect of aggregations of prey fish would be at a local scale, that being within 100 m of the farm; and
3. Reduction in potential invertebrate and fish prey available for benthic feeding seabirds because of impacts on the benthos by food residues and faeces from farmed fish (Sagar, 2013).

We note that the potential effects on food supply for nocturnal feeding seabirds associated with the salmon farm lighting is considered and assessed in Section 7.8 below.

7.4.2 Key species assessed

We have assessed the potential for changes in food supply for all key species.

7.4.3 Assessment of proposal

Gulls are usually the main birds utilising fisheries discards and are the most dependent on these discards due to their opportunistic and scavenging nature; a pattern observed by Harrison (2003) at Port Lincoln tuna farms in South Australia. While seabirds recorded feeding at the Port Lincoln farms included terns, shags, petrels and gannets, red-billed (silver) gulls were the most abundant species recorded. Short-tailed shearwater ate a very small proportion of the total feed taken by seabirds at the farms, and like all other species, showed a preference for bait fish (pilchards; *Sardinops sagax*) over pellet feed. At the proposed site, the amount of feed distributed into the sea cages will be monitored to minimise the waste accumulating on the seabed beneath cages. Furthermore, only pellet feed will be used; whole bait fish will not be used.

Harrison (2003) observed short-tailed shearwaters both inside and outside the seacages; birds were able to get inside the pens because exclusion top nets were not used at the Port Lincoln farms. However, the netting design at the proposed site will include top nets over sea cages to prevent birds from gaining access to the fish from above.

Aggregations of fish around the structures may provide enhanced feeding opportunities for piscivorous seabirds (Sagar, 2013). Harrison (2003) reported that the short-tailed shearwaters observed outside of the tuna farm sea cages at Port Lincoln were likely feeding on the naturally occurring wild fish around the cages that may have been attracted there due to excess tuna feed in the water. Harrison (2003) also noted that the shearwaters were not present all of the time, suggesting that they are not reliant on the farms and do forage for natural feed.

Seabed effects tend to be most evident directly beneath the pens and exhibit a strong gradient of decreasing impact with distance. However, sites in deep water (c. 30 m or greater) with strong current speeds (depth averaged current speed > 15 cm per second), such as the proposal area, will have a more dispersed depositional footprint with less concentrated enrichment than shallower sites with lower flushing ability due to increased levels of resuspension and dispersion (Bennett et al., 2025). Furthermore, the proposed farms have been placed so that primary organic deposition, and the associated effects, are unlikely to occur in areas of high-value habitats (high biogenic cover); the substratum within the boundaries of each farm block and associated depositional footprint is mainly sand (66% of proposal area), with sandy shell hash (16%) and coarse gravel shell and sand (18%) (Bennett et al., 2025).

While there will be an increase in particulate organic matter (uneaten feed and faeces), Bennett et al. (2025)note that given the strong current speeds and non-cohesive nature of the sediments across the proposal area, significant resuspension/dispersion of deposited particles is likely, as is the dispersal and redeposition of particles outside of the main footprint, into the far-field. Furthermore, Bennett et al. (2025)report that far-field deposition will occur at a reduced rate and that waste will be assimilated.

As such, the potential effects on benthos leading to changes in the fauna available to all seabirds as prey are considered to be Negligible (as defined by the criteria in Table 5) on the local populations of key species given the small area occupied by the proposal in relation to the total area of suitable habitats available for foraging seabirds in the wider area.

Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations resulting from changes in food supply as outlined in Table 14.

Table 14: Assessment of potential effects of changes to food supply on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook's petrel	~5,000 pairs	Moderate	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Negligible	Low
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Negligible	Low
Spotted shag	~1,000 pairs	Very High	Negligible	Low
Pied shag	~1,000 pairs	Moderate	Negligible	Very Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Red-billed gull	>500 pairs	High	Negligible	Very Low

7.5 Disturbance

7.5.1 Potential effect

The presence of the farm and associated activities, plus the additional small boat traffic, may disturb breeding and feeding seabirds (Sagar, 2013).

While little is known about the distances over which foraging and feeding seabirds may be disturbed, Sagar (2013) considers that such an effect would be at a local scale within 100 m of the farm. We concur that this would be the likely extent and scale of such an effect at the project site based on the location of the farm and the existing vessel traffic in the area (details regarding commercial fisheries activities are provided in Gibbs (2025), with Automatic Identification System (AIS) desity maps of various vessel types provided in Navigatus (2025)).

7.5.2 Key species assessed

We have assessed the potential effects of disturbance for all key species.

7.5.3 Assessment of proposal

The proposed salmon farm does not require human access to the coastline, therefore any birds breeding on land (e.g. penguins, shags, terns and variable oystercatcher) will not be directly impacted. While there may be increased vessel traffic or noise associated with the proposed farm, the potential for indirect disturbance to shags and terns nesting above ground on coastal cliffs and rock outcrops adjacent will be minimal on account of the fact that the nearest boundary of the project site will be approximately 2.0 km away from the coastal cliffs (see Map 1). As noted above, the potential effects of disturbance are likely to be within 100 m of the activity.

All species recorded either foraging in, or traversing over, the project site may be exposed to a level of disturbance. This disturbance is likely not to be significant given the small area occupied by the project site in relation to the large total area of suitable habitats available for foraging seabirds.

As such, we have determined that the potential effects of disturbance on the local populations of key species will be Negligible (as defined by the criteria in Table 5). Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations resulting from disturbance as outlined in Table 15.

Table 15: Assessment of potential effects of changes to food supply on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook’s petrel	~5,000 pairs	Moderate	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Negligible	Low
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Negligible	Low
Spotted shag	~1,000 pairs	Very High	Negligible	Low
Pied shag	~1,000 pairs	Moderate	Negligible	Very Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low
Red-billed gull	>500 pairs	High	Negligible	Very Low

7.6 Marine Litter

7.6.1 Potential effect

Ingestion of marine litter, particularly plastics, is common among seabirds and can cause death by dehydration, blockage of the digestive tract, or toxins released in the intestines (Brandão et al., 2011; Colabuono et al., 2009; Furness, 1985; Hutton et al., 2008; Pierce et al., 2004; Verlis et al., 2013). Ingestion of plastics may not be restricted to the individual seabird that consumed them because adults that regurgitate food to their chicks could pass them onto their offspring (Auman et al., 1997; Fry et al., 1987; van Franeker & Bell, 1988). Among seabirds, the ingestion of plastics is directly related to foraging behaviour and diet (Ryan, 1987). For example, species that feed on surface or near-surface dwelling invertebrates are more likely to confuse pieces of plastic with their prey than are piscivores, therefore, the former have a higher incidence of ingested plastics (Azzarello & Van Vleet, 1987); although piscivores have been recorded to consume plastic bags and food-handling gloves (Sagar, 2013).

In addition, seabirds have been reported as entangled in plastic debris, including discarded fishing gear (nets) (B. Rodríguez et al., 2013; Schrey & Vauk, 1987; Votier et al., 2011).

7.6.2 Key species assessed

We have assessed the potential effects of marine litter for all key species.

7.6.3 Assessment of proposal

A waste management plan will be prepared to ensure practices minimise the potential for rubbish to end up in the marine environment. Adherence to this plan will minimise the potential for seabirds to ingest litter associated with the salmon farming.

We have determined that the potential effect of marine litter on the local populations of key species will be Negligible (as defined by the criteria in Table 5) based on the assumption that the waste management plan will be adhered to.

Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations resulting from marine litter as outlined in Table 16.

Table 16: Assessment of potential effects of marine litter on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook's petrel	~5,000 pairs	Moderate	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Negligible	Low
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Negligible	Low
Spotted shag	~1,000 pairs	Very High	Negligible	Low
Pied shag	~1,000 pairs	Moderate	Negligible	Very Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low
Red-billed gull	>500 pairs	High	Negligible	Very Low

7.7 Vessel / Propellor Strike

7.7.1 Potential effect

Cannell et al. (2016) reporting on anthropogenic-related mortalities of little penguin in Perth (Western Australia), identified trauma, most likely caused by the propellers of motorised watercraft or the skegs of wind surfers, as the most prevalent cause of mortalities. As such, there is the potential for increased vessel traffic to result in boat/propeller strike when birds are at or close to the surface.

However, we note that penguins were the only seabird species for which we found any reports of propeller strike. This may in part be because all the time that they are not on land is spent underwater, unlike other seabird groups which spend a portion of their time flying over water.

7.7.2 Key species assessed

Our assessment of the potential effect for underwater vessel / propeller strike is restricted to the three penguin species that are likely present in the Foveaux Strait; hoiho, little and Fiordland crested penguin.

7.7.3 Assessment of the proposal

In the existing environment there is already the presence of regular anchoring of large ships in the area of the proposed salmon farm site (Navigatus, 2025). Furthermore, the Navigational Risk Assessment for the project provides AIS density maps for the various vessel types (e.g. cargo, container, fishing, tanker, passenger, pleasure, tug and special craft), showing the existing marine traffic throughout Foveaux Strait. Figure 12 below shows the AIS density maps for passenger vessels and pleasure crafts in the wider Foveaux Strait and Paterson Inlet area, which includes overlap with the hoiho tracking data collected by Mattern & Young (2019) in Paterson Inlet (Figure 13). It appears that Paterson Inlet is another location at which hoiho are foraging successfully while being exposed to relatively high levels of marine traffic.

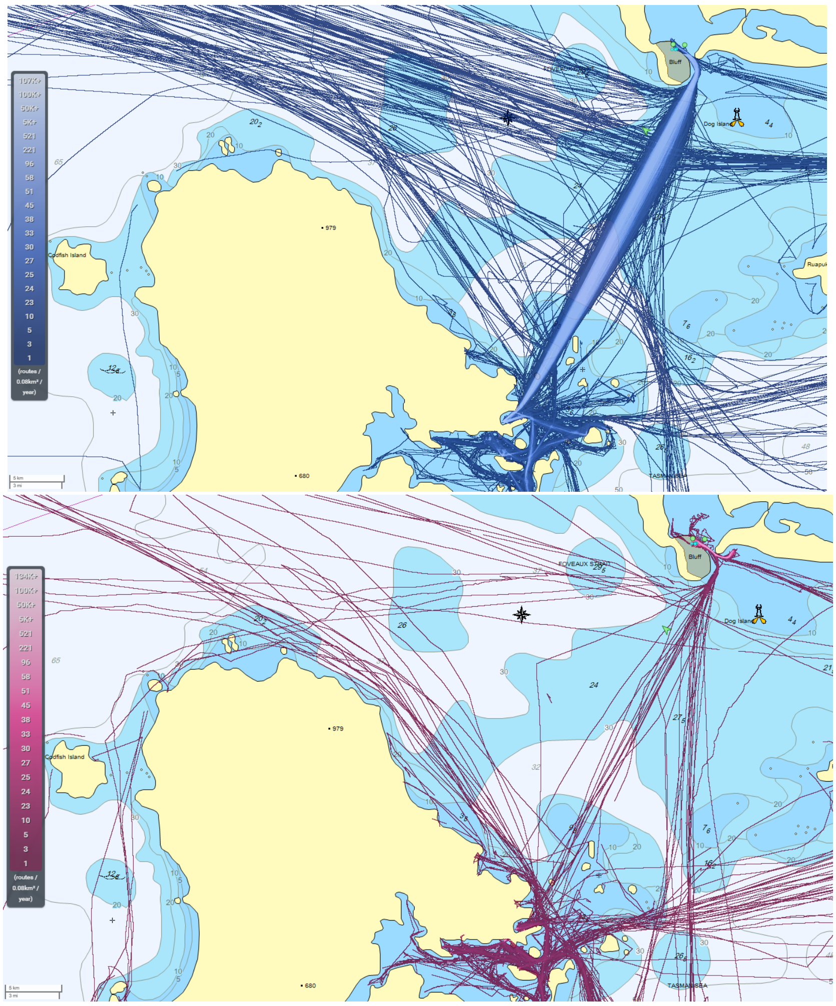

Figure 12: Passenger vessel (top image) and pleasure craft (bottom image) AIS density map for 2023. (Source: Navigatus (2025).

Figure 13: Example of hoiho tracks recorded in Paterson Inlet by Mattern & Young (2019).

In terms of differences in foraging / diving behaviours, little penguin dive at shallower depths than hoiho and Fiordland crested penguins, and as such are more likely to be exposed to potential impact of boat strike from the proposed salmon farm. However, as noted above, there is a considerable level of boat traffic in the area that penguin are already exposed to and the proposed salmon farm will not add to this in any significant way (refer to Table 1 on page 3 for a summary of the vessel traffic associated with the proposal).

As such, we have determined that the potential effect of vessel / propellor strike on the local populations of hoiho, little and Fiordland crested penguin will be Negligible (as defined by the criteria in Table 5) based on the existing level of marine traffic, the foraging depths of hoiho and Fiordland crested penguin, and the local population size of little penguin. Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations resulting from boat strike as outlined in Table 17.

Table 17: Assessment of potential effects of vessel / propellor strike on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low

7.8 Artificial lighting

Petrel vision is most sensitive to light in the short wavelength blue (400–500 nm), region of the visible spectrum. Relative to diurnal seabirds, such as gulls and terns, petrels have a higher number of short wavelength sensitive cones. This is thought to be an adaptation that increases prey visibility against a blue-water foraging field favoured by petrels (Hart, 2001).

Little has been published on vision in penguins. Penguins are visual foragers with the success of fish capture linked directly to the amount of light present (Cannell & Cullen, 1998). The eyes of the Humbolt penguin (*Spheniscus humboldti*) are adapted to the aquatic environment, seeing well in the violet to blue to green region of the spectrum, but poorly in the long wavelengths (red) (Bowmaker & Martin, 1985).

7.8.1 Potential effect

Two potential effects on seabirds associated with lighting have been identified:

1. Attraction to light resulting in collision with structures;
2. Bioluminescent and phototactic prey have an altered distribution in the water column within the area affected by the lights.

Birds attraction to lights can result in injury or death following collision with structures (Sagar, 2013). On vessels, nocturnal bird strikes tend to occur when bright, artificial light sources are used at times of poor visibility, typically during bad weather, often angled outwards or upwards from the vessel and when the vessel is relatively close to large breeding colonies. Petrel species are the most commonly reported birds being attracted to artificial lighting (Le Corre et al., 2002, 2003; Reed et al., 1985; A. Rodríguez et al., 2012; A. Rodríguez & Rodríguez, 2009). While shags have been recorded foraging at night, we found no records of species being attracted to artificial lights.

The intensity of light may be a more important cue than colour for seabirds. Very bright light will attract them, regardless of colour (Raine et al., 2007). There are numerous, although sometimes conflicting, reports of the attractiveness of different wavelengths of artificial light to seabirds. White light has the greatest effect on seabirds as it contains all wavelengths of light (Deppe et al., 2017; Montevecchi, 2006; Wiltschko & Wiltschko, 1999). Seabirds have reportedly been attracted to the yellow/orange colour of fire (Murphy, 1936), while white Mercury Vapour and broad-spectrum LED is more attractive to Barau's petrel (*Pterodroma baraui*) and Hutton's shearwater (*Puffinus huttoni*) than either Low or High-Pressure Sodium Vapour lights (Deppe et al., 2017).

Feeding of some seabirds, particularly species of petrels, shearwaters and shags, is related to the phase of the moon. Shags have also been recorded foraging at night, though the majority of feeding occurs during the day (Sapoznikow & Quintana, 2002; C. R. White et al., 2008). It is suggested that nocturnal-feeding petrels are instinctively attracted to light sources because they exploit bioluminescent prey (Imber, 1975). Some species of petrel are unusual for seabirds because they feed at sea when the light level is reduced (M. de L. Brooke & Prince, 1991; Imber, 1975; Warham, 1990), presumably feeding on bioluminescent prey. Imber (1975) noted that studies of the food of several species of oceanic birds (grey-faced petrel (Imber, 1973), wandering albatross (Imber & Russ, 1975), black petrel (Imber, 1976), Cook's petrel (Imber, 1996)) reported 80-100% of their prey being bioluminescent.

Artificial lighting directly affects the physical characteristics of the water column and, as a result, has the potential to affect a number of biological processes both within and adjacent to the pens (SLR, 2025). For instance, Montevecchi (2006) noted that some nocturnally migrating crustaceans and associated predators might be less likely to migrate toward surface waters that are artificially illuminated.

7.8.2 Key species assessed

We have considered the potential effects of attraction to artificial lights for all key species. However, vulnerability to artificial light appears to be greatest among species that feed on bioluminescent and phototactic prey and could have predispositions for light attraction (Montevecchi, 2006). Based on the existing research, the only groups of seabirds potentially affected include petrels, and possibly shag. As such, the key species identified (Table 7) in these groups, and therefore assessed below, are as follows: Foveaux shag, spotted shag, pied shag, little shag, black shag, sooty shearwater, Cook's petrel, southern and Whenua Hou diving petrel.

7.8.3 Assessment of proposal

Bennett & Cornelisen's (2018) nocturnal survey at the Kopāua salmon farm in Pelorus Sound reported that measurable light (above water) was confined to the pens and only very low levels were detected under the water, around the depth at which the lights were suspended. Furthermore, Bennett & Cornelisen (2018) reported that no seabirds were observed at the Kopāua salmon farm during the nocturnal survey.

The artificial lighting associated with the proposal will be submerged (deployed 3–7 m below the surface) with a downward light dispersion and little horizontal diffusion; it is unlikely that the diffuse underwater lighting will attract petrels or shags in any great numbers. Furthermore, the lighting will only operate for 6-8 months of the year, typically starting from March – April (which is near the end of the breeding season for most seabirds).

To manage light dispersion from barges associated with the farms, all barge windows will be fitted with black-out blinds or curtains that will be closed daily before dusk. Lights will also be turned off when not in use and minimal non-navigational lighting will be used at night.

As outlined in Table 2 (page 4), the lighting of the proposed navigational aids will involve pulsing / flashing, rather than continuous lights, which will make them less attractive to seabirds. In terms of the risk of changing bioluminescent prey availability, the area of the water column affected by underwater lighting would be restricted to the pens. The surface area proposed to be occupied by net pens totals an area of approximately 0.16 km^2 compared to the approximately 3,300 km^2 of Foveaux Strait, which in itself represents only part of the foraging range for the petrel species that may be most vulnerable to this effect, based on available seabird tracking data.

As noted above, attraction to artificial lighting by petrels has often been associated with poor visibility and lighting angled outwards or upwards. Thus, based on the proposed lighting design which has downward light dispersion, we have determined the magnitude of effect relating to attraction to artificial light and effects on bioluminescent prey on the local population of sooty shearwater, Cook's petrel and southern diving petrel will be Negligible (as defined by the criteria in Table 5), and Low for the Whenua Hou diving petrel.

While shags have been recorded foraging at night, the majority of feeding occurs during the day, and as such we have determined the magnitude of effect relating to attraction to artificial light to be Negligible (as defined by the criteria in Table 5) on the local shag populations.

Overall, we have determined the potential level of effects (combining ecological value and magnitude of effects) on the local coastal avifauna populations resulting from artificial lighting as outlined in Table 18.

Table 18: Assessment of potential effects of artificial lighting on local coastal avifauna populations

SPECIES	EST. LOCAL POPULATION	ECOLOGICAL VALUE[62]	MAGNITUDE OF EFFECT[63]	LEVEL OF EFFECT[64]
Hoiho	~30 pairs	Very High	Negligible	Low
Southern little penguin	>500 pairs	High	Negligible	Very Low
Fiordland crested penguin	~880 pairs	High	Negligible	Very Low
Sooty shearwater	>1,000,000 pairs	High	Negligible	Very Low
Cook's petrel	~5,000 pairs	Moderate	Negligible	Very Low
Southern diving petrel	>1,000 pairs	Moderate	Negligible	Very Low
Whenua Hou diving petrel	~200 birds	Very High	Low	Moderate
White-fronted tern	<200 pairs	High	Negligible	Very Low
Foveaux shag	~1,000 pairs	Very High	Negligible	Low
Spotted shag	~1,000 pairs	Very High	Negligible	Low
Pied shag	~1,000 pairs	Moderate	Negligible	Very Low
Little shag	>200 pairs	Moderate	Negligible	Very Low
Black shag	>200 pairs	Moderate	Negligible	Very Low
Red-billed gull	>500 pairs	High	Negligible	Very Low

8.0 Assessment Summary

The Hananui Aquaculture Project has adhered to measures, including by minimising and / or mitigating for potential interactions through site selection, design, and operation of farm infrastructure as recommended in Fisheries New Zealand Seabird Guidelines for Open Aquaculture (Gaskin et al., 2021).

The assessment of effects was undertaken on the basis of the implementation of all those measures (outlined in Section 6.0 above) which are critical to achieving the level of effects identified. In line with the EIANZ guidelines for undertaking ecological impact assessments, the overall level of effect has been assessed based on ecological value and magnitude of effect. While the risks of incidents with seabirds will be low and managed by the proposed management programme, many of the seabird species assessed have high or very high ecological. Thus should an incident occur involving species such as hoiho which have a declining population, the consequences would be high.

A summary of the potential positive and negative effects identified in Sections 7.1 - 7.8 is provided in Table 19. For most key species the potential negative effects are considered to be Low to Very Low, the exception being a potential Moderate level of effect on Foveaux shag and spotted shag from entanglement and on Whenua Hou diving petrel from attraction to the artificial lighting. As such, the monitoring of nets and lighting for potential interactions will be an important part of the management programme, especially for Foveaux shag and Whenua Hou diving petrel, and should be undertaken on a regular basis. Importantly, the Seabird Management Plan will include feedback loops that will make it possible to try to address causes and reduce risks of further incidences should interactions occur.

Hoiho and sooty shearwater are particularly significant species from a cultural perspective, and we therefore offer some summary explanation of our conclusion about the level of effect on these species.

Overall, we have determined that the potential effects of the proposal on hoiho based on:

- The proposed net design will include:
  - be made of visible black net - mesh material;
  - small enough underwater mesh sizes (≤40 mm mesh size) to avoid entanglements; and
  - a single net system made of predator resistant materials.
- There being no records of hoiho entanglements at Big Glory Bay salmon farm, despite tracking data showing birds foraging in this area.
- The relatively deep foraging behaviour of this species to minimise potential effects of habitat exclusion and vessel / propeller strike.

Overall, we have determined that the potential effects of the proposal on sooty shearwater based on:

- The proposed net design will include:
  - top nets over sea cages to exclude birds and prevent physical interactions with net pens using ≤60 mm mesh size[1];
  - be made of visible black net - mesh material;
  - small enough underwater mesh sizes (≤40 mm mesh size) to avoid entanglements; and
  - a single net system made of predator resistant materials.
- There being no published records of entanglements at Big Glory Bay salmon farm, which is located approximately 13 km from the Tītī Islands.
- There being a single record of a sooty shearwater entanglement within the FMA5 set net records (refer to Table 10 above), as well as only shearwater entanglement recorded in the Fisheries New Zealand set net data for all areas; that being a single flesh-footed shearwater (refer to Figure 11 above) recorded in FMA8 (Central - Egmont).
- There being no published records of shearwater entanglements at salmon farms located in the Marlborough Sounds, where large colonies of fluttering shearwater breed on nearby Trio (7 km from Otanerau farm) and Long (13 km from Waihinau Bay) islands.
- There being no records by Harrison (2003) of short-tailed shearwater entanglements at Port Lincoln tuna farms. This is despite the use of obsolete cage design and feeding practices, and shearwaters foraging in and around the seacages.

Table 19: Summary of potential positive and negative effects associated with the proposed salmon farm for each key seabird species

SPECIES	POTENTIAL EFFECT							
	Entanglement	Habitat exclusion	Roost sites	Changes to food supply	Disturbance	Marine litter	Vessel / propeller strike	Lighting
Hoiho	Low	Low	-	Low	Low	Low	Low	-
Southern little penguin	Very Low	Very Low	-	Very Low	Very Low	Very Low	Very Low	-
Fiordland crested penguin	Very Low	Very Low	-	Very Low	Very Low	Very Low	Very Low	-
Sooty shearwater	Very Low	Very Low	-	Very Low	Very Low	Very Low	-	Very Low
Cook's petrel	Very Low	Very Low	-	Very Low	Very Low	Very Low	-	Very Low
Southern diving petrel	Very Low	Very Low	-	Very Low	Very Low	Very Low	-	Very Low
Whenua Hou diving petrel	Low	Low	-	Low	Low	Low	-	Moderate
White-fronted tern	Very Low	Very Low	Net Gain	Very Low	Very Low	Very Low	-	-
Foveaux shag	Moderate	Low	Net Gain	Low	Low	Low	-	Low
Spotted shag	Moderate	Low	Net Gain	Low	Low	Low	-	Low
Pied shag	Low	Very Low	Net Gain	Very Low	Very Low	Very Low	-	Very Low
Little shag	Very Low	Very Low	Net Gain	Very Low	Very Low	Very Low		Very Low
Black shag	Very Low	Very Low	Net Gain	Very Low	Very Low	Very Low		Very Low
Red-billed gull	Low	Very Low	Net Gain	Very Low	Very Low	Very Low	-	-

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Appendix 1: Representative site photos (taken 31 January 2019)

View from ocean looking over proposed site towards Murray Beach.

Murray River stream mouth / estuary.

View south along Murray Beach


Understory behind Murray Beach dunes


Understory behind Murray Beach dunes

View south towards Gull Rock Point.

Coastal cliffs by Golden beach (north of Gull Rock Point) used by nesting Foveaux shag.

Gull Rock - Species observed roosting on the rock included white-fronted tern, red-billed gull and Foveaux shag.

View of Big Bungaree Beach

Spotted shag nesting on the coastal cliffs between Newton and Sawyers beaches.

Pied shag roosting in coastal tree north of Sawyers Beach.

Rock outcrops on southern point of Sawyers Beach. Species observed roosting on the rock included white-fronted tern and red-billed gull.

Appendix 2: Rakiura avifauna associated with the marine environment

The data presented in the following table comprises:

- The Threat Status has been taken from Robertson et al. (2021) with qualifiers: CD=Conservation Dependent (CDB indicates the need for only good biosecurity); CI=Climate Impact; CR=Conservation Research Needed; De=Designated; DPR=Data Poor Recognition; DPS=Data Poor Size; DPT=Data Poor Trend; EF=Extreme Fluctuations; IE=Island Endemic; Inc=Increasing; OL=One Location; PD=Partial Decline; PF=Population Fragmentation; RF=Recruitment Failure; RR=Range Restricted; SO=Secure Overseas; Sp=Sparse; TO=Threatened Overseas.
- The Fisheries Observer data presented in the table is take from the observer points around Rakiura and Foveaux Strait (refer to Map 2).
- The seabird tracking database entries for species with tracking points recorded around Rakiura and Foveaux Strait.
- Additional species identified by DOC (Graeme Taylor *pers. comm.*) which occur on occasion in the Foveaux Strait.
- The list provided is not a complete list of all avifauna species recorded within Ebird, but rather only those species for which the primary (dark green) or secondary (light green) habitat preferences are either oceanic or coastal/estuarine environments.

SPECIES		NZ THREAT STATUS		HABITAT			DATA SOURCES					
				Freshwater / wetlands	Coastal / Estuary	Oceanic	eBird	Protected spp bycatch	Observer counts	Tracking database	2019 Site visit	DOC
Antipodean wandering albatross	*Diomedea antipodensis antipodensis*	Threatened	Nationally Critical[CD CI CR IE RR]				✓		✓			
Black stilt	*Himantopus novaezelandiae*	Threatened	Nationally Critical[CD CR RR]				✓					
Gibson's wandering albatross	*Diomedea antipodensis gibsoni*	Threatened	Nationally Critical[CD CI,CR IE OL]						✓	✓		
Salvin's mollymawk	*Thalassarche salvini*	Threatened	Nationally Critical[CD CO CR RR]				✓	✓	✓	✓		
Whenua Hou diving petrel	*Pelecanoides whenuahouensis*	Threatened	Nationally Critical[CD CI CR IE OL]							✓		✓
Black-fronted tern	*Chlidonias albostriatus*	Threatened	Nationally Endangered[CI CD, PD, RF, Sp]				✓					
Hoiho	*Megadyptes antipodes*	Threatened	Nationally Endangered[CD CI CR DPS DPT EF PD RF]				✓	✓	✓		✓	
Reef heron	*Egretta sacra sacra*	Threatened	Nationally Endangered[CI CR DPT SO Sp]				✓					
Antarctic tern	*Sterna vittata bethunei*	Threatened	Nationally Increasing[CDB CI RR]				✓					
Northern NZ dotterel	*Charadrius obscurus aquilonius*	Threatened	Nationally Increasing[CD CI Inc RR]				✓					
Wrybill	*Anarhynchus frontalis*	Threatened	Nationally Increasing[RR CD CR]				✓					
Black petrel	*Procellaria parkinsoni*	Threatened	Nationally Vulnerable[CD CI CR RR]				✓		✓			
Brown skua	*Catharacta antarctica lonnbergi*	Threatened	Nationally Vulnerable[CD SO Sp]				✓					
Caspian tern	*Hydroprogne caspia*	Threatened	Nationally Vulnerable[CI SO Sp]				✓					
Foveaux shag	*Leucocarbo stewarti*	Threatened	Nationally Vulnerable[CD CR DPS DPT PD]				✓					
Grey-headed mollymawk	*Thalassarche chrysostoma*	Threatened	Nationally Vulnerable[CD CI OL TO]				✓		✓			
Hutton's shearwater	*Puffinus huttoni*	Threatened	Nationally Vulnerable[CD CI OL]				✓		✓			
Light-mantled sooty albatross	*Phoebetria palpebrata*	Threatened	Nationally Vulnerable[CD CI CR DPS DPT RR TO]				✓		✓			✓
Northern royal albatross	*Diomedea sanfordi*	Threatened	Nationally Vulnerable[CD CI CR DPT RF RR]				✓		✓	✓		
Southern royal albatross	*Diomedea e. epomophora*	Threatened	Nationally Vulnerable[CD CI CR DPT RR]				✓	✓	✓	✓	✓	
Spotted shag	*Stictocarbo p. punctatus*	Threatened	Nationally Vulnerable[CI CR]				✓	✓	✓		✓	
Banded dotterel	*Charadrius bicinctus bicinctus*	At Risk	Declining[CD CI CR DPS PD]				✓					

SPECIES		NZ THREAT STATUS		HABITAT			DATA SOURCES					
				Freshwater / wetlands	Coastal / Estuary	Oceanic	eBird	Protected spp bycatch	Observer counts	Tracking database	2019 Site visit	DOC
Black-billed gull	*Larus bulleri*	At Risk	Declining[CI CR RF]				✓					
Buller's shearwater	*Puffinus bulleri*	At Risk	Declining[CD CR DPT OL St]				✓		✓			
Erect-crested penguin	*Eudyptes sclateri*	At Risk	Declining[CDB CI CR PD RR]				✓					✓
Fiordland crested penguin	*Eudyptes pachyrhynchus*	At Risk	Declining[Sp]				✓	✓				
Lesser knot	*Calidris canutus rogersi*	At Risk	Declining[CI TO]				✓					
Little penguin	*Eudyptula minor*	At Risk	Declining[CI CR DPS DPT]				✓	✓	✓		✓	
NZ pied oystercatcher	*Haematopus finschi*	At Risk	Declining[CI]				✓					
NZ white-capped albatross	*Thalassarche cauta steadi*	At Risk	Declining[CD CI CR EF RR]				✓	✓	✓	✓	✓	
Red-billed gull	*Larus novaehollandiae scopulinus*	At Risk	Declining[CI]				✓		✓		✓	
Sooty shearwater	*Puffinus griseus*	At Risk	Declining[CD CI SO]				✓	✓	✓	✓	✓	
Southern Buller's mollymawk	*Thalassarche b. bulleri*	At Risk	Declining[CD CR RR]				✓	✓	✓	✓	✓	
White-fronted tern	*Sterna striata striata*	At Risk	Declining[CI CR DPT]				✓	✓	✓			
Northern giant petrel	*Macronectes halli*	At Risk	Recovering[RR Inc SO]				✓	✓	✓	✓		
Pied shag	*Phalacrocorax varius varius*	At Risk	Recovering[CD]				✓	✓	✓		✓	
Variable oystercatcher	*Haematopus unicolor*	At Risk	Recovering[CI Inc]				✓				✓	
Campbell black-browed mollymawk	*Thalassarche impavida*	At Risk	Naturally Uncommon[CD CI IE OL]						✓			✓
Chatham Island mollymawk	*Thalassarche eremita*	At Risk	Naturally Uncommon[CD IE OL]				✓		✓			
Fulmar prion	*Pachyptila crassirostris crassirostris*	At Risk	Naturally Uncommon[RR St]				✓					
Little black shag	*Phalacrocorax sulcirostris*	At Risk	Naturally Uncommon[RR SO]				✓					
Northern Buller's albatross	*Thalassarche bulleri platei*	At Risk	Naturally Uncommon[CD, CI, RR]						✓			
Royal spoonbill	*Platalea regia*	At Risk	Naturally Uncommon[Inc RR SO Sp]				✓					
Snares crested penguin	*Eudyptes robustus*	At Risk	Naturally Uncommon[CDB IE OL]				✓					✓

SPECIES		NZ THREAT STATUS		HABITAT			DATA SOURCES					
				Freshwater / wetlands	Coastal / Estuary	Oceanic	eBird	Protected spp bycatch	Observer counts	Tracking database	2019 Site visit	DOC
Snares snipe	*Coenocorypha huegeli*	At Risk	Naturally Uncommon[CDB IE RR St]				✓					
Soft-plumaged petrel	*Pterodroma mollis*	At Risk	Naturally Uncommon[CDB, CI, CR, DPT, Inc, OL, SO]				✓					
Subantarctic little shearwater	*Puffinus elegans*	At Risk	Naturally Uncommon [CDB CI CR DPT Inc OL SO]				✓					
Westland petrel	*Procellaria westlandica*	At Risk	Naturally Uncommon[CD CR OL St]				✓		✓	✓		
Antarctic prion	*Pachyptila desolata*	At Risk	Relict[CDB CR DPS DPT RR SO]				✓					
Black shag	*Phalacrocorax carbo novaehollandiae*	At Risk	Relict[CR DPS DPT SO Sp]				✓					
Broad-billed prion	*Pachyptila vittata*	At Risk	Relict[CDB RR SO]				✓	✓	✓			
Cook's petrel	*Pterodroma cookii*	At Risk	Relict[CDB RR Inc]				✓			✓		
Fairy prion	*Pachyptila turtur*	At Risk	Relict[CDB RR SO]				✓	✓	✓		✓	
Flesh-footed shearwater	*Puffinus carneipes*	At Risk	Relict[CD Inc RR SO]				✓		✓			
Fluttering shearwater	*Puffinus gavia*	At Risk	Relict[CDB RR]				✓		✓			
Grey petrel	*Procellaria cinerea*	At Risk	Relict[CD CR DPT RR SO]				✓		✓			
Grey-backed storm petrel	*Garrodia nereis*	At Risk	Relict[CDB RR SO]				✓	✓				
Little shag	*Phalacrocorax melanoleucos brevirostris*	At Risk	Relict[CR DPT]				✓					
Mottled petrel	*Pterodroma inexpectata*	At Risk	Relict[CDB RR Inc]				✓	✓	✓	✓		
Southern diving petrel	*Pelecanoides urinatrix chathamensis*	At Risk	Relict[CBD RR]				✓	✓	✓			✓
White-faced storm petrel	*Pelagodroma marina*	At Risk	Relict[CBD RR]				✓	✓			✓	
Australasian gannet	*Morus serrator*	Not Threatened	Not Threatened[CI De* Inc SO]				✓		✓			
Black-bellied storm petrel	*Fregetta tropica*	Not Threatened	Not Threatened[CDB De* DPS DPT RR]				✓		✓			
Black-winged petrel	*Pterodroma nigripennis*	Not Threatened	Not Threatened[DB De* Inc RR]				✓					
Grey-faced petrel	*Pterodroma macroptera gouldi*	Not Threatened	Not Threatened[De* Inc RR]				✓		✓			

SPECIES		NZ THREAT STATUS		HABITAT			DATA SOURCES					
				Freshwater / wetlands	Coastal / Estuary	Oceanic	eBird	Protected spp bycatch	Observer counts	Tracking database	2019 Site visit	DOC
Pied stilt	*Himantopus h. leucocephalus*	Not Threatened	Not Threatened[SO]				✓					
Southern black-backed gull	*Larus d. dominicanus*	Not Threatened	Not Threatened[SO]				✓		✓		✓	
White-chinned petrel	*Procellaria aequinoctialis*	Not Threatened	Not Threatened[CD De* RR TO]				✓	✓	✓	✓		
White-faced heron	*Egretta novaehollandiae*	Not Threatened	Not Threatened[SO]				✓				✓	
White-headed petrel	*Pterodroma lessonii*	Not Threatened	Not Threatened[CDB De* RR SO]				✓	✓				
Black-browed albatross	*Thalassarche melanophris*	Non-Resident Native	Coloniser[SO]				✓		✓			
Glossy ibis	*Plegadis falcinellus*	Non-Resident Native	Coloniser[OL SO]				✓					
Indian yellow-nosed mollymawk	*Thalassarche carteri*	Non-Resident Native	Coloniser[OL TO]						✓			
Antarctic fulmar	*Fulmarus glacialoides*	Non-Resident Native	Migrant[SO]				✓					✓
Arctic skua	*Stercorarius parasiticus*	Non-Resident Native	Migrant[SO]				✓					
Artic tern	*Sterna paradisaea*	Non-Resident Native	Migrant[SO]				✓					
Blue petrel	*Halobaena caerulea*	Non-Resident Native	Migrant[SO]				✓					
Cape petrel	*Daption c. capense*	Non-Resident Native	Migrant[SO]				✓	✓	✓			✓
Kerguelen petrel	*Lugensa brevirostris*	Non-Resident Native	Migrant[SO]				✓					
Little tern	*Sternula albifrons sinensis*	Non-Resident Native	Migrant[SO]				✓					
Long-tailed skua	*Stercorarius longicaudus*	Non-Resident Native	Migrant[SO]				✓					
Pacific golden plover	*Pluvialis fulva*	Non-Resident Native	Migrant[SO]				✓					
Pomarine skua	*Coprotheres pomarinus*	Non-Resident Native	Migrant[SO]				✓					✓
Red-necked stint	*Calidris ruficollis*	Non-Resident Native	Migrant[SO]				✓					
Salvin's prion	*Pachyptila salvini*	Non-Resident Native	Migrant[SO]				✓					
Sharp-tailed sandpiper	*Calidris acuminata*	Non-Resident Native	Migrant[SO]				✓					

SPECIES		NZ THREAT STATUS		HABITAT			DATA SOURCES					
				Freshwater / wetlands	Coastal / Estuary	Oceanic	eBird	Protected spp bycatch	Observer counts	Tracking database	2019 Site visit	DOC
Short-tailed shearwater	*Puffinus tenuirostris*	Non-Resident Native	Migrant[SO]			■	✓					
South polar skua	*Stercorarius maccormicki*	Non-Resident Native	Migrant[SO]			■	✓					
Southern giant petrel	*Macronectes giganteus*	Non-Resident Native	Migrant[SO]			■	✓		✓			
Thin-billed prion	*Pachyptila belcheri*	Non-Resident Native	Migrant[SO]			■	✓					
Turnstone	*Arenaria interpres*	Non-Resident Native	Migrant[SO]		■		✓					
Wandering albatross	*Diomedea exulans*	Non-Resident Native	Migrant[TO]			■			✓	✓		
White-winged black tern	*Chlidonias leucopterus*	Non-Resident Native	Migrant[SO]	■			✓					
Wilson's storm petrel	*Oceanites oceanicus exasperatus*	Non-Resident Native	Migrant[SO]			■	✓					
Great shearwater	*Puffinus gravis*	Non-Resident Native	Vagrant[SO]			■	✓					
Pink-footed shearwater	*Puffinus creatopus*	Non-Resident Native	Vagrant[SO]			■	✓					
Tasmanian albatross	*Thalassarche cauta cauta*	Non-Resident Native	Vagrant[SO]			■			✓			

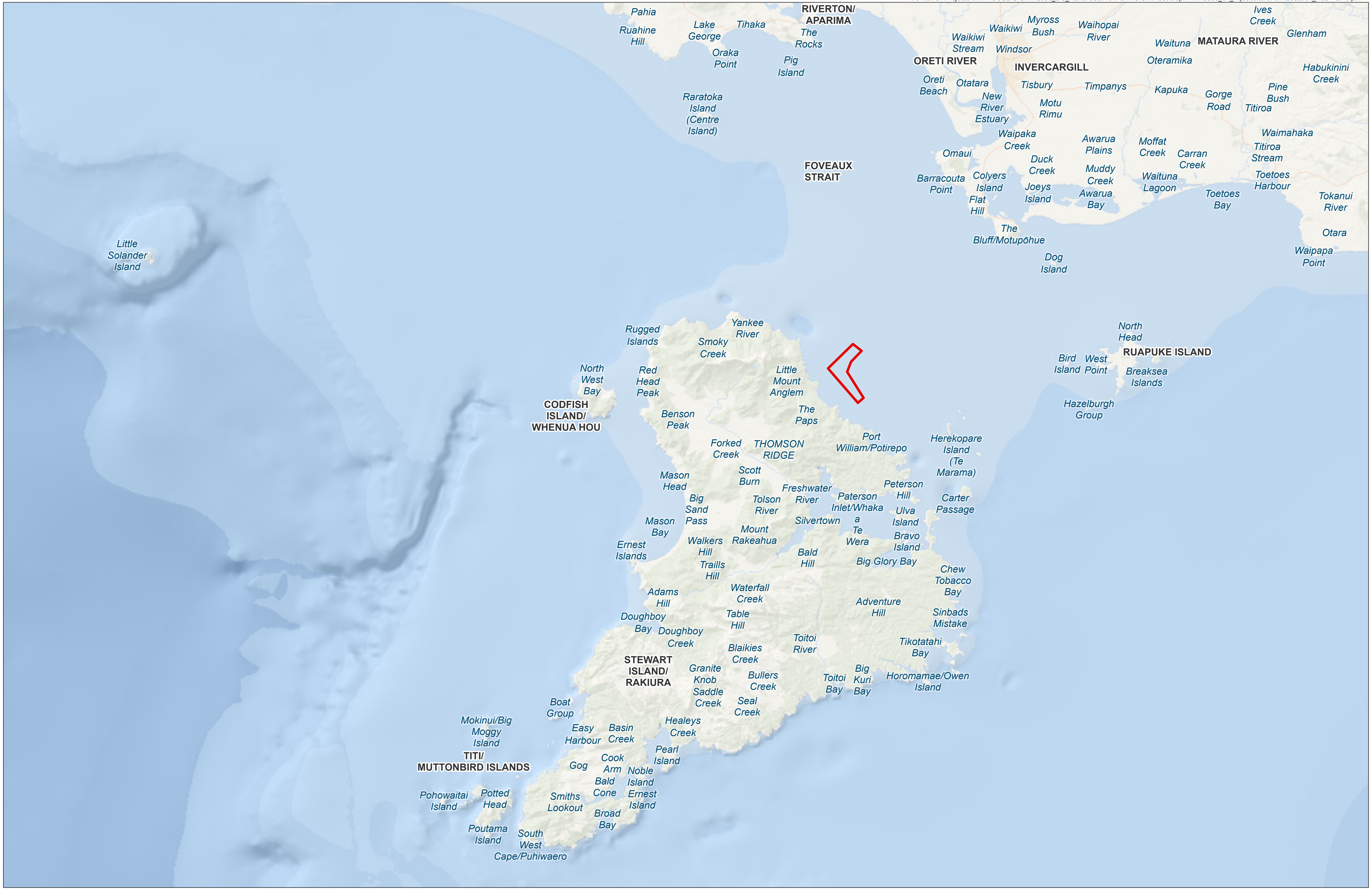
BlueGreen

About BlueGreen

Over the last 20 years we have gathered a high level of knowledge and expertise working on a number of large scale projects of national significance, right from pre-consenting investigations through to Environment Court and Board of Inquiry Hearings. As such we are able to offer our clients proven expertise to assist with a range of ecological challenges, both simple and complex, across various ecosystems.

E: Info@BlueGreenEcology.nz
BlueGreenEcology.nz
BlueGreen Ecology Ltd

File Ref: D:\Projects\MAPHOUSE\GIS\MH2503_BG_RaikuraSalmonFarm\GIS\MH2503.aprx MH2503_01_AquacultureFarmLocation_A3L 12:46 pm



Site Map

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 14 May 2025

BlueGreen MapHouse

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Project Area

Data Sources: BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue | *Projection:* NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 1

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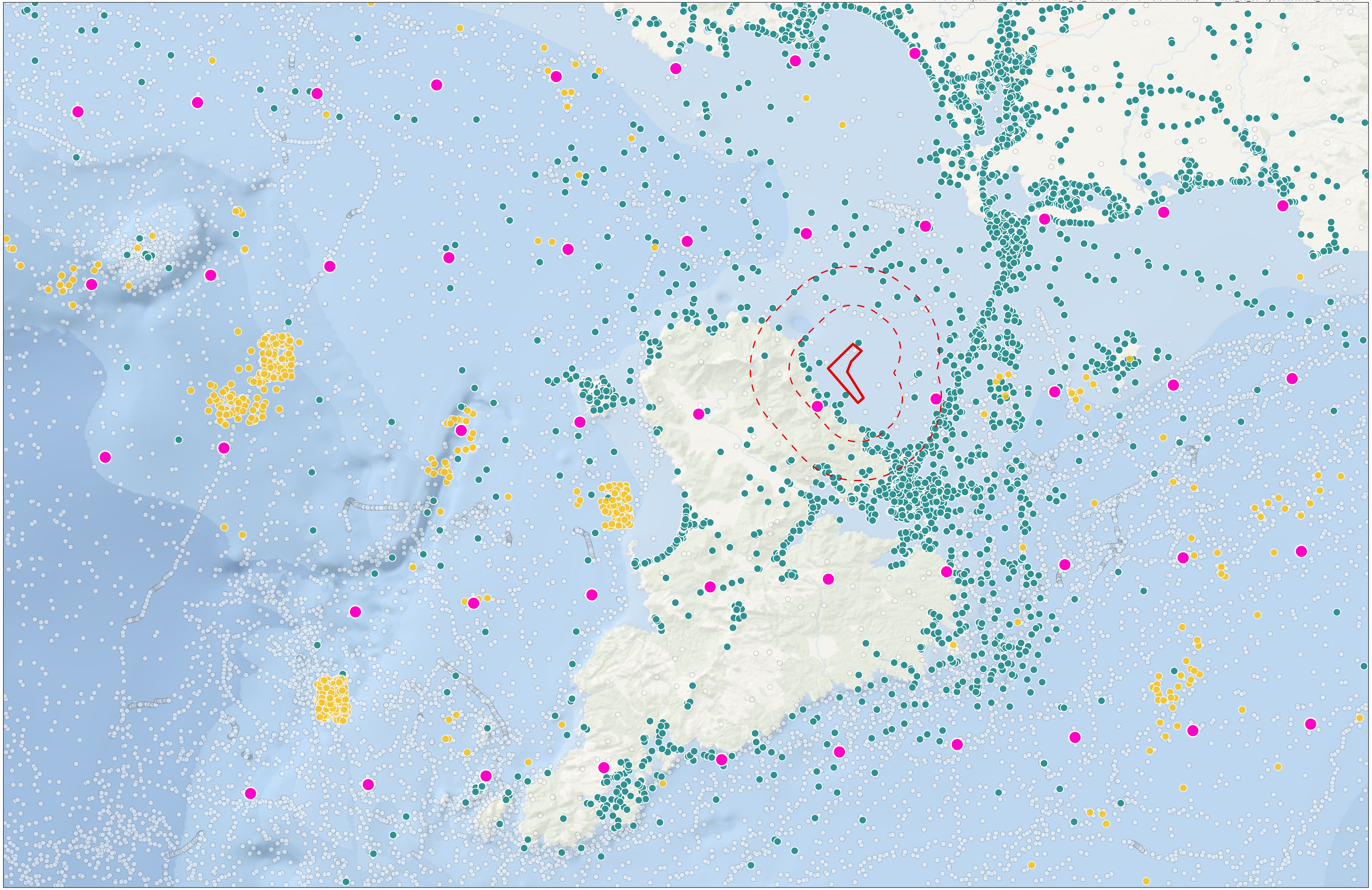

Survey Data Locations

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

- Project Area
- Project Buffer (5km & 10km)
- Counts of seabirds around fishing vessels, NZ Fisheries observers
- Protected Species Captures, Ministry for Primary Industries
- EBird
- Department of Conservation Tracking Data (SeaSketch)

Data Sources: Cornell Lab of Ornithology (Ebird), DOC(Seabird Observers and SeaSketch Tracking Data), MPI (Protected Species Captures), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 2

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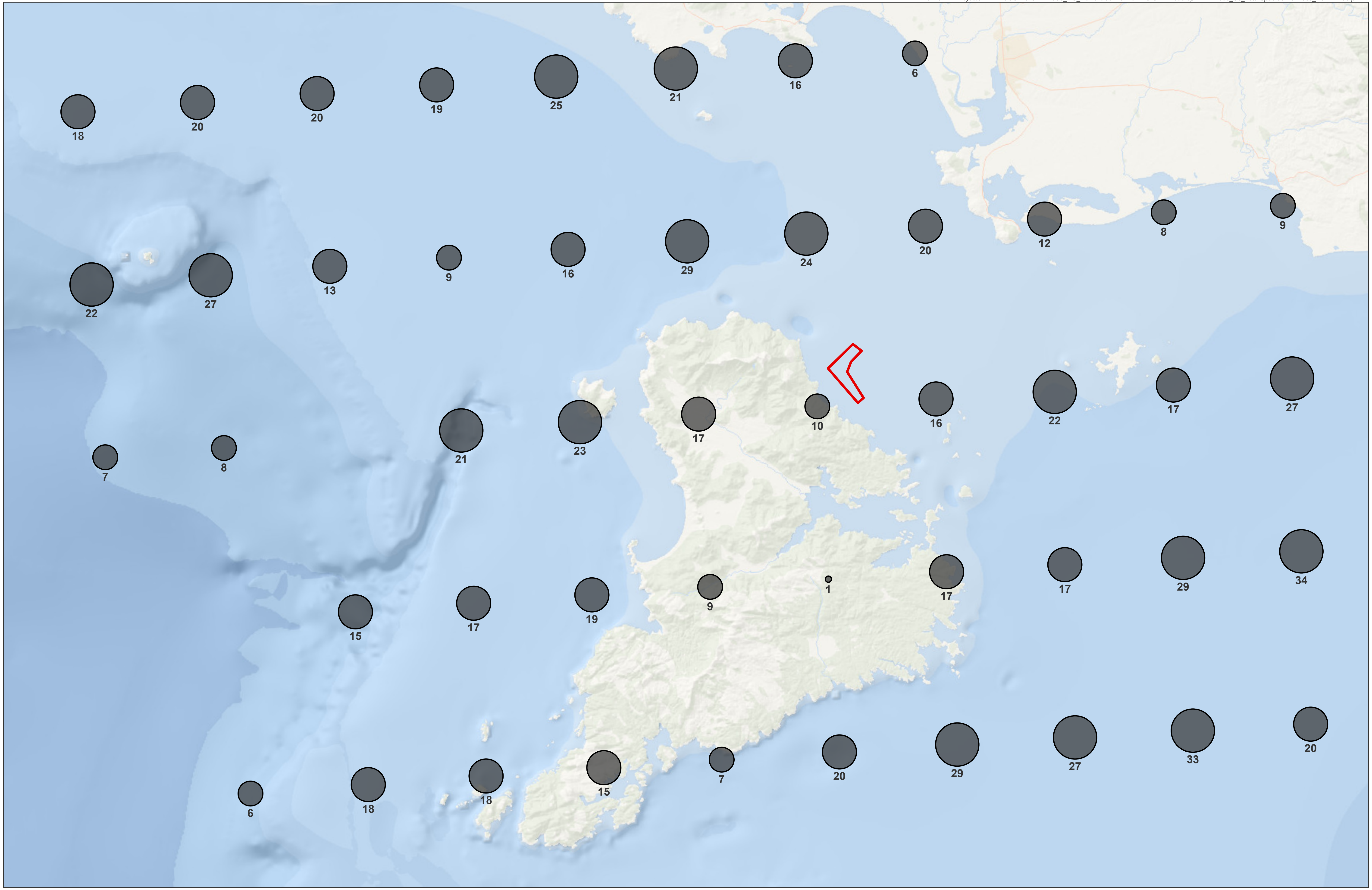


Fisheries Observer Data: Total species richness (all species)

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 14 May 2025

BlueGreen MapHouse

Project Area

Species Richness

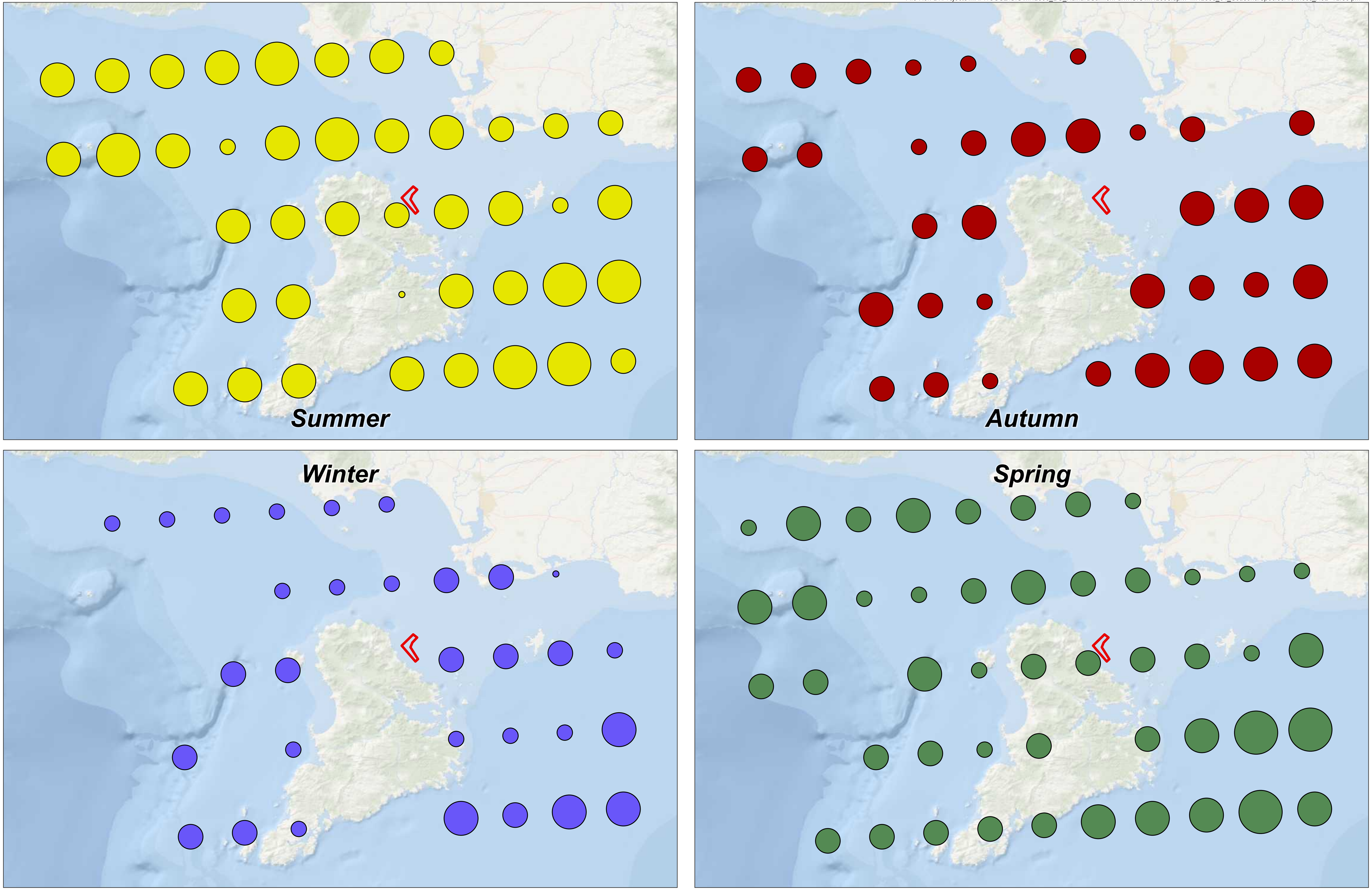
1 ≤5 ≤10 ≤20 ≤35

Data Sources: BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue | *Projection:* NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 3



Fisheries Observer Data: Seasonal species richness (all species)

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 14 May 2025

BlueGreen MapHouse

Project Area

Species Richness

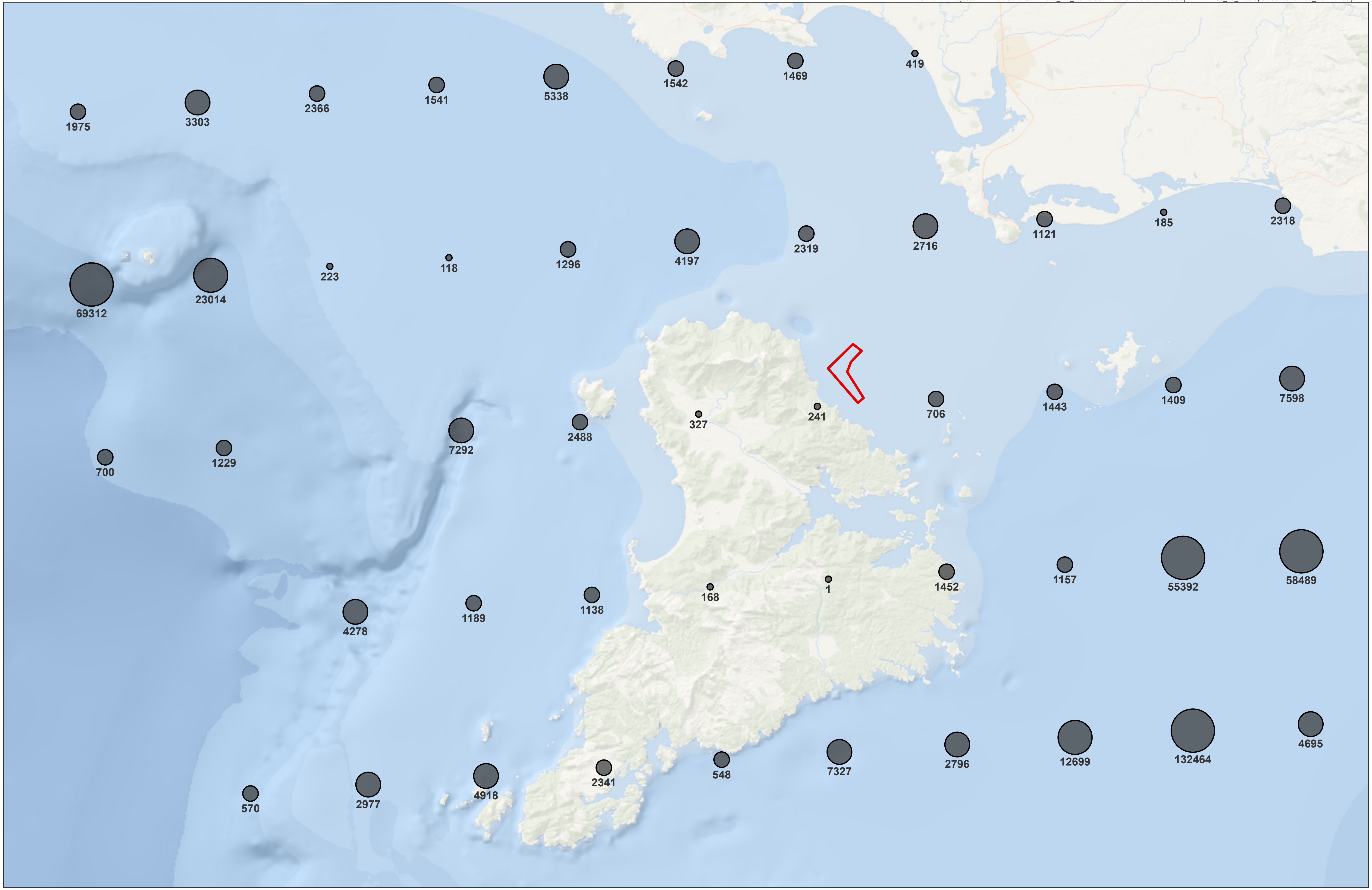
1, ≤5, ≤10, ≤20, ≤35

Data Sources: Department of Conservation, BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

Map 4



Fisheries Observer Data: Total species abundance (all species)

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 14 May 2025

BlueGreen MapHouse

Project Area

Species abundance (seabird observers)

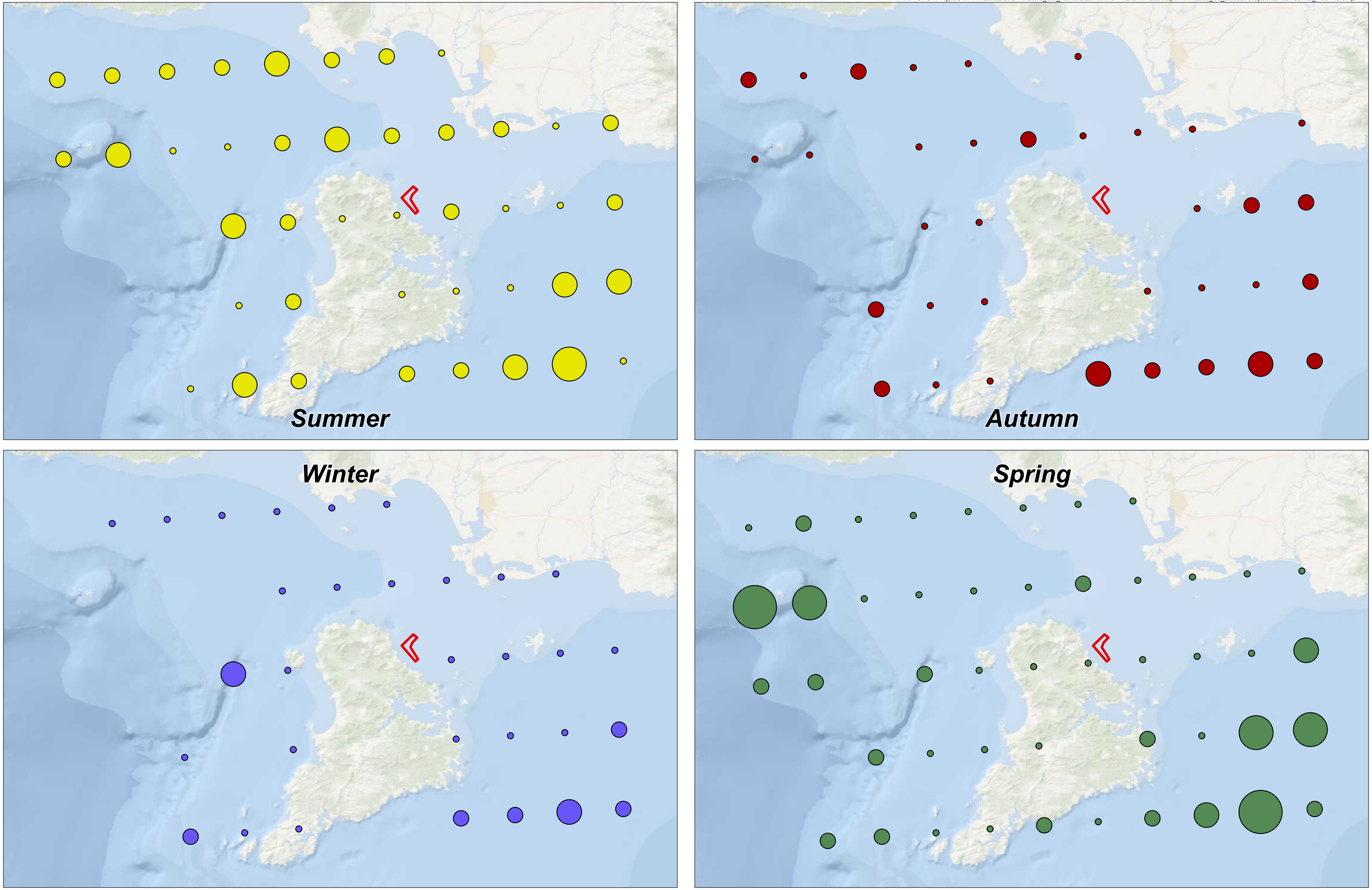
≤500
≤2,500
≤10,000
≤50,000
>50,000

Data Sources: BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue |
Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 5



Fisheries Observer Data: Seasonal species abundance (all species)

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 14 May 2025

BlueGreen MapHouse

Project Area

Species abundance (seabird observers)

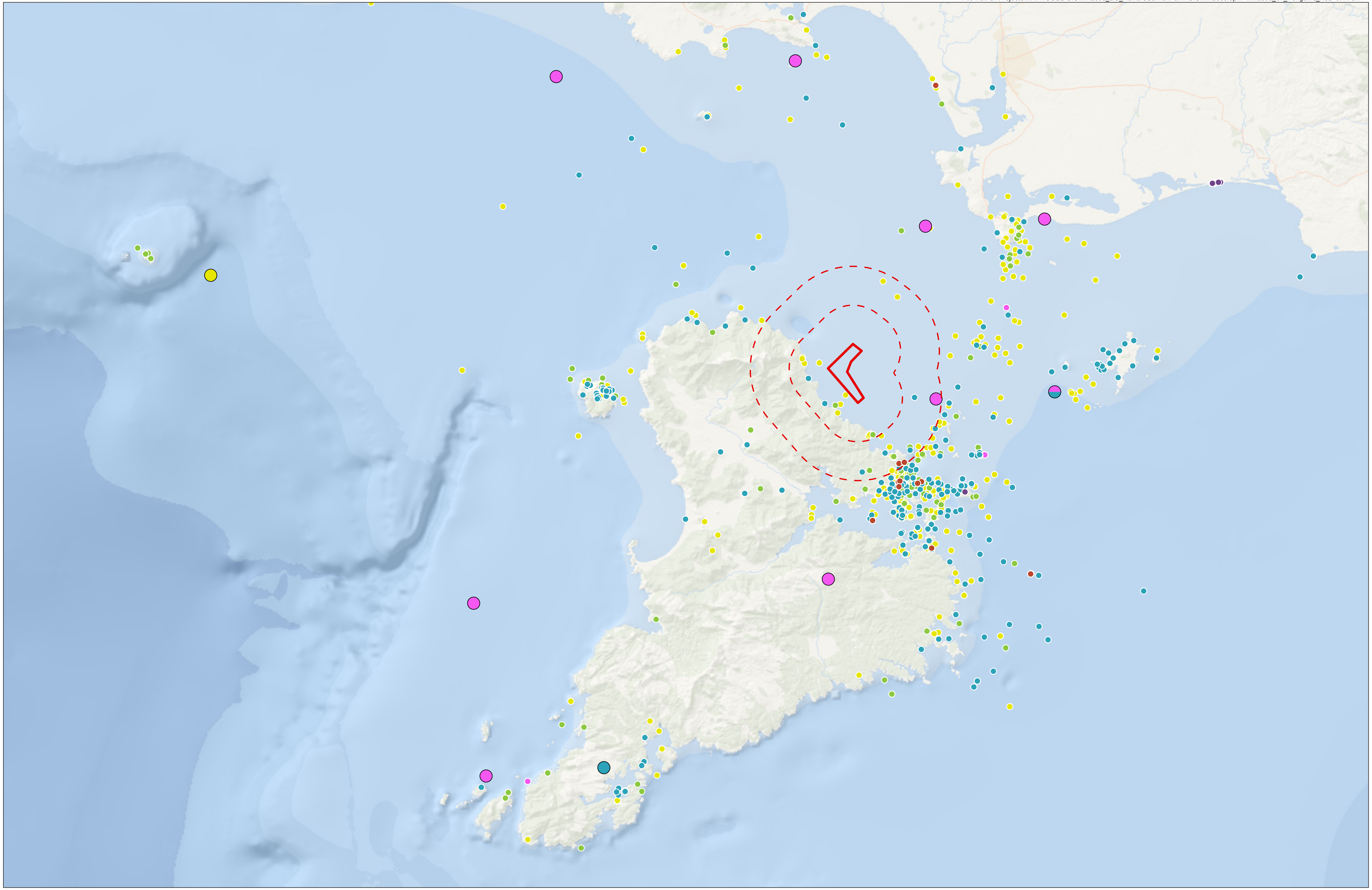
≤500
≤2,500
≤10,000
≤50,000
>50,000

Data Sources: Department of Conservation, BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

Map 6



Penguins

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

Species abundance (seabird observers)

≤10
≤500
≤2,500
≤10,000
>10,000

- Erect-crested penguin
- Fiordland crested penguin
- Snares crested penguin
- Yellow-eyed penguin
- Little penguin
- Penguin

- Project Area
- Project Buffer (5km & 10km)

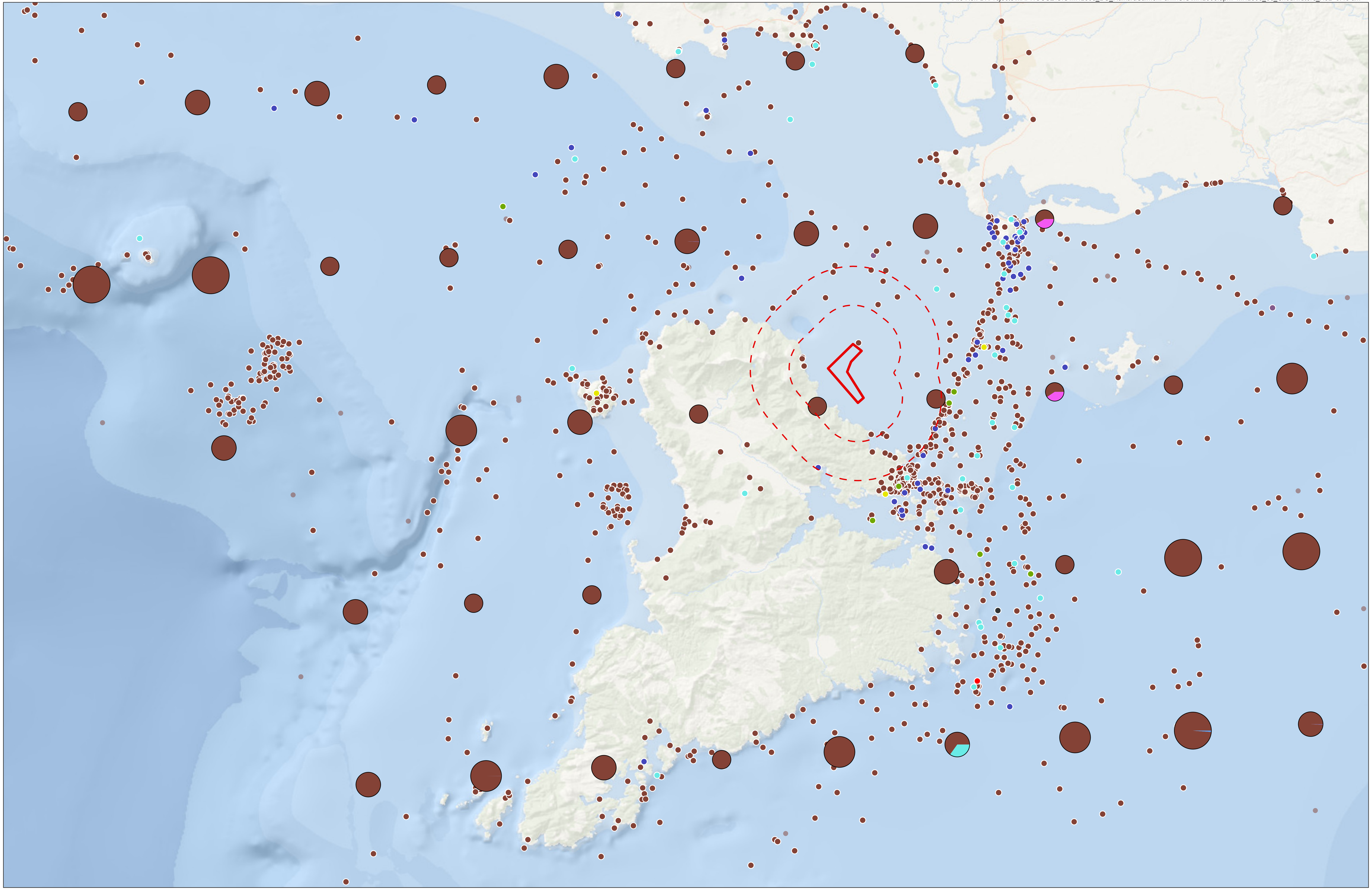
Data Sources:
Cornell Lab of Ornithology (Ebird), DOC (Seabird Observers), MPI (Protected Species Bycatch), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 7



Procellariidae petrel - Shearwaters

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

Species abundance (seabird observers)

≤10 ≤500 ≤2,500 ≤10,000 >10,000

- Buller's shearwater
- Flesh-footed shearwater
- Fluttering shearwater
- Great Shearwater
- Hutton's shearwater
- Little Shearwater
- Pink-footed shearwater
- Short-tailed shearwater
- Sooty shearwater
- Subantarctic little shearwater
- Project Area
- Project Buffer (5km & 10km)

Data Sources:
Cornell Lab of Ornithology (Ebird), DOC (Seabird Observers / SeaSketch), MPI (Protected Species Bycatch), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 8

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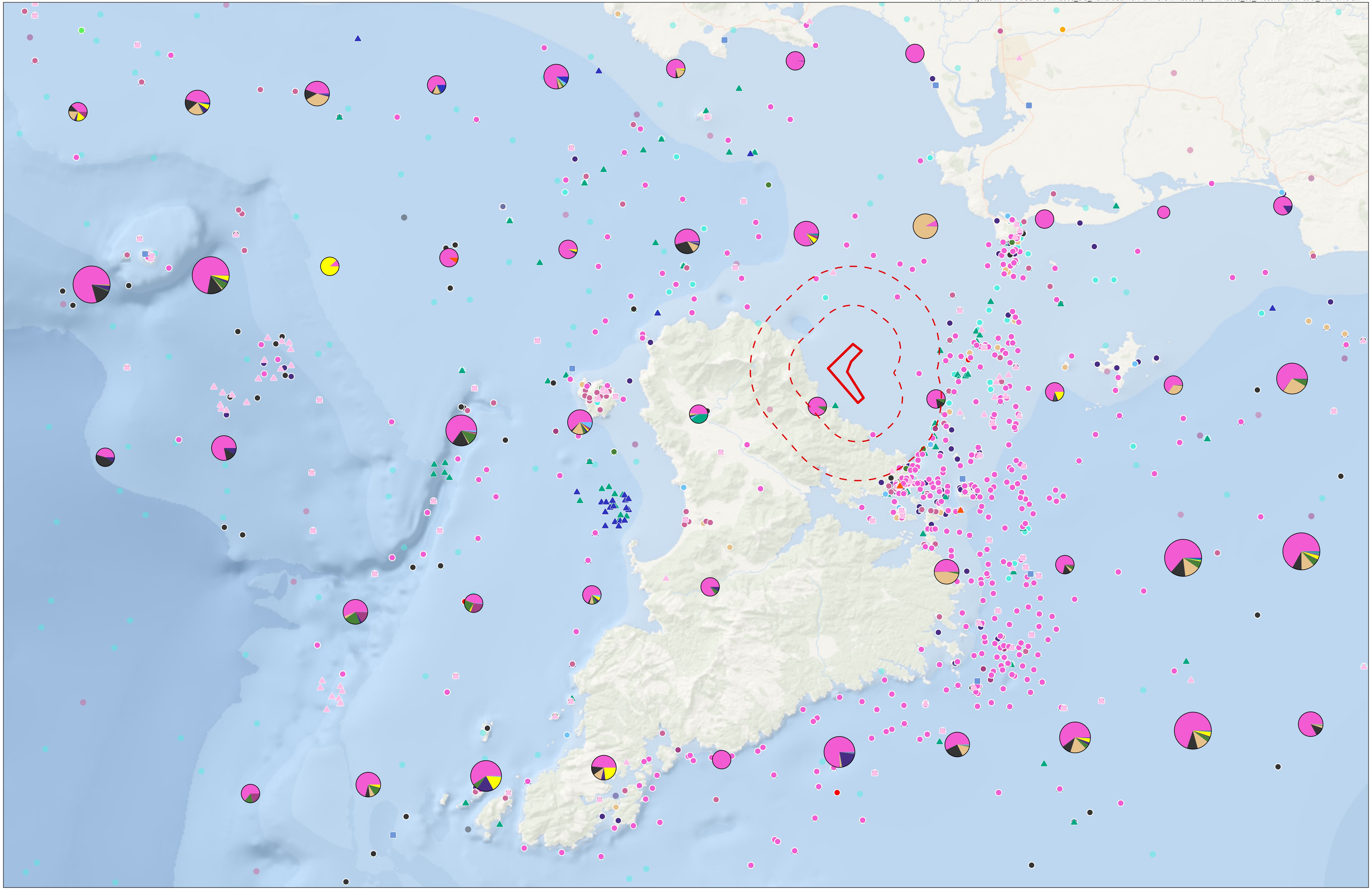


Petrels (excluding Shearwaters)

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen   MapHouse

Species abundance (seabird observers)

≤10 ≤500 ≤2,500 ≤10,000 >10,000

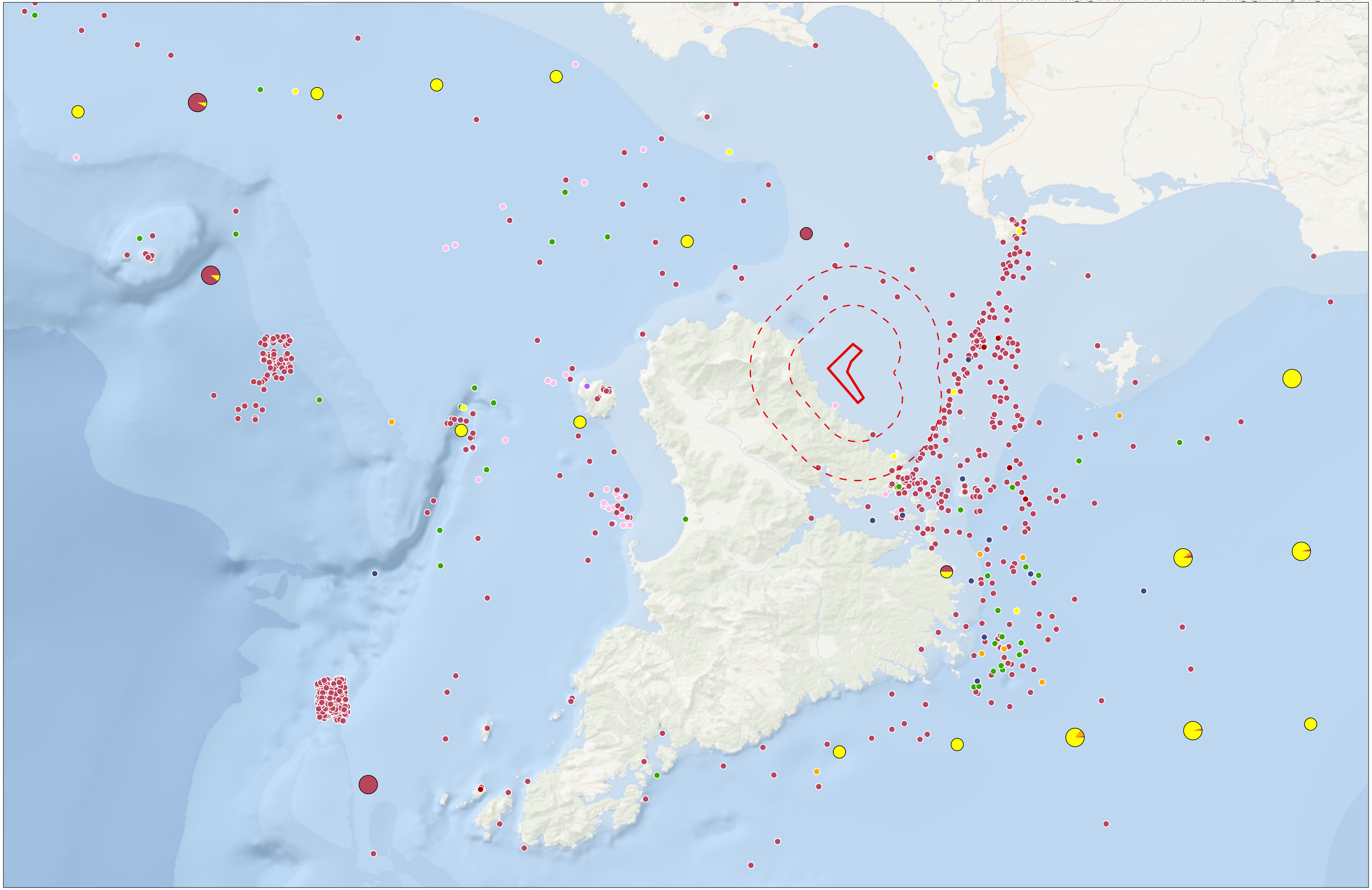
- Antarctic fulmar
- Antarctic prion
- Broad-billed prion
- Fairy prion
- Fulmar prion
- Salvin's prion
- Thin-billed prion
- Prion sp.
- Black petrel
- Black-winged petrel
- Blue Petrel
- Cape petrel
- Cook's petrel
- Giant petrel
- Grey petrel
- Grey-faced petrel
- Kerguelen petrel
- Mottled petrel
- Northern giant petrel
- Procellaria petrel
- Snares Cape petrel
- Soft-plumaged petrel
- Southern giant petrel
- Westland petrel
- White-chinned petrel
- White-headed petrel
- Petrel sp.
- Projeact Area
- Project Buffer (5km & 10km)

0 10 km

1:450,000 @ A3

Map 9

File Ref: D:\Projects\MAPHOUSE\GIS\MH2503_BG_RaikuraSalmonFarm\GIS\MH2503.aprx MH2503_10_StormDivingPetrels_A3L 9:47 am



Storm & diving petrels

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen   MapHouse

Species abundance (seabird observers)

≤10 ≤500 ≤2,500 ≤10,000 >10,000

- Black-bellied storm petrel
- Common diving petrel
- Grey-backed storm petrel
- NZ white-faced storm petrel
- Wilson's storm petrel
- South Georgia diving-Petrel
- Storm petrel sp.
- Diving petrel sp.

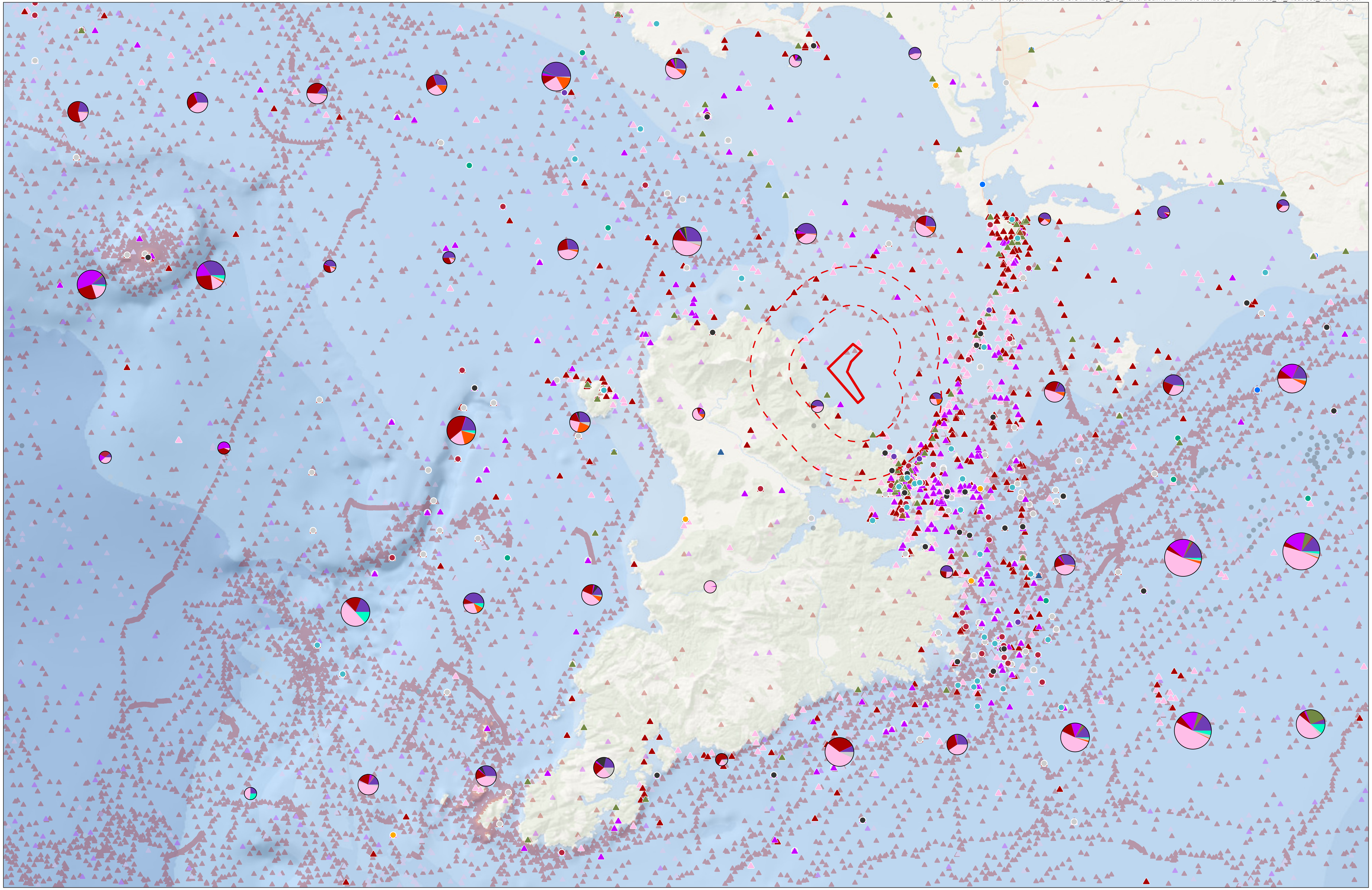
- Project Area
- Project Buffer (5km & 10km)

Data Sources:
Cornell Lab of Ornithology (Ebird), DOC (Seabird Observers), MPI (Protected Species Capture), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km
1:450,000 @ A3

Map 10



Albatross

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

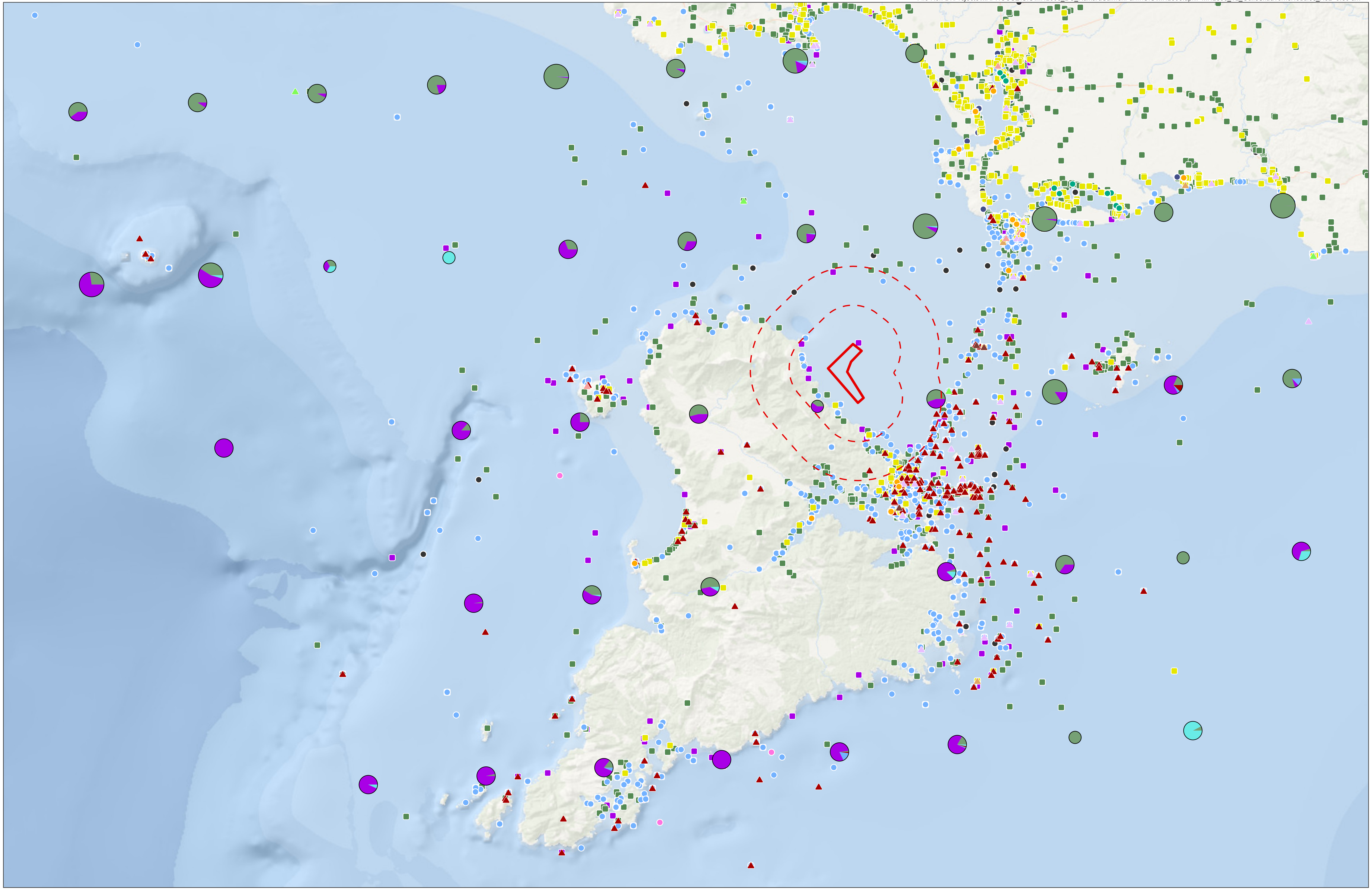
Species abundance (seabird observers)

≤10
≤500
≤2,500
≤10,000
>10,000

Antipodean wandering albatross
Black-browed albatross
Buller's albatross
Gibson's wandering albatross
Light-mantled sooty albatross
Northern Buller's albatross
Northern royal albatross
Southern royal albatross
Shy albatross
Tasmanian albatross
Wandering albatross
Albatross sp.
Large albatross sp.
Campbell Island mollymawk
Chatham Island mollymawk
Grey-headed mollymawk
Indian yellow-nosed mollymawk
NZ white-capped mollymawk
Salvin's mollymawk
Southern Buller's mollymawk
Mollymawk

Tracking Data
Gibson's wandering albatross
NZ white-capped mollymawk
Northern royal albatross
Salvin's mollymawk
Southern Buller's mollymawk
Southern royal albatross
Wandering albatross

Map 11



Gulls, skua, terns & noddies

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

Species abundance (seabird observers)

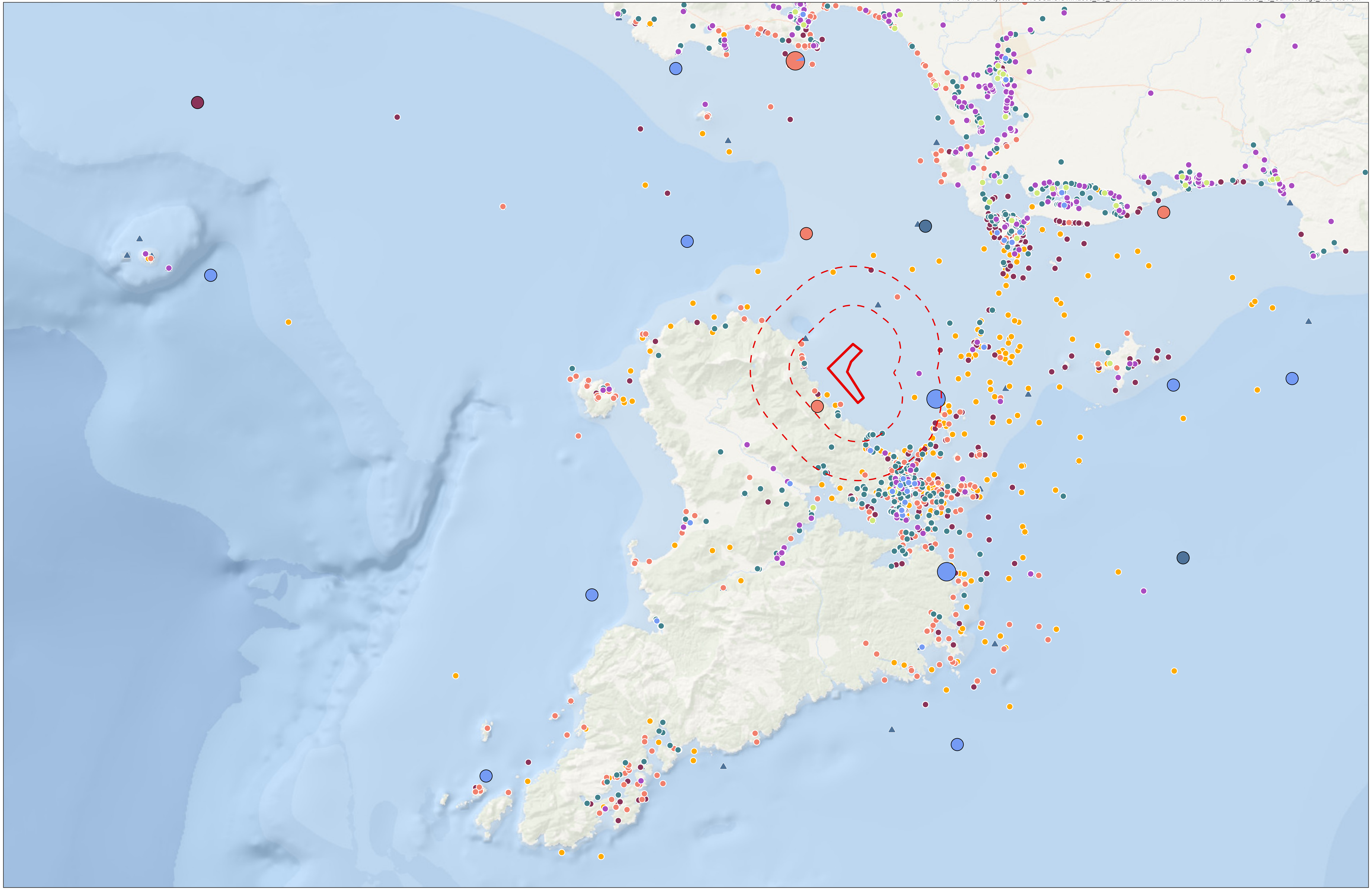
≤10
≤500
≤2,500
≤10,000
>10,000

- Black-billed gull
- Red-billed gull
- Southern black-backed gull
- Gull sp.
- Arctic skua
- Brown skua
- Long-tailed skua
- Pomarine skua
- South Polar Skua
- Skua sp.
- Antarctic tern
- Black-fronted tern
- Gull-billed tern
- Caspian tern
- White-fronted tern
- Tern sp.
- Project Area
- Project Buffer (5km & 10km)

0 10 km

1:450,000 @ A3

Map 12



Gannet & Shag

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

Species abundance (seabird observers)

≤10
≤500
≤2,500
≤10,000
>10,000

- Black shag
- Foveaux shag
- Little black shag
- Little shag
- Pied shag
- Shag
- Spotted shag
- Australasian gannet
- Project Area
- Project Buffer (5km & 10km)

Data Sources:
Cornell Lab of Ornithology (Ebird), DOC (Seabird Observers), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km
1:450,000 @ A3

Map 13

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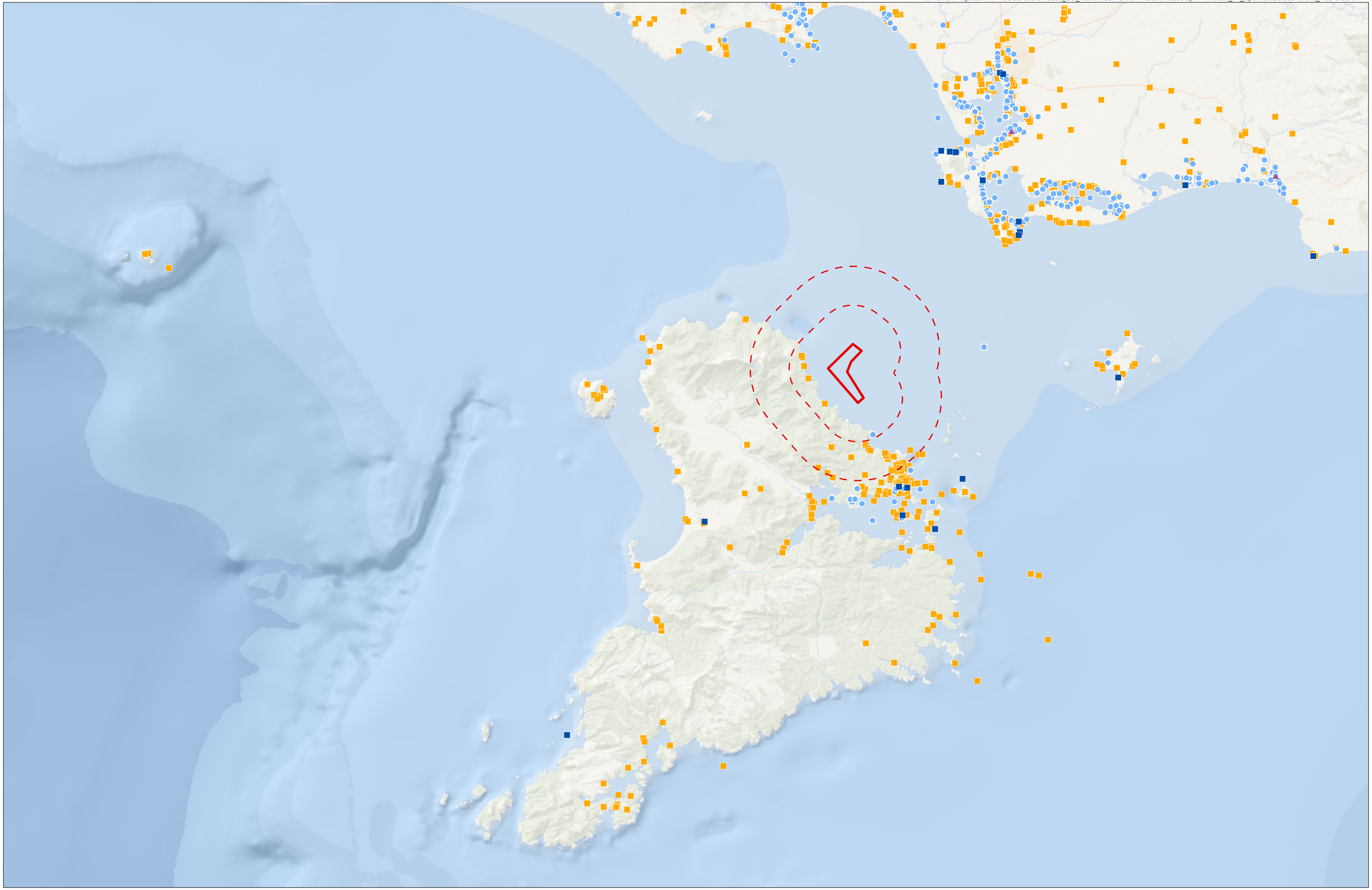

Heron, Spoonbill & Ibis

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

Project Area
Project Buffer (5km & 10km)
Glossy ibis
Royal spoonbill
Reef heron
White-faced heron

Data Sources:
Cornell Lab of Ornithology (Ebird), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km
1:450,000 @ A3

Map 14

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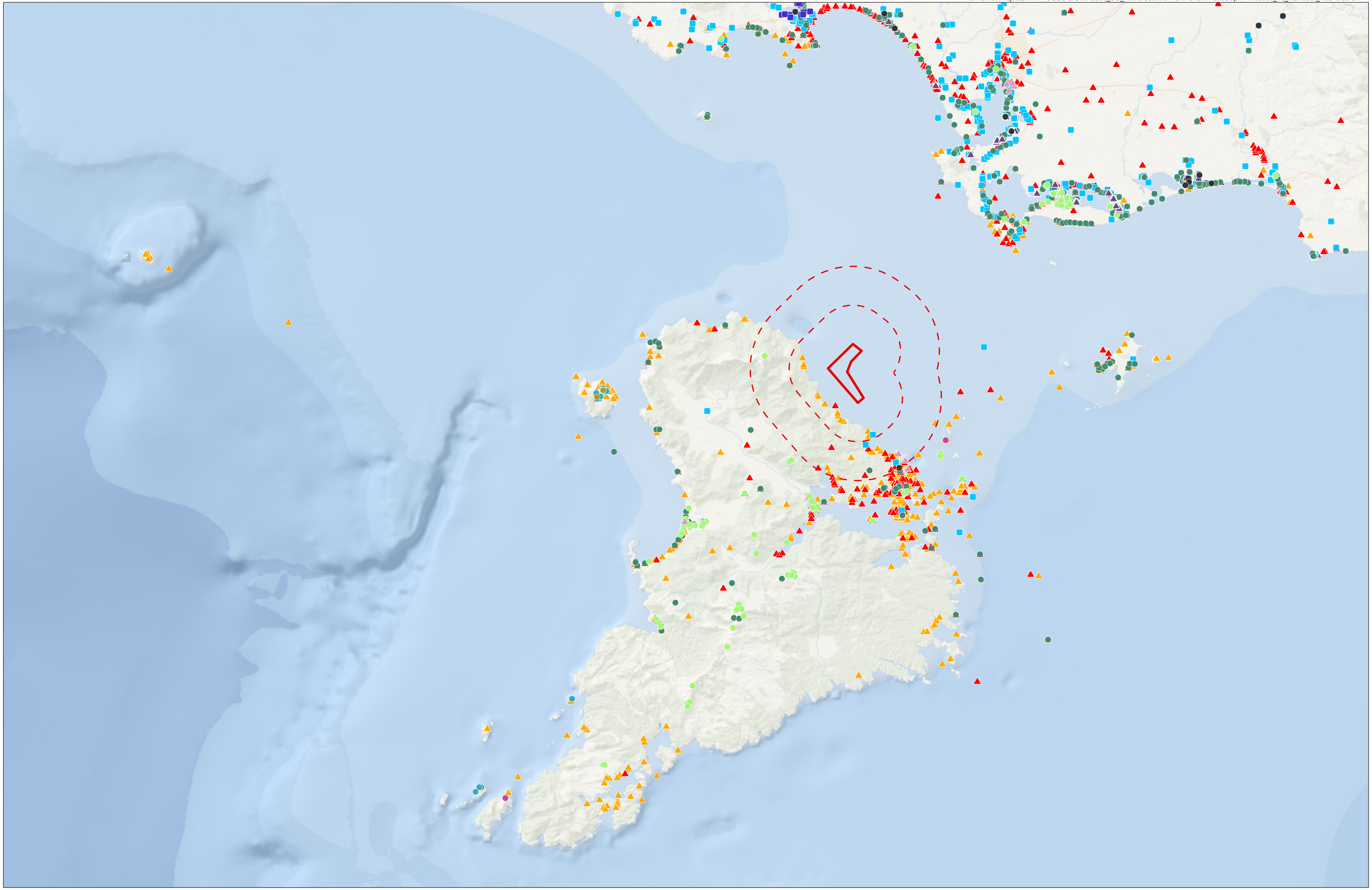

NZ wader

HANANUI AQUACULTURE PROJECT

Plan prepared for BlueGreen | 26 May 2025

BlueGreen MapHouse

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- Project Area
- Project Buffer (5km & 10km)
- Black stilt
- Pied stilt
- Banded dotterel
- Black-fronted dotterel
- Northern NZ dotterel
- Wrybill
- NZ pied oystercatcher
- Variable oystercatcher
- Oystercatcher sp.
- Snares Snipe
- South Island Snipe
- Subantarctic Snipe

Data Sources:
Cornell Lab of Ornithology (Ebird), BlueGreen Ecology, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

Projection: NZGD 2000 New Zealand Transverse Mercator

0 10 km

1:450,000 @ A3

Map 15