BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY
AT WELLINGTON

IN THE MATTER	of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
AND	
IN THE MATTER	of a decision-making committee appointed to reconsider a marine consent application by Trans Tasman Resources Limited to undertake iron ore extraction and processing operations offshore in the South Taranaki Bight

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EXPERT EVIDENCE OF SIMON JOHN CHILDERHOUSE ON BEHALF OF TRANS TASMAN RESOURCES LIMITED

19 MAY 2023

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EXECUTIVE SUMMARY

1. I have been asked by Trans-Tasman Resources Ltd (**TTR**) to provide an update and review of marine mammal evidence relevant to the 2016 consent application. In undertaking my review, I considered the following material: (i) the original evidence relating to marine mammals that was provided in the 2016 TTR consent process including the final decision of the Decision Making Committee (**DMC**); (ii) the Supreme Court decision relevant to the 2016 application including the evidence deficits they identified; and (iii) a detailed literature review of new marine mammal data and publications that has become available since 2017.

2. There has been a considerable amount of new material on marine mammals in the South Taranaki Bight (**STB**) become available since 2017. In some areas, in particular spatial modelling and marine mammal distributions, there have been significant advances with individual species distribution models now available. In other areas, including abundance, there has been limited new material. This new material has provided useful new insights into the distribution, ecology and behaviour of marine mammals within the region. Overall, this new information is consistent with and supports my previous assessments, namely that there is a low likelihood of marine mammals being present in the proposed TTR consent area and there is nothing to suggest that the mining area is of any significance to any marine mammal species.

3. Specifically, new spatial, distribution, and habitat suitability modelling confirms that the offshore areas of the STB, including the proposed consent area, are highly unlikely to be suitable habitat for Māui dolphins, are areas where Māui dolphins will be found very rarely and, if they are present, are likely to be in very low numbers. These same data confirm that the offshore part of the STB is an important area for blue

whales and that the north-eastern and inshore waters of the STB, including the proposed consent area, have a very low probability of presence. Furthermore, the proposed consent location is highly unlikely to be an area of any special biological significance to blue whales.

4. More generally, the new data confirms the STB as an important hotspot for marine mammal diversity within New Zealand, including as a feeding and breeding location. Overall, the modelled distribution of most marine mammal species is further offshore of the proposed consent area with some notable exceptions such as common dolphins.

5. I also reviewed new information related to the potential impacts of underwater noise from the proposed operation on marine mammals. Overall, the evidence indicates that there is no likelihood of Permanent Threshold Shift (**PTS**) for any marine mammal at 500 m from the operation. Furthermore, there is no likelihood of Temporary Threshold Shift (**TTS**) for any marine mammal at 500 m from the operation except for a small possibility of TTS for VHF cetaceans if they remain in the area for more than 24 hours. I consider the likelihood of this is so low as to be a negligible risk.

6. I note that the acoustic standard for the assessment of behavioural impacts from underwater noise that was used for the 2016 hearing is no longer considered best international practice. It has not been replaced with anything equivalent but rather a recommendation that a case by case and species by species approach should be undertaken. Given this lack of a recognised standard, consideration will need to be given to how to best assess and manage potential behavioural effects.

7. I believe that the Conditions as described, including some suggested refinements, are comprehensive and will avoid

material harm from the activity on the local marine mammal populations. I also believe that the Conditions favour caution and environmental protection.

INTRODUCTION

Qualifications and experience

8. My full name is Dr Simon John Childerhouse. I am presently employed as a Senior Researcher specialising in marine issues at the Environmental Law Initiative. However, I am not appearing as a representative of the Environmental Law Initiative at this hearing but rather as an independent consultant on behalf of Trans-Tasman Resources Limited (**TTR**).

9. I have a PhD in Marine Science (2009; Thesis – Conservation Biology of New Zealand sea lions) and a Graduate Diploma in Wildlife Management (1993; Thesis – Individual photographic identification and population size estimates for sperm whales at Kaikoura, New Zealand) from the University of Otago, and a BSc in Zoology (1991) from the University of Auckland.

10. I have worked as a marine mammal scientist for more than 25 years in New Zealand, Australia, Antarctica, the USA, Canada and the South Pacific. My work has included: pure and applied marine research; leading and managing large-scale, international research projects; publication across a broad range of marine research topics; lecturing and teaching at various universities; representation of both Australian and New Zealand Governments at international meetings; development of national and international policy and strategic documents; and delivering applied and practical solutions to challenging marine conservation and resource utilisation issues. I have considerable experience in the ecology and behaviour of marine mammals and the identification and mitigation of impacts of anthropogenic activities on marine mammals.

11. Previously I worked as a:

    (a) Senior Marine Scientist at the Cawthron Institute for 3.5 years;

(b) Senior Marine Scientist at Blue Planet Marine, an environmental consultancy company, for 7 years;

(c) Research Partnership Coordinator for 3.5 years at the Australian Government's Marine Mammal Centre; and

(d) Senior Marine Mammal Scientist for 11 years at the Department of Conservation (**DOC**).

12. I was a member of the Scientific Committee of the International Whaling Commission for more than 15 years, during which time I have held the positions of Head of the New Zealand delegation for eight years, Chair of the Southern Ocean Whales sub-committee for three years and a member of the Australian delegation for three years.

13. I am also an Executive Officer of the South Pacific Whale Research Consortium, a member of the Convention on Migratory Species (**CMS**) Scientific Council's Aquatic Mammals Working Group, a member of DOC's New Zealand Threat Classification System team for marine mammals and am the New Zealand Coordinator for the International Union for the Conservation of Nature (**IUCN**) Marine Mammals Protected Area Task Force. I also hold a Ministerial appointment as a Fiordland Marine Guardian.

14. I have three book chapters and over 60 peer-reviewed research papers published in the international scientific literature. These include papers on ten different New Zealand marine mammal species including: Weddell seals, New Zealand sea lions; whales (sperm, humpback, southern right and blue); and dolphins (Hector's, Māui, dusky and bottlenose). I have also authored more than 90 unpublished research reports.

15. I have provided expert evidence on marine mammal ecology and / or the potential impacts on marine mammals for a wide range of resource consent applications under the Resource Management Act 1991 and the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012. I have provided technical advice on behalf of applicants, submitters, the Crown and Regulators.

16. I previously gave evidence for TTR before a Decision-making Committee (**DMC**) in 2017. My evidence before the 2017 Committee comprised:

    (a) A primary statement of evidence dated 15 December 2016;

    (b) A rebuttal statement of evidence dated 9 February 2017;

    (c) Supplementary statements of evidence dated 2 March 2017, 9 March 2017, 1 May 2017 and 23 May 2017

    (d) A summary presentation of evidence dated 21 February 2016;

    (e) Written responses to questions approved in DMC Minute 21;

    (f) A joint statement of experts in the field of effects on marine mammals dated 3 March 2017;

    (g) Oral evidence on 21 February 2017 (Transcript pages 486-51;

    (h) Oral evidence on 3 March 2017 (Transcript pages 1058-1083); and

    (i) Oral evidence on 22 May 2017 (Transcript pages 3110-3135).

Code of conduct

17. I confirm that I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note dated 1 January 2023. I agree to comply with this Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

18. I have been asked to review and update my evidence taking into account the decision of the Supreme Court in *Trans-Tasman Resources Ltd v Taranaki-Whanganui Conservation Board and Others* [2021] NZSC 127.

19. I note that the Supreme Court identified that there were deficits in the original evidence, including about marine mammals. In particular, that the evidence about habitats and populations of marine mammal numbers in the area was incomplete and that there was particular uncertainty about noise effects on marine mammals in the absence of comprehensive, well-researched, species-specific and habitat-specific information about noise effects on marine mammals.

20. I have reviewed the information available in 2017 and all relevant subsequent new information to provide an updated assessment of potential effects on marine mammals for the new DMC's consideration.

21. In light of the Supreme Court's findings, I have considered whether granting consent, subject to the proposed conditions, will favour caution and environmental protection in relation to potential effects on marine mammals.

UPDATING EVIDENCE

22. I have used a range of sources when undertaking my review of new marine mammal information that has become available since the 2017 case. Research has included online library search systems, general online search platforms, and reviewing published and unpublished literature including grey literature. All of these sources have been supplemented by my own experience with marine mammals and the assessment of potential impacts on them. I have used a wide variety of information sources to summarise what is known regarding marine mammals in the region and the potential effects upon them from the proposed activity.

23. I include as **Appendix 1** a list of the new key papers and reports that I have considered in updating my evidence. Overall, there has been a considerable amount of new information published (e.g., more than 50 new scientific papers and reports) about marine mammals in the South Taranaki Bight (**STB**) region. I provide a short summary of this new information in the following two sections.

24. I also undertook a review of all the new data available in the DOC Marine Mammal Sighting and Stranding database from November 2016 (i.e., the end date of my previous assessment) until April 2023 (DOC 2023). A summary of the available (old and new) spatial data is presented in **Appendix 2**.

25. I have synthesised these new data that have become available since the 2017 hearing with the marine mammal data that was considered at that hearing to provide an updated account of the existing environment of the STB and potential impacts on marine mammals from the proposed activity. This information is covered in the next two sections.

SUMMARY OF NEW INFORMATION ON THE EXISTING ENVIRONMENT RELEVANT TO MARINE MAMMALS

26. This section provides a summary of the new information about marine mammals that has become available since my earlier evidence. I have broken it down into sections relevant to species and/or issues.

DOC Sighting and Stranding Database

27. I reassessed the DOC Marine Mammal Sighting and Stranding database including data until April 2023. This includes an additional 6 years and 5 months of data since my original assessment. In addition to the DOC data, I also added the 17 blue whale records that were provided to me by Dr Leigh Torres as part of the previous hearing which were also included in my previous maps.

28. There were approximately 671 new records added to the database since November 2016 when I last downloaded the DOC database. I say approximately as there have been some amendments and updates made to the original pre-November 2016 data since I downloaded it, and therefore those records do not directly correspond to the records as I reported on in 2016 (i.e., the pre-November 2016 records I have presented here are not identical to the figures I presented in my previous evidence). A full breakdown of records pre- and post-November 2016 plus figures are shown in **Appendix 2**.

29. While these additional records represent a significant increase in the available data, these data sets still retain the same limitations as previously noted, including that they are primarily collected in a non-systematic manner, are not necessarily representative of marine mammal diversity within either the proposed consent area or the wider STB region, and species identifications are generally not confirmed by experts.

Notwithstanding these potential limitations, these data sets represent the best available sighting and stranding data for marine mammals within the region.

30. There are some interesting new findings from the updated data set including:

    (a) There were 671 additional records reported from within the proposed project area bringing the total number of records to 2,668 up to April 2023;

    (b) There was one new record from a new species, rough toothed dolphin, which previously hadn't been reported in the database bringing the total number of species recorded in the STB region to 41;

    (c) The highest number of new records by species were:

        i. Hector's and Māui dolphins with 406 records;

        ii. Common dolphins with 65 records;

        iii. Killer whales with 47 records;

        iv. Dusky dolphins with 24 records;

        v. Humpback whales with 16 records, and

        vi. Blue whales with 11 records.

31. It is important to note these new records do not necessarily reflect the most abundant or commonly found species in the STB region but rather other factors such as how much their distribution may overlap with people, active research and/or monitoring programmes (e.g., DOC encourage the public to report all sightings of Hector's and Māui dolphins within the region and have an active reporting programme), and the interest of the public.

32. There were no records of any marine mammals from within the proposed consent area prior to November 2016. The addition of the new data to April 2017 means there is now:

(a) Only one record of a common dolphin within the proposed consent area;

(b) Six records from within a 5 km buffer around the outside of the proposed consent area (i.e., 4 common dolphin, 1 minke whale, 1 killer whale); and

(c) Six further records within a 5km and 10km buffer around the outside of the proposed area (i.e., 4 common dolphins; 1 Hector's or Māui dolphin, 1 blue whale).

33. Overall, these new data are consistent with and confirm the findings of my previous assessment that the STB region is an area of high marine mammal diversity and some parts of the region represent important habitat and foraging areas for some species. The single marine mammal record from within the proposed consent area mean that the updated database records still do not provide much useful information about which marine mammals occur within the proposed consent area and how they may use it.

General Marine Mammal Modelling

34. Stephenson et al. (2020a,b; 2021) developed species occurrence and diversity hotspot models for species of Cetacea to predict spatial distributions and identify hotspots based on available sighting records. Models for rarely sighted species showed reasonable fits to available sightings and showed high predictive power for commonly sighted species. Important variables for predicting the occurrence of cetacean taxa were temperature residuals, bathymetry, distance to the 500 m isobath, mixed layer depth and water

turbidity. Cetacean distribution patterns varied from highly localised, nearshore (e.g., Hector's dolphin), to more ubiquitous (e.g., common dolphin) to primarily offshore species (e.g., blue whale). The STB was identified as an important area both for species richness (i.e., the number of different species that occur in an area) and spatial prioritisation (i.e., a method for assessing the representativeness of species in an area) when the high levels of uncertainty were included in the assessment. A selection of predicted probability occurrence maps for various species are included in Figure A2-4 in **Appendix 2**.

35. Stephenson et al. (2020b) predicted the following probability of occurrence for species within the proposed consent area:

(a) a very low probability for Hector's and Māui dolphins;

(b) a low-moderate probability for blue whales;

(c) a high probability for common dolphins.

36. MacKenzie et al. (2022) provides an updated spatially explicit fisheries risk assessment for most New Zealand marine mammal populations. While the focus of the paper is fishing impacts, there is some useful information about the spatial distribution of marine mammals in the STB.

37. With respect to the results of modelling, it is important to be completely clear what the model outcomes represent. For example, Stephenson et al. (2020b) models probability of occurrence measures which estimate the probability that an individual may occur in a specific location. However, this measure doesn't prove that an individual is in an area only that it might be found there with some degree of probability. Areas with high probability of occurrence mean that an individual is more likely to be in that area, but it still may not be there for a range of reasons (e.g., it used to be there, but

is no longer there as it has been driven away or killed by impacts). Similarly, areas with a low probability of occurrence doesn't necessarily mean that individuals aren't there.

38. Habitat suitability measures as used in Derville et al. (2016; discussed later in the Māui and Hector's dolphin section) measure how suitable a location is for an individual. This measure is generally based on physical and biological features (e.g., depth, prey availability, water temperature, etc). It assesses which areas are likely to be suitable for a species but again, provide no data on whether there are actually individuals there or no. Deville et al. (2016) identified large areas of the west coast of the North Island as suitable habitat for Māui dolphins where there used to be dolphins historically, but aren't any more likely to due to habitat loss and fishing mortality.

39. Spatial models can be useful tools when outcomes are interpreted correctly but can also be misleading if outputs maps are simply taken at face value as representing actual individual presence or absence.

Blue Whales

40. There have been more than a dozen new scientific publications on blue whales. These are listed in **Appendix 1**. I summarise some of the new key findings relevant to the proposed consent.

41. Barlow et al. (2018) confirmed the almost year-round presence of blue whales in the STB, where foraging behaviour was frequently observed. Results (e.g., genetic, lack of photo-identification matches) suggest a high degree of isolation of the New Zealand population from other southern hemisphere blue whale populations. The researchers also estimated the within-year abundance of blue whales within the STB region

at 166 (95% CI[1] = 75-367) plus an abundance estimate of 718 whales for all blue whales in New Zealand, although these estimates are likely to be underestimates and come with some qualifiers. Whales from the STB were also resighted in the Hauraki Gulf, Kaikoura, Westport, and Greymouth.

42. Barlow et al. (2023a) confirmed the presence of three different blue whale populations: New Zealand, Antarctic and Australian within the STB from acoustic monitoring and almost year-round presence (See Figure A4-2). The authors concluded that the STB region is the primary niche of the New Zealand population, a migratory corridor for the Antarctic population, and outside the typical range of the Australian population. The mean daily detection range for acoustic detections was estimated at 79.21 ± 19.09 km for New Zealand blue whales, 147.57 ± 20.62 km for Antarctic blue whales and 253.55 ± 116.60 km for Australian blue whales.

43. Barlow et al. (2023b) confirmed the presence of near constant blue whale calls within the STB from acoustic monitoring during 2016-2018 (see Figure A4-3), including from a recorder located close to the proposed consent area. Calls were strongly correlated with oceanographic drivers of upwelling in spring and summer whereas songs peaked in autumn aligning with conception data. The authors also found a link between a marine heatwave and reduced acoustic behaviour which they hypothesised was linked to reduced foraging and a lower reproductive effort.

44. Barlow et al. (2020, 2021) confirmed strong correlations between environmental conditions, upwelling, krill distribution and blue whale presence. Barlow et al. (2020) included survey

[1] 95% CI are 95% confidence intervals. A confidence interval is the range of values that you expect your estimate to fall between a certain percentage of the time (95% in this case) if you run your experiment again or re-sample the population in the same way.

effort in the STB, including around the proposed consent area, in 2016 and 2017 (see Figure A4-4).

45. Barlow & Torres (2021) developed a blue whale distribution model based on environmental variables with a high degree of predictive performance. The model identified areas with a mean probability of blue whale presence. It shows that the proposed project location falls in an area of very low predicted blue whale presence[2] (see Figure A4-1).

46. Torres et al. (2020) confirmed the importance of surface feeding on krill by New Zealand blue whales. Blue whales were encountered where prey was relatively shallow and denser.

47. Goetz et al. (2022) satellite tagged two blue whales off Karamea. One travelled over 500 km north before transmissions ceased after 6 days off the west coast of Auckland and the other transmitted for 47 days during which time it completely circumnavigated the South Island and then when into the STB. The results from this study show that blue whales spend time in areas outside the STB, though the amount of time is likely driven by the presence of upwelling conditions which varies from year to year.

48. Warren (2021a, b) used acoustic monitoring in the STB to confirm the presence of pygmy and Antarctic blue whales in the region and the importance of the region to both species. Detection range for the acoustic recorder was estimated at between 35-50 km within the STB region. The acoustic recorder was located approximately 75 km from the proposed consent area.

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[2] Figure 6 in Barlow & Torres 2021

Māui and Hector's Dolphins

49. This section focuses on Māui dolphins but will also include some details of relevant Hector's dolphin data.

50. Derville et al. (2016) used a model to predict habitat suitability for Māui dolphins. The model achieved good overlap with existing sighting and stranding data and identified a hotspot of high habitat suitability near Hawera in the inshore waters of the STB. It is important to note that while these data indicate that the area is deemed to be highly suitable for Māui dolphin, it doesn't provide any information on whether there are actually Māui dolphins there now. The authors also noted that some of the identified hotspots are outside of the presently known distribution of Māui dolphins and therefore these may be areas where dolphins were historically present prior to human impacts.

51. Forney et al. (2017) considers potential underwater noise impacts on Māui dolphins. They highlight the potential for displacement caused by anthropogenic noise to increase risks for Māui dolphins through animals moving out of protected into unprotected areas. This is not likely to be the case for the proposed consent area as it isn't considered to be a part of the normal range of Māui dolphins.

52. Roberts et al. (2019) undertook a spatial risk assessment of threats to Hector's and Māui dolphins. The estimated density of Māui dolphins within the proposed consent area was assessed as extremely low, while waters inshore of the consent area identified as very low densities[3]. There was no formal assessment of potential impacts from seabed mining.

53. Cooke et al. (2019) undertook some individual-based population modelling based on genetic mark recapture

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[3] Figure 25 in Roberts et al. (2019)

data. A variety of modelling scenarios were considered which led to a continued decline in the population unless strong management action was taken.

54. de Jager et al. (2019) modelled the spatial distribution of Māui dolphins using an assumed and random distribution of dolphins sampled from the full potential range (i.e., known present range plus historic range). Results highlight that dolphins from the randomly allocated dolphin distribution were estimated to move well outside the present protected areas. In some model runs, when dolphins were randomly allocated to the waters inshore of the proposed consent area, the model suggested that these dolphins could move offshore and potentially enter the proposed consent area. However, based on our current understanding of Māui dolphin distribution, there is an extremely low likelihood of dolphins being inshore of the proposed consent area.

55. Wright & Tregenza (2019) provided a summary of acoustic monitoring of Māui dolphins along the west coast of Auckland. The preliminary data suggests some trends with diel (24-hour) and tidal patterns. Nelson & Radford (2019) also undertook acoustic monitoring of Māui dolphins at several sites around Taranaki including one site 2 km off the Whanganui River mouth during 2016/17, which is approximately 55 km east of the proposed consent area. There were no narrow-band high frequency detections (characteristic of Hector's and Māui dolphins) recorded during the 95-day monitoring period at Whanganui. The lack of detections is consistent with our understanding that Māui dolphins are very rare in the region.

56. Slooten (2020) and Slooten & Dawson (2020a,b; 2021) review the current management for the conservation of Māui and Hector's dolphins. There is little information specifically relevant to seabed mining other than to identify it as potential

cumulative effect and to confirm that the Māui dolphin population cannot sustain any mortality without risking a catastrophic decline.

57. The Hector's and Māui Dolphin Threat Management Plan 2020 was released in 2021 by DOC and Fisheries New Zealand (FNZ). The Plan extended the West Coast North Island Marine Mammal Sanctuary (the Sanctuary) south as far as Cook Strait in 2020 and prohibited all seabed mining within the Sanctuary. The Sanctuary now runs inshore and is contiguous with the proposed consent area. Other increased protections included the extension of a four nautical mile set net exclusion area south to Cook Strait.

58. McPherson et al. (2019) provide an indicative assessment of underwater sound propagation modelling used to illustrate potential noise exposure to Māui dolphins from seismic surveys and vessel traffic on West Coast North Island, New Zealand. The study demonstrates that traffic density north of the Taranaki region is relatively low within 12 nautical miles of the coast, while higher densities occur in the Taranaki and STB regions. However, the authors didn't assess the modelled noise levels against potential Māui dolphin thresholds but commented that the noise levels could be high enough to cause disturbance in some areas.

59. Constantine et al. (2021) estimates the census abundance and effective population size of Māui dolphins as 54 (95% CI = 48-66) and 35 (95% CI = 21-67) respectively from genetic sampling of dolphins around and north of the North Taranaki Bight. They also suggest that the population is approximately stable. There were a few long-distance movements of identified individuals, but most movements were less than 10 km confirming that Māui dolphins do not appear to generally travel large distance or have large home ranges.

60. The FNZ (2022) Aquatic Environment and Biodiversity Annual Review 2021 provides a useful summary of Hector's and Māui dolphin biology, ecology and (primarily fisheries) impacts.

61. Ogilvy et al. (2022) assessed the diet of Māui dolphins from stable isotope analysis. They confirm that the diet of Māui dolphins has significantly changed over time including with a strong effect from El Nino. There were no samples available from the STB so it is unknown if these data will be representative of any Māui potentially found in the STB.

Southern Right Whales

62. There are spatial models of the nationwide distribution of southern right whales provided in Stephenson et al. (2020a,b) and Torres et al. (2013), although the former offers little fine-scale resolution within the STB and the latter is primarily offshore distributions. Both models confirm that southern right whales have low probability of occurrence within the STB.

63. Carroll et al. (2013) provides the first national abundance estimate for southern right whales of 2,169 (95% CI 1836-2563) although there are no regional estimates, including for the STB.

Killer Whales

64. Reeves et al. (2022) confirms that there a minimum of three regional killer whale populations in the Australia region: New Zealand, North-west Australia and South-west Australia. These populations present moderate levels of genomic diversity, negligible levels of inbreeding, small effective population sizes, and low contemporary migration rates among them. Stephenson et al. (2020b) modelled the probability of occurrence of killer whales with low probability of them being present in the STB and proposed consent area. These data are consistent with the idea that killer whales are rare visitors to the STB region.

Common Dolphins

65. Common dolphins are the second most recorded species in the DOC database (**Table A2-1**) within the STB with an apparent widespread distribution throughout the region. Stephenson et al. (2020b) modelled the probability of occurrence of common dolphins nationally including with a high probability of them being within the proposed consent area. Common dolphin are frequently captured in New Zealand trawl fisheries, particularly in the large-vessel jack mackerel target fishery off the North Island west coast (Abraham et al. 2021) although within the STB, captures are normally considerably further offshore than the proposed consent area. There is no abundance estimate available for the STB although the population has high genetic diversity consistent with a large population size (Baker et al. 2016).

Other Species

66. There is new information on other marine mammal species available in a range of publications and reports including Betty et al. (2020), Stephenson et al. (2020a,b, 2021), MacKenzie et al. (2022), IUCN (2020), McConnell (2022), SLR Consulting Limited (2022), Warren et al. (2020, 2021a,b), and Constaratas et al. (2021). I have considered these papers when drawing my conclusions about marine mammals in the STB but haven't referred to them specifically in detail in my evidence in the interests of trying to keep my evidence to a manageable size.

DOC Marine Mammal Threat Ranking System

67. In 2019, DOC updated the status of all marine mammals in New Zealand following the New Zealand Threat Classification System (NZTCS) (Baker et al. 2019) from the previous listing in 2013 (Baker et al. 2016). The conservation status of several

species found in the STB has been updated since the original impact assessment. These updates are shown in **Table 1**.

68. Overall, while there has been some change in the status of marine mammals found in the Taranaki region, there is nothing to suggest that any of these status changes would materially affect the previous assessments of impact from the proposed activity.

Table 1: Summary of status changes for marine mammals found in the South Taranaki Bight region under the New Zealand Threat Classification System (NZTCS)

Species	2013 NZTCS status	2019 NZTCS status
Pygmy blue whale	Non-resident Native - Migrant	Data Deficient
Antarctic blue whale	Non-resident Native – Migrant	Data Deficient
Hector's dolphin	Threatened – Nationally Endangered	Threatened – Nationally Vulnerable
Southern right whale	Threatened – Nationally Vulnerable	At Risk – Recovering
New Zealand sea lion	Threatened – Nationally Critical	Threatened – Nationally Vulnerable
Leopard seal	Non-resident Native – Vagrant	At Risk – Naturally Uncommon
False killer whale	Not Threatened	At Risk – Naturally Uncommon

Species	2013 NZTCS status	2019 NZTCS status
16 taxa (various)	5 Not Threatened 4 Non-resident Native – Migrant 7 Non-resident Native – Vagrant	Data Deficient

IUCN IMMAs

69. Impact Marine Mammal Areas (**IMMAs**) have been developed by the IUCN in response to a conservation crisis in the protection of marine mammals and wider global ocean biodiversity (Tetley et al. 2022). IMMAs identify discrete portions of habitat that are important for one or more marine mammal species, and that have the potential to be delineated and managed for conservation. While IMMAs confer no specific international or legal protection, they are increasingly being utilised in environmental impact assessments, marine planning exercises and in international, national, and supra-regional conservation, policy, and management initiatives.

70. In 2020, the IUCN designated two IMMAs within the broader STB region[4]. Specifically, the *South Taranaki Bight IMMA* and the *Marlborough Sounds and Cook Strait IMMA*, which provide contiguous coverage of most of the STB region (IUCN 2020). The IMMAs were recognised on the basis of the high diversity of marine mammals within each area, including the presence of threatened and endangered species. Figure A2-

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[4] As background, I am the present New Zealand Coordinator for the IUCN IMMA programme and was the primary author of both applications for the SBT IMMA and the Marlborough Sounds and Cook Strait IMMA which were accepted by the IUCN.

1 shows most of the boundaries of the South Taranaki Bight IMMA which covers an area of 47,361 km^2 stretching from Karamea in the South to more than 100 km offshore and west of Cape Egmont, to Patea in the east. The proposed consent area falls completely within the South Taranaki Bight IMMA and covers approximately 0.1% of the IMMA.

71. The recognition of the SBT as an IMMA by the IUCN is consistent with my previous statements that recognise the STB as an important area for marine mammals while noting that the proposed consent area represents only a tiny part of the whole region and that the specific location for the consent does not appear to be an area of any significance for any marine mammal species.

Relevant Resource Consent Applications

72. There have been several resource consent applications for activities in the STB since 2016 which have considered information on marine mammals. While not directly relevant to the assessment of potential impacts from seabed mining, these are a useful additional source of information on marine mammals. For example, the application for the Kupe development drilling programme (i.e., EEZ100021) in 2022 considers similar information as I have in this evidence, including relevant reports such as McConnell (2022), SLR Consulting Limited (2022), and the Board of Inquiry Decision document (EPA Board of Inquiry 2023). While I haven't attempted to summarise their relevant findings in this evidence, I have utilised any relevant available information and included it in my update.

EVIDENCE ON EXISTING ENVIRONMENT RELEVANT TO MARINE MAMMALS

73. I have summarised the new data on marine mammals that has become available since 2017 in the section above. I now review my previous assessments of the existing environment in light of this new information.

74. I quote from paragraph 1 of my Evidence of 15 December 2016, which reads:

> *There is a low likelihood of marine mammals being present in the proposed Trans-Tasman Resources Limited (TTRL) mining area and there is nothing to suggest that the mining area is of any significance to any marine mammal species. These conclusions are supported by dedicated marine mammal surveys of the proposed mining area and by existing knowledge about how marine mammals use the greater Taranaki area. While Māui dolphins and/or Hector's dolphins are found in very low numbers in the STB region, the operational area is at the margins of the southern-most recognised range for Māui dolphins. It appears very unlikely that Māui dolphins are present in the TTRL operational area given that the majority of their distribution is considerably further north of this site.*

75. A considerable amount of new data on marine mammals has been published since 2016, as noted in the section above. However, nothing in the new material I have reviewed contradicts or conflicts with my statement above. In fact, much of the new research supports my previous conclusions. Specifically, I provide a summary below of my updated conclusions for key marine mammals species present in the region:

(a) ***Māui dolphins***: New spatial, distribution, and habitat suitability modelling confirms that the offshore areas of the STB, including the proposed consent area, are highly unlikely to be suitable habitat for Māui dolphins, are areas where Māui dolphins will be found very rarely and, if they are present, are likely to be in very low numbers (Derville et al. 2016; Roberts et al. 2019; de Jager et al. 2019; Stephenson et al. 2020a,b, 2021). These models also confirm that the proposed consent location is highly unlikely to be an area of any special biological significance to Māui dolphins.

(b) ***Blue whales***: New spatial, distribution, and habitat suitability modelling confirms that the offshore part of the STB is an important area for blue whales (Barlow & Torres 2021; Stephenson et al. 2020a,b). These models also confirm that the north-eastern and inshore waters of the STB, including the proposed consent area, have a very low probability of presence (Figure 6 in Barlow & Torres 2021; Figure 4 in Stephenson et al. 2020b). As for Māui dolphins, these models also confirm that the proposed consent location is highly unlikely to be an area of any special biological significance to blue whales. These model results are also consistent with data from acoustic monitoring which demonstrates that blue whales are in the STB region almost year-round (Barlow et al. 2023a). There is one blue whale sighting within 10 km and only two within 30 km of the proposed site with most sightings considerably further west (e.g., >40-50 km) and offshore (see Figures A2-1, A2-3)

(c) ***General marine mammals***: The spatial modelling from a wide range of marine mammal species, confirms the STB as an important hotspot for marine mammal diversity within New Zealand, including as a feeding and breeding location (Stephenson et al. 2020a,b, 2021; IUCN 2020). Generally speaking, the modelled distribution of most marine mammal species is further offshore of the proposed consent area with some notable exceptions such as common dolphins.

(d) ***Threat status***: Hector's dolphins, southern right whales and New Zealand sea lions have all improved their threat status since 2013. 18 taxa, including pygmy and

Antarctic blue whales, have been relisted as "Data Deficient". Overall, these updates in threat status do not cause me to change my previous assessments as these status changes by themselves are not sufficient grounds to revise an assessment which is primarily based on a relationship between a range of variables including distribution, abundance, ecology and actual potential for an impact.

76. I quote from paragraph 27 of my Evidence of 15 December 2016, which reads:

> *With respect to other marine mammals (e.g. killer whales, southern right whales, bottlenose dolphins, fur seals) in the proposed mining area, I conclude that they are likely to be infrequent visitors most likely transiting through the area with no evidence of the location being of any particular significance to any species.*

77. My previous assessment included an assessment of data from dedicated marine mammal aerial surveys by Cawthorn (2015) which covered more than 8,400 km of transects of the proposed consent area and surroundings and had only one sightings of common dolphins and 4 sightings of New Zealand fur seals. There is little new survey data available for marine mammal species since 2016. However, based on outputs from new spatial models (e.g., Stephenson et al. 2020a,b, 2021) which are broadly consistent with my original findings, I confirm that my previous conclusions are also still correct.

78. In conclusion, the Supreme Court found that the evidence about habitats and population numbers in the area was incomplete and uncertain. As I stated previously in my paragraph 20, I believe that there was sufficient information relating to marine mammals and the potential impacts upon them provided in the 2017 case for the DMC to make an informed decision about the consent. Nevertheless, considerable additional information about marine mammal habitats in particular has become available since 2017 which

has considerably improved our understanding of marine mammals in the region.

79. There has been less new information about marine mammal population numbers in the region but I would argue that this is an extremely difficult task to address given the variety and sheer number of species, the large area over which they range and the logistical, financial and scientific challenges with estimating abundance of marine mammals. Again, I would refer to the aerial survey data collected over a two-year period by Cawthorn (2015) where there were only 5 sightings of marine mammals. This evidence demonstrates that the density of marine mammals is extremely low in the area and, while it may be possible to obtain abundance estimates for the area, it is still possible to assess impacts upon marine mammals in the absence of abundance estimates.

EFFECTS OF UNDERWATER NOISE ON MARINE MAMMALS

80. I have provided an update on the potential effects of underwater noise on marine mammals as that was noted as the only specific impact identified as a deficit in the original hearing by the Supreme Court decision. I have not revisited any other potential effects.

Underwater Noise

81. Mr Humpheson, a specialist acoustician, provided highly comprehensive and analytical models of underwater noise from the proposed mining and associated operation to the 2017 hearing (Humpheson 2017). His modelling work is still consistent with international best practice underwater modelling and therefore still represents the best available data about the underwater noise from the proposed operation.

82. There are still no available estimates for the specific underwater noise generated by this proposal. Humpheson

(2017) used estimates available from the De Beers Marine seabed mining operation as underwater source levels for his modelling. I believe that these source levels still represent the best available information about the likely noise level of the proposed operation.

83. Humpheson (2017) estimated the Sound Exposure Levels (SEL; the total noise energy produced from a single noise event) at specific distances from the proposed operation including source noise from both the crawler unit and the integrated mining vessel (IMV; the surface processing vessel). His data is presented below in **Table 2**. I believe that these sound exposure levels still represent the best available information about the likely noise level of the proposed operation.

Table 2: Sound Exposure Levels (SEL) and Sound Pressure Level (SPL) estimated for differing exposure periods and distances from the underwater noise generated from the crawler unit and integrated mining vessel combined. Source: Humpheson (2017)

		SEL dB re 1µPa².s				
Distance	**SPL re 1µPa**	**10 sec**	**10 min**	**1 hr**	**3 hr**	**24 hr**
500 m	135	145	163	167	170	175
1000 m	130	140	157	162	165	170
1500 m	129	139	156	161	164	169
2000 m	128	138	155	160	163	168

84. My previous assessment of the potential impacts of underwater noise on marine mammals was based on standards that represented international best practice at that time: Southall et al. (2007) and Finneran & Jenkins (2012). The original DMC for the 2017 hearing also requested that additional consideration be given to application of the USA National Oceanic and Atmospheric Administration (NOAA) interim Sounds Threshold Guidance in 2016.

85. Since my previous evidence, the original Southall publication has been updated by Southall et al. (2019), which now represents international best practice (and also incorporates the work from Finneran & Jenkins 2012 and supersedes the NOAA interim guidelines) for assessing impacts of underwater noise on marine mammals. In addition to setting new standards for Temporary Threshold Shift[5] (**TTS**) and Permanent Threshold Shift[6] (**PTS**) (**Table 3**), Southall et al. (2019) also provides a useful update on recent research on the effects of underwater noise on marine mammals.

Table 3: International best practice standards for Temporary- (TTS) and Permanent-onset (PTS) thresholds for marine mammal groups exposed to non-impulsive noise (e.g., seabed mining) taken from Table 6 of Southall et al. (2019). SEL thresholds in dB re 1 μPa²s under water

Marine mammal hearing group	Examples	TTS onset: SEL (weighted)	PTS onset: SEL (weighted)
Low frequency cetaceans (LF)	Blue, humpback, southern right whale	179	199
High frequency cetaceans (HF)	Bottlenose, dusky dolphin, killer whale	178	198
Very high frequency cetaceans (VHF)	Hector's, Māui dolphin	153	173
Phocid carnivores in water (PCW)	Leopard seal	181	201
Otariid carnivores in water (OCW)	NZ fur seal	199	219

86. In all cases, the new international best practice standards for non-impulsive, continuous underwater noise (such as for

[5] A temporary reduction of hearing sensitivity.

[6] A unrecoverable tissue damage that leads to a permanent reduction in hearing sensitivity to sounds over a specific frequency range.

seabed mining operations) are identical or slightly higher (i.e., ± 1 dB) to the standards that I used in my original assessment.[7]

87. To assess the estimated underwater noise of the proposed operation against the new standards, it is necessary to make some assumptions including:

(a) The SEL metric in the new standard is m-weighted which means that the frequency spectra of the noise is weighted by the hearing sensitivity of each particular marine mammal group. For example, some marine mammals can't or don't hear some frequencies of sounds and therefore even if they are exposed to loud noises of those frequencies, they won't be affected by them (akin to high-pitched dog whistles which are audible to dogs but not humans); and

(b) The estimated noise SELs from the operation in **Table 2** are broadband noise and are not m-weighted. In essence, this assumes that the noise produced will be 100% audible to all marine mammals even when particular elements of that noise may not even be audible to some species. In practice, this makes the testing of broadband SELs noise levels of the operation against m-weighted SEL noise standards highly precautionary.

88. Therefore, comparing the operational noise levels from **Table 2** with the new standards in **Table 3**, the following conclusions are reached:

(a) For LF cetaceans (e.g., blue and humpback whales), HF cetaceans (e.g., bottlenose and common

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[7] Table 1 of my original evidence (15 December 2016); Table 6 of Southall et al. (2019).

dolphins), phocids (e.g., elephant seals) and otariids (e.g., NZ for seals), there will be no risk of either TTS or PTS at 500m from the operation as all noise levels are lower than the standards;

(b) For VHF cetaceans (e.g., Hector's and Māui dolphins), the picture is quite different when comparing broadband noise SELs against the new standards. When using broadband levels, both TTS and PTS are possible at 500m and further from the operation. However, given that most of the energy from the operation's underwater noise is in the low frequencies, and that Hector's and Māui dolphins are less sensitive to low frequencies, the approach of using broadband SELs isn't appropriate, is likely to be highly biased and is unlikely to provide a robust assessment. For this reason, it is necessary to estimate specific VHF m-weighted SELs for the consideration of impacts on this group of marine mammals;

(c) Using the data in Table 1 of Humpheson (2017), it is possible to back calculate the VHF m-weighted SPL and SEL of the operation[8]. This yields a VHF m-weighted estimate of a source level of SEL 182 dB re 1μPa^2.s specific to VHF cetaceans. The dB propagation losses identified from the source to 500 m from the various models in Humpheson's (2017) Table 2 range from 18 to 61 dB depending on the model selected (**Table 4**). This results in VHF m-weighted noise levels at 500 m from the source ranging from 121 to 164 dB re 1μPa^2.s. It is then possible to compare these VHF m-weighted SELs with the new

8 I received some technical advice on this process from Dr Matt Pine, an underwater acoustics expert, of Styles Group, Auckland.

VHF m-weighted TTS and PTS standards of 153 and 173 dB re 1μPa^2.s;

Table 4: Estimated very high frequency (VHF) m-weighted Sound Exposure Level (SEL) for Hector's and Māui dolphins at 500 m from the operational noise source. VHF Permanent Threshold Shift (PTS) = 173 dB re 1μPa^2.s. VHF Temporary Threshold Shift (TTS) SEL = 153 dB re 1μPa^2.s. Data modified from Humpheson (2017).

Sound propagation algorithm	Estimated m-weighted SEL at source 1m (dB re 1μPa^2.s)	dB loss from source to 500 m	Estimated m-weighted SEL at 500 m from source (dB re 1μPa^2.s)
20 log (r/r0)	182	61	121
20 log(rd/ro+10log(r/rd)	182	44	138
user defined 15log	182	36	146
dBSeaPE	182	18	164
dBSeaModes	182	36	146
dbSeaRay	182	34	148

(d) Overall, these new calculations confirm that there will be no risk of PTS at 500m from the operation as all estimated VHF m-weighted noise levels from the six different propagation models tested are lower than the PTS standard. There is also no risk of TTS for five out of the six models tested as the estimated noise levels at 500 m are lower than the TTS threshold. In one model (i.e., dBSeaPE), the estimated noise level, 164 dB re 1μPa^2.s, is higher than the TTS threshold of 153 dB re 1μPa^2.s. Humpheson (2017) stated that in his opinion the dBSeaModes model algorithm was the most appropriate model for the STB region and the TTRL operation[9]. This model indicates no evidence of either PTS or TTS for VHF cetaceans;

[9] Paragraph 29 in Childerhouse Supplementary Evidence 1 May 2017.

(e) While one of the six propagation models suggested that TTS may be possible for VHF cetaceans, it is important to consider several of the other assumptions of the assessment including that the SEL TTS standard is applied over a 24-hour exposure period and assumes that an individual dolphin will be exposed to that level of noise for the full period. This is highly precautionary given that the crawler and IMV will only be moving at several knots and therefore any marine mammal could easily move away from the operation if they wish. Furthermore, the propagation models considered do not incorporate frequency specific attenuation which means that the high frequency components of the operational noise (to which VHF cetaceans are highly sensitive) are likely to be overestimated in how far they travel and underestimated in how much they attenuate.

89. Overall, the evidence indicates that there is no likelihood of PTS for any marine mammal at 500 m from the operation. Furthermore, there is no likelihood of TTS for any marine mammal at 500 m from the operation except for a small possibility of TTS for VHF cetaceans if they remain in the area for more than 24 hours. Notwithstanding these results at 500m from the operation, it is possible for TTS or PTS to potentially occur within 500m of the operation.

90. However, as I noted in my original evidence,[10] it is important to consider the real-world situation. For example, it is extremely unlikely that an animal could get within 1 m of the sound sources as the sound source is not a point discharge but is rather dispersed and distributed in space since the generators, winches, and suction are all dispersed over the

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[10] Paragraphs 53-55 in my Statement of Evidence 15 December 2016.

>300 m length of the ship and between the surface and the seabed. Furthermore, a marine mammal would have to swim towards the source of noise to reach a point close enough where they may be physiologically impacted by it and remain within that area for sufficient time. Therefore, while TTS and PTS are theoretically possible, I believe that they are highly unlikely given the length of time and close approach a marine mammal would need to make to potentially be affected, and therefore this represents a negligible risk.

91. There was also consideration of behavioural effects on marine mammals from underwater noise from the operation during the previous hearing. Humpheson (2017) developed a map of the STB region that showed modelled underwater SPLs which were used to assess impacts of noise on marine mammals.[11] While the 120 dB threshold associated with that map is no longer considered to be a useful threshold, the figure itself it still useful. During the previous hearing, I took the approach of applying the NOAA Fisheries in-water interim acoustic threshold of 120 dB_{RMS} re 1µPa and came to the conclusion that there was potential for behavioural disruption over a 10 km area around the mining site.[12] This interim threshold is no longer used by NOAA nor is considered to be international best practice.

92. Southall et al. (2021) state that recent data strongly suggests that efforts to derive simple all-or-nothing thresholds for single noise parameters and behavioural responses can lead to significant errors in predicting effects. They note that several new approaches are being developed to understand and manage behavioural impacts on a case-by-case basis. While these approaches are a significant step forward, they are very

[11] Appendix 4 in Childerhouse Supplementary Evidence 1 May 2017.

[12] Paragraph 38-41 in Childerhouse Supplementary Evidence 1 May 2017.

data intensive. I believe that it would be a challenge to develop such robust assessments for marine mammals from this operation given the limited data on marine mammals from the STB region. There are some approaches (e.g., dose-response studies, masking assessments) that may be useful for exploring behavioural effects if sufficient data was available but even then, I believe that it would include a high degree of uncertainty.

93. Therefore, based on the close similarity between the previous and new acoustic standards, applied source levels and the Humpheson (2017) modelling, which were used in my original assessment, I am confident that my previous assessment of potential acoustic impacts on marine mammals is still useful, informative, and represents the best available information.

94. In conclusion, I believe that, assuming the previous condition 11 is retained in the same or similar form as proposed, then the risk of TTS and PTS impacts from the operation are likely to be very low to negligible and, if they do occur, will only occur within the immediate vicinity (i.e., < 500 m) of the operation and only for individuals that spend significant amounts of time with that area. Given the highly mobile nature of marine mammals, I believe that this latter event is highly unlikely.

95. With respect to potential behavioural effects, it is has become more difficult to provide a definitive assessment as the previously used assessment standard is no longer considered appropriate and there is no new standard. I note that the combined noise level estimated to be generated by the crawler unit and IMV combined is 177 dB re 1μPa[13] and that this level is significantly lower (i.e., 90% quieter) than the average noise level of 187 dB re 1μPa for large vessels (i.e., 100-300 m in length) measured in New Zealand and overseas

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[13] Paragraph 25 & Appendix 3 of Childerhouse Supplementary Evidence 1 May 2017.

(Pine et al. 2016). This suggests that the potential behavioural effects from this operation will be significantly less than we would expect to see from a large vessel with the possible caveat that this operation is very slow moving compared with faster moving a large vessel.

96. Finally, noise impacts on marine mammals requires that there are marine mammals in the immediate area around the operation. While this is clearly possible given the importance of the wider STB area for marine mammals, there is nothing to suggest that the proposed consent area is of any significance to marine mammals and, in fact, the evidence suggests that the area has a low likelihood and low abundance of marine mammals being presence. This low level of marine mammal presence means that the likelihood of significant impacts on marine mammals are very low.

2017 DECISION

97. I broadly agree with the findings relating to marine mammals by the 2017 DMC as recorded in their Decision document.[14] I have highlighted some areas where I either do no agree with their decision or believe that some additional clarification is useful.

98. Paragraph 524 – the DMC note that 'We also agree that the marine mammal aerial survey data provided by TTRL should be treated with caution'. I agree that the aerial survey data was not useful for estimating abundance as that was not its intended purpose. However, it is useful for investigating distribution and presence of marine mammals. The survey was undertaken using methodology following international standards using experienced personnel. The survey included

[14] EPA (2017) Decision on marine consents and marine discharge consents application Trans-Tasman Resources Limited Extracting and processing iron sand within the South Taranaki Bight. Application Ref: EEZ000011. August 2017. 368 p.

dedicated aerial surveys for marine mammals inside and outside the mining area every 2-3 months for over two years covering over 8,400 km of transects. It only recorded one sightings of common dolphins and 4 sightings of New Zealand fur seals.

99. Some of the experts (and potentially the DMC) interpreted this lack of sightings as being indicative of a poor survey but the more plausible explanation is that it simply reflects an area with few marine mammals. It is hard to imagine how repeated dedicated surveys of the proposed consent area would have consistently missed blue whales, the largest animal ever to live, during two years of surveys. I agree that smaller more cryptic species could be missed but large whales are highly unlikely. That the DMC agreed that these data should be treated with caution is concerning as they represent the best data we have for the survey area.

100. Paragraph 542 – the DMC note that 'Much of the STB appears to be subject to shipping noise levels of 115 dB to 120 dB on a semi-regular basis. The sources of shipping noise include commercial fishing, as well as larger international transport vessels'. While I agree with that statement that the STB is regularly exposed to shipping noise on a regular basis, I believe that the DMC has mis-interpreted the actual noise levels from those vessels. Pine et al. (2016) measured individual vessel noise around New Zealand and reported that medium vessels (e.g., 20-85 m long) and large vessels (e.g., 98-290 m long) similar to those that transit the STB had mean underwater noise source levels of 174 and 187 dB re 1μPa respectively. These levels are significantly louder by many orders of magnitude (e.g., 60-70 dB which equates to approximately 10 million times louder) than the levels cited by the DMC. The source level generated by the crawler unit and IMV

combined is 177 dB re 1μPa.[15] This is important when considering what other noise marine mammals may be exposed to within the STB region and confirms that the proposed operation creates noise levels similar to medium sized vessels and considerably less than large vessels.

101. Paragraphs 543-549 – I agree with the decision of the DMC to use the 120 dB level as the appropriate level for assessing behaviour impacts on marine mammals based on the best available information at that time. However, as I noted previously in my paragraphs 90-91, the 120 dB level is no longer considered appropriate by NOAA and is not used as a standard. It has not been replaced with anything equivalent but rather a recommendation that a case by case and species by species approach should be undertaken. This requires extraordinary amounts of data which is not available in this case. I have been unable to find another simple proxy for the 120 dB level.

CONDITIONS

102. Appendix 2 to the 2017 Marine Consent Decision on TTR's application details the Marine Consent Conditions. Several of these conditions are relevant to marine mammals. Specifically:

(a) Condition 10 relating directly to marine mammals;

(b) Conditions 11-19 relating to underwater noise;

(c) Condition 36-37 relating to soft starts;

(d) Condition 47 relating to marine mammal monitoring in Admiralty Bay;

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15 Paragraph 25 & Appendix 3 of Childerhouse Supplementary Evidence 1 May 2017.

(e) Conditions 48 and 54 relating to marine mammal monitoring;

(f) Condition 67 relating to the Marine Mammal Management Plan;

(g) Condition 88 relating to requirements under the Marine Mammal Protection Act 1978; and

(h) Schedule 6 relating to monitoring of indicators including marine mammal monitoring and acoustic surveys.

103. I do not propose to review all these conditions in detail here but to highlight some of the Conditions which I believe are particularly important or require some additional comment.

Condition 10(a)

104. Condition 10(a) states that the consent holder shall ensure that there are no adverse effects at a population level on various specified marine mammal species. This is a very high-level condition and while I support the intent of the Condition, I appreciate the complexity of implementation. I believe that the intent of this Condition was likely to clearly distinguish between:

(a) *individual level impacts* – where there may be an impact on a single individual but that impact does not result in a significant impact at the population. An example might be where one individual is killed which is clearly a significant impact for that individual but if the population size is large, then the loss of one individual will have no significant impact; and

(b) *population level impacts* – generally where there are either (i) impacts on many individuals such that is causes a significant population level impact (e.g., a reduction in population growth rate) or (ii) impacts on only a small number of individuals from a population with a very small total population size that also causes a significant population level impact.

105. Obviously while both impacts are ideally avoided or mitigated, impacts are more biologically significant at the population than the individual level. I recall that there was discussion amongst the marine mammal experts about individual versus population level impacts which may have contributed to the development of this Condition in an attempt to clarify the commitment of the applicant to avoiding adverse effects at the population level.

106. While I was not involved in the development of this Condition, I support its positive intent. As I understand it, this intent is broadly consistent with requirements under legislation such as the Marine Mammals Protection Act 1978. As such, I believe that the Condition was developed to clearly articulate this positive intent into the consent but that it was highly unlikely that it was ever intended to be strictly operationalised. My reason for this is that monitoring and determining compliance with such a Condition would be extremely difficult as it would require robust, complex and very expensive monitoring to: (i) collect sufficient data to robustly define and characterise each marine mammal population; (ii) to robustly identify and quantify any population level changes; and (iii) to actually attribute any population level changes to a specific cause such as the consent activity. I believe it would be almost impossible to collect the data required to make this assessment however, it could be possible to collect some useful and robust data that could be used to investigate trends in variables such as distribution and density in the area immediately around the proposed consent area.

107. I note the concerns of the Supreme Court relating to this Condition. As I noted above, the Condition would be

extremely challenging to monitor and measure progress against in its present form and therefore, while the intent is positive, it may require either: (i) some refinement to make it more measurable and achievable which is likely to be challenging; (ii) to agree that the Condition actually reflects a positive intent by the applicant but that it cannot and should not be considered as a target that can be monitored; or (iii) be simply removed.

Condition 10

108. I note that the conditions states that 'For the purpose of this condition, any observer engaged by the Consent Holder shall be a qualified observer as defined in the 2013 Department of Conservation Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations (or any subsequent updated Code of Conduct)'. I suggest that it may be useful to review this requirement as while the intent is positive, I note that practically and operationally it has proven challenging to find and secure observers with these qualifications. It is possible to train observers to a different standard (e.g., as has been done for RMA consents for pile driving operations) that doesn't necessary relate to specific requirements for seismic surveys that may not be relevant to this operation.

Conditions 11 - 19

109. I have identified the risk of impacts from underwater noise as low to negligible assuming that Condition 11 is retained in the same or similar form as proposed. This is essential to the effective management of noise as it limits the source noise of the operation to a modest level through the implementation of a noise limit at both 500 m (e.g., Conditions 11(b), 11(c)) and at source (e.g., Condition 12). I strongly support these conditions and believe that with these Conditions in place,

underwater noise impacts of the operation will be avoided or mitigated.

110. I suggest that Condition 11 as written could be slightly updated to reflect more recent metrics for underwater sound such as using an approach such as m-weighted SEL thresholds rather than SPLs.[16] This would be more consistent with international best practice (e.g., Southall et al. 2019) and is likely to be more meaningful for assessing and avoiding potential effects to marine mammals. I believe that the threshold levels expressed in Condition 11 are still appropriate and that they only need to be expressed in a different metric with the allowed underwater noise level being essentially equivalent.

Condition 48 and 54

111. I strongly support the proposed minimum of two years of marine mammal and environmental monitoring prior to the commencement of any seabed extraction detailed in Condition 48 and also the ongoing monitoring described in Condition 54. The previous marine mammal survey data is now very dated and therefore it is essential that new baseline data is collected. I would recommend that both aerial surveys and acoustic monitoring are probably the most cost effective and robust monitoring methods for marine mammals in the area and should be included in the monitoring programmes. I also note is that these surveys are not intended to provide full and robust abundance estimates and distribution models for all species using the STB but rather to provide focused information about which marine mammals are found in the proposed consent area and immediate surrounds and how

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[16] Essentially Sound Pressure Levels (SPLs) measure instantaneous sound levels over 1 second whereas Sound Exposure Levels (SELs) measure total sound levels over time, commonly over 24-hour periods. This latter metric is the new standard for the assessment of acoustic impacts on marine mammals as described in Southall et al. (2019)

they are using it. This sets up meaningful baseline data sets to (i) describe marine mammals with in the area and (ii) to allow for meaningful comparisons with future and ongoing survey work to assess potential trends or changes.

Condition 67

112. Condition 67 details the development of a Marine Mammal Management Plan (MMMP). I note that it specifies setting out how the activity will comply with Condition 10 and identify indicators of adverse effects under Condition 10. Given my previous comments in my paragraphs 104-107 about Condition 10, and the challenges in both identifying and robustly monitoring population level impacts, there may also need to be come refinement and reconsideration of these details.

113. Overall, I believe that the Conditions as described, including my suggested refinements in this evidence, are comprehensive and will avoid or mitigate significant impacts from the activity on the local marine mammal populations. I also believe that the Conditions favour caution and environmental protection.

CONCLUSION

114. With the utmost respect to the decision of the Supreme Court, my personal view is that there was sufficient information relating to marine mammals and the potential impacts upon them provided in the 2017 case for the DMC to make an informed decision about the consent. While I acknowledge that there were some information gaps and uncertainties in the information provided, I believe that most of these gaps would be impossible to fill given their complexity and the significant difficulties in actually collecting the required data (e.g., robust abundance estimates and distribution maps for all marine mammals in the region). In addition, I believe that

where there was uncertainty in the available data, it could be and was addressed through a comprehensive and pre-cautionary set of consent conditions ensuring that if the consent did proceed, there would be no material harm on marine mammals.

115. It is my understanding that much of the Supreme Court's concerns stemmed from the imposition of conditions requiring that there were "no adverse effects at a population level". I am supportive of the sentiment of this condition but believe that the condition as written would be challenging to monitor and enforce. I believe that this condition could be amended for clarity or potentially even removed without affecting the performance of the conditions for ensuring there is no material harm on marine mammals.

SIMON JOHN CHILDERHOUSE

19 May 2023

REFERENCES

Please see Appendix 1 for a full list of references reviewed in developing this evidence and cited in the text.

APPENDIX 1- SUMMARY OF KEY NEW PUBLICATIONS AND REPORTS ON MARINE MAMMALS WITHIN THE SOUTH TARANAKI BIGHT REGION

Abraham ER et al. (2021) Estimated Captures of New Zealand Fur Seal, Common Dolphin, and Turtles in New Zealand Commercial Fisheries, to 2017-18. Ministry for Primary Industries.

Baker CS, Boren L, Childerhouse S, Constantine R, van Helden A, Lundquist D, Rayment W, Rolfe JR (2019) Conservation status of New Zealand marine mammals. New Zealand Threat Classification Series 29, Department of Conservation, Wellington, New Zealand, 18p.

Baker CS, Chilvers BL, Childerhouse S, Constantine R, Currey R, Mattlin R, van Helden A, Hitchmough R, Rolfe J (2016) Conservation status of New Zealand marine mammals, 2013. New Zealand Threat Classification Series 14. Department of Conservation, Wellington, New Zealand. 18 p.

Barlow DR, Torres LG (2021) Planning Ahead: Dynamic Models Forecast Blue Whale Distribution with Applications for Spatial Management. The Journal of Applied Ecology 58(11): 2493–504. https://doi.org/10.1111/1365-2664.13992.

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APPENDIX 2 - ASSESSMENT OF MARINE MAMMAL SIGHTING AND STRANDING DATA FOR THE SOUTH TARANAKI BIGHT REGION FROM THE DOC MARINE MAMMAL DATABASE TO APRIL 2023

Table A2-1 Number of marine mammal sightings and incidents in the Taranaki region of interest up to November 2016 (all records until 14 November 2016) and since November 2016 (from 15 November 2016 to 27 April 2023). When the species identification was unknown but the record confirmed what group the animal(s) were, this was counted under the species groupings in italics. Data source: DOC marine mammal sighting and incident database (downloaded on 30 April 2023); Additional blue whale sightings provided by Dr. L. Torres in 2017).

Species	**# sightings**		**# incidents**		**Total**		
	≤ Nov 2016	**> Nov 2016**	**≤ Nov 2016**	**> Nov 2016**	**≤ Nov 2016**	**> Nov 2016**	**All**
Andrews' beaked whale	0	0	3	0	3	0	3
Antarctic minke whale	0	0	6	0	6	0	6
Arnoux's beaked whale	2	1	17	2	19	3	22
Baleen whale	46	1	10	4	56	5	61
Beaked whale	2	2	10	1	12	3	15
Blainville's beaked whale	0	0	3	0	3	0	3
Blue whale	140	11	7	0	147	11	158
Bottlenose dolphin	32	4	26	0	58	4	62
Bryde's whale	3	1	1	1	4	2	6
Common dolphin	232	39	109	26	341	65	406
Crabeater seal	0	0	1	2	1	2	3
Cuvier's beaked whale	1	0	33	2	34	2	36
Dolphin	23	1	0	0	23	1	24
Dusky dolphin	37	10	66	14	103	24	127
False killer whale	2	1	4	1	6	2	8
Fin whale	3	0	6	0	9	0	9
Gray's beaked whale	0	0	51	4	51	4	55
Hector's and Maui dolphins	242	400	38	6	280	406	686
Hector's beaked whale	0	0	3	0	3	0	3
Humpback whale	137	16	12	0	149	16	165
Leopard seal	19	10	0	2	19	12	31
Long-finned pilot whale	8	3	95	6	103	9	112
Minke whale	2	0	17	2	19	2	21
New Zealand fur seal	2	1	5	7	7	8	15
Orca	185	45	9	2	194	47	241

Species	# sightings		# incidents		Total		
	≤ Nov 2016	> Nov 2016	≤ Nov 2016	> Nov 2016	≤ Nov 2016	> Nov 2016	All
Pantropical spotted dolphin	0	0	1	0	1	0	1
Pilot whale	31	0	7	2	38	2	40
Pinniped	2	0	0	0	2	0	2
Pygmy blue whale	1	0	3	3	4	3	7
Pygmy right whale	0	0	22	0	22	0	22
Pygmy sperm whale	0	0	46	9	46	9	55
Risso's dolphin	3	0	4	1	7	1	8
Ross seal	1	0	0	0	1	0	1
Rough-toothed dolphin	0	0	0	1	0	0	1
Sei whale	7	0	4	4	11	4	15
Shepherd's beaked whale	0	0	7	1	7	1	8
Short-finned pilot whale	0	0	1	0	1	0	1
Southern bottlenose whale	0	0	2	0	2	0	2
Southern right whale	103	10	2	0	105	10	115
Southern right whale dolphin	0	0	8	0	8	0	8
Spectacled porpoise	0	0	1	0	1	0	1
Sperm whale	15	6	43	5	58	11	69
Strap-toothed whale	0	0	25	1	25	1	26
Striped dolphin	0	0	3	0	3	0	3
Subantarctic fur seal	2	1	1	0	3	1	4
Toothed whale	1	0	0	0	1	0	1
TOTAL	1284	563	712	109	1996	671	2668

Table A2-2. Number of marine mammal sightings in the area of the proposed consent area, and in the 5 km and 10 km buffers around it, up to November 2016 (all records until 14 November 2016) and since November 2016 (from 15 November 2016 to 27 April 2023). Data source: DOC marine mammal sighting and incident database (downloaded on 30 April 2023); Additional blue whale sightings provided by Dr. L. Torres in 2017).

Species	**In the proposed consent area**		**In 5 km buffer**		**In 10 km buffer**	
	≤ Nov 2016	> Nov 2016	≤ Nov 2016	> Nov 2016	≤ Nov 2016	> Nov 2016
Blue whale	0	0	0	0	0	1
Minke whale	0	0	1	0	0	0
Common dolphin	0	1	3	1	4	0
Hector's and Maui dolphins	0	0	0	0	1	0
Orca	0	0	1	0	0	0
TOTAL	0	1	5	1	5	1

Figure A2-1. Locations of marine mammal sightings and incidents in the Taranaki region of interest up to November 2016 (all records until 14 November 2016) and since November 2016 (from 15 November 2016 to 27 April 2023). When the species was unknown but the record confirmed what group the animal(s) were, this was counted under the species groupings in italics. Data source: DOC marine mammal sighting and incident database (downloaded on 30 April 2023); Additional blue whale sightings provided by Dr. L. Torres in 2017).

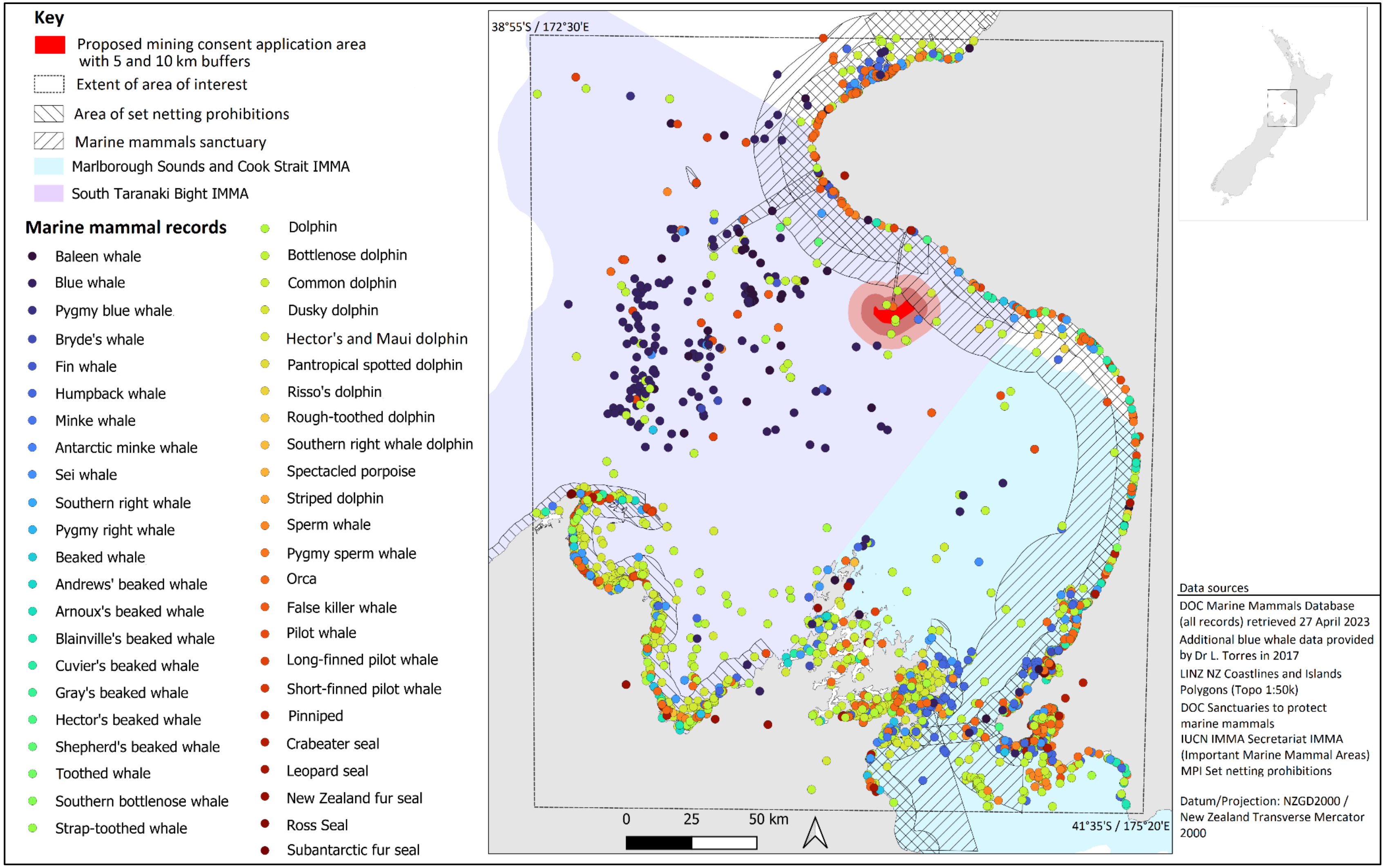


Figure A2-2. Comparison of locations of all sightings and incidents of marine mammals by date, with left: all records until 14 November 2016 and right: all records from 15 November 2016. See Figure 1 for the key of names of marine mammal species associated with each colour. The proposed consent area is in bright red with 5 km and 10 km buffer around it in shades of red. Data source: DOC marine mammal sighting and incident database (downloaded on 30 April 2023); Additional blue whale sightings provided by Dr. L. Torres in 2017).

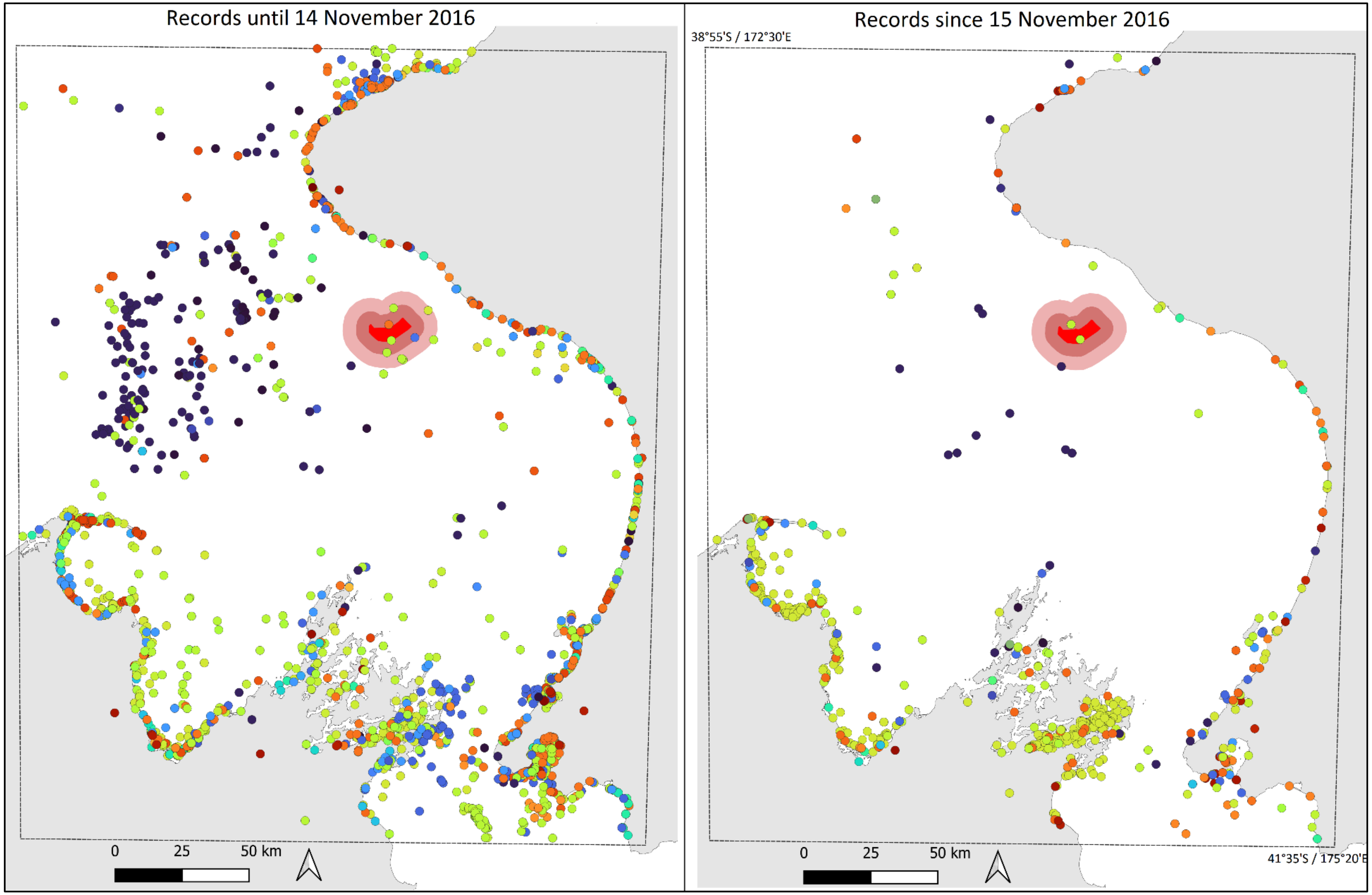
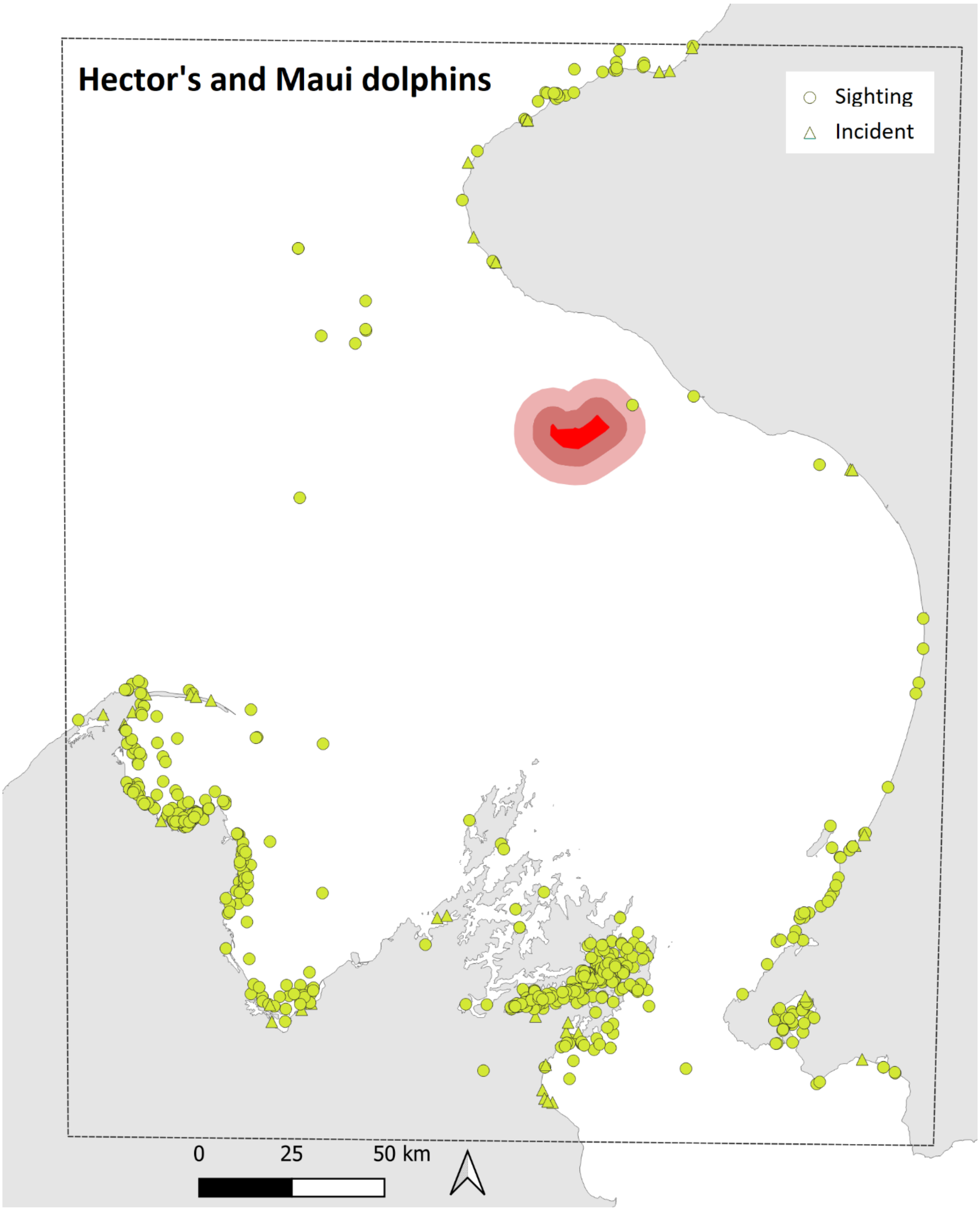
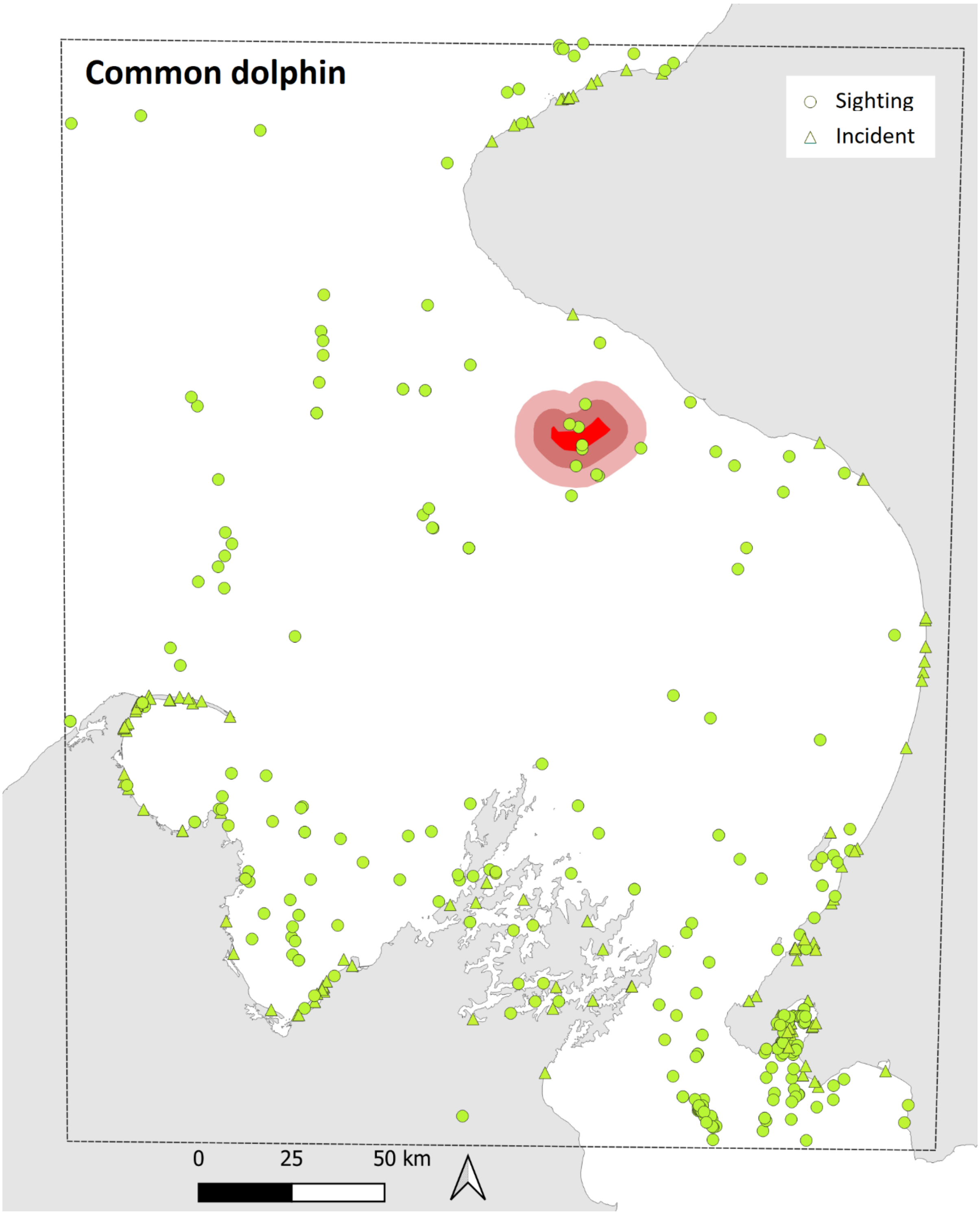
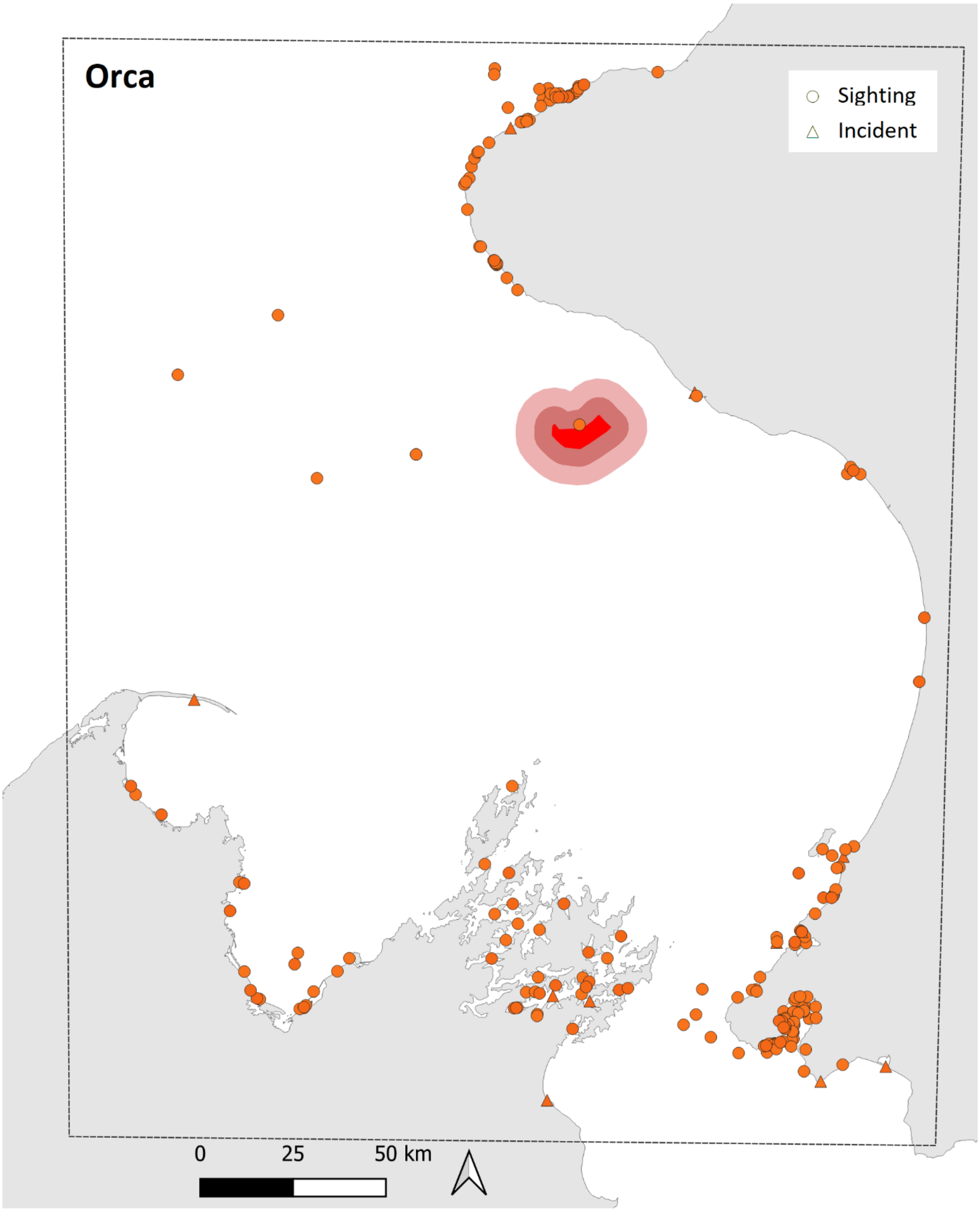
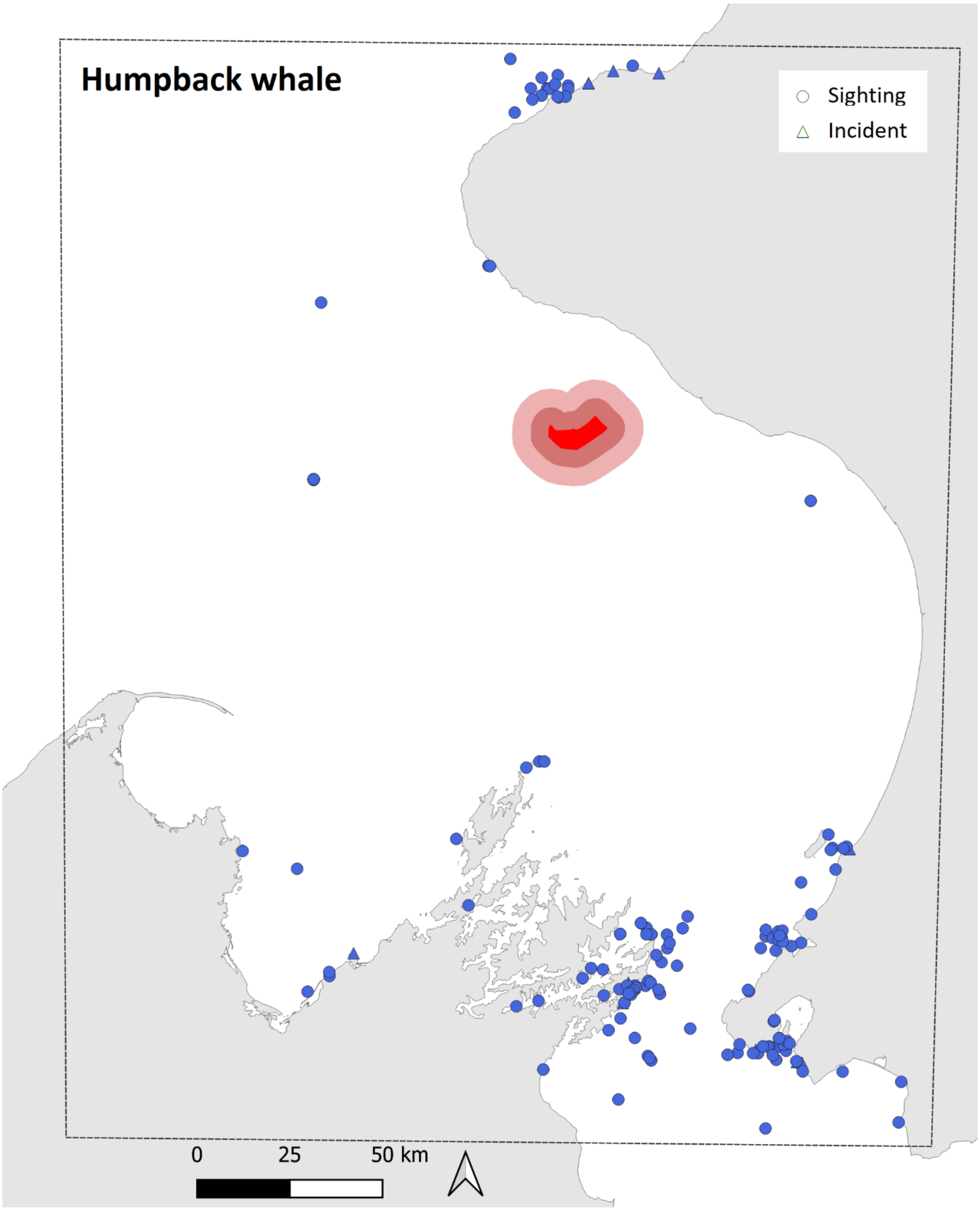


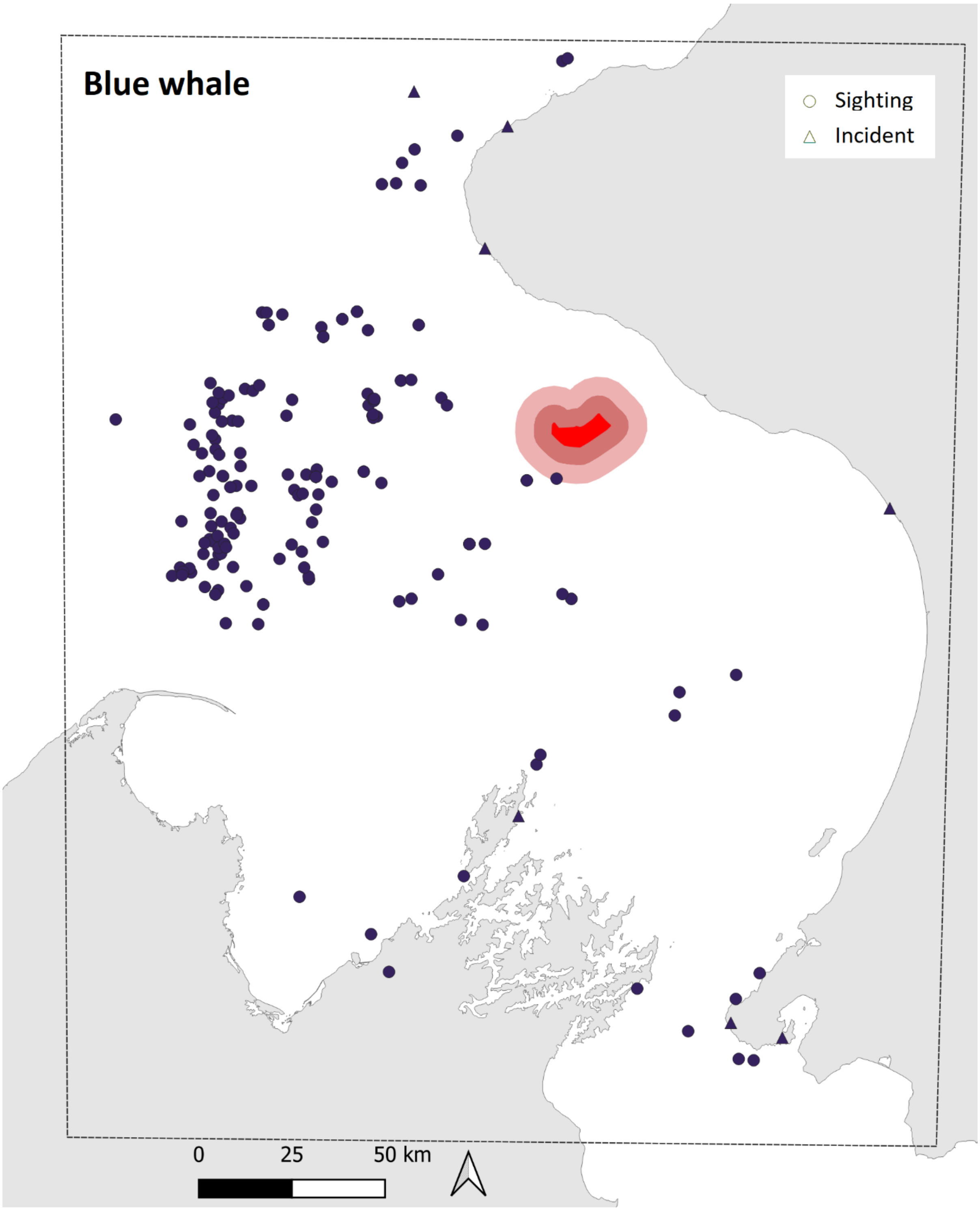
Figure A2-3. Locations of all sightings and incidents presented by species, for the 20 species that had the most records (sorted by descending order of number of records): Hector's and Maui dolphin, common dolphin, orca, humpback whale, blue whale, dusky dolphin, southern right whale, long-finned pilot whale, sperm whale, bottlenose dolphin, pygmy sperm whale, Gray's beaked whale, Cuvier's beaked whale, leopard seal, strap-toothed whale, Arnoux's beaked whale, pygmy right whale, minke whale, Sei whale and NZ fur seal.

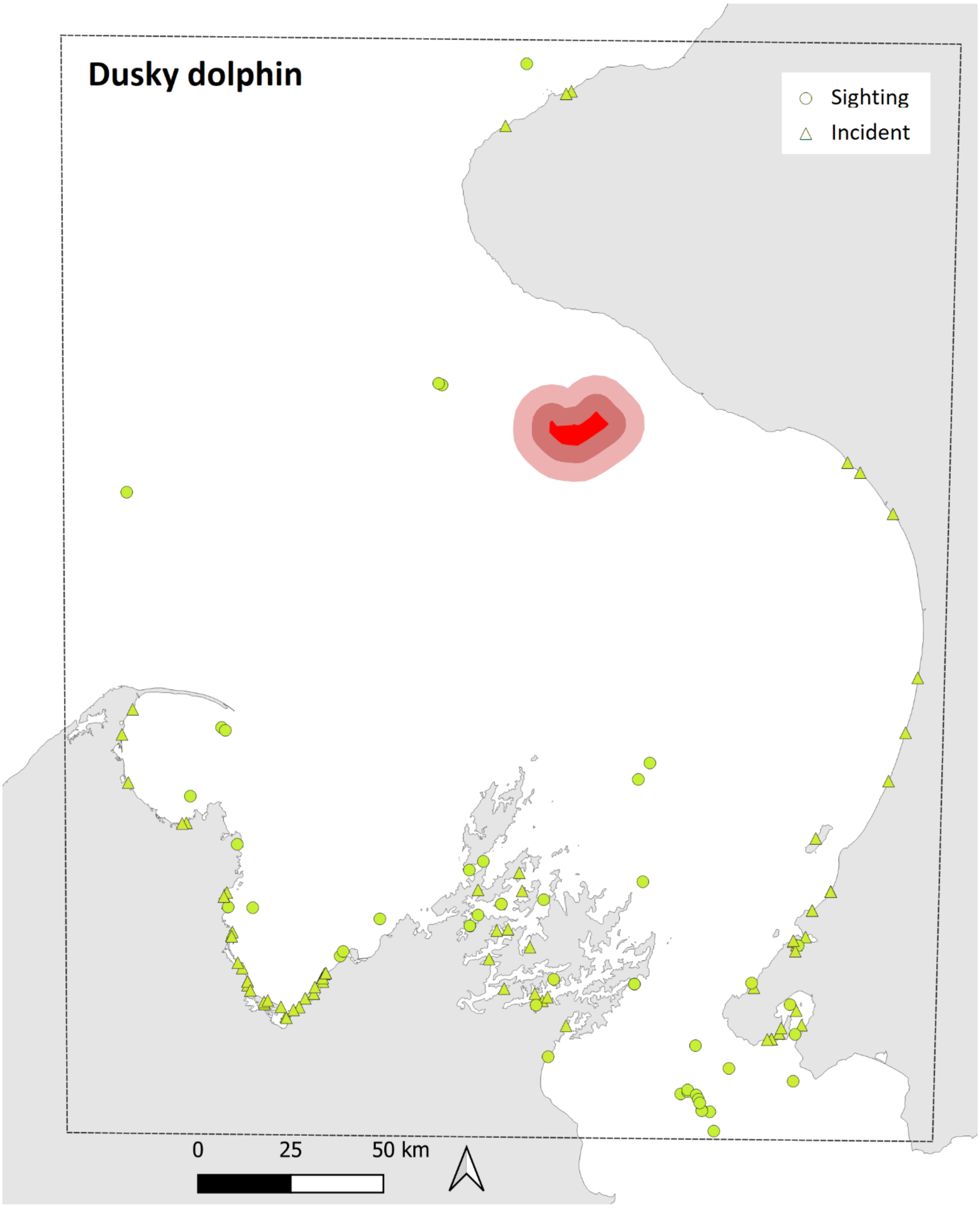


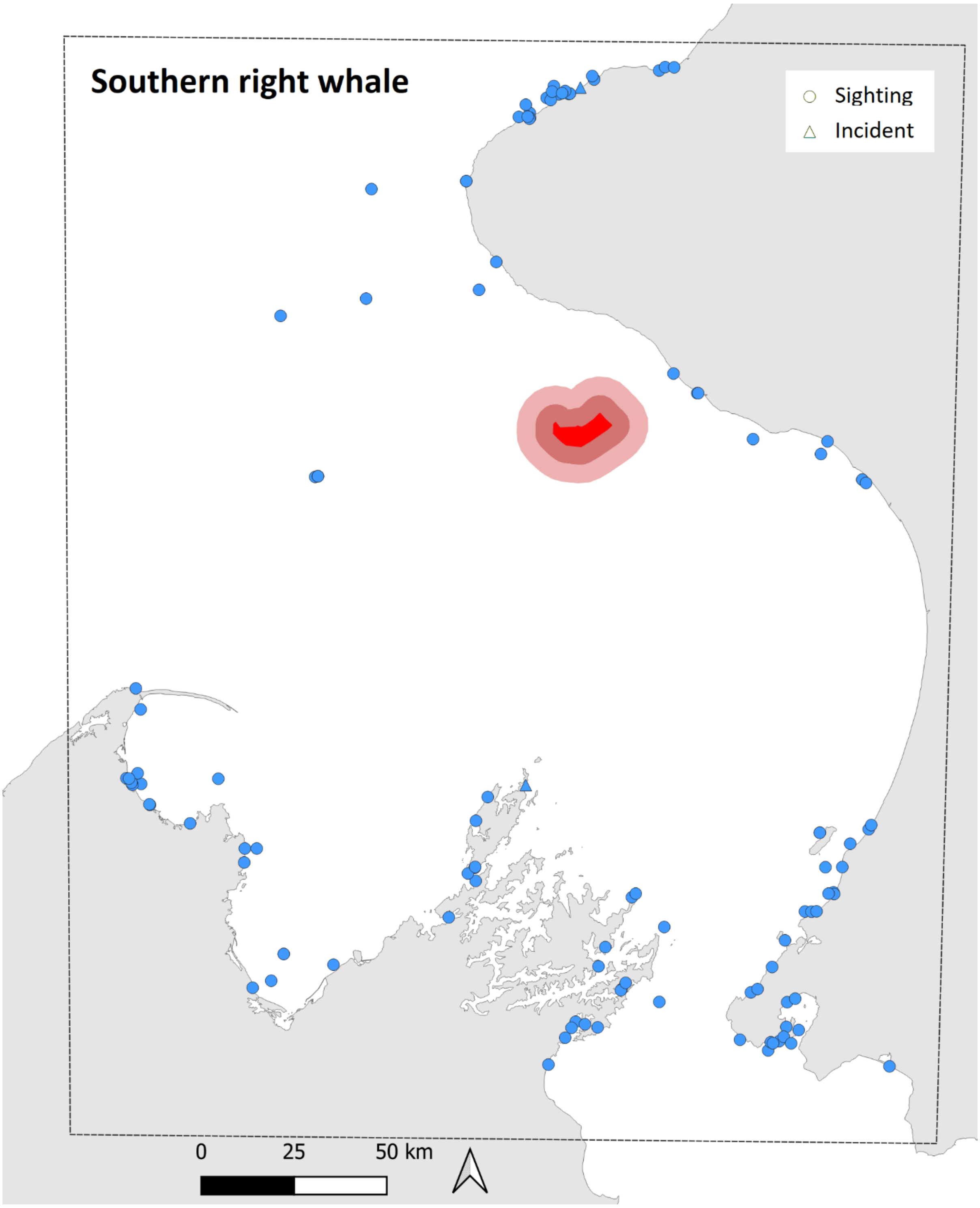

Common dolphin
Sighting
Incident
0
25
50 km

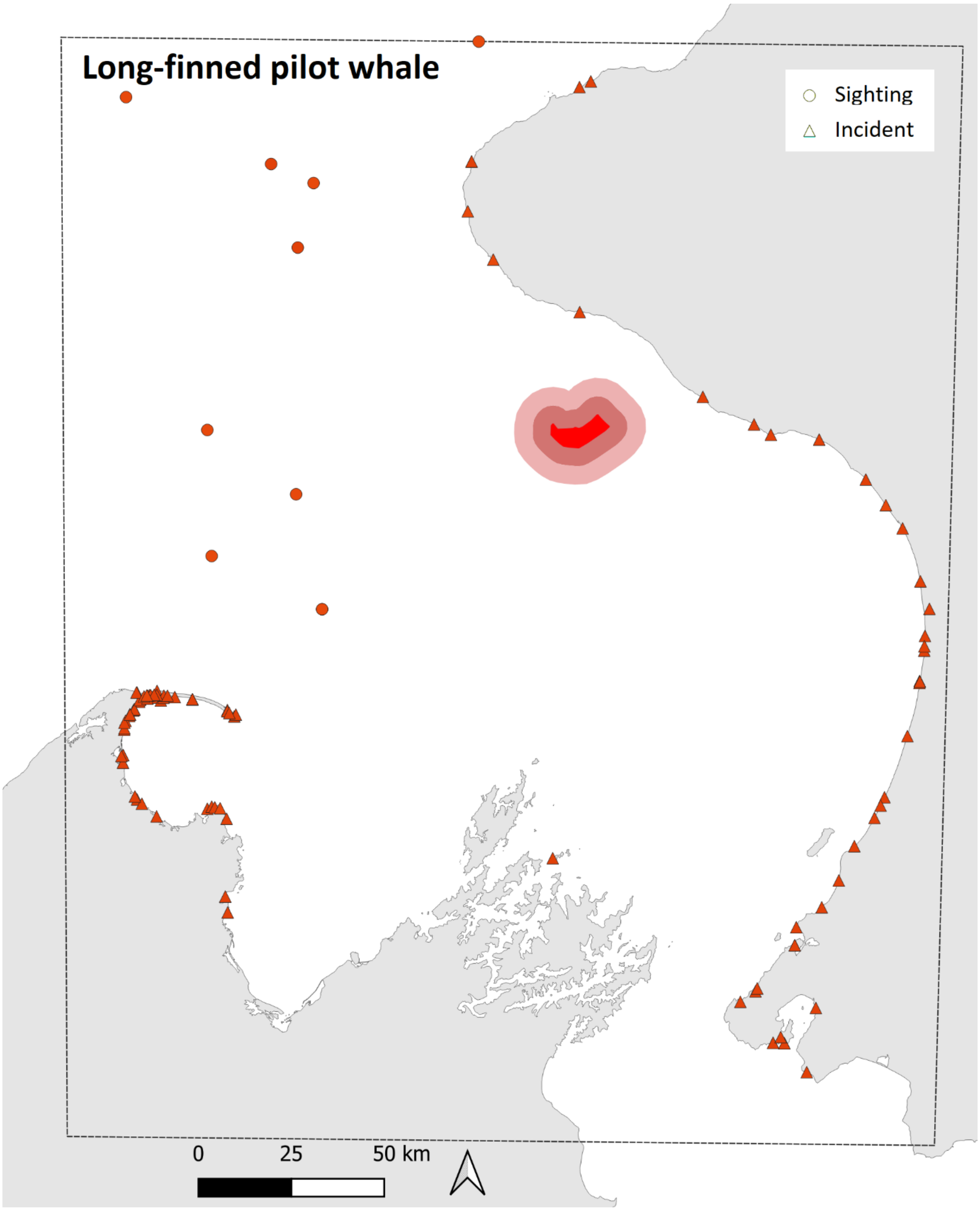

Orca
Sighting
Incident
0
25
50 km

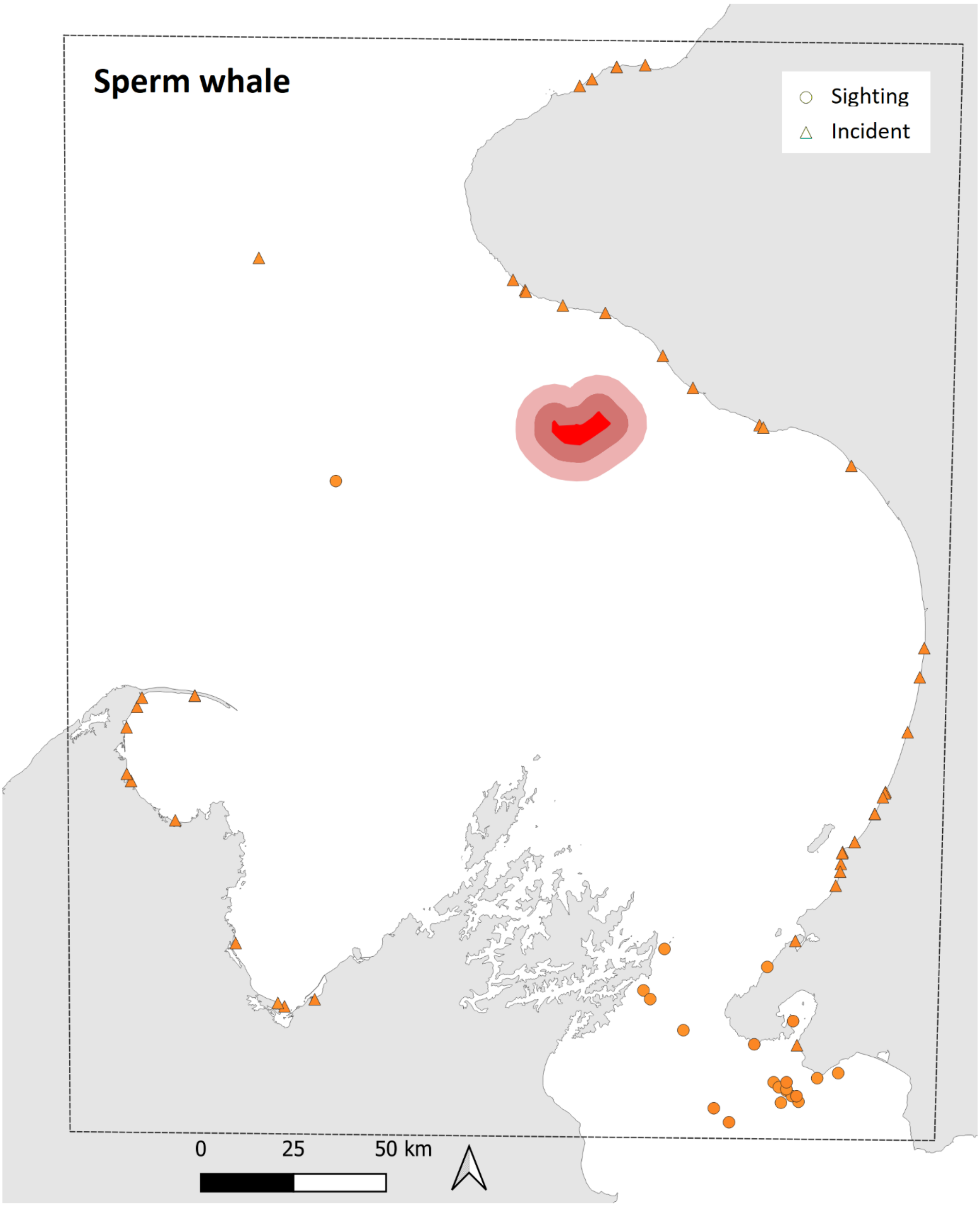

Humpback whale
Sighting
Incident
0
25
50 km

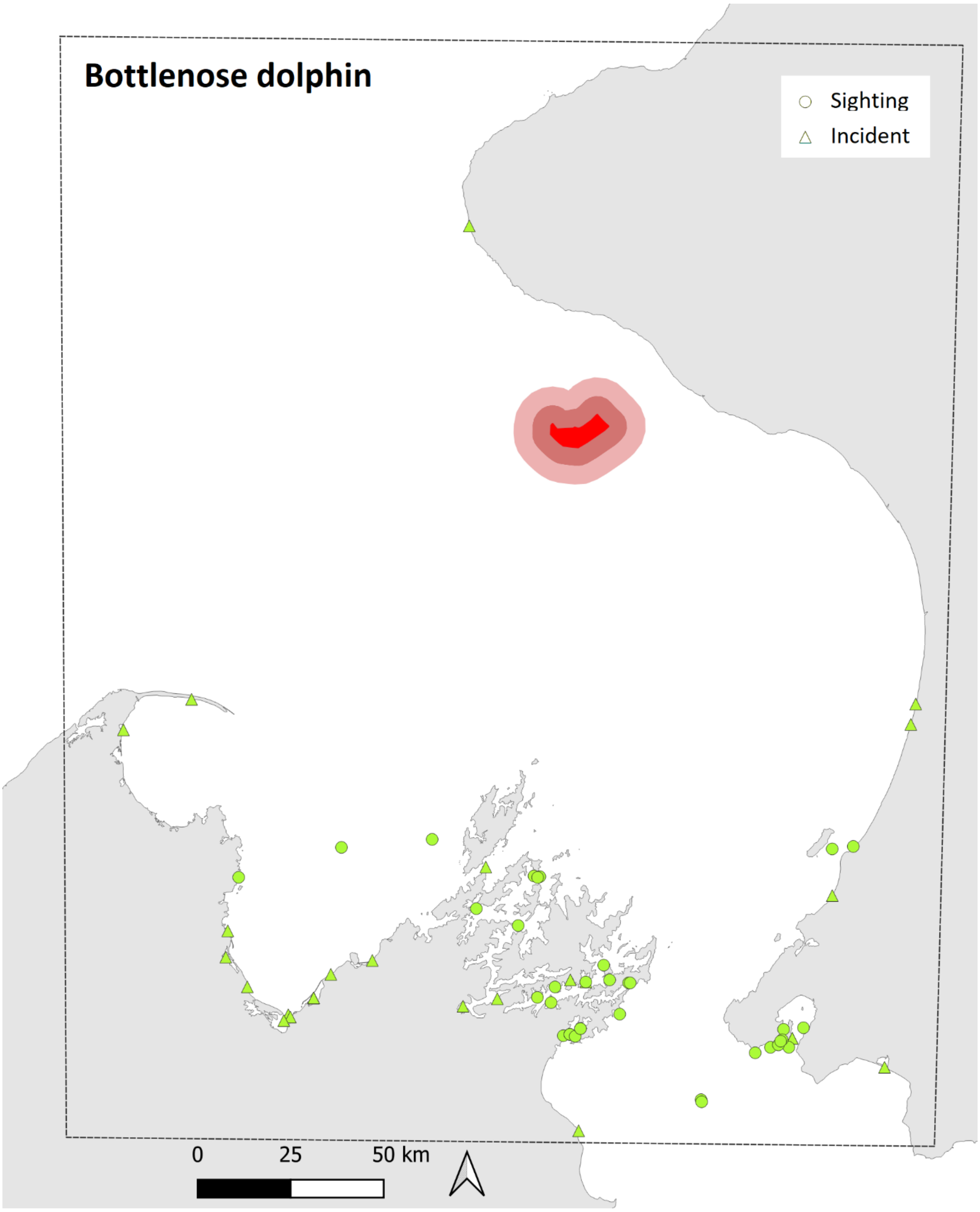

Blue whale
Sighting
Incident
0
25
50 km


Dusky dolphin
Sighting
Incident
0
25
50 km

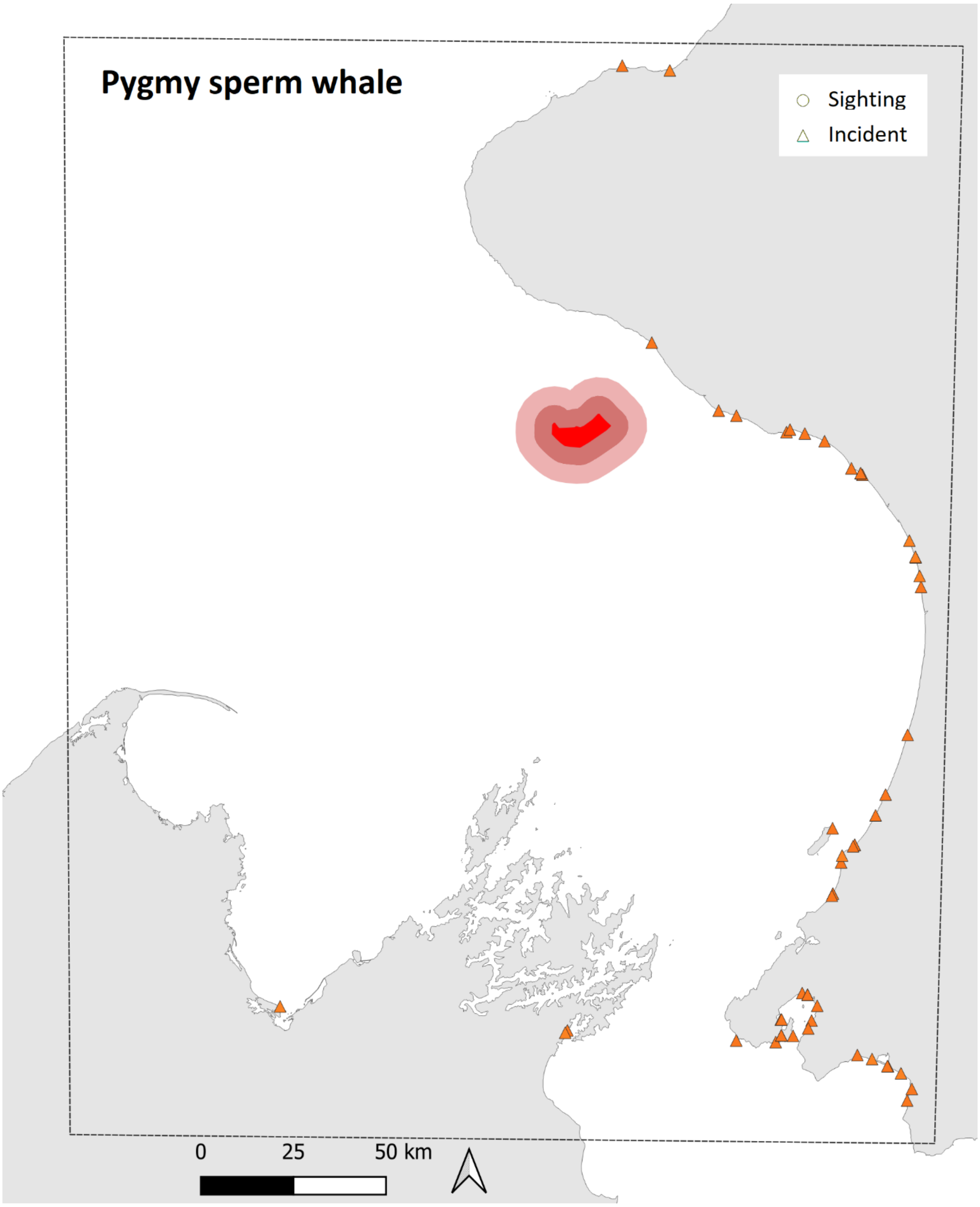

Southern right whale
Sighting
Incident
0
25
50 km

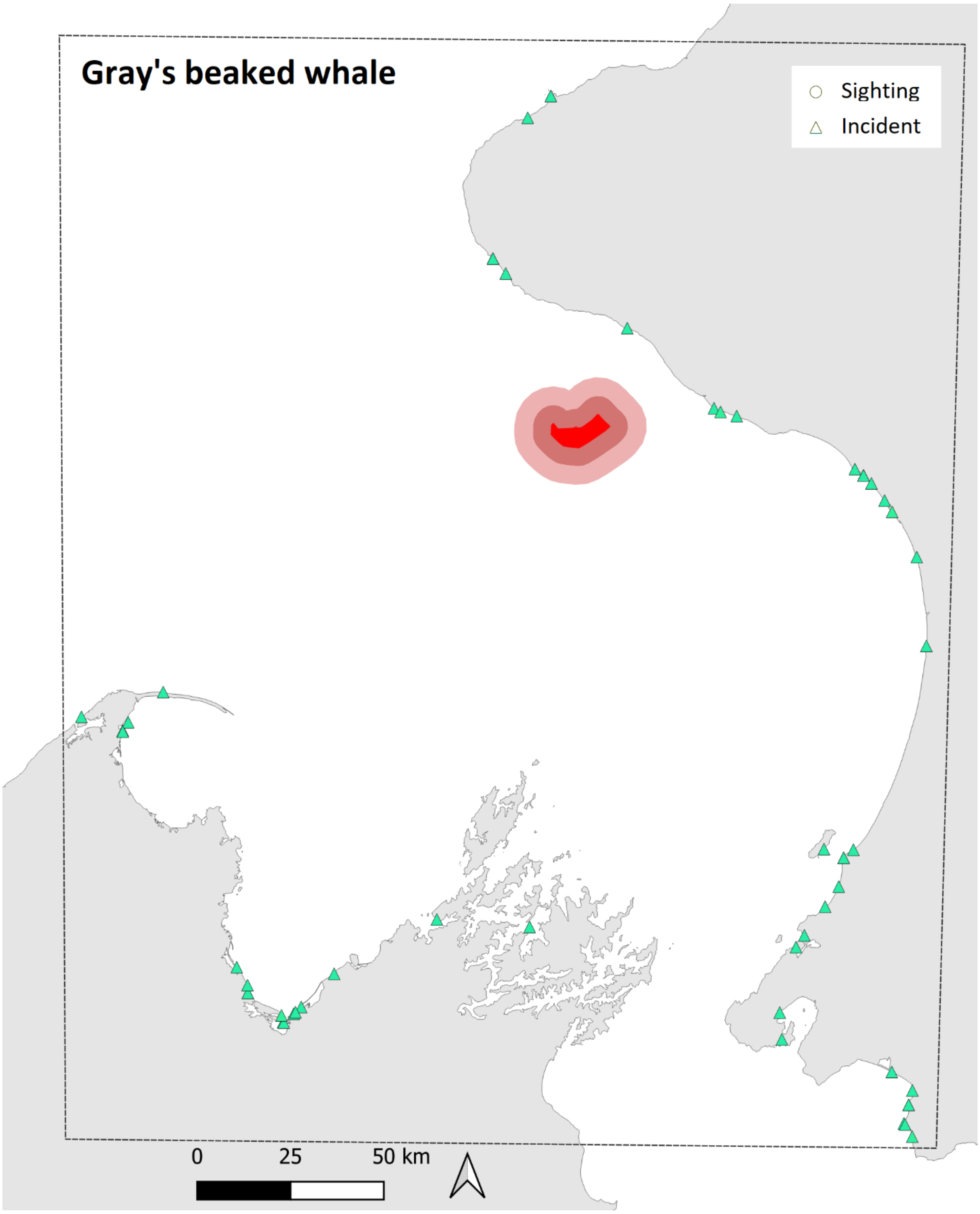

Long-finned pilot whale
Sighting
Incident
0
25
50 km

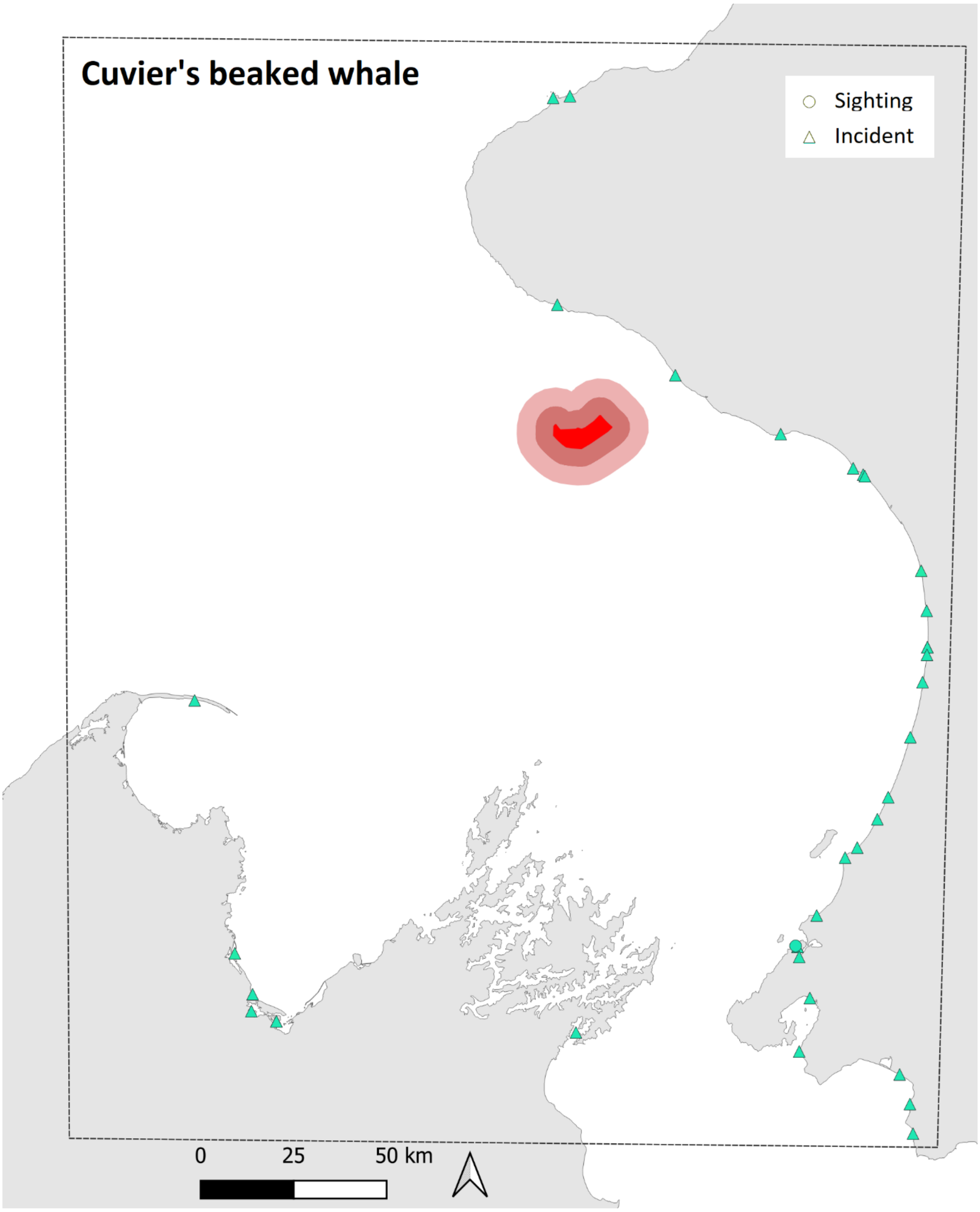

Sperm whale
Sighting
Incident
0
25
50 km

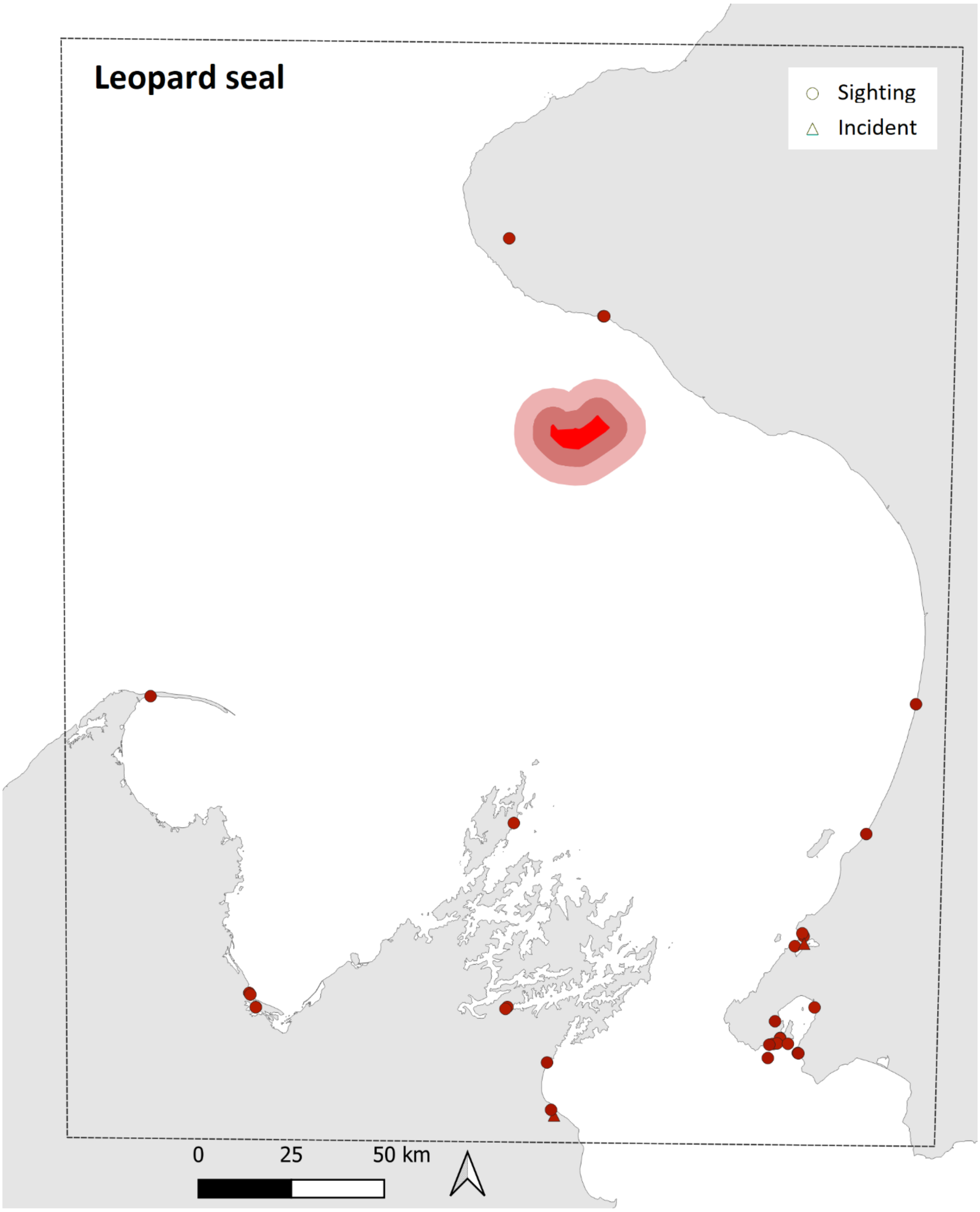


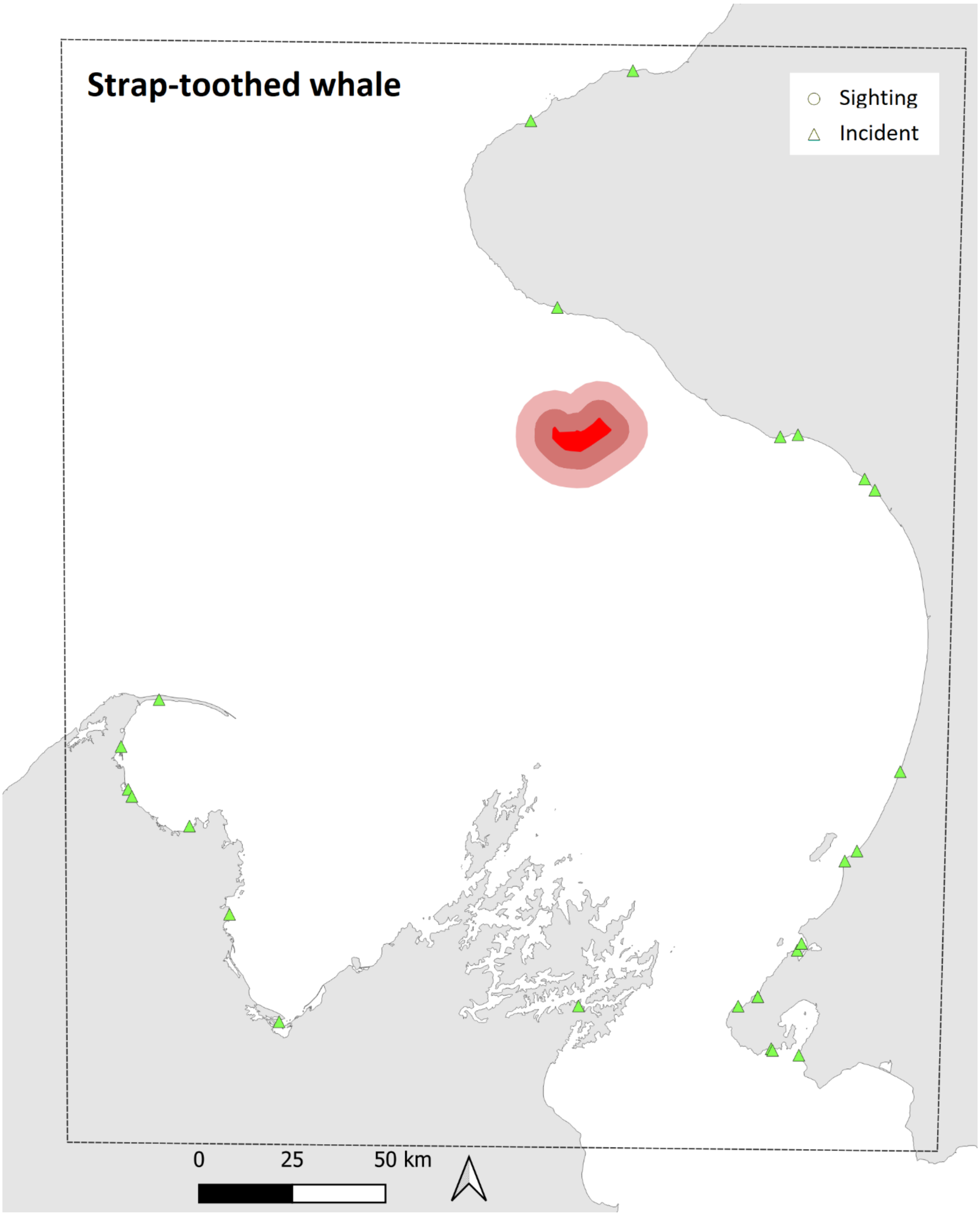
Bottlenose dolphin
Sighting
Incident
0
25
50 km

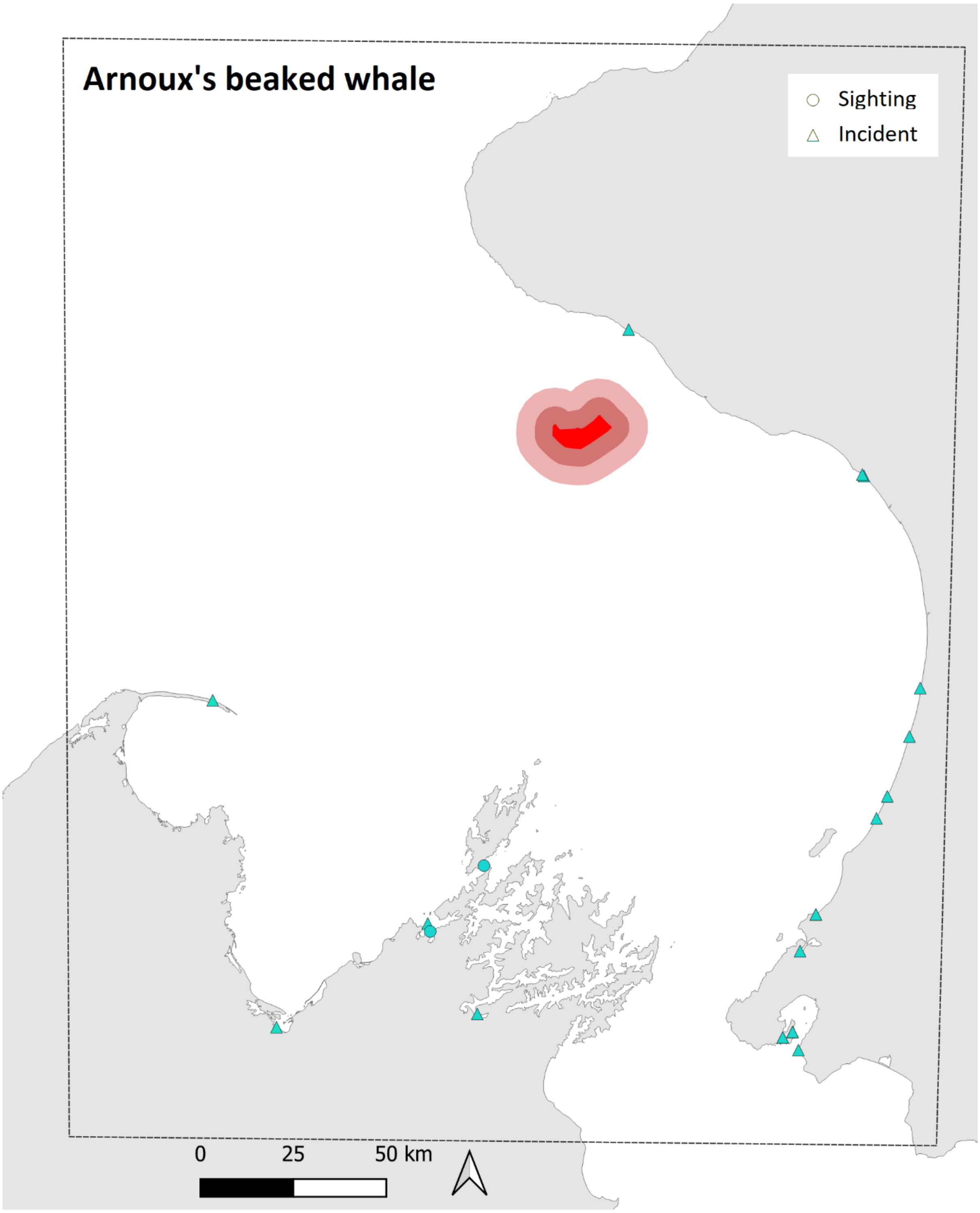

Pygmy sperm whale
Sighting
Incident
0
25
50 km


Gray's beaked whale
Sighting
Incident
0
25
50 km

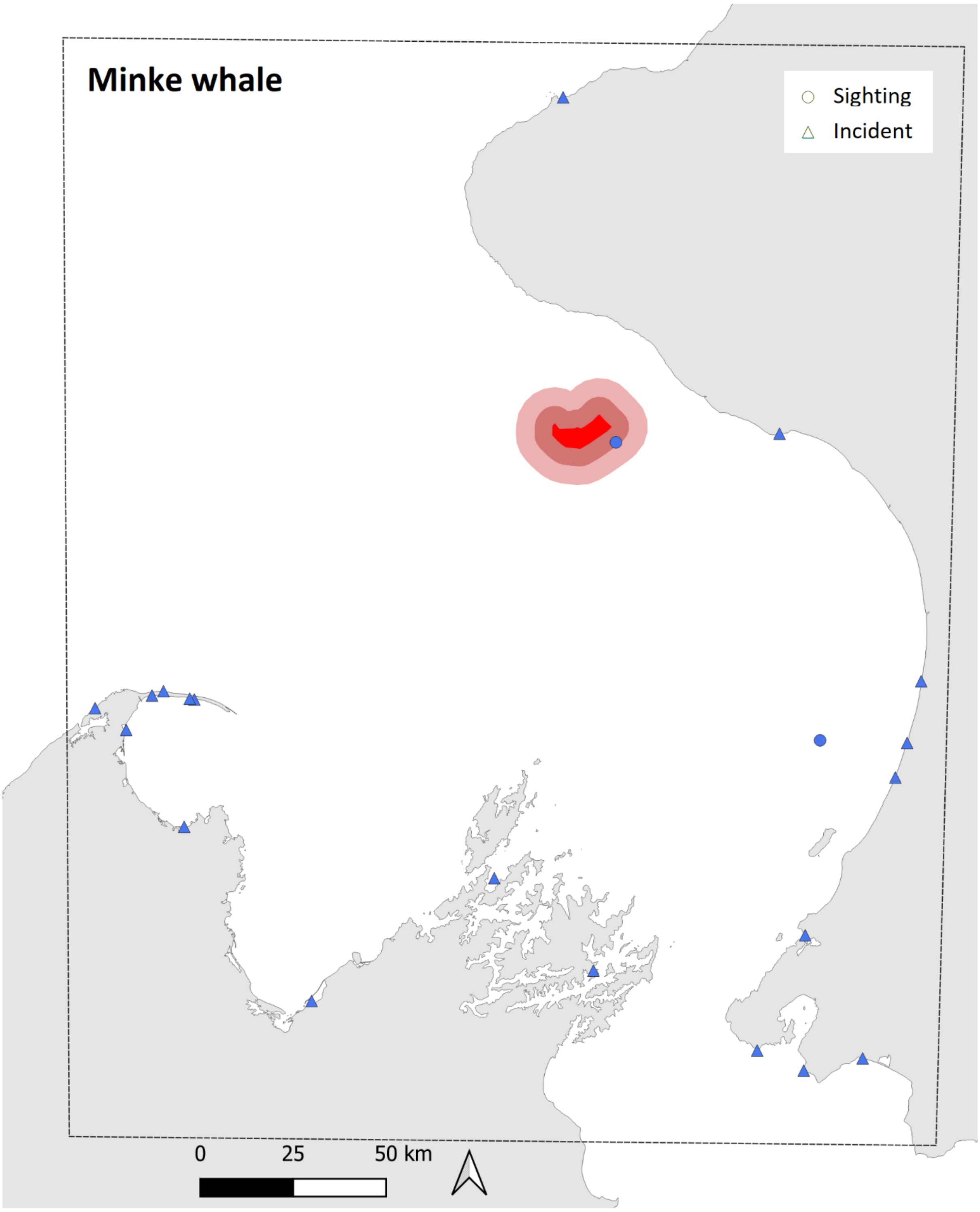

Cuvier's beaked whale
Sighting
Incident
0
25
50 km

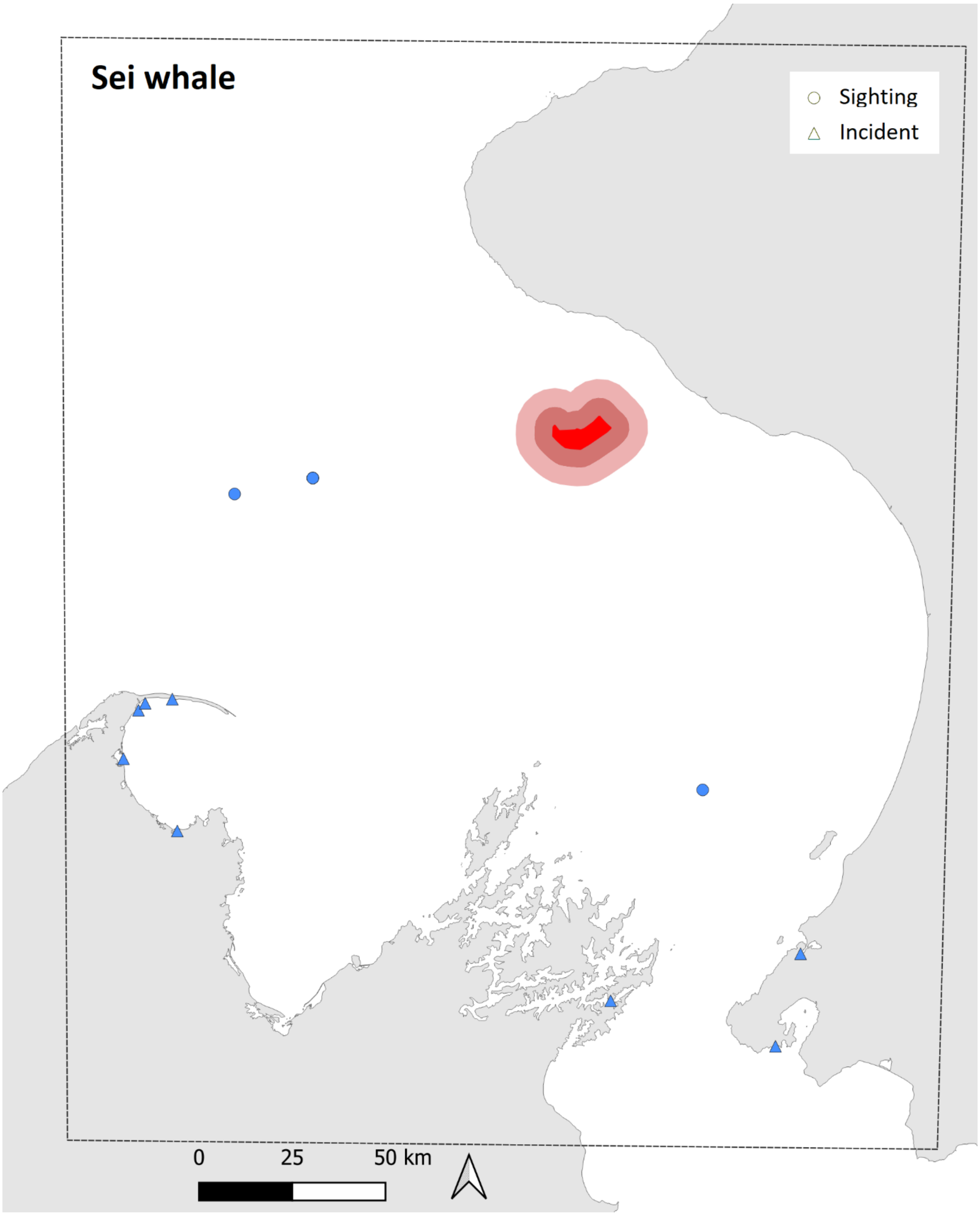

Leopard seal
Sighting
Incident
0
25
50 km

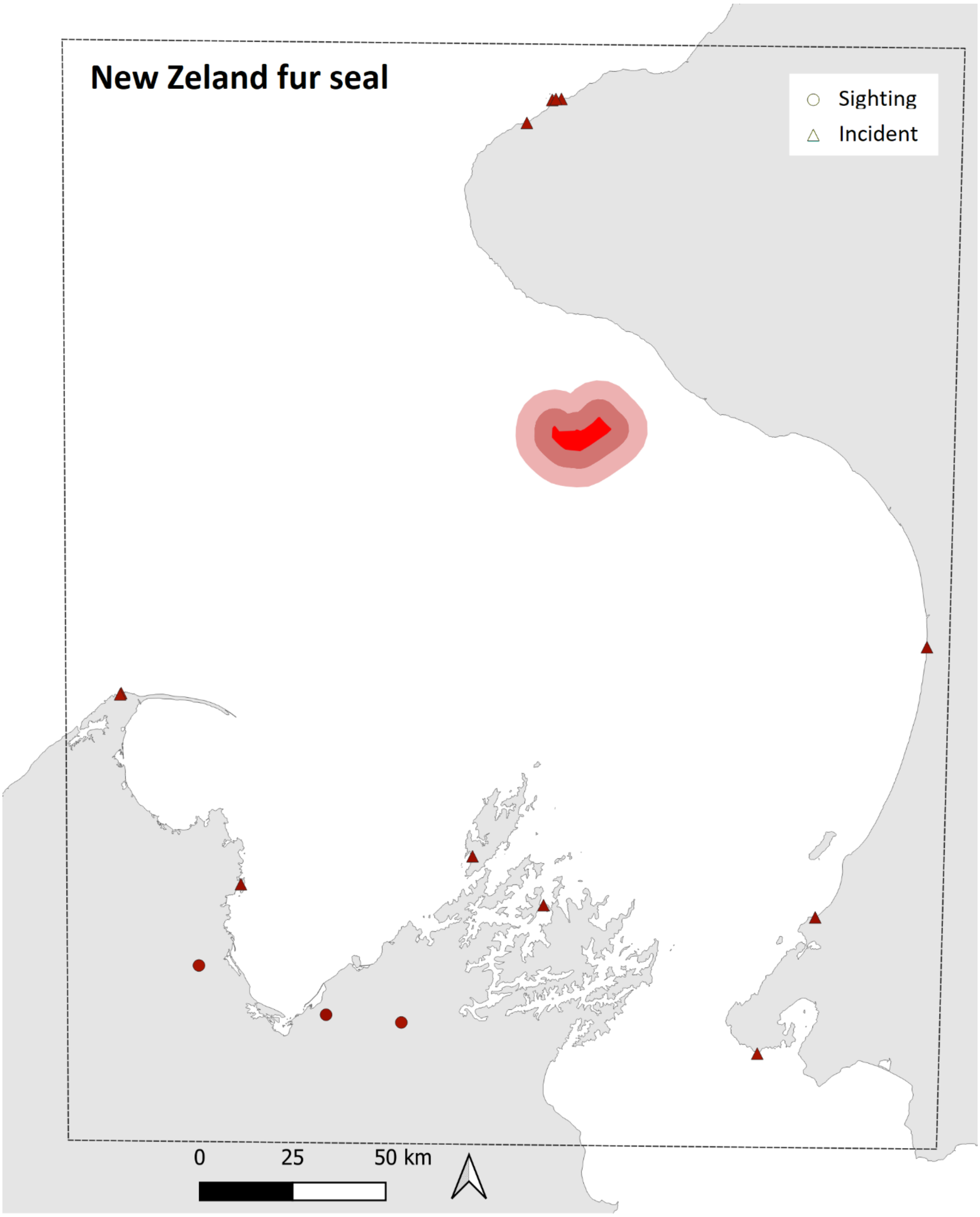

Strap-toothed whale
Sighting
Incident
0
25
50 km


Arnoux's beaked whale
Sighting
Incident
0
25
50 km


Pygmy right whale
Sighting
Incident
0
25
50 km


Minke whale
Sighting
Incident
0
25
50 km

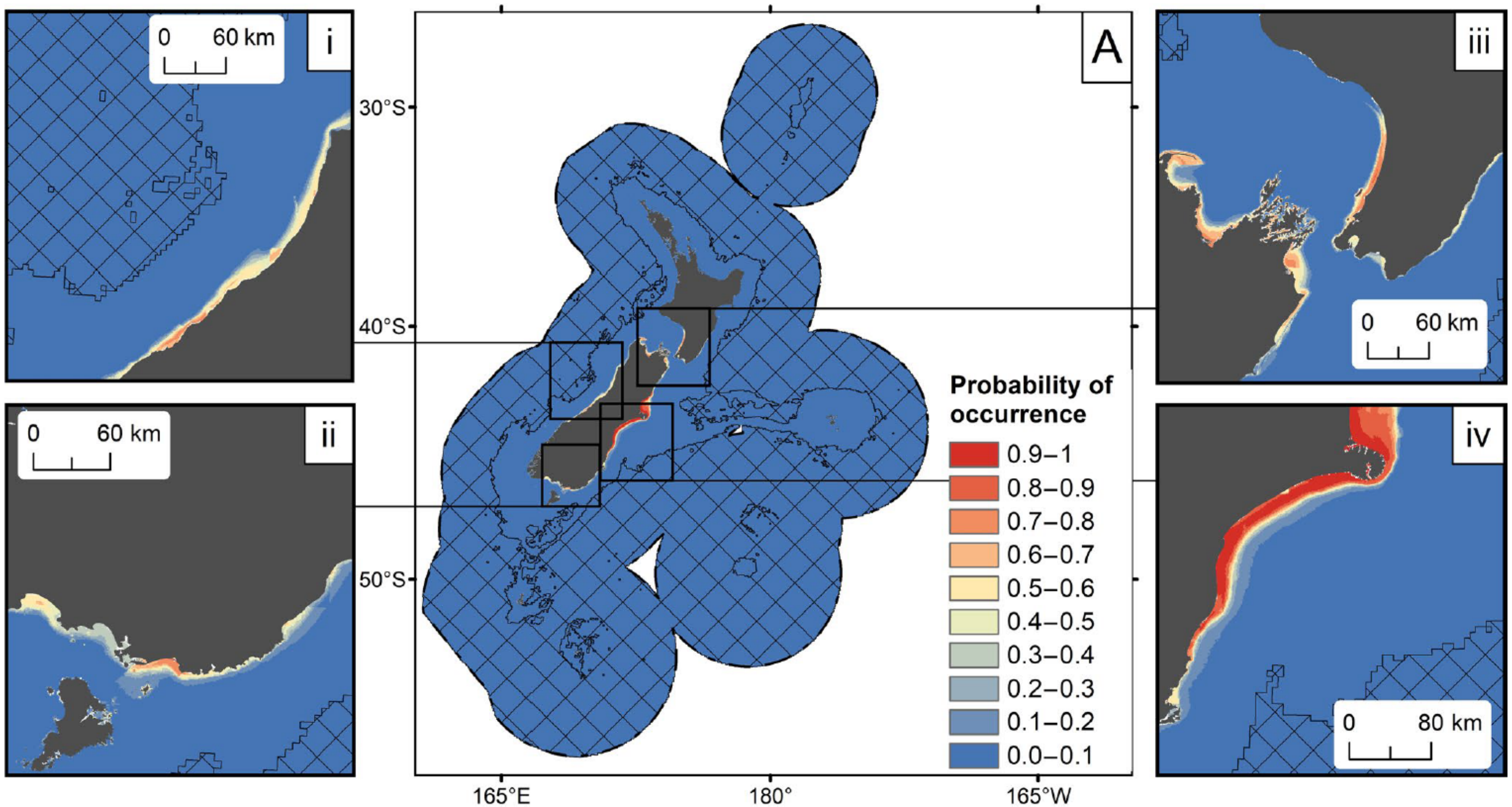

Sei whale
Sighting
Incident
0
25
50 km


New Zeland fur seal
Sighting
Incident
0
25
50 km

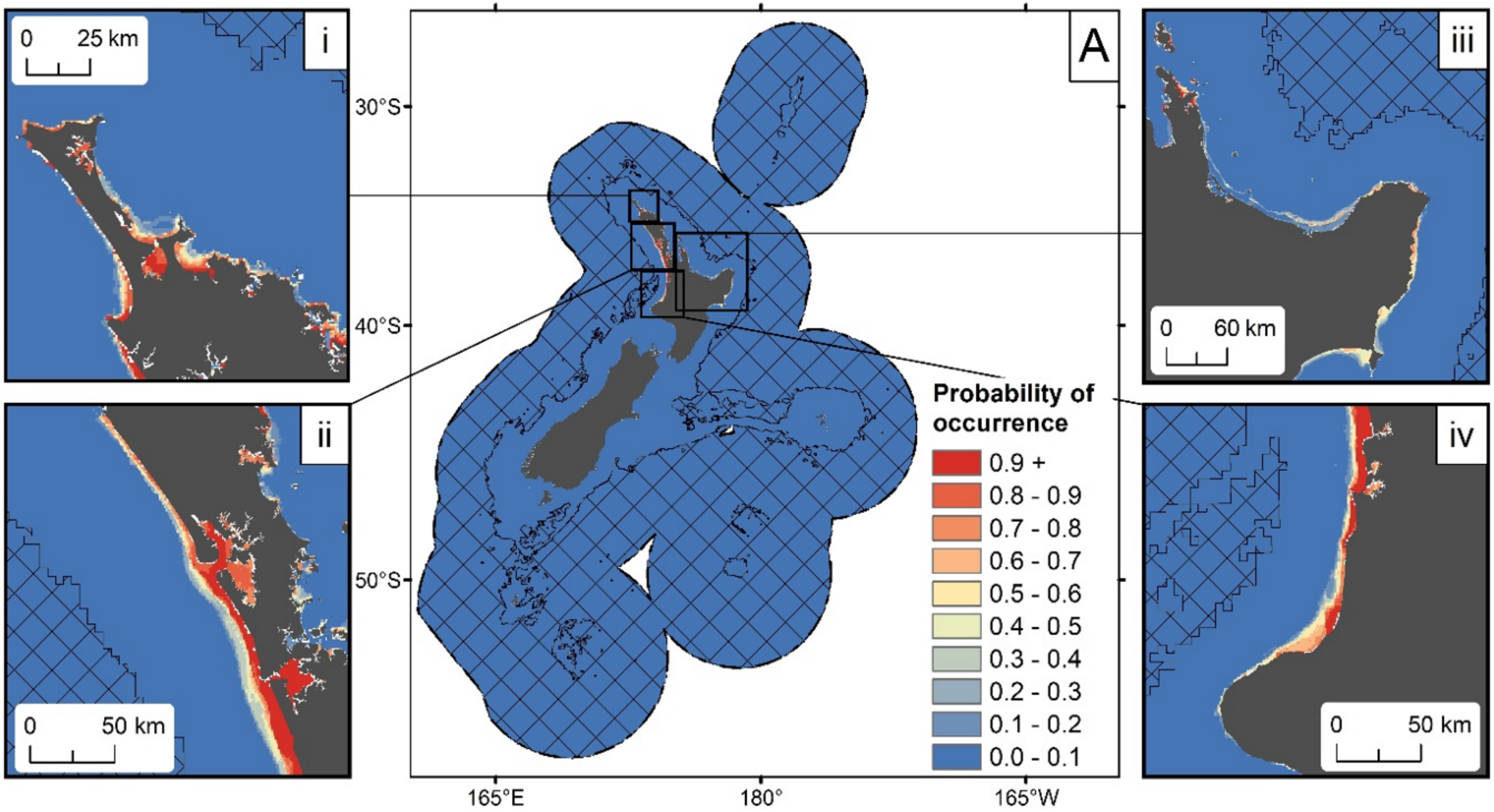
APPENDIX 3 - MAPS OF MODELLED, PREDICTED PROBABILITY OCCURRENCE OF VARIOUS SPECIES OF MARINE MAMMALS IN THE NEW ZEALAND EEZ MODELLED FROM STEPHENSON ET AL. (2020B)

Figure A3-1. Maps of the predicted probability occurrence of various species of marine mammals in the New Zealand EEZ modelled using bootstrapped BRTs and areas of low predicted environmental coverage depicting the lower confidence that can be placed in the predicted probability occurrence (criss-cross black line). Inset maps: (i) west coast of South Island including the Fiordland Coast; (ii) south of the South Island including Stewart Island/ Rakiura; (iii) south of the North Island and north of the South Island including Tasman and Golden Bays and Cook Strait; (iv) East of the South Island including Canterbury Bight. Source: Stephenson et al. 2020b.

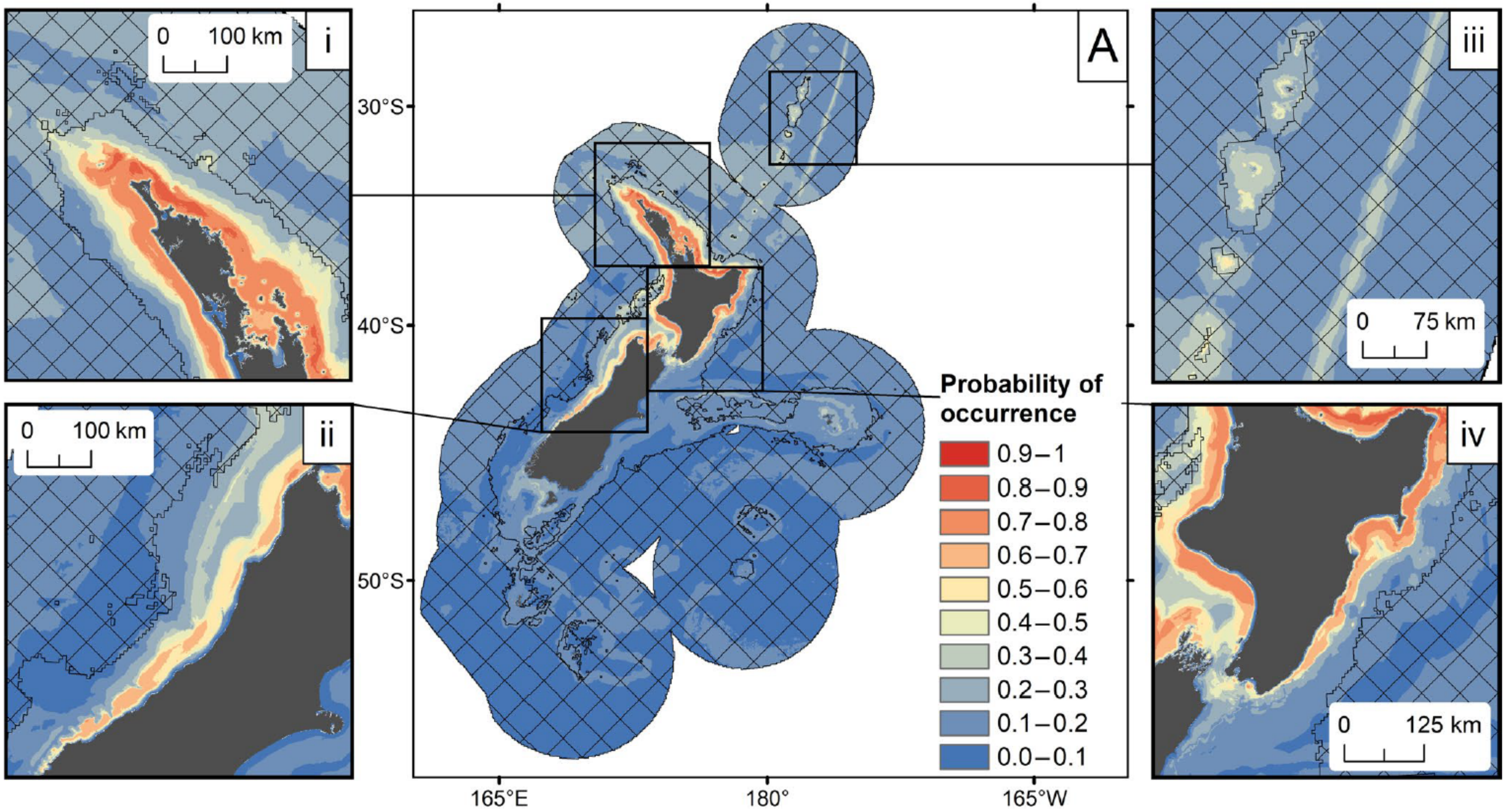
Hector's dolphin



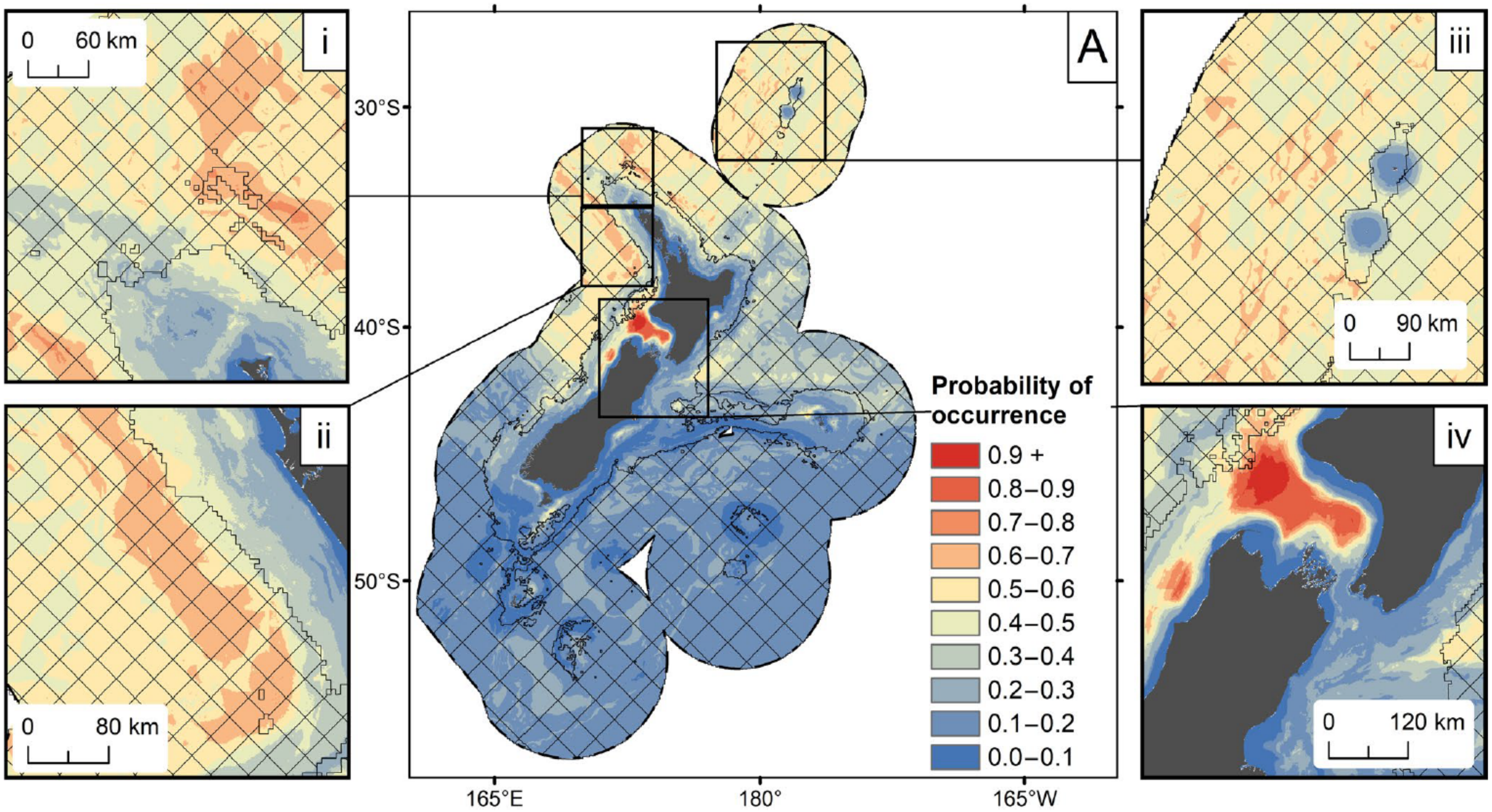
Maui dolphin



Common dolphins

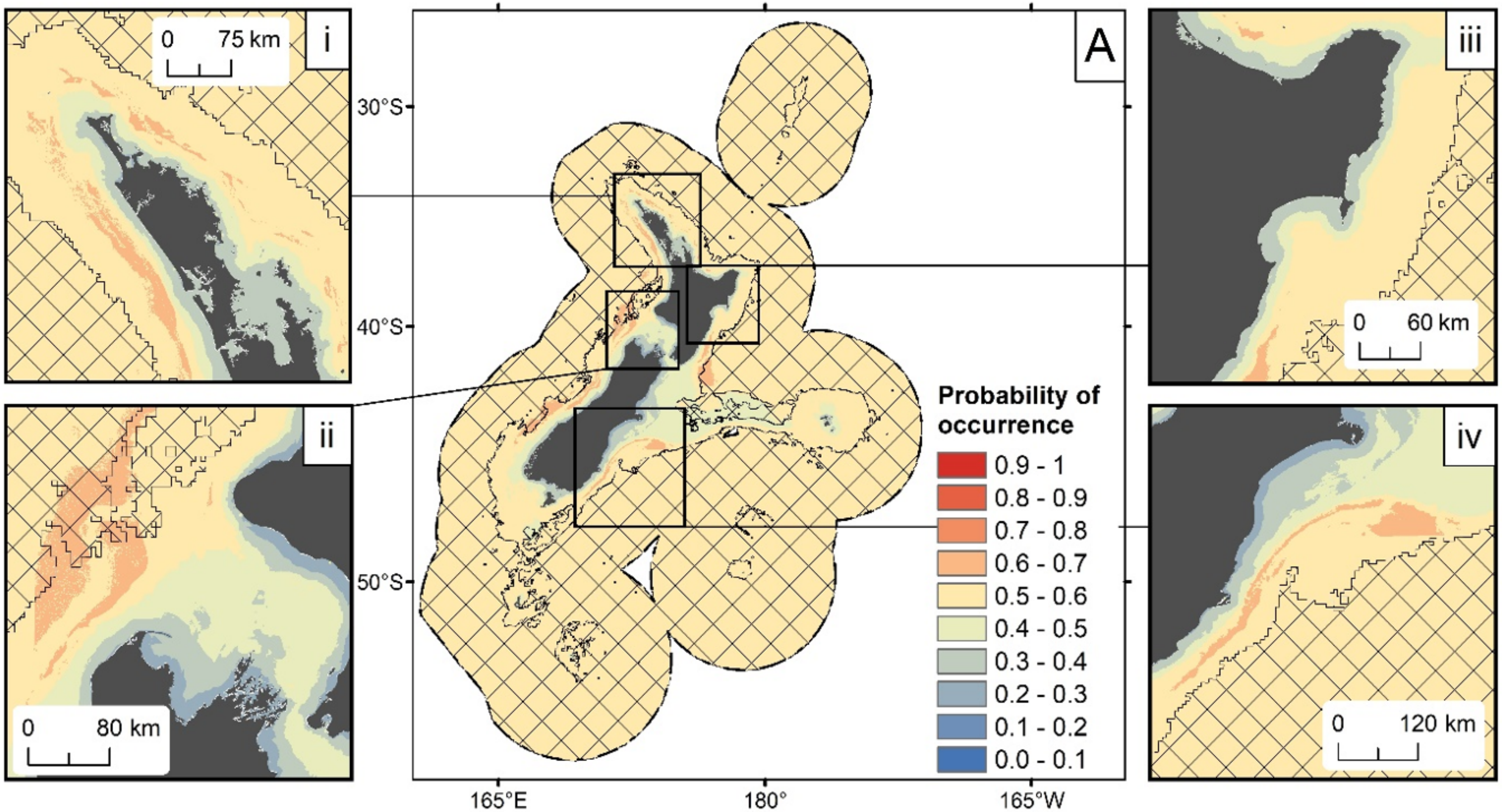


Blue whale

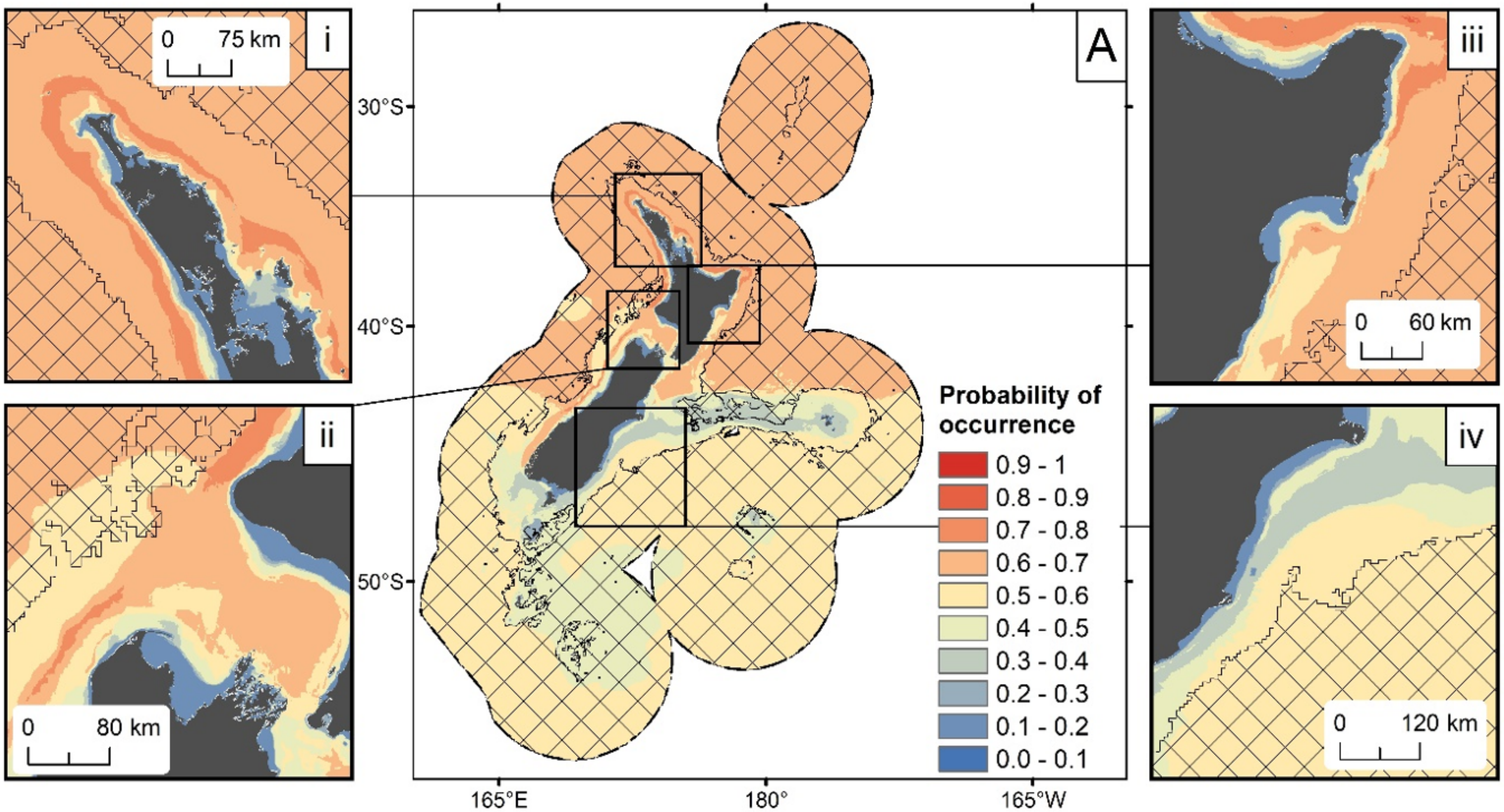


i
0 60 km
ii
0 80 km
A
30°S
40°S
50°S
165°E
180°
165°W
iii
0 90 km
iv
0 120 km
Probability of occurrence
0.9 +
0.8–0.9
0.7–0.8
0.6–0.7
0.5–0.6
0.4–0.5
0.3–0.4
0.2–0.3
0.1–0.2
0.0–0.1

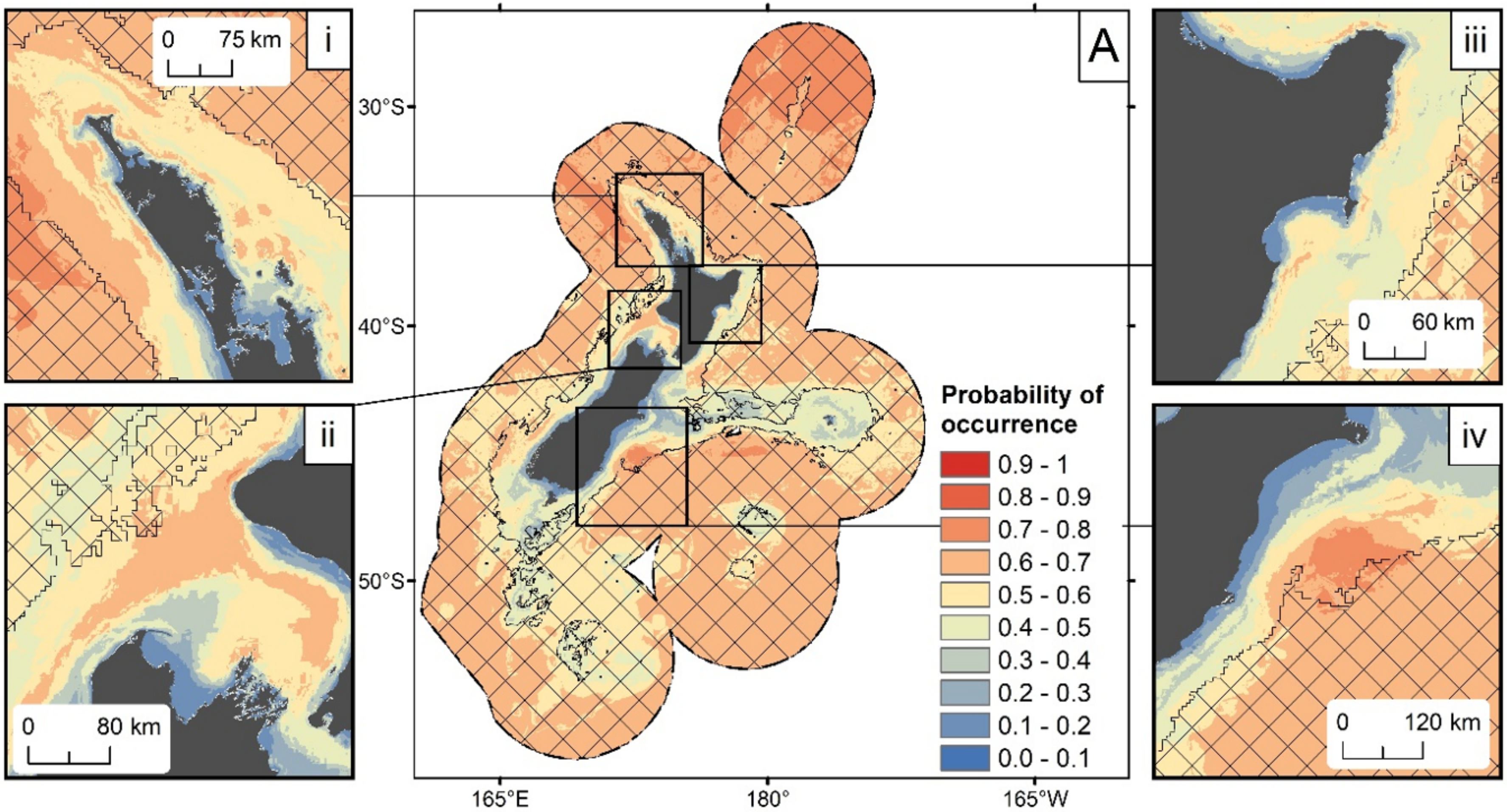
Minke whale


i
0 75 km
ii
0 80 km
A
30°S
40°S
50°S
165°E
180°
165°W
Probability of occurrence
0.9 - 1
0.8 - 0.9
0.7 - 0.8
0.6 - 0.7
0.5 - 0.6
0.4 - 0.5
0.3 - 0.4
0.2 - 0.3
0.1 - 0.2
0.0 - 0.1
iii
0 60 km
iv
0 120 km

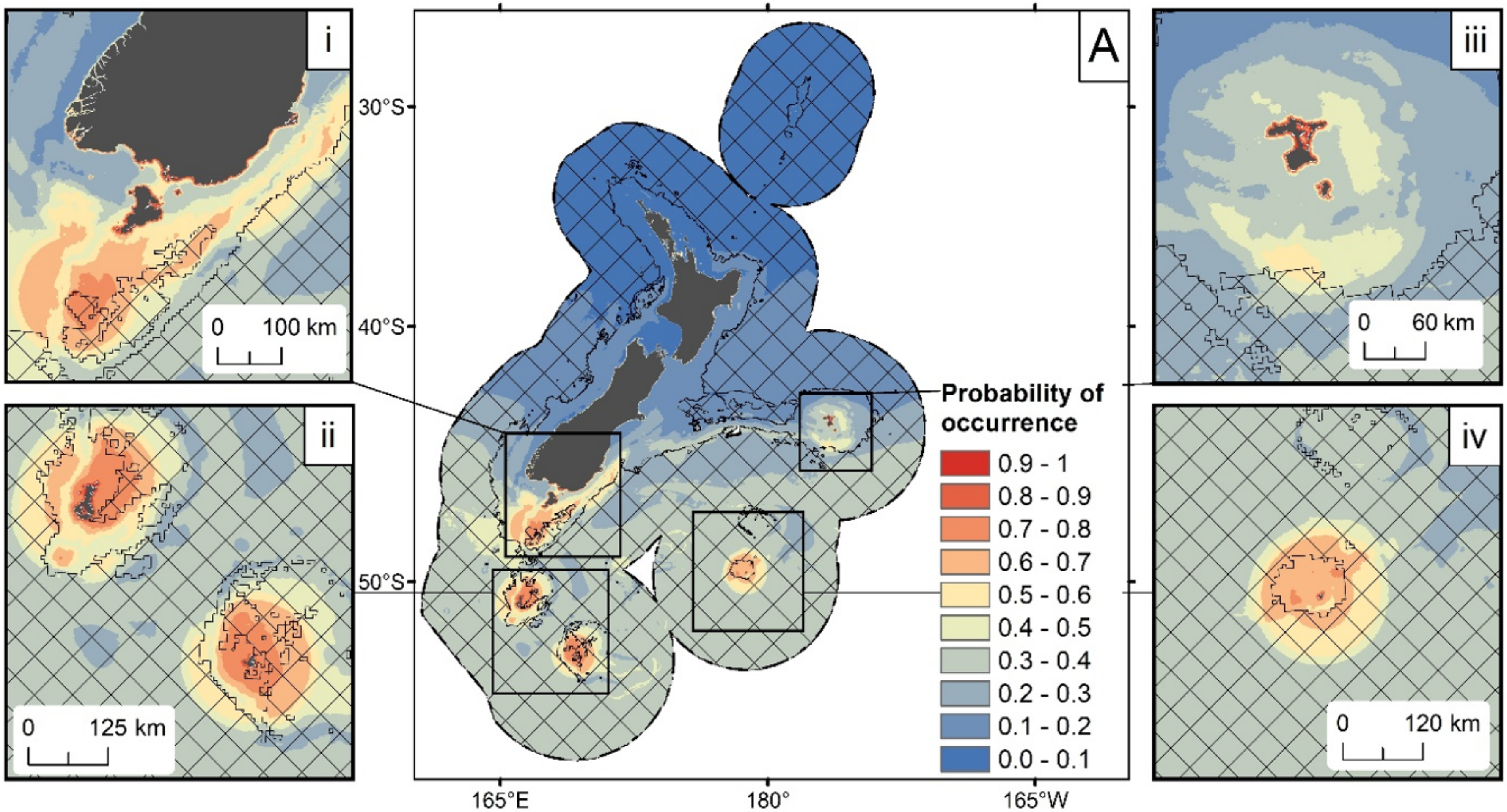
Fin whale


i
0 75 km
ii
0 80 km
A
30°S
40°S
50°S
165°E
180°
165°W
Probability of occurrence
0.9 - 1
0.8 - 0.9
0.7 - 0.8
0.6 - 0.7
0.5 - 0.6
0.4 - 0.5
0.3 - 0.4
0.2 - 0.3
0.1 - 0.2
0.0 - 0.1
iii
0 60 km
iv
0 120 km

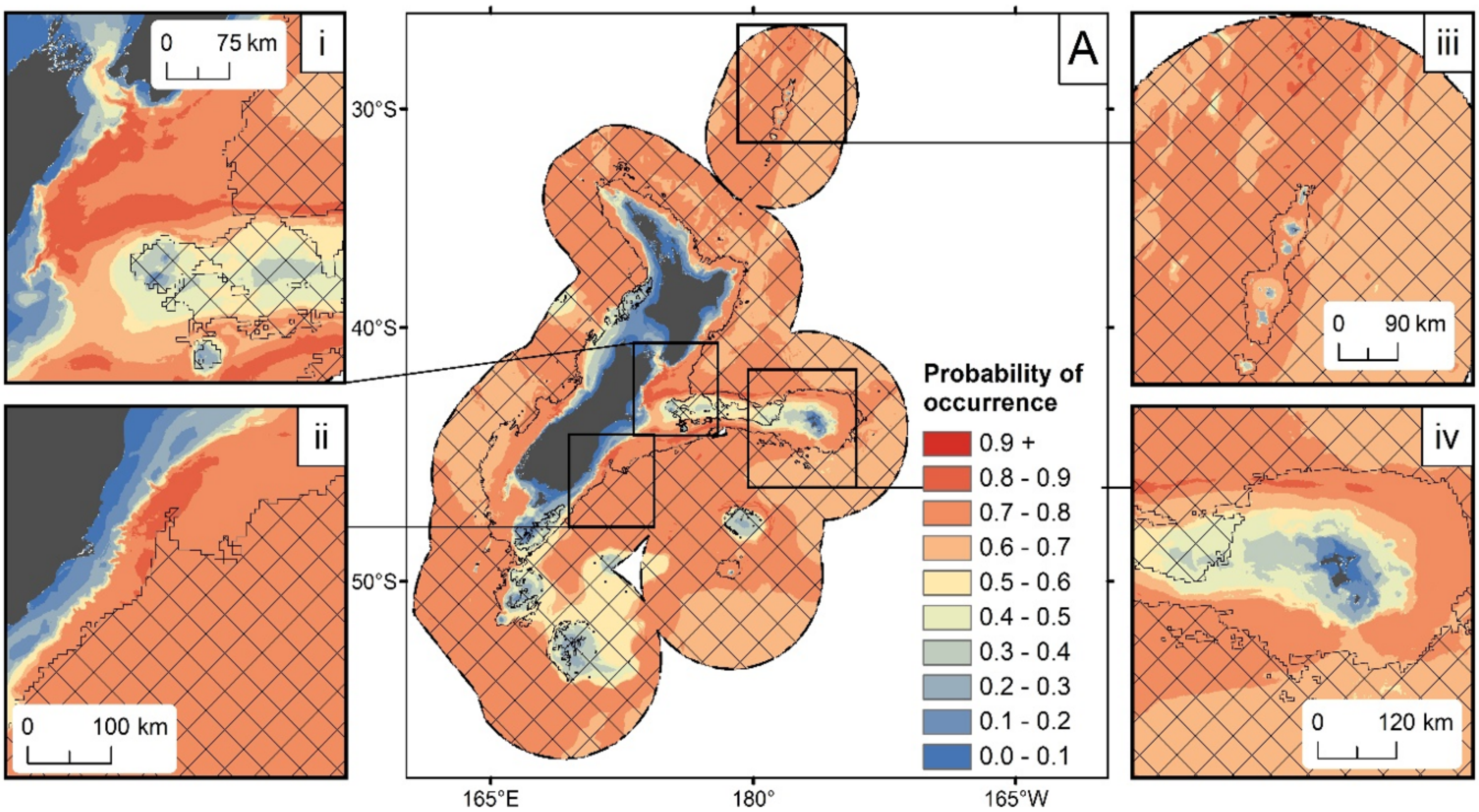
Sei whale


i
0 75 km
ii
0 80 km
A
30°S
40°S
50°S
165°E
180°
165°W
Probability of occurrence
0.9 - 1
0.8 - 0.9
0.7 - 0.8
0.6 - 0.7
0.5 - 0.6
0.4 - 0.5
0.3 - 0.4
0.2 - 0.3
0.1 - 0.2
0.0 - 0.1
iii
0 60 km
iv
0 120 km

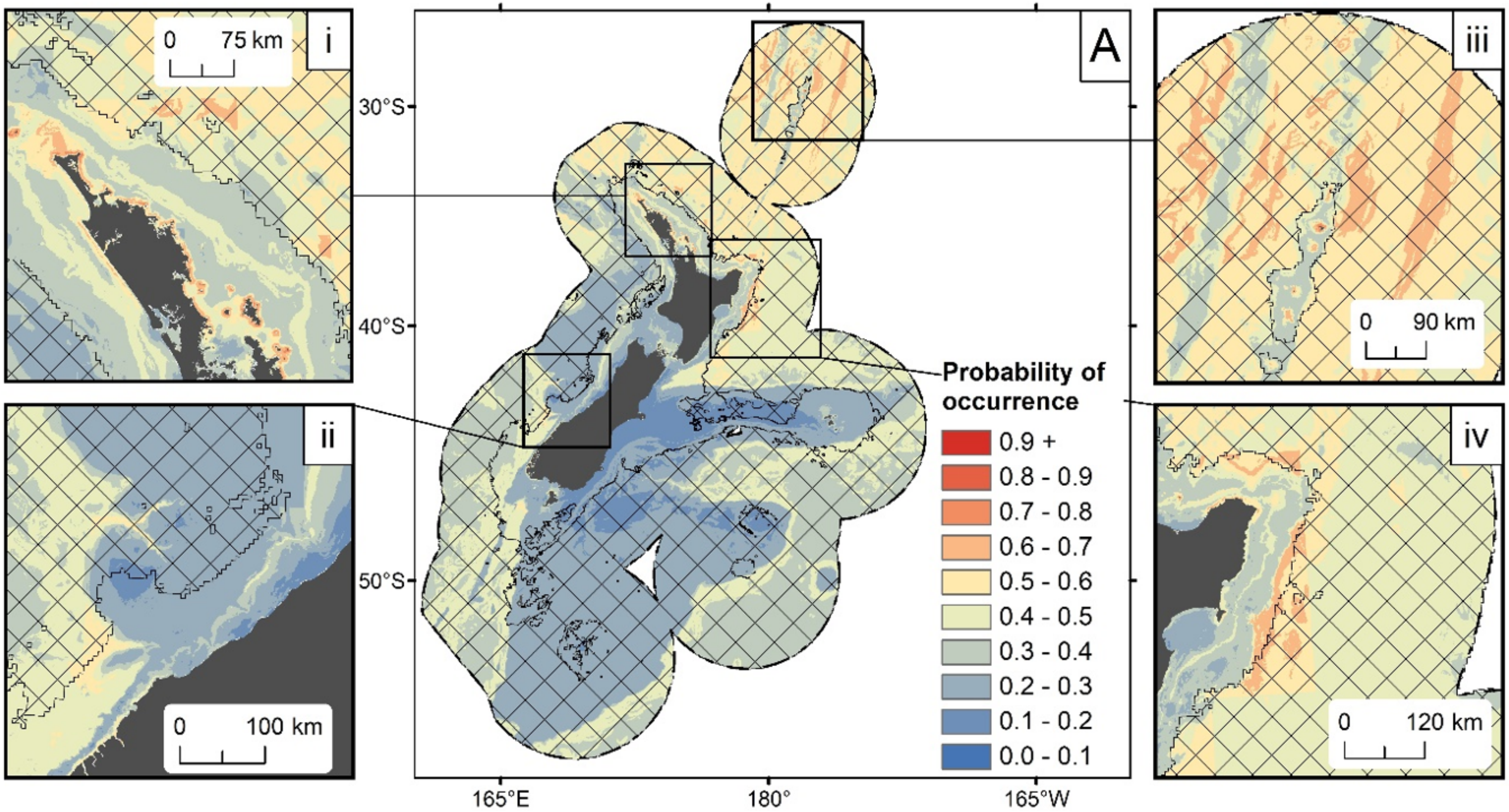
Southern right whale



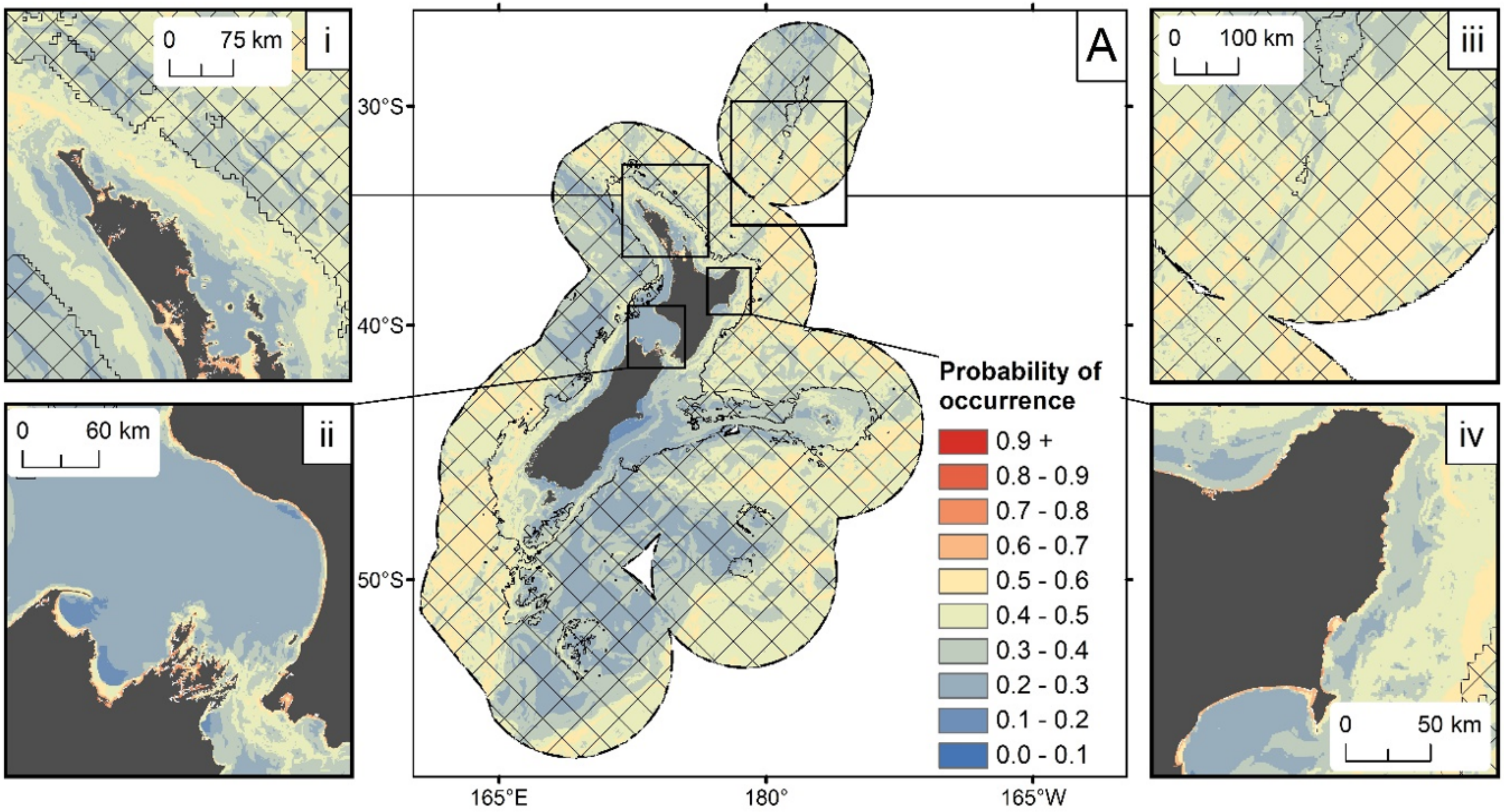
Sperm whale


i
0 75 km
ii
0 100 km
A
30°S
40°S
50°S
165°E
180°
165°W
Probability of occurrence
0.9 +
0.8 - 0.9
0.7 - 0.8
0.6 - 0.7
0.5 - 0.6
0.4 - 0.5
0.3 - 0.4
0.2 - 0.3
0.1 - 0.2
0.0 - 0.1
iii
0 90 km
iv
0 120 km

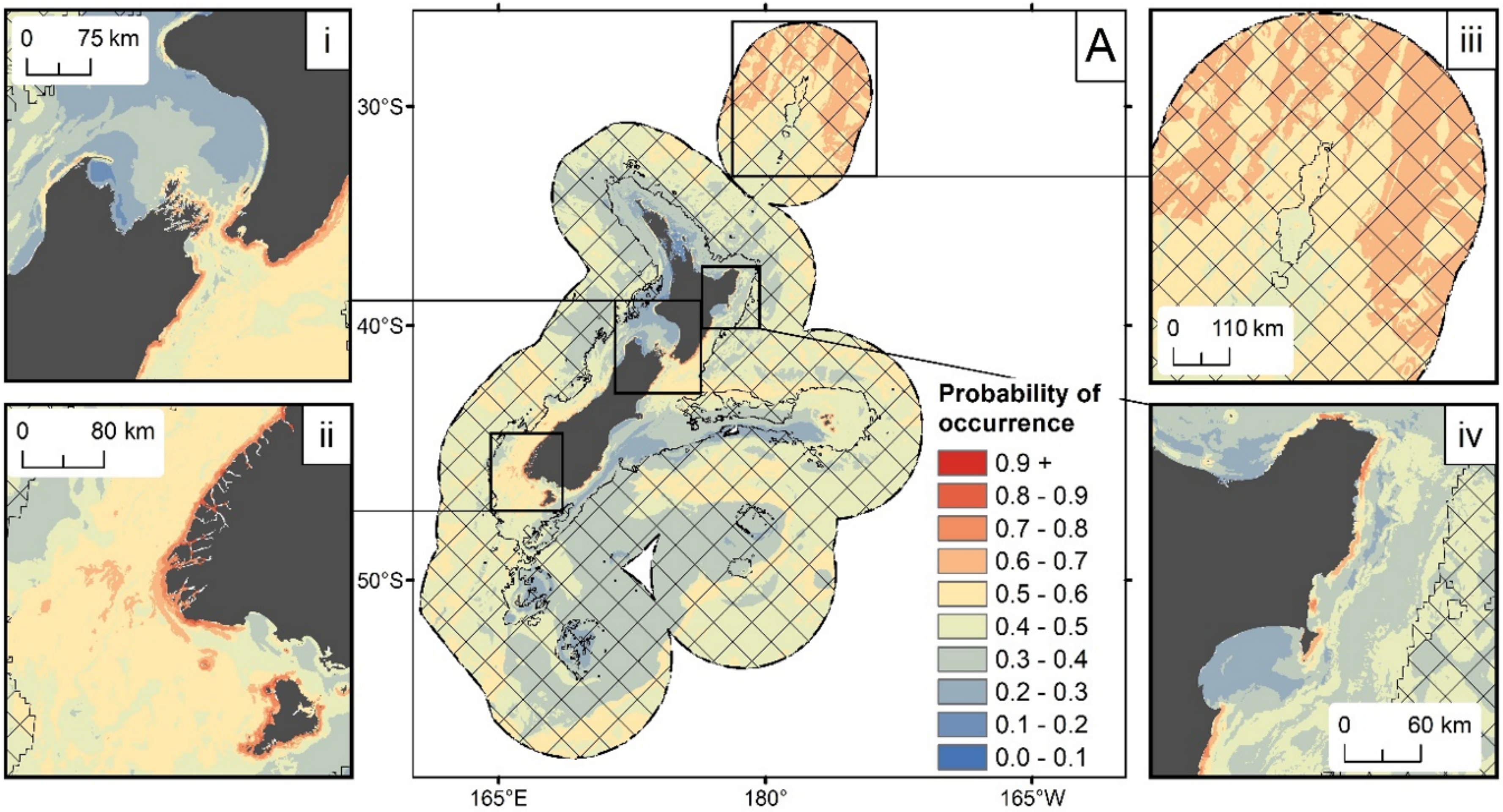
Bottlenose dolphin



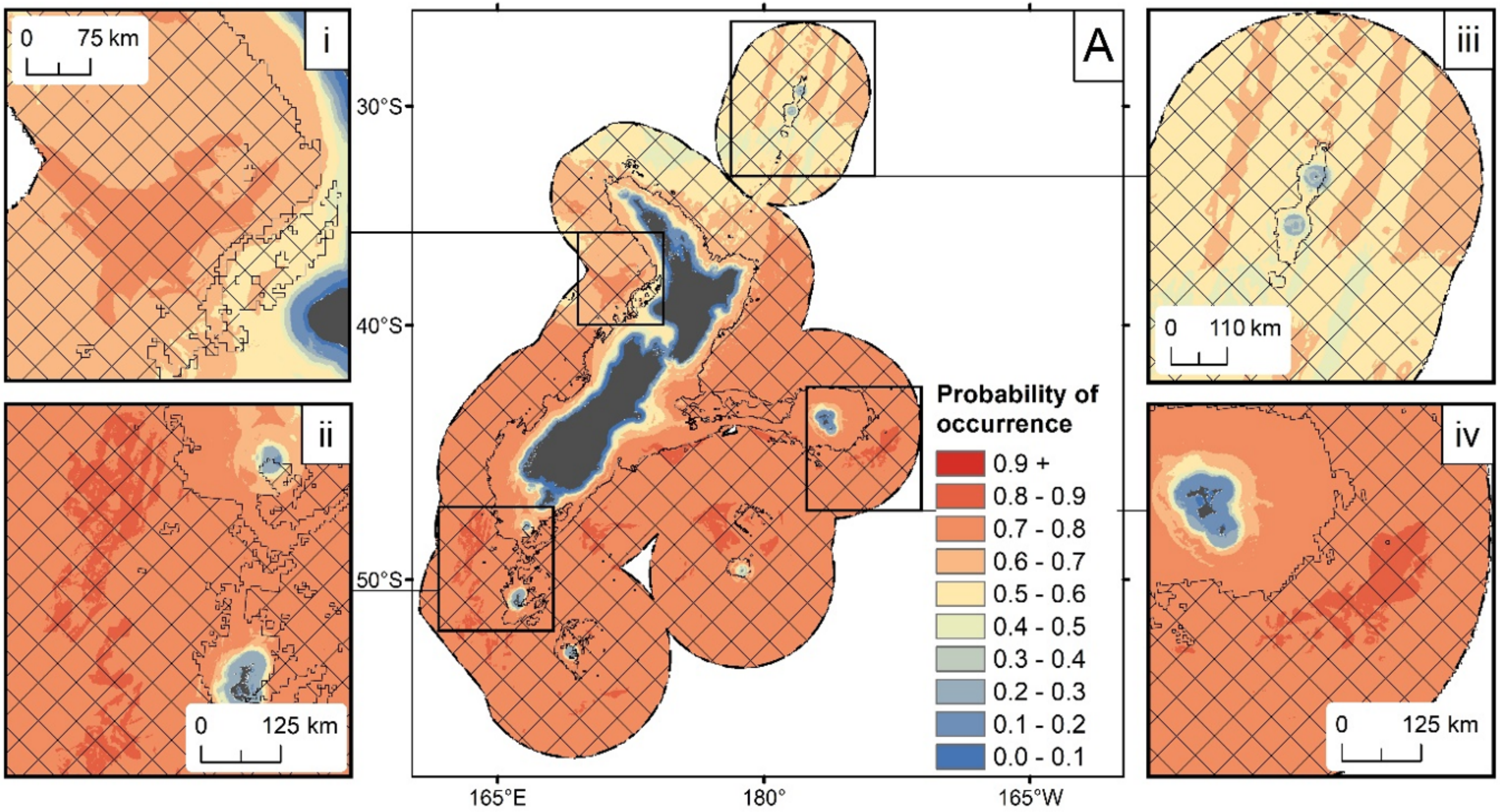
Killer whale



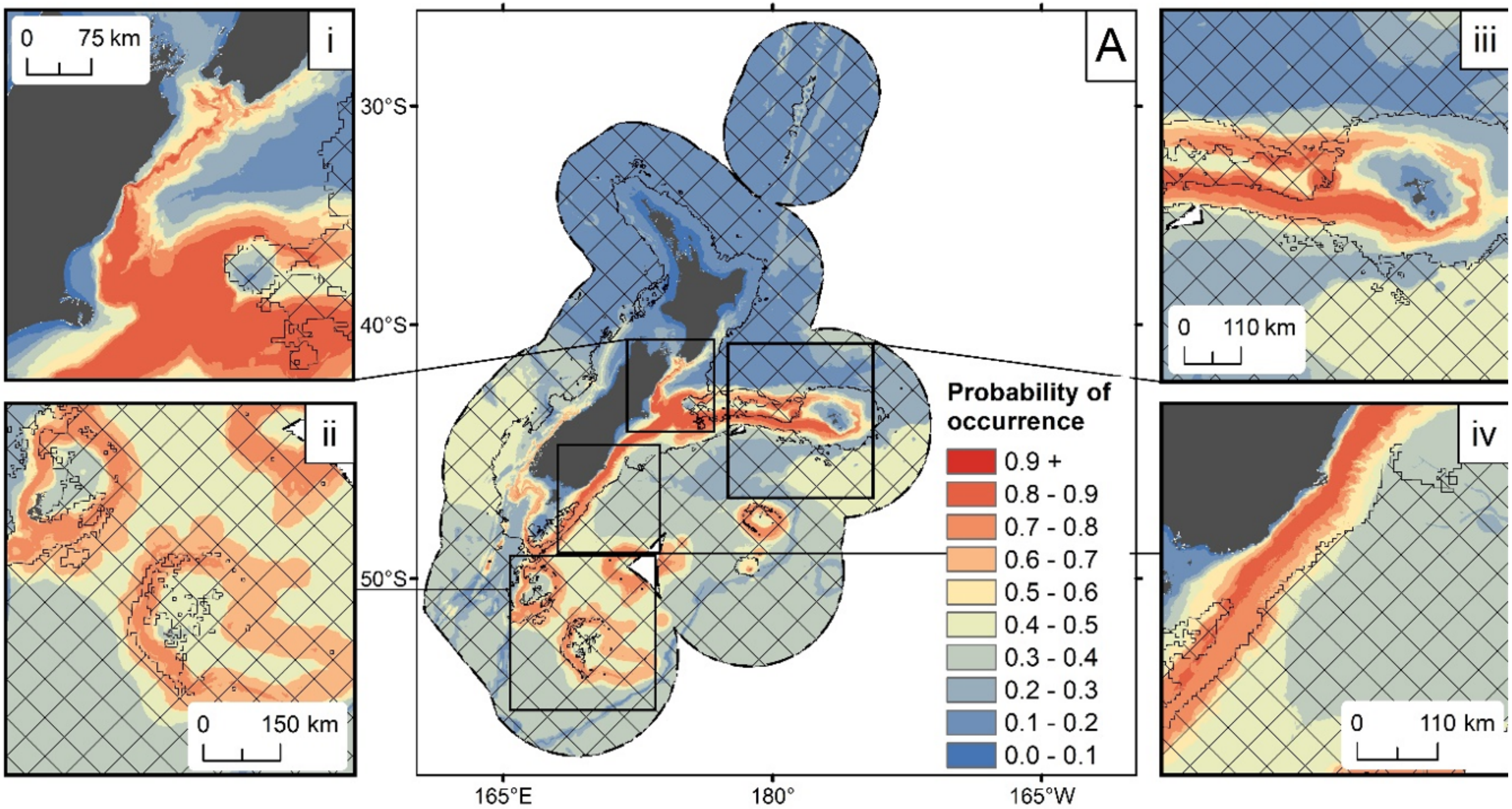
Humpback whale



Pilot whales



Dusky dolphin



APPENDIX 4 SELECTED FIGURES ABOUT BLUE WHALES FROM RECENT SCIENTIFIC PUBLICATIONS

Figure A4-1 Adapted from Figure 6 from Barlow & Torres (2021). Mean probability of blue whale presence predicted by the BRT whale model, calculated across 100 bootstrap runs. Anthropogenic pressures are overlaid, including petroleum and mineral permit areas (as of May 2021), ports (blue squares) and active oil rigs (red triangles)

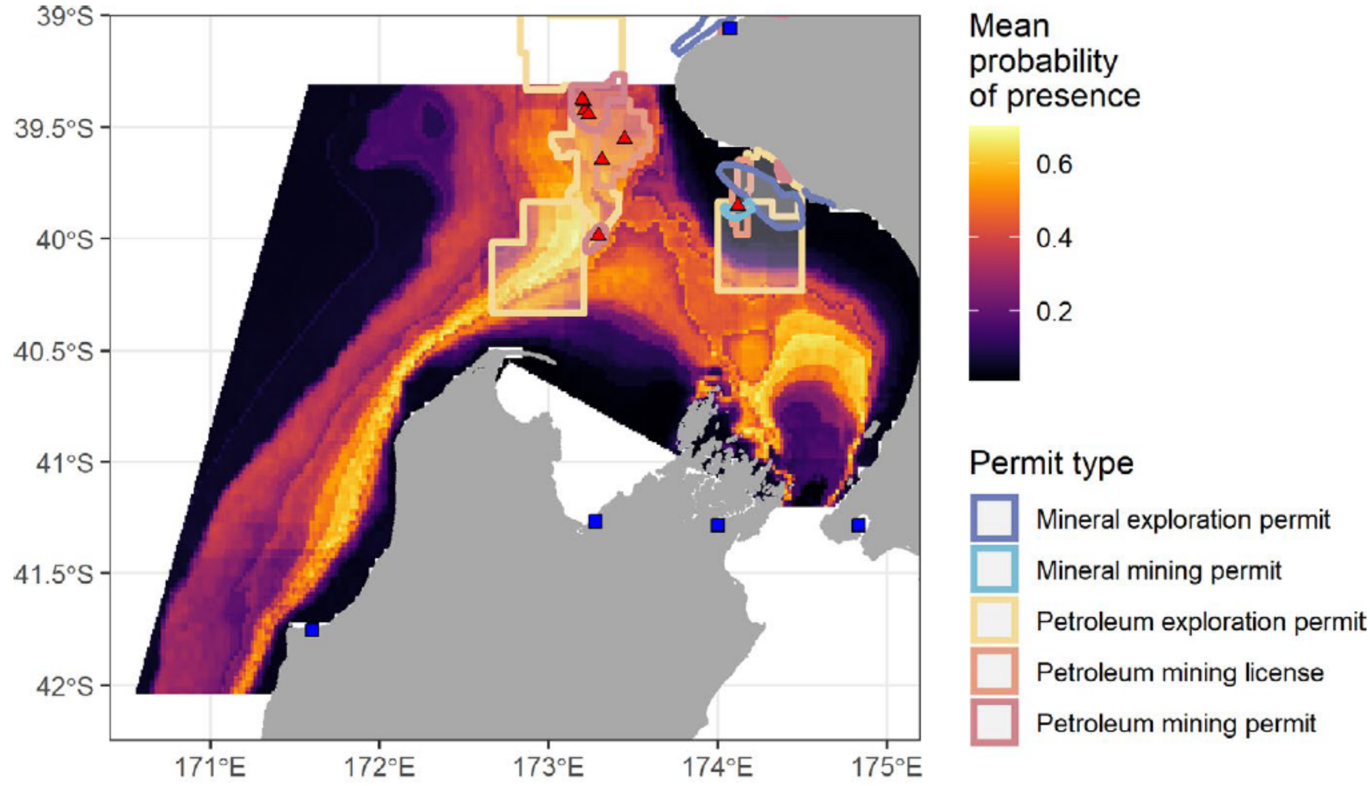


Figure A4-2 Adapted from Figure 3 in Barlow et al. (2023a). Temporal occurrence pattern of New Zealand (dark blue), Antarctic (red), and Australian (yellow) blue whale song detections at each of the five hydrophones. The y-axis represents the number of hours per day that blue whale song was detected, and the x-axis represents the recording period. Grayed out sections represent gaps in recording due to hydrophone refurbishment.

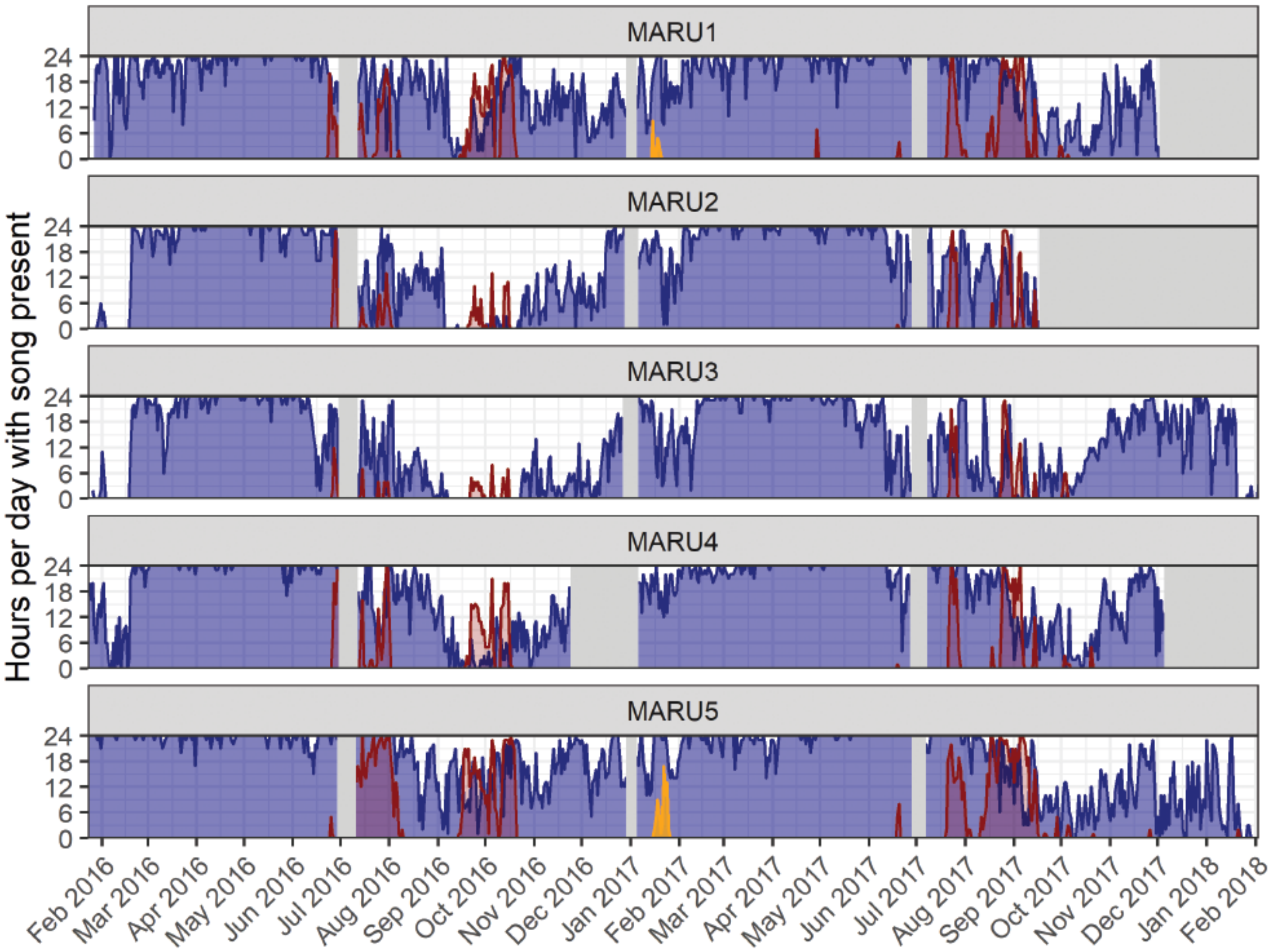


Figure A4-3 Adapted from Figure 3 in Barlow et al. (2023b). Annual cycle of calling activity. Average annual cycle in the song intensity index (dark blue) and D calls per day of the year, computed across all hydrophone locations and the entire recording period.

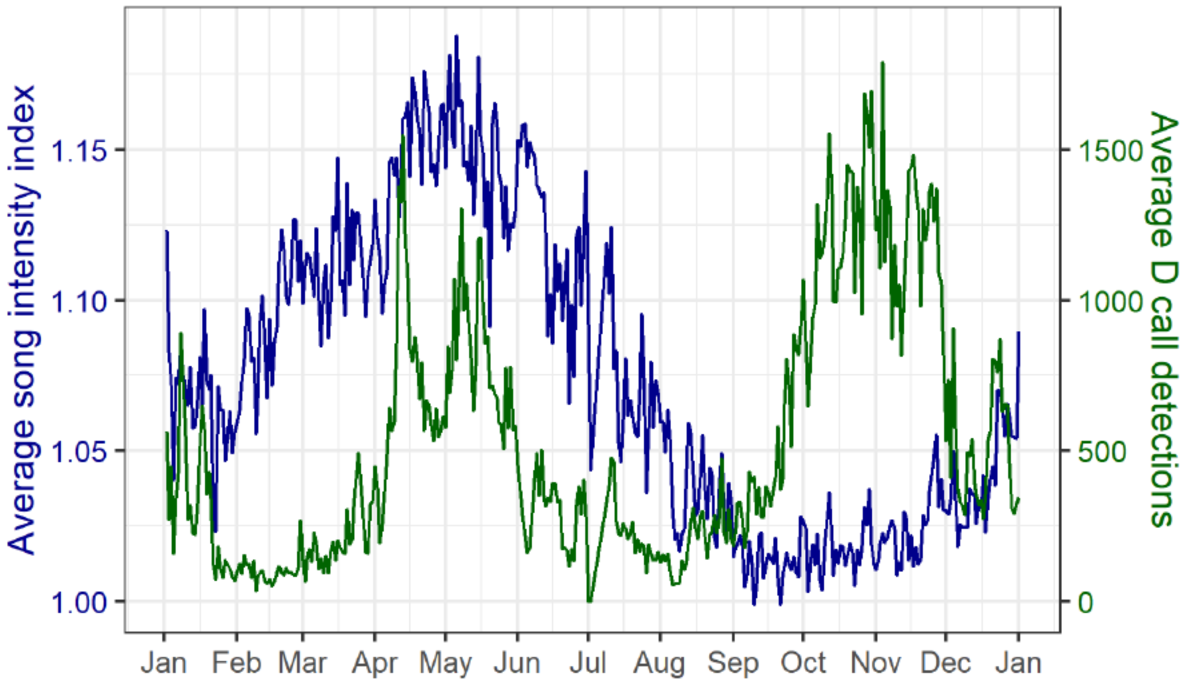


Figure A4-4 Adapted from Figure 1 in Barlow et al. 2020. Survey effort in the South Taranaki Bight (STB) region of New Zealand in each of the 3 study years. Black lines represent vessel tracklines during survey effort. Yellow circles represent blue whale sighting locations, scaled by number of blue whales recorded. CTD casts are shown as red crosses. Inset map of New Zealand in the 2014 panel indicates the location of the STB region within the white box