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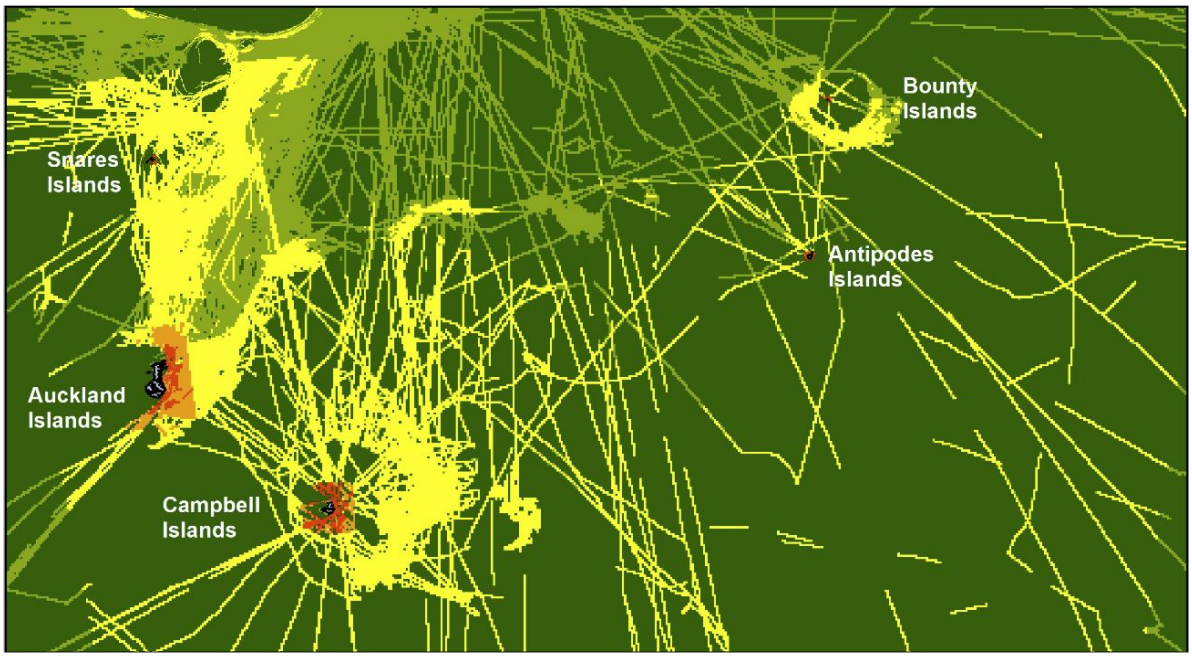
SUB-ANTARCTIC ISLANDS HYDROGRAPHIC RISK ASSESSMENT - REPORT SYNOPSIS



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SUB-ANTARCTIC ISLANDS HYDROGRAPHIC RISK ASSESSMENT - REPORT SYNOPSIS

Prepared for: **Land Information New Zealand**

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1 INTRODUCTION

This synopsis summarises the findings of a Hydrographic Risk Assessment for a sea area encompassing New Zealand's Sub-Antarctic Islands, which was carried out for Land Information New Zealand (LINZ). This Risk Assessment uses Geographic Information System (GIS) spatial analysis techniques to identify areas of hydrographic risk, using data-based techniques and marine expertise to produce the evidence.

The study uses risk comparatively to assist LINZ with the effective prioritisation of future hydrographic survey and charting improvement planning throughout the Sub-Antarctic Islands.

This synopsis provides an overview of conclusions and recommendations, to allow decision makers to prioritise charting improvements, based on the needs of contemporary shipping for accurate and adequate nautical charts taking account of present and potential future expansion of operations. The risk criteria for this assessment takes the ecological importance of rare colonies one each island group into account when determining hydrographic risk.

More detailed information on the project can be found in the main report, Marico Marine, number: **18NZ385-2**[1].

1.1 THE ISLANDS

The New Zealand Sub-Antarctic Islands consist of five Island groups; the Auckland Islands, Campbell Islands, Bounty Islands, the Antipodes Islands and Snares Islands. The islands are recognised as a unique ecological landscape for an array of distinct endemic species. Recognised as a UNESCO World Heritage Site in 1998, the islands are home to 40 species of seabird as their principal breeding grounds. The islands provide breeding sites for approximately 11% of all seabird species in the world, 30% of the world's petrels and 14 species of endemic land birds. The islands also feature many species of marine mammals throughout the year, acting as important seasonal breeding grounds for migratory cetaceans, in particular Southern Right Whales.

The remote nature of the islands makes these areas particularly attractive to the specialist expedition cruise tourism industry and there is evidence of growth in the number of visitors who plan to visit the islands. Traffic to the islands is presently low by any relative measure and this risk

[1] **Report Title: Sub-Antarctic Hydrographic Risk Assessment -Issue 1**

result is driven in no small part by the importance of the endangered colonies that exist in these southern islands.

1.2 IMPORTANT PROJECT INFORMATION

Deriving hydrographic risk for any area allows prioritisation of locations where hydrographic survey or charting upgrade would provide the most benefit and be the most cost effective. The risk approach takes into account the traffic using the sea areas, the coastline locations that are more vulnerable than others to a shipping accident, as well as the standard of the existing charting.

In the Sub-Antarctic Islands, the environmental and ecological significance of the area are crucially important factors. The Department of Conservation (DOC) limit:

1) Ship size (length);
2) the islands which can be accessed for landing;
3) those islands that can be visited offshore only, and
4) the number of people landing per-annum at any one site.

DOC's ongoing protection of this unique environment is a significant factor in limiting future growth (cruise is the most important trade in this region by risk, but fishing is the most important economically).

It is accepted there are three key components, which when combined numerically provide an estimate of hydrographic risk; causation factors, consequence factors and vessel traffic (ship type and size). Given the unique ecological importance of the island groups in the area, those most sensitive to environmental damage have been given special focus.

In this study, ecological importance is such that vulnerability to damage from a ship grounding can provide a risk result in itself. This concept is new and termed *Inherent Hydrographic Risk*, which is a calculation across all factors in the risk matrix, other than those associated with marine traffic flows. The application of traffic completes the hydrographic risk calculation. This provides a balanced assessment of risk in the study, first identifying most vulnerable locations because of species present. Inherent risk plots are important to this study and can be found in the main report, which provides explanation. In this assessment, the key factors of environmental sensitivity/rare ecology are factors with high influence in hydrographic risk calculations for this area.

The overall severity of impacts from a marine accident on a coastal zone depends on a large number of factors. Areas of environmental importance are most severely affected, but severity is dependent on distance from the casualty. Longer term impacts to the environment and tourism are also lessened, the greater the distance from the casualty event. The severity of consequence is

thus geographically relevant and the best way to assess this is through the use of GIS technology, with a risk matrix to set the factors used in calculations per grid cell.

The prioritisation process used is risk based and transparent against set criteria. Criteria were designed specifically for this area, and can be used in a future Antarctica study if local species are taken into account.

1.3 PROJECT SCOPE

The geographical scope comprised the development of a Hydrography Risk Assessment for the Sub-Antarctic Islands. In more detail, this was:

- Decoding, cleaning and post-processing to prepare a fused AIS data set, made up from raw Satellite AIS and VMS data. AIS data is transmitted by all SOLAS ships in service over 350 gross tons and some NZ domestic registered vessels, while VMS is most commonly used by fishing vessels.
- Undertaking a programme of data gathering from relevant parties with an interest in the Sub-Antarctic Islands, including DOC, Cruise New Zealand and NZ Navy.
- Provision of traffic analysis of all SOLAS vessel types and domestic vessels, including traffic frequency, density and type.
- Developing risk criteria appropriate to the Sub-Antarctic Islands data volume and ship traffic types.
- Developing a hydrographic risk model using the developed risk criteria.
- Producing a hydrographic risk assessment for the Sub-Antarctic Islands.

1.4 RISK CRITERIA DEVELOPMENT – RISK MATRIX

Risk criteria were developed specifically for the Sub-Antarctic Hydrographic Risk analysis. As the criteria are specific to this region, a comparison should not be made with hydrographic risk results from New Zealand waters or the South West Pacific.

Most notably, the Ecological Subset Value (ESV) is a concept used for the first time in an assessment of risk. This was a solution developed in this project in order to represent the value, health, and status of ecologically important aspects of the islands. Various population indices, including the New Zealand Threat Classification System were accounted for by the ESV formula. The ESV was developed to acknowledge the ecology of the area in a numerical output so that it could be implemented into the Risk Criteria Matrix. These ecological attributes are uniquely significant and relative to the Sub-Antarctic study area. For an Antarctica project, development of a modified ESV formula would be required to account for the ecology at the study area.

2 DATA USED IN THE PROJECT

A key component of the risk assessment was the gathering of location specific information to support the identification of risk areas and provide input to assist with prioritising future hydrographic surveys.

2.1.1 SATELLITE AUTOMATIC IDENTIFICATION SYSTEM DATA (S-AIS)

A 6-month record of shipping traffic in the Sub-Antarctic Islands waters was specified as a core input into this hydrographic risk assessment. However, in order to deliver a robust result, Marico Marine took an internal project decision to continue a policy of using a full 12 months of traffic data to drive the risk assessment. With a low traffic volume in the Sub-Antarctic Islands and a portion of that traffic record transiting onwards to Antarctica, it was logical to adopt the wider timescale to take account of the return of this traffic, which provided records outside of the 6-month traffic record.

Satellite recorded AIS (S-AIS) data was used, sourced from the exactEarth© satellite constellation. This source was assessed for its frequency of data update, as well as satellite download delay. The relationship between the download timestamp and the actual time associated with a vessel position is important to the risk assessment record[2].

As S-AIS data is not recorded real time and is intermittent in nature, some correction to tracks is inevitable, especially in coastal areas. This means the exact track taken by a vessel is not represented, but is adequate for risk needs.

2.1.2 FISHING VESSEL MONITORING (VMS) DATA

Fishing vessels make up the largest traffic levels by volume in the Sub-Antarctic waters. VMS data for a 12-month period was provided by the New Zealand Ministry of Primary Industries (MPI). This is a system where registered fishing vessels are tracked periodically by the regulator as part of the fishing quota management system. VMS data provides a periodic record of such vessel positions and identity, but it is not as comprehensive a dataset as is provided by the AIS transponder transmission. A majority of fishing vessels in the study area were fitted with AIS transponders, in addition to VMS. This data was combined to ensure that double-counting of fishing vessels did not occur. VMS data did add fishing vessel records to the database of smaller fishing vessels, not fitted with an AIS transponder.

[2] **Transmitted AIS data packets do have time included within the transmission, but this a sub-second record allowing AIS transponders in contact to synchronise transmission/reception (and thus avoid data collisions). AIS "time" within transmission does not include minutes (or hours), so remote reception needs to add those time elements when the data is received. Delay from transmission to reception affects positional accuracy.**

2.1.3 Species Descriptions and Distributions

Information on key species present at the Sub-Antarctic Islands was gathered and allocated numerical values based on their associated ecological attributes. The underlying information on these species' distributions and a general description of their population status was gathered and quantified. The Ecological Subset Value (ESV) score was then derived from this information and implemented into the risk model.

2.1.4 Sensitive Locations in Each Island Group

Where GIS records (shapefiles) of sensitive sites and other data sets were available, these were added into the GIS risk model to record extents. Shapefiles of Marine Reserves were kindly supplied by the DOC, identifying areas where breeding habitats are located for the varying species, some of which are critically endangered .

2.1.5 Cruise and other Vessel Operations

Cruise vessels are the most significant in terms of risk contribution. Input from Cruise New Zealand was critical to this as operators are specialist (expedition cruises) and few in number. The predominant cruise operator to the Sub-Antarctic Islands, Heritage Expeditions, kindly provided direct input. Information about other vessel activities (e.g. NZ Navy, pest eradication projects and some survey work) were added to by stakeholder interface, augmented by internet records.

2.1.6 Official Nautical Charts and Publications

Hydrographic charts have two functions: the facilitation of safe navigation ***and*** the provision of accurate information resources for marine activities in general. The Official Nautical Charts used for this risk assessment are published by LINZ and constructed in accordance with the IHO recommendations. In addition to nautical charts, LINZ provides nautical publications, such as light lists, notices to mariners, tide tables and other nautical publications necessary for any intended voyage, are required to be carried by vessels to remain compliant with the SOLAS Convention.

The standard of the existing charting in the area is an important causation factor with significant influence on navigational risk in this study. This Hydrographic Risk assessment analyses charting scores in relation to: -

- Chart Quality – Assessed according to the ZOC ratings in the area;
- Age of the Source Data on which the chart is based;
- Charting Adequacy.

3 TRAFFIC ANALYSIS

Traffic was broken down into ship types as transmitted by AIS transponders fitted to all internationally trading vessels ("SOLAS" vessel) and fishing vessels using VMS data.

3.1 VESSEL TYPES PRESENT

The AIS data record shows the following types of vessel are present in and around the waters of the Sub-Antarctic Islands.

- Passenger Vessels (Cruise)
- Cargo Vessels (including Container)
- Tankers
- Naval Vessels
- Special Purpose Vessels
- Research/Supply Vessels
- Fishing Vessels
- Recreational Vessels
- Bulk Carriers (small in number)
- Other (Class B transmitters) type unknown.

A combination of S-AIS and VMS fishing vessel data was used in the risk assessment from October 2016 to March 2017.

The traffic in the Sub-Antarctic region is by numbers at least overwhelmingly dominated by fishing operations. Cargo vessels and tankers are almost exclusively found in the northern parts of the study area, immediately north and south of Stewart Island where shipping routes between Australia and New Zealand exist. During the time-period covered by the traffic data a round-the-world yacht race passed through the study area, which can be seen as horizontal green tracks. Also, of interest are vessels falling into the "Research/Supply" category, which can be seen passing through the study area to continue to Antarctica. This category includes icebreakers (special purpose vessels).

3.2 GREAT CIRCLE ANALYSIS

The traffic profile in the North of the study area is interesting. While fishing vessel operations dominate the traffic within the study area, it was found that there was a higher than expected number of large bulk carriers in the traffic data set, with periodic transits to the South of New Zealand. These vessels were most commonly found passing through the north-eastern corner of

the study area. These vessels are following a great circle route to Panama or Cape Horn. It was established, using a Gnomonic Projection, that a number of great circle routes passed through the study area, some south of Auckland and Campbell Islands. This work established a reported occasion voyage pattern for a large cruise vessel to call at the Snares in an evening (for sunset) and north to the Chatham Islands for next morning (for sunrise). There were no records of this having occurred in the traffic data set used.

4 RISK RESULTS

4.1 INTRODUCTION

This section provides a summary of the hydrographic risk assessment results. The main report of the project provides further information, particularly in relation to the Inherent Risk Results and the use of the NZ species threat index, used in this project to help with risk quantification.

4.2 HYDROGRAPHIC RISK – ALL ISLANDS RESULTS

An overview of the hydrographic risk results for the Sub-Antarctic Islands is presented in **Figure 1.** **Table 1** references locations showing notable and heightened risk results. Although vessel traffic density is low, hydrographic risk results are sensitive to single vessel transits permitted through the design of the risk matrix, developed for this project. It should be noted here that the different risk matrix criteria developed for this project means that other hydrographic risk project results will not have the same output scales, and comparison should not be made in terms of quantum.

Heightened risk is evident around each of the Island groups, in particular around Campbell Islands, Auckland Islands and Snares Islands. Areas of moderate risk also feature prominently around the Auckland Islands and Campbell Islands. Regions of low risk are situated around offshore regions and represent fishing grounds and great circle routes, rather than typical abiotic/biotic risk factors, which are clustered around the Island groups. The results are discussed in more detail in the next section.

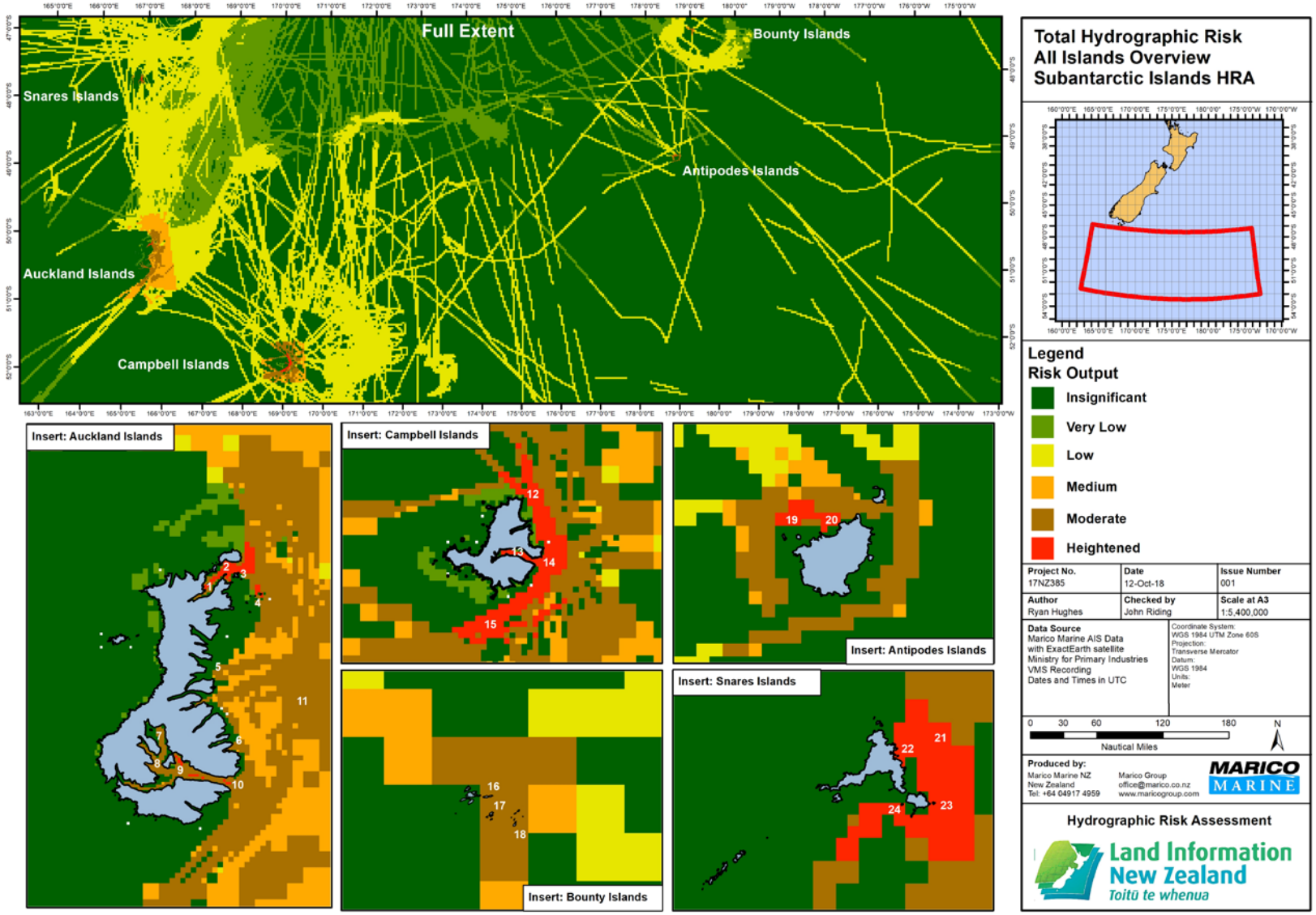

Figure Reference: 17NZ385_RMC_All_Island_Total_Summary_Overview_v1

Figure 1: Sites of Notable Hydrographic Risk - Overview and Island Group Inserts

Site #	Location	Comparative Risk Level		Hydrographic Risk Contributions
		Moderate	Heightened	
Auckland Islands				
1	Port Ross		✓	• Fishing + Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Tourist Sites • Shallow/Uncharted Depth
2	Enderby Island		✓	• Fishing + Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Tourist Sites • Shallow/Uncharted Depth
3	Ewing Island		✓	• Fishing + Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Charted Tidal Hazards • Proximity to Isolated Dangers • Proximity to Tourist Sites
4	Dundas Island		✓	• Fishing + Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Charted Tidal Hazards • Proximity to Isolated Dangers • Shallow/Uncharted Depth
5	Falla Peninsula	✓		• Fishing + Passenger Vessel Traffic
6	Cape Bennett	✓		• Fishing Vessel Traffic
7	Carnley Harbour—North Arm	✓		• Fishing Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Tourist Sites
8	Carnley Harbour—Western Arm	✓		• Fishing Vessel Traffic • High number of species colonies and breeding sites in close proximity

Site #	Location	Comparative Risk Level		Hydrographic Risk Contributions
		Moderate	Heightened	
				• Proximity to Isolated Dangers • Proximity to Tourist Sites
9	Carnley Harbour—Tagua Bay	✓		• Fishing Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Tourist Sites
10	Auckland Island—East	✓		• Fishing + Passenger + Research/Patrol Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Tourist Sites
11	Carnley Harbour—Entrance		✓	• Fishing (Heavy) + Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Charted Tidal Hazards • Low CATZOC Score (offshore)
Campbell Islands				
12	North Cape		✓	• Fishing + Passenger + Research/Patrol + Navy (Otago) Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth
13	Perseverance Harbour		✓	• Fishing + Passenger + Research/Patrol + Navy (Otago) Vessel Traffic • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Proximity to Seamounts
14	East Cape		✓	• Fishing + Passenger + Research/Patrol + Navy (Otago) Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth

Site #	Location	Comparative Risk Level		Hydrographic Risk Contributions
		Moderate	Heightened	
15	Campbell Island—South		✓	• Passenger Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth
Bounty Islands				
16	Lion Island	✓		• Fishing + Passenger Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth
17	Centre Group	✓		• Fishing + Passenger Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth
18	East Group	✓		• Passenger (Professor Khromov) Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Charted Tidal Hazards • Shallow/Uncharted Depth
Antipodes Islands				
19	Antipodes—Northwest		✓	• Cargo (Norfolk Guardian) Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth

Site #	Location	Comparative Risk Level		Hydrographic Risk Contributions
		Moderate	Heightened	
20	Mirouga Bay		✓	• Cargo (Norfolk Guardian) Vessel Traffic • Low CATZOC Score • High number of species colonies and breeding sites in close proximity • Proximity to Isolated Dangers • Shallow/Uncharted Depth
Snares Islands				
21	Snares Islands—Northeast		✓	• Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity
22	Punui Bay		✓	• Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity
23	Broughton Island		✓	• Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity
24	Snares Islands—South		✓	• Passenger Vessel Traffic • High number of species colonies and breeding sites in close proximity

Table 1: Sites of Notable Hydrographic Risk in the Sub-Antarctic Islands

4.3 SITES OF NOTABLE HYDROGRAPHIC RISK BY ISLAND GROUP

4.3.1 AUCKLAND ISLANDS

For the Auckland Islands, hydrographic risk results were moderate at six locations and heightened at five locations (**Figure 1**). Areas of heightened risk are evident within the harbour entrances of Auckland Island, in particular, Port Ross, Enderby Islands, Ewing Island, Dundas Islands and Carnley Harbour – entrance. The contributing factors towards heightened risk involved a combination of a high number of species colonies and breeding sites, charting quality (CATZOC score of D, outwards of Auckland Islands), charted tidal hazards and the proximity to isolated dangers. Traffic type contributing to heightened risk within Auckland Islands consisted of both fishing traffic and cruise vessel traffic (**Table 1**).

The eastern region of the Auckland Islands is comparatively more sheltered than the western region resulting in a focus of hydrographic surveying in the eastern side. This focused survey approach has resulted in sections of unsurveyed areas on the western side of the Island with excellent charting through harbour approaches.

4.3.2 CAMPBELL ISLANDS

The Campbell Islands showed heightened risk at four locations including the North Cape, East Cape, Perseverance Harbour and the south of Campbell Islands (**Figure 1**). Traffic type contributing to heightened risk within Campbell Islands was fishing traffic, cruise vessel traffic, and traffic associated with research/patrol from the Navy (HMNZ Otago). Generally, the chart quality has a CATZOC rating of C and D and is classified as moderate to poor around the Island. Despite a CATZOC score of B within Perseverance Harbour entrance, heightened hydrographic risk is evident here as a result of a higher number of different species colonies and breeding sites, the charting quality and shallow/uncharted depths and the proximity to isolated dangers and seamounts (a seamount exists around Terror Reef) (**Table 1**).

The eastern region of Campbell Islands is comparatively more sheltered than the western region resulting in a focus of hydrographic surveying on the eastern side.

4.3.3 BOUNTY ISLANDS

Bounty Islands provided a moderate hydrographic risk result at three locations, Lion Island, Centre Group and the East Coast Group (Figure 1**)**. The heightened risk result at these three locations is due to a high number of endangered colonies and breeding sites of numerous species of importance. The proximity to isolated dangers and the CATZOC rating of

Unassessed (this is in the area immediately surrounding the landmass) in combination with shallow and unsurveyed areas are also drivers. The vessel traffic type comprised of lower volumes of fishing vessels than other islands in the study area, with a single transit of a passenger vessel providing what is an important hydrographic risk result (**Table 1**). The ecological sensitivity of Bounty Islands means that a passenger vessel transit represents an immediate increased risk result[3].

In relation to the already low levels of traffic than other Islands of the Sub Antarctic's, traffic at Bounty is even lower. Note should be taken of this result by decision-makers as the stakeholder advice is an expected increase in traffic. The Bounty Islands have specialist attractions, even though it is not possible to land.

4.3.4 ANTIPODES ISLANDS

Antipodes Islands showed heightened hydrographic risk at two locations; the North West of Antipodes Islands and Mirouga Bay (**Figure 1**). The most notable contributing factors to risk within these areas are the high number of species colonies that are in close proximity, charting quality (Low CATZOC Score) and the shallow/uncharted depths. The chart quality illustrates an unsurveyed area encompassing most of the Antipodes and Bollons Islands. There is a distinct region of moderate chart quality (CATZOC score of B) between the main Island and Bollons Island and to the East of Antipodes Island. The surrounding area is mostly comprised of CATZOC A chart quality. The traffic type contributing to heightened risk within Antipodes Islands is cargo traffic (**Table 1**).

The cargo vessel identified is the Norfolk Guardian, this vessel was used for pest eradication within Antipodes, most notably, the 'million-dollar mouse' project aimed at eradicating mice from Antipodes Islands. Pest control has been paramount in preserving the unique flora and fauna that persist within the Antipodes Islands. The substantial cost spent on protecting these Islands presents a significant area of heightened risk, whereby, vessel accidents within these areas could result in a significant degree of loss and additional cost to assist with potential wipe-out of sensitive populations currently recovering on these islands. The expenditure on pest eradication within the Sub-Antarctic's is particularly significant and charting improvements may help to prevent re-infestation.

[3] **This was a Heritage Cruises vessel and is verified to have made the visit to Bounty and the recorded transit through the islands.**

4.3.5 SNARES ISLANDS

The Snares Islands showed heightened hydrographic risk at four locations; the Eastern and Southern coast of Snares Islands (Figure 1**)**. These areas include the northeast, Punui Bay, Broughton Island, Snares Islands – South. The heightened hydrographic risk result was due to the high number of species colonies and breeding sites, the proximity to the great circle route, the proximity to isolated dangers, the shallow/uncharted depth. Traffic type contributing to heightened risk within Snares Islands was predominantly cruise vessel traffic (**Table 1**).

The relatively high traffic density is in association with the great circle route. Following discussion with representatives from the cruise industry, it was evident the Snares are a convenient stop, lying just one steaming day from the mainland of NZ. Most cruises to the Sub-Antarctic Islands, as well as some vessels passing South of New Zealand visit the Snares Islands for either dawn or dusk, when wildlife activity is most active.

5 RESULTS DISCUSSION

This section raises key items of interest which add to the Conclusions and Recommendations. Overall, the results of the risk assessment have shown that a number of the Sub-Antarctic Islands have localised regions of heightened hydrographic risk, in relative terms, based on the criteria in the matrix. Areas of particular note for heightened risk include:

- Auckland Islands: Port Ross and Carnley Harbour;
- Campbell Islands: Entire eastern coast of the island;
- Antipodes Islands: Northwest coast of the island;
- Snares Islands: Eastern and Southern coasts of the island.

5.1 RISK RELATIVITY AND COMPARISON

Risk has been derived relatively, allowing direct comparison to be made between Sub-Antarctic areas which might have quite different characteristics. This result is not comparable with previous risk assessments from other locations as the risk criteria have been designed for Sub-Antarctic Islands. They can though be used for an Antarctic assessment, provided that work is undertaken to research to application of the ESV system to the biodiversity of this location.

5.2 CHANGING VISITOR DEMANDS

Maritime activity around the Sub-Antarctic Islands is changing. Although cruise ships are small and presently limited by size, there have been ongoing increases in passenger numbers, with some larger vessels visiting the northern groups (Snares Islands). Heritage Cruises is the specialist cruise line in the area, and have already enjoyed growth. This growth trend is projected to continue, with DOC and Cruise New Zealand advising of new interest and enquiries by operators of larger vessels. The risks associated with the use of older or outdated charts are becoming more relevant, but with traffic volumes low, the need to prioritise hydrography in this remote region, is today more driven by future traffic potential and an overwhelming need to protect the sensitive ecology of the area.

At present, vessel size visiting the Sub Antarctic Islands is limited by DOC to 125m length. This DOC limit will need to be reviewed in the longer term as the average vessel size for the expedition cruise vessel is moving upwards of 150m (length overall); one expedition cruise vessel of 180m is reportedly under construction. These are modest size increases that the DOC licencing system can accommodate, as the licencing system ultimately limits the number of people landing and visiting any one site. The stated landing numbers allowed is greater than the actual number of people visiting each of the sites

The New Zealand Cruise Association advised of plans already in place for new applications for DOC licencing. Although this growth may be limited in terms of vessel size growth, the risk assessment provides a result that suggests a need for both charting review and survey plans.

5.3 CHARTING ADEQUACY

5.3.1 WESTERN SIDES OF ISLANDS

While many of the Sub Antarctic Islands have high charting accuracy, the western sides of most islands are less well or unsurveyed. This reflects the predominant weather conditions in the region, with strong westerly winds and associated long period swell making conditions difficult for landing, as well as being an unlikely place for small fishing vessels to seek shelter. An expressed interest to visit western sides of some of the Sub Antarctic Islands was discussed with Heritage Cruises and DOC. The DOC representative referenced that observation sites on western sides of Auckland and Campbell Islands were under visited (due to hiking distance, when landing on the east). The benefits of access to Auckland and Campbell Islands was advised, despite the prevailing weather conditions being unfavourable for significant periods of the year. The lack of access overall is regulated by DOC and there is no evidence of the

consent system increasing the flexibility of visit location, or visitor numbers overall. Thus, the interest from expedition cruise operations to access locations that are presently under-visited needs to be taken into account, for charting upgrade decision making. Survey to the west may be most relevant to the Campbell Islands where a landing to the West in the summer months would almost certainly increase visitor numbers to some of the boardwalk tracks. Visitation to the upper west coast of Campbell Islands could increase visitor access to Penguin Bay and the Northwest Bay Circuit. Operators cited Macquarie Island (Australian Waters), which reportedly present similar exposure to weather from the west and sheltering capabilities, though cruise ships are able to visit all areas of these islands.

Fishing vessels can shelter in an onshore situation taking advantage of calmer waters provided. Cruise vessels on the other hand have large hull areas in comparison and thus high windage loads. The possibility exists for cruise vessels to benefit from improved charting on the western side, for access during changing weather patterns. Again, this would be suitable at Campbell or Auckland Islands only, due to land height. With the potential for larger, cruise vessels to start visiting the islands, the possibility of the wish to seek shelter as well as landing either side of the islands will increase. Thus, a review of the areas of uncharted regions would be beneficial for Campbell or Auckland Islands.

5.3.2 Bounty Chart Adequacy

The Bounty Islands provide a very interesting result, because they have a high ecological value overall, with rare species having made home on each island, which are in close proximity. The hydrographic risk scores achieved here are again due to areas of unsurveyed waters in between these small islands. The hydrographic risk was influenced by one cruise vessel transit through the waters; this confirms the interest.

5.3.3 Charting Benefit Assessment

Given the nature and prominence of medium risk in the nearshore waters of some of the islands, in areas where charting is considered poor it does seem worthwhile to consider a Charting Benefit Assessment. This was done for the New Zealand EEZ assessment. This technique uses the charting detail as the focus of the assessment, as opposed to charting quality being one of many factors that deliver the risk assessment result.

6 CONCLUSIONS

1) A hydrographic risk assessment has successfully been performed for the New Zealand Sub-Antarctic Islands using a set of risk criteria designed specifically for this region and Antarctica. Risk has been used relatively in the study, allowing direct comparison to be made between areas which might have quite different characteristics.

2) The results of the risk assessment have shown that a number of the Sub-Antarctic Islands have localised regions of heightened hydrographic risk. This level of risk is unrelated to the risk results of any other hydrographic risk study. Areas of particular note for heightened risk include:

   - Auckland Islands: Port Ross and Carnley Harbour;
   - Campbell Islands: Entire eastern coast of the island;
   - Antipodes Islands: Northwest coast of the island;
   - Snares Islands: Eastern and Southern coasts of the island.

3) The concept of 'inherent risk' has been developed to solve a critical aspect of this hydrographic risk assessment. Inherent risk is the risk associated with consequence and causation criteria in the absence of vessel traffic. In this risk assessment the ecological importance of the resident endangered colonies is a core driver. The importance and disposition of these colonies throughout the Sub-Antarctic Islands has allowed the design of a risk system that differentiates locations on the basis of ecological importance. This approach can be applied, with care, to other truly remote areas, such as Antarctica. As the hydrographic risk result appears once the traffic component is added.

4) The Sub-Antarctic Islands traffic is presently dominated by fishing vessels, but cruise operations are increasingly present. However, the dominant traffic did not have a significant impact on the hydrographic risk result. This is due to fishing activity being largely offshore, as fishing vessels only access the 12 mile limit of the islands for shelter.

5) Traffic levels overall in the Sub-Antarctic Islands are at least an order of magnitude lower than other remote areas of the New Zealand EEZ. DOC licencing limits are in place on vessel size (125m length limit) and the number of people that can be landed in any one site, meaning further expansion is likely to be measured.

6) It is clear that all stakeholders consulted, including DOC (as regulator and custodian of the Islands), are expecting an increase in both vessel numbers and visitors to these Islands. The present licensing system can accommodate an increase in numbers and in most cases, there is variance between consented numbers planning to visit (per vessel) and actual passengers landed. Current trends for the cruise industry equally indicate an increase in passenger numbers, vessel size, and trips to the islands. Even a small increase in cruise visits is a significant increase by percentage.

7) It is also noted that whilst many of the Sub-Antarctic Islands have reasonable charting accuracy in the eastern coastal waters, the western sides of most islands are in many cases unsurveyed (CATZOC U). This is a reflection of the predominant weather and sea conditions in the region, combined with natural harbour inlets lying to the east. Shelter is available practically only on Campbell and Auckland Islands, but whilst the occurrence is low, strong winds from other directions do occur. With the potential for medium sized cruise vessels to start visiting the islands, the possibility of them trying to seek shelter on either side of these islands may increase (hull windage). Thus, it is recommended that surveys be considered to the west of Campbell and to a lesser extent Auckland Island. There is also stakeholder reasoning for this to facilitate landings closer to DOC licenced visitor sites.

8) The traffic profile in the North of the study area was typical of vessel traffic transiting the Great Circle Route north to Panama. The risk criteria of the matrix were modified to cause such transits further offshore to trigger a risk response, on the basis that these are large vessels. The majority of vessels taking the Great Circle Route were far enough from most of the Island groups to not affect their levels of hydrographic risk. The Snares Islands were an exception to this and bulk carriers in proximity to the Snares Islands provide a risk contribution in comparison to elsewhere in the Sub-Antarctic Islands.

9) The Snares Islands are a useful cruise destination due to their proximity to New Zealand (1 day by sea). This, accompanied with anticipated increases in cruise vessel activity poses a significant contribution to the risk result amongst these islands. Like Bounty Group, the Snares present a hydrographic decision-making need, as it is possible for larger cruise vessels to visit for offshore viewing as part of a New Zealand itinerary, especially when proceeding to or from southern Australian waters.

10) The hydrographic risk result for Bounty Islands shows moderate risk. However, these islands possess significant endangered ecological diversity, in colonies that are grouped in close proximity to each other, but each on a different island. The risk assessment is sensitive to any increase in traffic volume. However, only one small cruise vessel transit that year provided this result (a verified transit). This in an interesting result, with the inshore waters of each island remaining uncharted as traffic is not expected. This result should be specifically reviewed by hydrographic planners and a decision to make charting improvements may be justified by the ecological importance of the Bounty Islands.

11) The results are based on the data that could be gathered. This risk assessment is different to others undertaken to date, in that it was not possible to obtain direct feedback from stakeholders with local knowledge, simply because there are no human residents. Data has thus been taken at face value, which may suggest a vulnerability in the results. Wind and wave data for the area relies on macro gathering and mariners particularly cite, for example, inaccuracy in wave data.

12) A single incident in 2017 where a cruise vessel touched bottom, demonstrated the potential vulnerability of passenger operations in these remote areas of the globe. This was, in the event, a minor incident, but if the vessel had needed assistance or harbour support interface, this would have been difficult.

13) The cruise industry consultation included the potential for future visits to Western regions of the Sub-Antarctic Islands. While acknowledging high frequency of unfavourable weather conditions from the west, the views expressed were based on some experience of cruise operations able to land or shelter on the west of Macquarie Island – which has similar conditions. Campbell and Auckland Islands feature suitable topography to provide shelter to cruise vessels.

7 RECOMMENDATIONS

1) Given the low levels of traffic, and the fact that this risk assessment prioritised the importance of the unique ecology in order to deliver a hydrographic risk assessment that differentiated amongst island groups, it is worthwhile considering a Charting Benefit Assessment to assist in hydrographic decision making.

2) Hydrographic risk methodology was further developed for this study in that the concept of Inherent Hydrographic Risk was derived. It is a solution that should be used where traffic is truly sparse. The Hydrographic Methodology document should be revised to take account of the developments made in the New Zealand EEZ study and now this Sub-Antarctic study.

3) DOC presently have a 125m length limit for cruise vessels visiting the Sub-Antarctic Islands. However, expedition cruise vessels are increasing in size, in common with other vessel types. There was one expedition vessel under construction in 2018 at 180m in length. The increase in length is not significant as passenger demand for expedition cruising is likely to expand only slowly. An increase in the present DOC length limit to 150m is recommended, as an increased length limit allows vessels with better seakeeping capabilities to visit. The passenger capacity of these vessels is unlikely to increase significantly and the daily landing limits set for individual locations can still apply.

4) With the potential for larger, high-windage cruise vessels to start visiting the islands, the possibility of one needing to seek shelter on either side of the islands will increase. This is only relevant to islands such as Campbell and Auckland Islands, where land height is available to provide some lee shelter in an easterly. Thus, it is recommended that the western side of these Islands, Campbell in particular, are given some priority for charting upgrade.

5) This Hydrographic Risk Assessment was necessarily undertaken during the summer period for the Southern Hemisphere. This created some difficulties with data gathering as personnel most able to contribute (including key DOC personnel) were deployed either in Antarctica or the Sub-Antarctic Islands. Project delays occurred in the ability to meet and obtain necessary inputs. It is thus recommended that further work in the Southern Ocean is programmed to take place during the winter period in the southern hemisphere.