Māui's dolphin
(*Cephalorhynchus hectori maui*)
and South Island Hector's dolphin
(*Cephalorhynchus hectori hectori*)

5-Year Review:
Summary and Evaluation

E.C.M. Parsons

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD
2024

5-YEAR REVIEW
Māui's dolphin (*Cephalorhynchus hectori maui*)
and South Island Hector's dolphin (*Cephalorhynchus hectori hectori*)

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1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office:

E.C.M. Parsons,

Office of Protected Resources, 1315 East-West Highway. 13th Floor. Silver Spring Maryland 20910.

1.2 Methodology used to complete review

A 5-year review is a periodic analysis of a species' status conducted to ensure that the listing classification of a species currently listed as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.11 – 17.12) is accurate. The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA), and was prepared pursuant to the joint National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service's 5-year Review Guidance and Template (NMFS and USFWS 2018). The NMFS Office of Protected Resources (OPR) conducted the 5-year review. Information was updated from the last status review report (Manning and Grantz 2017) based on peer-reviewed publications, government and technical reports, conference papers, workshop reports, dissertations, theses, and personal communications. Information was gathered from May through July 2024. The information on the biology and habitat, threats, and conservation efforts related to Māui's dolphins and South Island (SI) Hector's dolphins was summarized and analyzed in light of the ESA section 4(a)(1) factors (see **Section 2.5**) to determine whether a reclassification or delisting may be warranted (see **Section 3.0**).

NMFS initiated a 5-year review of the Māui's dolphin and SI Hector's dolphin, and solicited information from the public, on June 18 2024 (89 FR 51511). One public comments was received and was incorporated, as appropriate, in this review.

1.3 Background

1.3.1 FRN notice citation announcing initiation of this review

89 FR 51511, June 18, 2024

1.3.2 Listing history

Original Listing

FR notice: 82 FR 43701

Date listed: 09/19/2017

Entity listed: *Cephalorhynchus hectori maui*

Classification: Endangered

Entity listed: *C. hectori hectori*

Classification: Threatened

1.3.3 Associated rulemakings

None

1.3.4 Review history

The initial status review (Manning and Grantz 2017) concluded that the Māui's dolphin is at a high risk of extinction and recommended its classification be "endangered" and that the SI Hector's dolphin is at moderate risk of extinction and recommended that its classification be "threatened."

1.3.5 Species' recovery priority number at start of 5-year review

No recovery priority number has been issued for either the Māui's dolphin or SI Hector's dolphin.

1.3.6 Recovery Plan or outline

A recovery plan was not prepared for either the Māui's dolphin or SI Hector's dolphin. This is in accordance with NMFS' March 8, 2019 finding that a recovery plan would not promote their conservation as these subspecies occur entirely in foreign waters (i.e. the territorial waters of New Zealand) and, therefore, the threats to these subspecies occur under foreign jurisdiction.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy[1]

2.1.1 Is the species under review a vertebrate?

_X_Yes

__No

2.1.2 Is the species under review listed as a DPS?

___Yes

_X_No

2.1.3 Is there relevant new information for this species regarding the application of the DPS policy?

___Yes

_X_No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

__Yes

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[1] To be considered for listing under the ESA, a group of organisms must constitute a "species," which is defined in section 3 of the ESA to include "any subspecies of fish or wildlife or plants, and any distinct population segment [DPS] of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS and USFWS jointly published a policy regarding the recognition of DPSs of vertebrate species under the Endangered Species Act (61 FR 4722, February 7, 1996). "DPS" is not a scientifically defined term; it is a term used in the context of ESA law and policy. Furthermore, when passing the provisions of the ESA that give us authority to list DPSs, Congress indicated that this provision should be used sparingly. We have discretion with regard to listing DPSs and, in order to be consistent with the directive of the Congressional report that followed the introduction of the DPS language in the ESA to identify DPSs sparingly. We will generally not, on our own accord, evaluate listings below the taxonomic species.

_X_No

Not applicable. A recovery plan was not prepared for either Māui's dolphin or the SI Hector's dolphin. This is in accordance with NMFS' March 8, 2019 finding that a recovery plan would not promote its conservation as this species occurs entirely in foreign waters (i.e., the territorial waters of New Zealand) and, therefore, the threats to this species occur under foreign jurisdiction.

2.3 Updated information and current species status of the Māui's dolphin (*Cephalorhynchus hectori maui*)

2.3.1 Biology and habitat of Māui's dolphin

2.3.1.1 New information on the species' biology and life history

New information and research has been published or conducted since the initial status review on the Māui's dolphin (Manning and Grantz 2017).

Māui's dolphin (*Cephalorhynchus hectori maui*), also known as Maui's dolphin or the Māui dolphin, is so named because:

> *In a Maori legend about the creation of Aotearoa/New Zealand, Maui [Māui] is a hero (male gender) who fished up the North Island, Te Ika a Maui, from the ocean depths. The common name of this subspecies will be Maui's dolphin* (p. 725 in Baker *et al*. 2002).

In this status review, the common name Māui's dolphin will be used to follow the common name given in Baker *et al.* (2002), while recognizing the Māori pronunciation of Māui.

Māui's dolphin is one of two subspecies of Hector's dolphin (*Cephalorhynchus hectori*) (Manning and Grantz 2017) or the Aotearoa dolphin, a renaming suggested by Brownell *et al.* (2024).[2] Māui's dolphin was only recognized as a separate subspecies of Hector's dolphin in 2002 (Baker *et al.* 2002). The subspecies is endemic to New Zealand (Māori: Aotearoa) and is found primarily on the northwest coast of the North Island (Māori: Te Ika-a-Māui) of New Zealand. In contrast, the SI Hector's dolphin (*C. h. hectori*) is found predominantly in three discrete locations on the western, eastern and southern coasts of the South Island (Māori: Te Waipounamu) of New Zealand. Both subspecies are relatively unusual for cetaceans, as they are endemic to such a small area. Māori names for both subspecies of Hector's dolphin include: popoto, tutumairekurai, tupoupou, hopuhopu, pehipehi, waiaua and upokohue.

Māui's dolphin has declined from several hundred individuals in the 1980s (Constantine 2023) to an estimated 48 in 2021 (95% confidence interval: 40-57; IWC 2023). The primary cause of anthropogenic mortality is entanglement in set gill nets or trawl fishing gear (see **Section 2.3.2.4.1.1** and **Section 2.3.2.4.1.2**); however, other factors, such as disease (**Section 2.3.2.3.1**), vessel traffic (**Section 2.3.2.4.2**), mining (**Section 2.3.2.1.2**), oil and gas extraction (**Section 2.3.2.1.3**), climate change (**Section 2.3.2.1.4**), and underwater noise (**Section 2.3.2.4.3**), are additional stressors or causes of mortality.

2.3.1.1.1 Life history

No substantive new information on life history has been presented since the initial status review on the Māui's dolphin (Manning and Grantz 2017). Constantine *et al.* (2021) reported that one male was biopsy-sampled and genetically identified in both 2001 and 2020, confirming a minimum survival

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[2] As the suggestion to rename Hector's dolphin the Aotearoa dolphin (Brownell *et al.* 2024) is new and has not yet been officially adopted by the scientific community, this review continues to use the common name Hector's dolphin for *Cephalorhynchus hectori.*

duration of 20 years.

Hernandez *et al.* (2023) conducted a study to age skin taken in dolphin biopsy samples by analyzing the rate of DNA methylation.[3] The study was calibrated by comparing ages of stranded and by-caught dolphins, determined by counting tooth dentine layers, with DNA methylation ratios in tissue samples taken from these animals. Hernandez *et al*. (2023) was then able to use this method to estimate the ages of living dolphins that had been biopsied for genetic analysis.

Comparing biopsy samples taken in 2015–2016 and 2020–2021, the estimated age distribution of Māui's dolphins became significantly younger. Using one method, the average estimated dolphin age went from 8.5 years (2015–2016; 95% confidence interval: 8.18-9.15) to 7.4 years (2020–2021; 95% confidence interval: 6.72-8.05). With a second method, the average age similarly decreased from 9.7 (95% confidence interval: 8.74-10.53) to 8.5 years (95% confidence interval: 7.26-9.29).

This shift in age structure could be due to an increase in reproduction, resulting in more young animals in the population, which would be positive for the conservation of the subspecies. But, it could conversely be due to the mortality of older animals, which would be detrimental to the subspecies.

2.3.1.1.2 Survival

No substantive new information on Māui's dolphin growth and reproduction has been presented since the initial status review on the Māui's dolphin (Manning and Grantz 2017). Hamner *et al*. (2012b) estimated the annual survival rate for Māui's dolphins to be 0.83 (95% confidence interval: 0.75 – 0.90). This is an annual mortality rate of 17% for dolphins aged one year or older.

2.3.1.1.3 Reproduction and growth

The intrinsic rate of growth – the percentage increase in the population due to successful reproduction – is an essential parameter to estimate the potential for a species' recovery. In previous studies, Slooten and Lad (1991) and Currey *et al.* (2012) estimated an intrinsic rate of growth (or r_{max}) for Māui's dolphins of 0.018 (i.e. a 1.8% increase per year).

Edwards *et al.* (2018) estimated age at maturity of SI Hector's dolphins as 6.9 years (95% confidence interval: 5.8 – 8.2) by plotting body size and reproductive rate for a variety of mammal groups (see **Fig. 21**; **Section 2.4.1.1.3.1**). This was then used to estimate an intrinsic rate of growth of 0.05, or a 5% increase per year for SI Hector's dolphins. This value, however, was criticized by Slooten and Dawson (2020) (**Section 2.3.2.5.2** and **Section 2.4.1.1.3.1**).

It should be noted that the International Whaling Commission (IWC) Scientific Committee (2024b) also stated that the method used by Edwards *et al.* (2018) had poorer reliability for estimating the age at sexual maturity and, therefore, intrinsic rate of growth, compared to calculating the values based on life history data from animals in the population.

For their spatial analysis and risk assessment of Māui's dolphin (**Section 2.3.1.5**), Roberts *et al.* (2019) ran an individual-based model[4] using the r_{max} value of 0.05 calculated by Edwards *et al.* (2018), in order to assess the impact that small population size and inbreeding might have on the rate of growth of this subspecies. In summary, Roberts *et al.* (2019) derived a slightly lower r_{max} value of 0.045 in their spatial risk model for Māui's dolphin, i.e., a rate of growth of 4.5%. However, they note that

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[3] DNA methylation refers to the addition of methyl groups ($-CH_3$) throughout the genome over time. The ratio of methylated to non-methylated can give an estimation of age.

[4] This was done via the VORTEX modelling software, an individual-based simulation for modelling demographic, environmental and genetic stochastic events on wildlife populations (Lacy and Pollak 2023).

environmental variation and inbreeding might reduce that value to 4%.

2.3.1.1.4 Feeding and diet

Information on Māui's dolphin diet is limited to a single publication describing the stomach contents of just two stranded individuals (Miller *et al*. 2013). These dolphins had eaten ahuru (*Auchenoceros punctatus*), flounder (*Rhombosolea plebia*), red cod (*Pseudophycis bachus*), and sole (*Peltorhamphus* spp.).

To gain a better understanding of Māui's dolphin diet over time, Ogilvy *et al.* (2022) analyzed levels of carbon (∂13C) and nitrogen (∂15N) isotopes in skin biopsy samples. They found that, prior to 2008, dolphin prey had much higher ∂13C values and slightly higher ∂15N values (Ogilvy *et al.* 2022). This suggests that the dolphins' diet prior to 2008 was comprised of more inshore, demersal (near the seabed) species of a higher trophic level, but after 2008 it shifted to continental shelf-associated, benthopelagic (sea bed and mid-water) prey.

In 2008, the North Island Marine Mammal Sanctuary was established, which limited nearshore fisheries. However, the isotope levels after 2008 do not indicate prey levels increased; rather the levels suggest that dolphins may have been foraging farther offshore (Ogilvy *et al.* 2022).

Both carbon and nitrogen isotope values decreased over time, except in 2015–16, when levels were similar to those before 2008 (Ogilvy *et al.* 2022). This variation coincided with the largest El Niño event to occur in the Pacific region in the last 145 years and it suggests that during this period Māui's dolphin prey was affected by climate-driven events (Ogilvy *et al.* 2022). As the whole population seems to have shown a similar variation in isotope levels, and then returned to the previous trend, it is unlikely that the isotope variation was caused by a permanent shift in prey species.

The decreasing level of nitrogen was unusual; most coastal dolphin species experience an increase in nitrogen due to terrestrial runoff and fertilizers entering the coastal ecosystem. As Māui's dolphins inhabit waters close to Auckland, one might, therefore, expect an increasing level of nitrogen. Carbon (∂13C) levels are an indicator of the productivity of an ecosystem and levels tend to be higher closer to the shore. The decreasing trend in carbon and nitrogen seen in Māui's dolphin prey could be due to a decrease in the productivity of their ecosystem over time or, as noted above, dolphins shifting to a more pelagic, less nearshore prey – or a combination of both (Ogilvy *et al.* 2022).

There was no difference in isotope levels between males and females (Ogilvy *et al.* 2022); therefore, it appears that there is no segregation of sexes in Māui's dolphins, which is different than SI Hector's dolphins. Male dolphins around the Banks Peninsula (Te Pātaka-o-Rākaihautū) have a lower ∂15N values compared to females, an indication that males feed on different prey or in different locations to females (Miller 2015).

In summary, prior to 2008, Māui's dolphins were consuming a more nearshore, higher trophic level prey, and after either shifted to a more pelagic, lower trophic level prey, or their ecosystem experienced a decreasing trend in productivity. Either scenario might have conservation implications for the subspecies, whether in terms of potentially declining nutrient levels, climate change causing a shift in prey species, or animals having to forage in more offshore waters (Ogilvy *et al.* 2022). The isotope levels also demonstrate a dramatic shift in prey consumed during the 2015–2016 El Niño event.

Sea-surface temperatures influence the distribution of Māui's dolphins (Derville *et al*. 2016; Roberts *et al.* 2019), which may in turn be linked to the distribution of their prey. It is possible that climate change may be causing a shift in Māui's dolphin prey species, causing them to forage further offshore. The feeding behavior of the dolphins, and the potential impacts of climate change on the species, therefore, warrant continued monitoring (Ogilvy *et al.* 2022).

2.3.1.1.5 Social structure and behavior

No substantive new information on Māui's dolphin social structure and behavior has been published since the initial status review on the Māui's dolphin (Manning and Grantz 2017).

2.3.1.1.6 Movement

There is no substantive new information on the movement of Māui's dolphins, although Constantine *et al.* (2021) present some data on the movement of individuals gathered during their biopsy sampling program to estimate population size. In this study, the movements of individual animals could be monitored during and between survey years. The maximum distance reported between two sampling events for an individual was 32km, for a male dolphin over 15 days between biopsy samples. A female dolphin also travelled from south of Manukau to near Port Waikato, a 31km distance over a 29-day period. Four dolphins moved distances of 19km to 32km between sampling events, in 2020 and 2021 respectively, but nine animals moved fewer than 10km. One dolphin was observed in south Kaipara in 2020 and at a location just 3km away in 2021, suggesting at least some individuals have high degree of site fidelity in this northern part of their range (Constantine *et al*. 2021).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends

In the 2017 assessment of Māui's dolphins, the abundance estimate was 63 animals over one year of age (95% confidence interval: 57-75; Manning and Grantz 2017). This estimate was based on a genetic mark-recapture analysis using biopsy samples collected in 2015 and 2016 (Baker *et al*. 2016). Cooke *et al*. (2018) used an open-population model to produce an estimated abundance of 57 dolphins for 2016 (95% confidence interval: 44-75) using those same data. In a comparable study, samples from 2010 and 2011 estimated a population size of 55 (95% confidence interval: 48–69; Hamner *et al*. 2012). In contrast, the most recent genetic mark-capture analysis with samples from 2020 and 2021 estimated 54 animals (95% confidence interval: 48–66; Constantine *et al.* 2021). **Table 1** summarizes these abundance estimates for Māui's dolphins with the methods used for calculating these estimates.

However, the effective population size (i.e., the number of potentially reproductive individuals that could contribute to producing the next generation) is considerably lower for the Māui's dolphin. In 2001–2007, this was estimated to be 69 (95% confidence interval: 40–168; Baker *et al*. 2013), 68 in 2010–2011 (95% confidence interval: 34–293; Hamner *et al*. 2012), decreasing to 34 for 2015–2016 (95% confidence interval: 24–51; Baker *et al*. 2016) and 35 in 2020–2021 (95% confidence interval: 21–67; Constantine *et al*. 2021).

Assuming a 50:50 sex ratio, an effective population size of 35 (Constantine *et al.* 2021) means that there may only be 17 or 18 reproductively viable females. This low effective population size has obvious implications for the ability of the subspecies to recover (**Section 2.3.1.2.1**).

Several studies have attempted to extrapolate the historical size of the Māui's dolphin population prior to the introduction of monofilament set gillnets in 1970. Although assumptions about bycatch rates and distribution of animals can significantly affect estimates, most analyses produced a value in the low to mid hundreds (**Table 2**).

Wade *et al.* (2012) estimated an annual decline of 3% for the Māui's dolphin. Baker *et al.* (2016) estimated a 1-2% annual rate of decline between 2001 and 2016 and Slooten and Dawson (2016) estimated that the population has been declining at a rate of 2 percent per year between 1985 and 2016. Cooke *et al*. (2019) similarly estimated a population rate of decline of 3–4% per year between 2001 and 2016, using an individual-based population model based on genetic capture-recapture data from stranded and by-caught Māui's dolphin carcasses. This study took into account mortalities from bycatch and deaths attributable to disease (specifically toxoplasmosis and other anthropogenic threats).

Table 1. Summary of abundance estimates for Māui's dolphins with the method calculated. Because survey methodologies different between studies the results are not necessarily comparable.

Sampling Period	**Research Method**	**N**	**95% Confidence Interval**	**Reference**
1985	Small boat, line transect	140	46-280	Dawson and Slooten 1988
1998	Small boat	80	N/A	Russell 1999
2001/02	Aerial, line transect	75	48 - 130	Ferreira and Roberts 2003
2001	Genetic capture/ recapture	87	62 - 121	Baker *et al.* 2013
2001	Population modelling on genetic data	85	54 - 133	Cooke *et al.* 2018
2004	Aerial, line transect	111	48 - 252	Slooten *et al.* 2006
2006	Genetic capture/ recapture	59	19 - 181	Baker *et al.* 2013
2010-2011	Genetic capture/ recapture	55	48 - 69	Hamner *et al.* 2012
2015-2016	Genetic capture/ recapture	63	57 - 75	Baker *et al*. 2016
2016	Population modelling on genetic data	57	44 - 75	Cooke *et al.* 2018
2020-2021	Genetic capture/ recapture	54	48 - 66	Constantine *et al.* 2021

Table 2. Extrapolated estimates for historical Māui's dolphin population sizes.

1970 estimate	**Reference**
437, 448, 524	Martien *et al.* 1999
577	Burkhart and Slooten 2003
1729	Slooten 2007
227, 254, 208	Davies *et al.* 2008
2200	Slooten and Dawson 2010
300	MacKenzie 2020

2.3.1.2.1 The Allee effect

With the small restricted size of the Māui's dolphin population, in addition to vulnerability from catastrophic local events (e.g., a major oil spill or similar environmental event), or disease outbreaks (potentially exacerbated by low genetic diversity), the dolphins may be vulnerable to the ecological phenomenon known as the "Allee effect" (Stephens *et al.* 1999). When population sizes in certain species, particularly social animals (Angulo *et al*. 2018), drop below a certain level, there can be additional negative effects for these small populations. For example, it may be more difficult for animals to find mates. Their ability to cooperatively search for, and defend against, predators may be reduced. They may be less effective at foraging, as they lack sufficient numbers to effectively herd and trap prey. They may also have reduced reproductive success, as they lack numbers to cooperatively care for offspring (Stephens and Sutherland 1999; Stephens *et al.* 1999; Courchamp *et al.* 2008; Angulo *et al.* 2018). The lack of sexual segregation in Māui's dolphin, as compared to Hector's dolphins, might be an indicator of the Allee effect, i.e., all animals in the population may be contributing to cooperative activities regardless of sex, such as foraging. This may also explain the inclusion of SI Hector's dolphin's in Māui's dolphin groups, as discussed in **Section 2.3.1.3** below. (Hamner *et al.* 2014; Baker *et al.* 2016; Constantine 2021).

The low effective population size of Māui's dolphins (**Section 2.3.1.2**) is also likely to be reducing the population's reproductive success due to inbreeding depression (Charlesworth and Willis 2009), i.e., a lack of genetic diversity in a breeding population can lead to more frequent expression of deleterious genes that can reduce the fitness of offspring.

Soulé (1980) suggested the "50/500" rule regarding small populations of animals in conservation, which states that a minimum population size of 50 is necessary to combat inbreeding and a minimum population size of 500 is needed to reduce genetic drift.[5] However, Frankham *et al.* (2014) suggested that an effective population of more than 100 animals is required to prevent inbreeding depression. If inbreeding depression and the Allee effect are prevalent in this population, then it could lead to a reduction in survival and reproductive success.

In their spatial analysis and risk assessment for Māui's dolphins, Roberts *et al.* (2019) simulated some of the possible effects of inbreeding in a small population, which reduced the intrinsic rate of growth in their analysis from 0.05 to 0.045 (**Section 2.3.1.1.3**), although the social and behavioral effects on reproduction rate caused by the Allee effect were not incorporated.

Haider *et al.* (2017) proposed that, for small populations where the Allee effect may be a factor when calculating the limits of allowable human-caused mortality,[6] the final value should be approximately half to two-thirds that of populations not experiencing the Allee effect.

If cross-breeding is occurring between the SI Hector's dolphins and Māui's dolphins where they coexist, this might help to alleviate concerns over inbreeding. However, there is no evidence for this, despite the majority of the vagrant SI Hector's dolphins displaying haplotypes from multiple South Island populations, which suggests their parents have already at some time cross-bred with other SI Hector's dolphin populations (Baker *et al.* 2016; Constantine *et al.* 2021).

2.3.1.3. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding)

Among the biopsied Māui's dolphins in recent surveys, some of the animals have been confirmed to be SI Hector's dolphins. For example, Hamner *et al.* (2014) noted two female SI Hector's dolphins living in Māui's dolphin habitat. Constantine *et al.* (2021) reported one male and one female SI Hector's dolphin that had migrated to the North Island and into the range of the Māui's dolphins. The female SI Hector's dolphin (Che20NZ23) was first biopsied and identified in 2010, suggesting a permanent migration to the North Island (Constantine *et al.* 2021). However, the male had not been biopsied previously. Including these animals, since 2001 a total of four live SI Hector's dolphins (two females and two males) have been biopsied during surveys for Māui's dolphins. Altogether at least eight SI Hector's dolphins have been reported from the west coast of the North Island, four of which were amongst Māui's dolphins (Hamner *et al.* 2014; Baker *et al.* 2016; Constantine 2021).

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[5] The latter is the random genetic skewing of small populations, with normally rare genes becoming unusually common (Masel 2011; Star & Spencer 2013).

[6] The U.S. 1994 amendments to the 1972 US Marine Mammal Protection Act created the Potential Biological Removal (PBR) approach for setting human-caused mortality limits that would allow the recovery of imperiled marine mammal populations (Wade 1998). In New Zealand, government-set limits are referred to as the Population Sustainability Threshold or PST (Abraham *et al.* 2017; Roberts *et al.* 2019).

Although several of these vagrant animals have clear genetic characteristics of the South Island west coast subpopulation of Hector's dolphins, the majority also display South Island east coast subpopulation genetic characteristics (Baker *et al.* 2016), with the most recently discovered animal (Che20NZ42) also having south coast genetic characteristics (Constantine *et al.* 2021; **Fig1**). It is possible that this mixed east/west coast genetic profile may be the result of "wandering" parents cross-breeding with other SI Hector's dolphin populations.

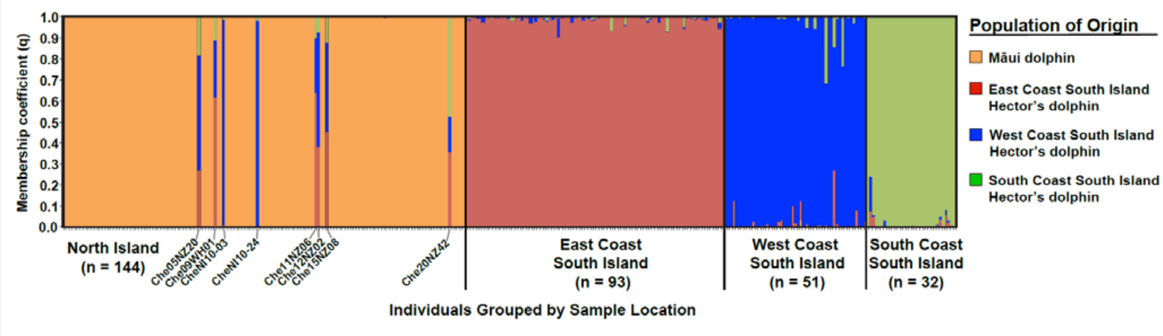

Figure 1. Assignment of individuals to the Māui's dolphin subspecies (*Cephalorhynchus hectori maui*) or to regional populations of SI Hector's dolphin populations via microsatellite genotype analysis. Each vertical bar represents an individual dolphin and is color-coded depending on whether it is from the Māui's dolphin subspecies (orange) or the East Coast (red), West Coast (blue) or South Coast (green) SI Hector's dolphin populations. Amid the Māui's dolphins, the eight SI Hector's dolphins found in the waters of the North Island can clearly be seen. Four of these animals (CheNI10-03, CheNI10-24, Che15NZ08 and Che20NZ042) have been observed associating with Māui's dolphins (from Constantine *et al.* 2021; reproduced with permission from the NZ Department of Conservation).

Despite these vagrant SI Hector's dolphins being found in North Island waters, there has, as yet, been no evidence of interbreeding between the SI Hector's and Māui's dolphins (Constantine *et al.* 2021). However, these instances illustrate that SI Hector's dolphins occasionally migrate over 400km from the west coast of the South Island to the west coast of the North Island.

Despite the lack of cross-breeding to date, this natural translocation of SI Hector's dolphins could help to alleviate the low genetic diversity of Māui's dolphins if they do hybridize. However, there are also concerns that interbreeding could cause outbreeding depression, i.e., when genetic adaptations to local conditions are lost in "hybrid" offspring (Marr *et al*. 2002), and this could in turn be detrimental to the fitness of the offspring (Constantine *et al.* 2021)

2.3.1.4 Taxonomic classification or changes in nomenclature

There has been no change in taxonomic classification or nomenclature since the initial status review of the Māui's dolphin (Manning and Grantz 2017).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range)

McGrath (2020) conducted a historical review of Māui's and SI Hector's dolphin distribution and abundance. He noted that not only were Māui's and SI Hector's dolphins historically the most commonly seen dolphin species in New Zealand waters, and found in groups of up to a hundred or more, but they were widespread around the coast of the North Island, as well as in harbors and estuaries. However, populations started to decline in the 1960s on the coasts of North and South Taranaki. In the 1980s, populations in Palliser (south North Island), Hawke's Bay (east North Island), Wairarapa (southeast North Island), Whānganui (southwest North Island), Kawhia and Piha (east coast North Island) likewise declined and/or were extirpated.

Stephenson *et al*. (2020) developed a spatial distribution model for New Zealand cetaceans using data from 1,051 sightings of Māui's dolphin and environmental variables that included bathymetry, turbidity, productivity, and temperature (see also **Section 2.4.1.5**). The results predict a nearshore distribution for Māui's dolphins, but with hotspots on the southwest coast, as well as an east coast distribution. This reinforces the conclusions of McGrath (2020) that there were populations on the southwest and east coasts of the North Island that have been extirpated.

At the time of the previous status review (Manning and Grantz 2017), Māui's dolphins were distributed along the northwest coast of the North Island of New Zealand, between Kaipara Harbour in the north and Whanganui in the south, with occasional sightings and strandings reported on the east coast of the North Island in Hawke Bay. Animals were most frequently sighted within 4 nautical miles (7.4km) of the coast but were sighted out to 7 nautical miles (13km) from shore (DuFresne 2010).

Māui's dolphin has, however, seen a notable change in its range, as recent sightings and stranding records are primarily between Manukau Harbour and Port Waikato, a stretch of coastline only 50km in length, within just a few kilometers of the shore. There have been a small number of sightings on the ocean side of the South Head peninsula, adjacent to Kaipara Harbour (**Fig. 2** and **Fig. 3**; Baker *et al.* 2016; Constantine *et al*. 2021). Sightings of Māui's dolphins appear to be more widespread, (**Fig. 4**; DuFresne 2010) with sightings being more frequent south of Port Waikato to Raglan (Dawson *et al.* 2001; Slooten *et al.* 2006; DuFresne 2010; Oremus *et al*. 2012).

Recent acoustic studies by Nelson and Radford (2019) and Wright and Tregenza (2019) deployed acoustic dolphin detectors (C-PODs) about 1 km from Hamilton's Gap, south of Manukau Harbour, and successfully detected Māui's dolphins.[7] Nelson and Radford (2019) also detected dolphins 8km (4.3 nm) offshore from Manukau Harbour with C-PODS. Other studies have been conducted to acoustically detect SI Hector's and Māui's dolphins (e.g. Rayment *et al.* 2011), but these earlier studies were limited to areas within harbors, and use of C-PODs could help to acoustically monitor for dolphins year-round over a wider area than currently surveyed by research vessels.

Importantly, detectors placed in the coastal waters of the Taranaki region also detected Māui's (or SI Hector's) dolphins during winter-spring months, with acoustic detections made as far south as Tapuae (to the north of Oakura) – the location of a marine reserve (Nelson and Radford 2019) – and near the southern limit of the North Island Marine Mammal Sanctuary. However, the researchers were unable to determine whether the detections were of SI Hector's dolphins moving northwards or Māui's dolphins occupying the southern part of their historic range (Nelson and Radford 2019). Since March 2000, the southernmost confirmed Māui's dolphins (as verified by genetic sampling) have been near Raglan; it is therefore possible that acoustically detected dolphins off of Taranaki could be SI Hector's dolphins.

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[7] Or potentially SI Hector's dolphins, as it is difficult to differentiate the two subspecies acoustically.

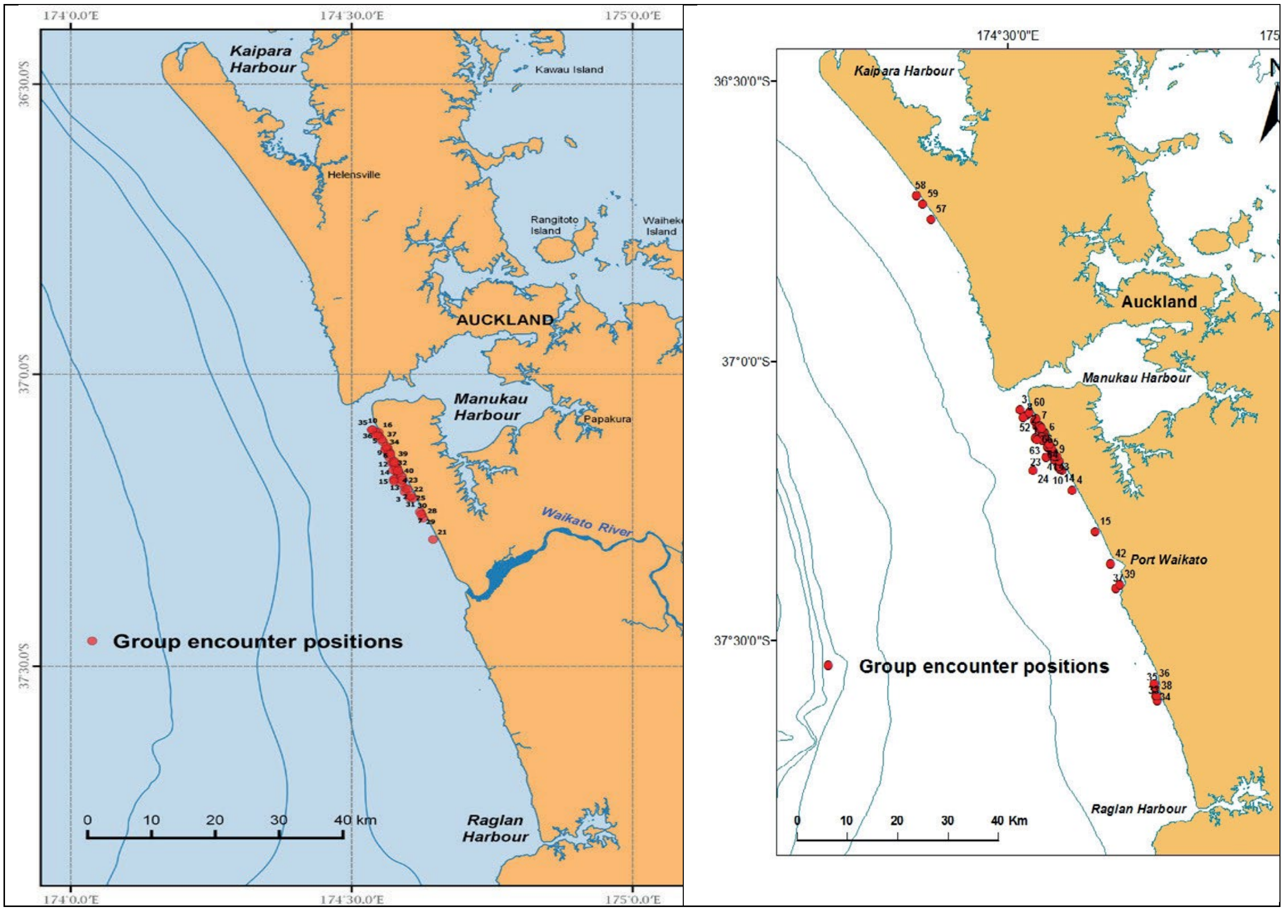

Figure 2. Encounters of Māui's dolphin groups in February-March 2015 and February-March 2016 (from Baker *et al.* 2016; reproduced with permission from the NZ Department of Conservation).

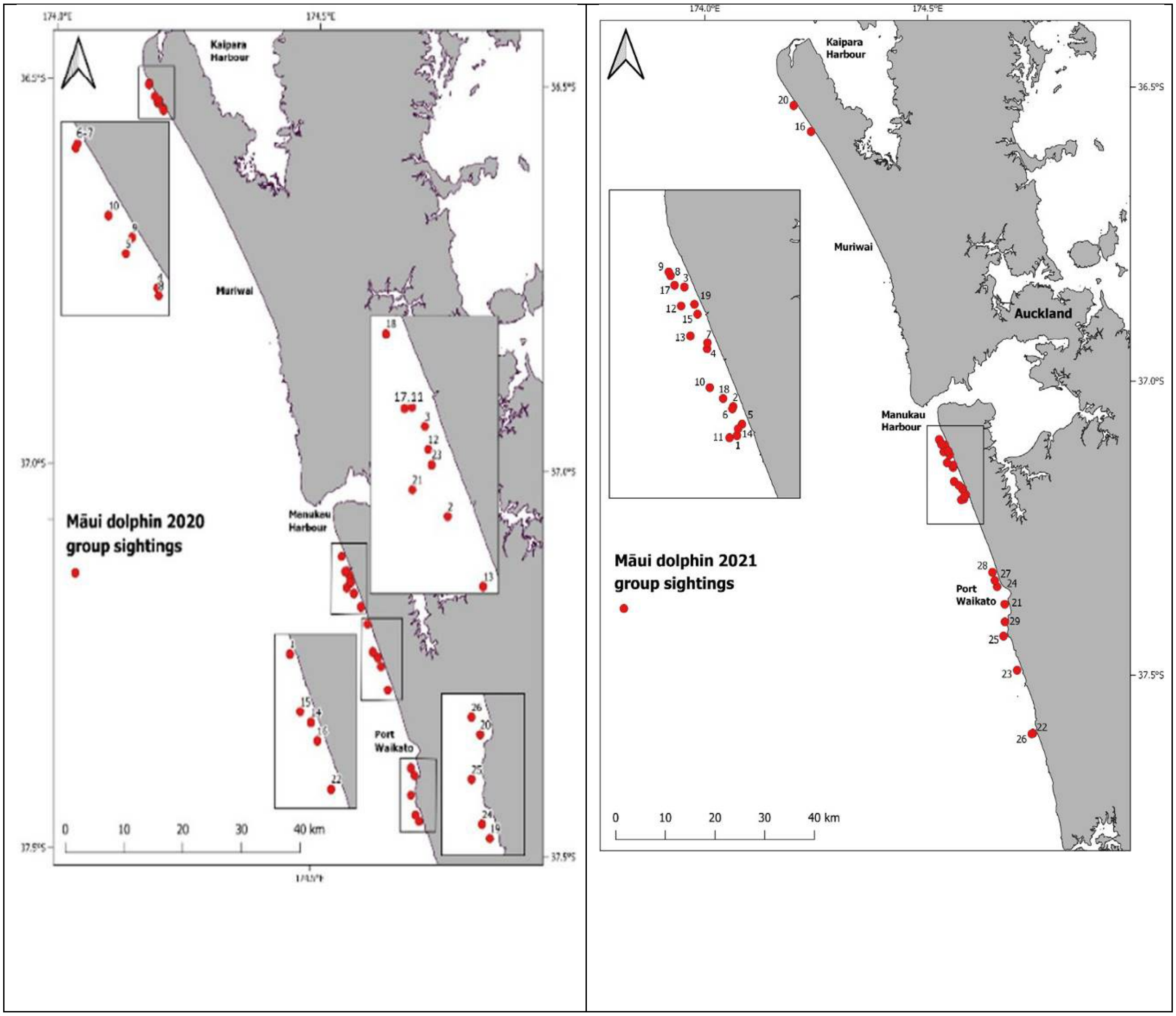

Figure 3. Encounters of Māui's dolphin groups in February 2020 and February-March 2021 (from Constantine *et al.* 2021; reproduced with permission from the NZ Department of Conservation).

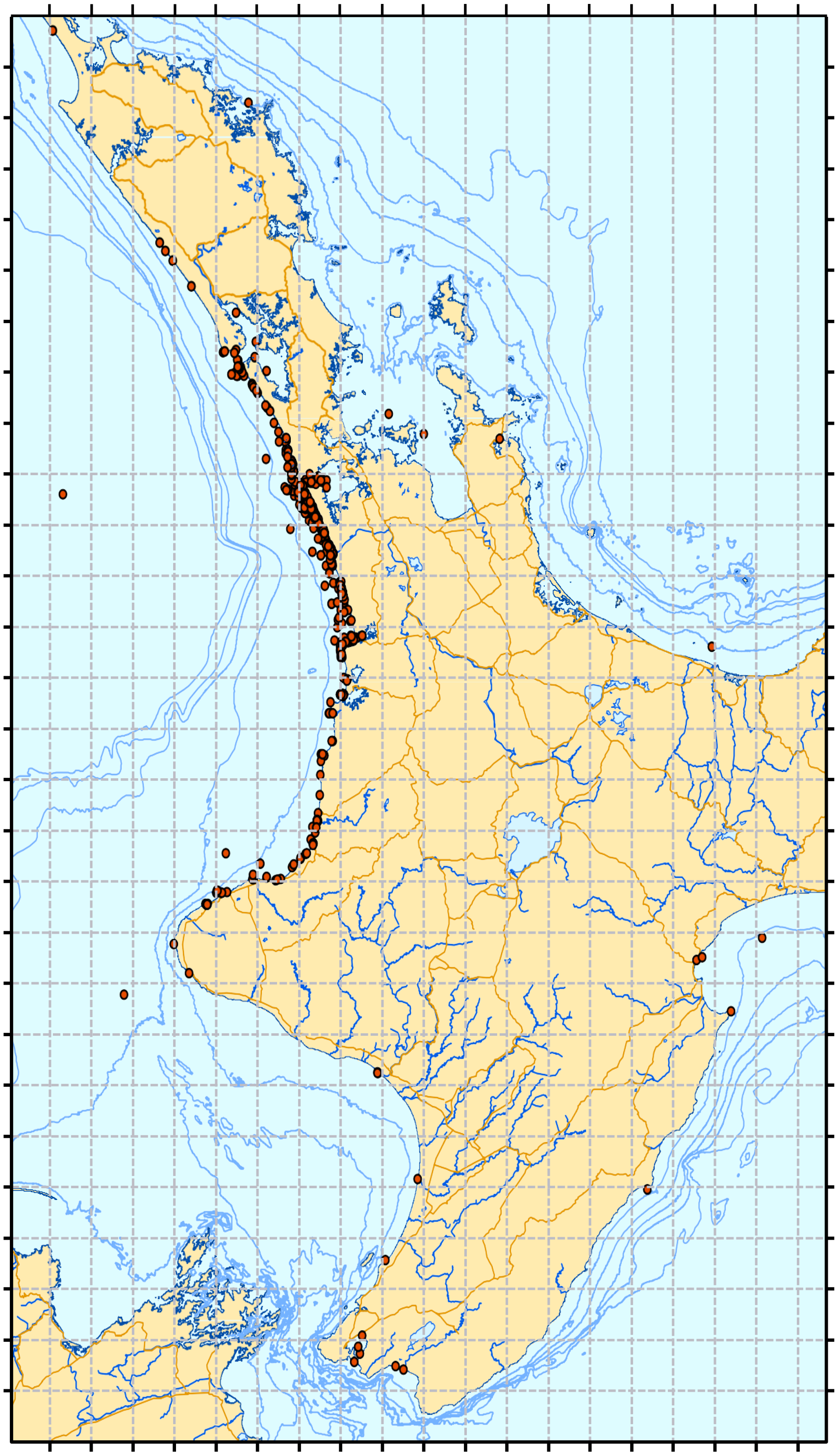

Figure 4. Historical Māui's (or South Island Hector's) dolphin sightings from 1920-2010 (from Dufresne 2010; reproduced with permission from the NZ Department of Conservation).

Because of the limited data on Māui's dolphin distribution, de Jager *et al*. (2019) used individual-based modelling to predict their potential distribution. The model was calibrated using empirical survey data, and the predicted distribution is shown in **Fig. 5**.

Roberts *et al.* (2019) developed a "Spatially Explicit Fisheries Risk Assessment" (SEFRA) model that used SI Hector's dolphin aerial survey data and opportunistic sightings of Māui's dolphins to develop habitat models, to then predict the seasonal distribution and density of Māui's dolphins (**Fig. 6**). This spatial model was overlapped with fisheries effort data to produce a risk model for fisheries interaction, injury, and mortality (i.e., fisheries bycatch). The model also incorporated estimations of dolphin deaths from disease (**Section 2.3.2.3.1**) and other possible causes of mortality. Roberts *et al.* (2019) then estimated a "Population Sustainability Threshold" (PST) or an estimated limit on the number of dolphin deaths to prevent the decline of the subspecies.

When presented to the Scientific Committee of the International Whaling Commission, the use of this spatial model, however, led to concerns from some scientists. This led to the development of a workshop held by the IWC Scientific Committee to discuss the applicability of this method to advise the management of Māui's dolphins (IWC 2023b). Issues related to by-batch estimates and population sustainability thresholds in Roberts *et al*. (2019) are described in **Sections 2.3.2.5.2** and **Section 2.3.2.5.3** below. The IWC Scientific Committee was not in agreement as to whether the methods, model variables, and data used in Roberts *et al.* (2019) were suitable to inform on the degree, and the spatial distribution, of threats on Māui's dolphins and, therefore, there was a lack of agreement as to whether Roberts *et al.* (2019) could be used for management advice recommendations (IWC 2023a). Discussion on this spatial model and SI Hector's dolphins can be found in **Section 2.4.2.4.1** and **Section 2.4.2.5.3.2**.

Sightings data in a New Zealand Government database suggest that there have been recent sightings and catches of Māui's dolphins from the east coast of the North Island (**Fig. 7**).[8] A number of sightings were reported in 2015 and 2016 from the east coast, a group of Māui's dolphins was sighted in 2020, and there was a Māui's dolphin by-caught in a recreational gill net in 2015 (Sea Shepherd 2020). Roberts *et al.* (2019) noted a population size of 10 dolphins for the area from Kapati (50 miles north of Wellington City) to Cape Reinga (northern tip of the North Island), suggesting that the New Zealand Government was aware of sightings in this region.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

As noted above (**Section 2.3.1.5**), the core range of the Māui's dolphin currently extends between Manukau Harbour and Port Waikato, but a small, consistent group of dolphins has been sighted just south of the entrance to Kaipara Harbour (Oremus *et al*. 2012; Hamner *et al*. 2014; Baker *et al*. 2016; Constantine *et al*. 2021). Their distribution is primarily close to shore (within 4km or 2.2 nautical miles) and they are often associated with turbid waters (Derville *et al*. 2016; Roberts *et al*. 2019). This association with turbid water may be due to these mixed and nutrient-rich waters also being good for prey, but it is also possible that turbid waters provide protection from some predators, as seen in some other coastal dolphins (e.g., Parsons 1998; Parsons 2004). In 2020–2021, the majority of re-sightings of surveyed Māui's dolphins was less than 10km apart (Constantine *et al.* 2021), suggesting that their range may be becoming more restricted (**Section 2.3.1.5**).

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[8] From an Institute of Water & Atmospheric Research Ltd (NIWA) sightings database received on October 22, 2019 through an Official Information Act request (similar to a FOIA (Freedom of Information Act) request in the US) - see Sea Shepherd (2020) for details.

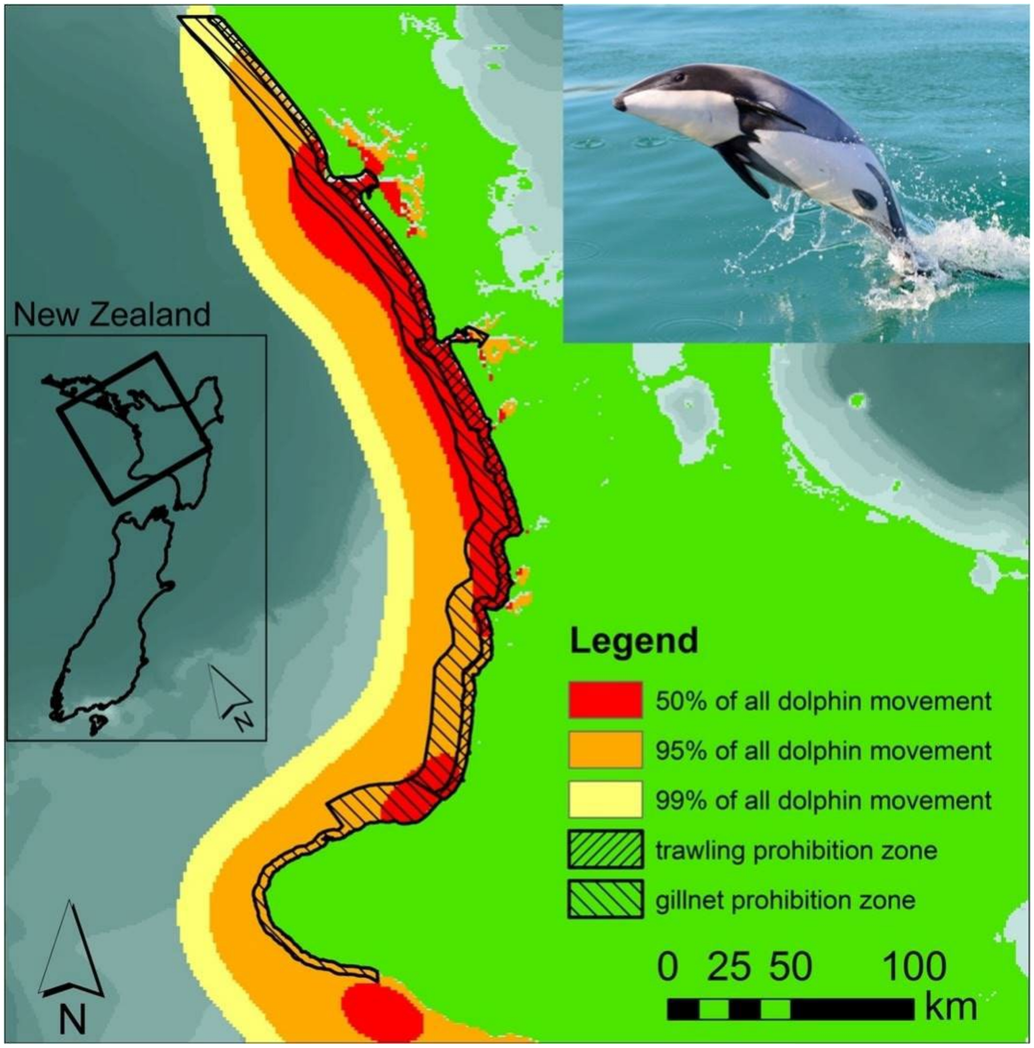

Figure 5. Māui's dolphin spatial distribution predicted by an individual-based model. The distribution map is overlaid with the current boundaries of fishing prohibition zones (from de Jager *et al*. 2019; reproduced with permission from Dr E. Slooten).

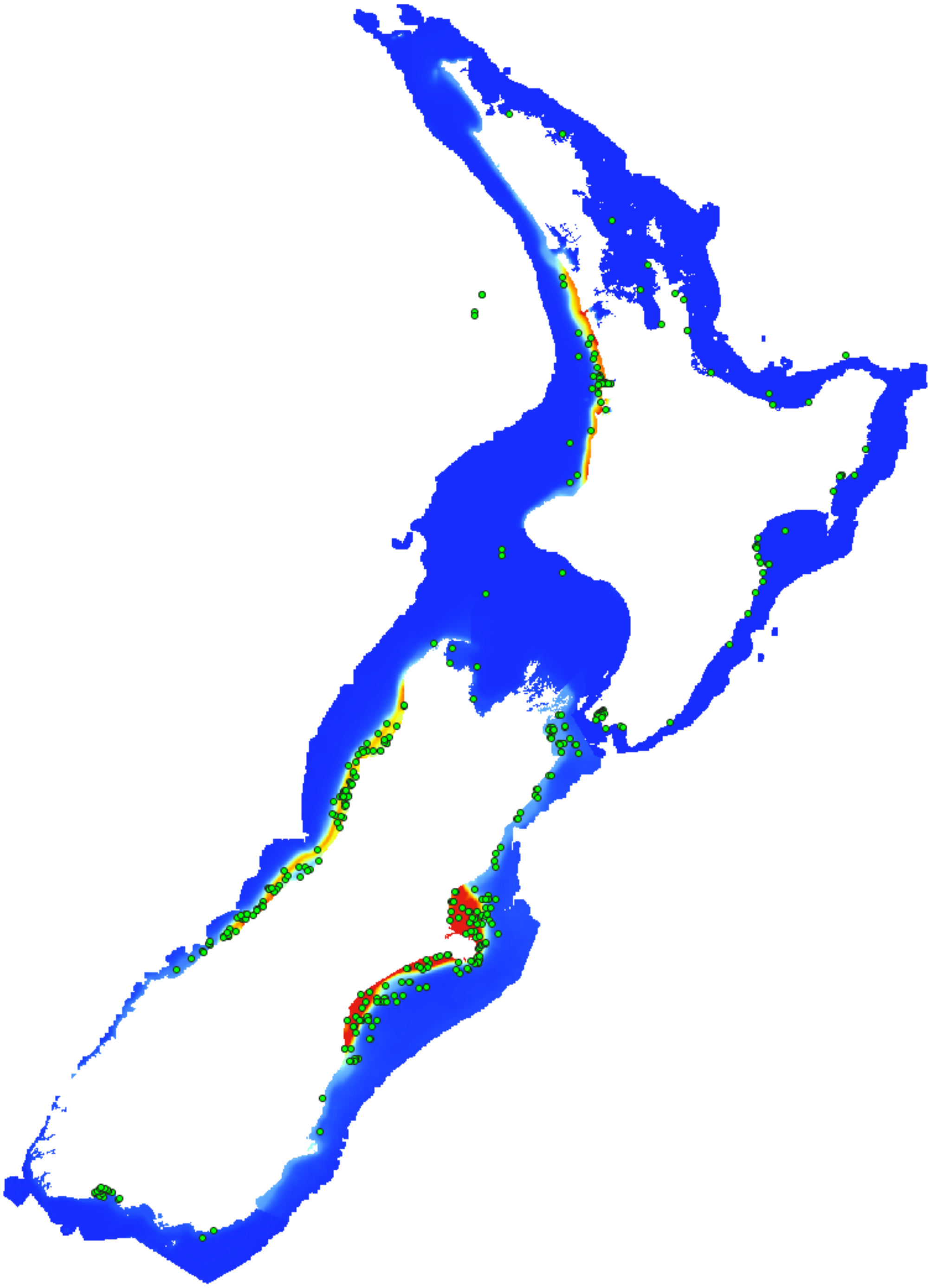

Figure 6. Māui's and SI Hector's dolphin spatial distribution predicted by the Roberts *et al.* (2019) SEFRA model. The green dots represent dolphin sightings. Methodologies for sightings information differ between the islands: North Island sightings include validated public sightings, whereas South Island sightings are from aerial surveys (reproduced with permission from Fisheries New Zealand).

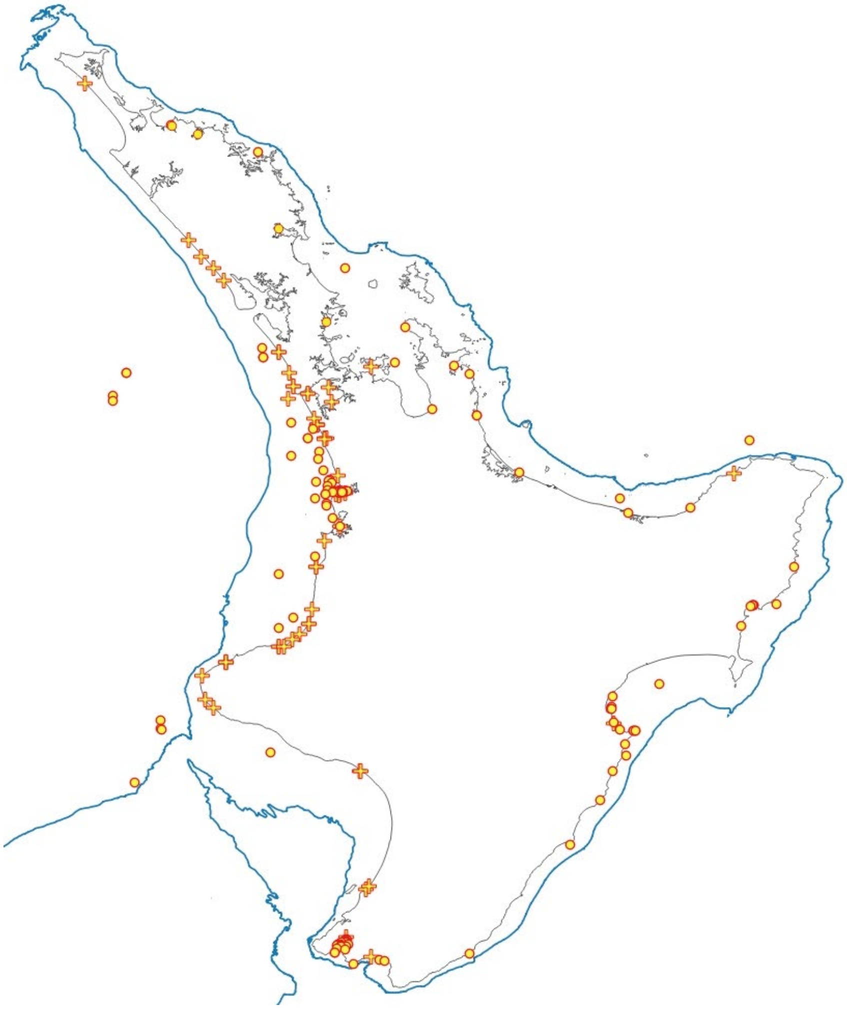

Figure 7. Māui's dolphin sightings (circles) and strandings (crosses) from the NIWA/New Zealand Government sightings database – there are a notable number of sightings on east coast of the North Island (from Slooten 2024; reproduced with permission).

Most of our information on Māui's dolphin distribution, habitat use, and behavior is restricted to the austral summer (i.e., February to March) and information about their ecology and distribution outside this period is limited. Year-round acoustic monitoring of potential Māui's dolphin habitat may help to fill in data gaps (**Section 2.3.1.5**).

Like SI Hector's dolphins, Māui's dolphins appear to feed on small nearshore demersal fish species, although recently more offshore bathypelagic species appear to be preferred (Miller *et al*. 2013; Ogilvy *et al*. 2022). Richards *et al*. (2019) noted that the habitat of Māui's dolphins is less productive than the habitat of SI Hector's dolphins.

A dramatic shift in prey preference during the major 2015–2016 El Niño event, as suggested by a change in stable isotope levels during that period (Ogilvy *et al.* 2022) – plus a recent shift from nearshore prey to lower trophic level, more offshore prey – may be an indicator of the ecology of Māui's dolphins altering in response to climate change (Ogilvy *et al.* 2022), as noted above (**Section 2.3.1.1.4)** and in the section on climate change below (**Section 2.3.2.1.4**).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range

2.3.2.1.1 Contamination/pollution

There has only been one major study on pollutants in Māui's dolphins to date. Stockin *et al.* (2010) investigated organochlorine contaminant levels in Hector's dolphins, from a sample that included three Māui's dolphins (**Table 3**). However, Stockin *et al*. (2007, 2021a) also investigated trace element levels in New Zealand common dolphins (*Delphinus delphis*) and Lischka *et al.* (2021) analyzed trace element levels in stranded pilot whales (*Globicephala melas)*. Both studies found mercury in the tissues of examined cetaceans, which was of a level that could potentially cause toxic effects in some animals.[9] Cadmium levels were also relatively high in the pilot whales analyzed,[10] which might be due to a cadmium-rich diet (squid) or due to the historic use of high cadmium fertilizers in New Zealand agriculture (Williams and David 1973).

Stockin *et al.* (2021a) also investigated levels of perfluorinated hydrocarbons in New Zealand common dolphins. These contaminants are not produced in New Zealand, but levels of this potentially toxic contaminant were comparable to those found in other cetacean populations.

In recent years, the threat that ingested microplastics (plastic particles less than five millimeters in size) might pose to cetaceans has been raised. Stockin *et al.* (2021b) found microplastics in the stomachs of all examined common dolphins (n = 15) found stranded along the New Zealand coast in 2019 and 2020. There were an average of 7.8 plastic fragments (77%) or fibers (23%) in the dolphins' stomachs, ranging in size from 0.58mm to 1.57mm. It is a reasonable assumption that Māui's dolphins are similarly ingesting microplastics from both contaminated prey and their environment.

Table 3. Summary of organochlorine contaminants reported in the Māui's dolphins in Stockin *et al*. (2010). The notation "n.d." means the contaminant was not detectable.

Contaminant	Range (µg.kgg^{-1} wet weight)
β-HCH	n.d.
γ-HCH	n.d.–0.27
HCB	5.7–15.0
Dieldrin	7.7–110
Heptachlor-epoxide	n.d.
α-Chlordane	1.6–11
γ-Chlordane	n.d.
DDTs	273–2151
PCBs	192–1516

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[9] Up to 110 µg g^{-1} wet weight in common dolphins and 705 µg g^{-1} dry weight in pilot whales (Stockin *et al.* 2007; Lischka *et al.* 2021).

[10] Up to 614 µg g^{-1} dry weight (Lischka *et al.* 2021).

2.3.2.1.2 Mining

The continental shelf area of New Zealand has a number of mineral resources that are potential targets for seabed mining (**Fig. 8**). In particular, deposits of sand and iron ore can be found in Māui's dolphin habitat. In 2016, an application was made to extract 50 million tonnes of iron-rich seabed material annually from south of Taranaki (Lucke *et al.* 2019), with an associated discharge of 45 million tonnes of waste. Although initially granted a permit by the New Zealand Environmental Protection Authority, a court case was lodged and eventually the company withdrew its application to mine in March 2024.[11]

Seabed mining is technically prohibited within the West Coast North Island Marine Mammal Sanctuary, although companies possessing previous permits are exempted from this ban and, therefore, active permits exist for exploratory activities within the southern part of the Sanctuary, as well as for active mining and exploration in potential Māui's dolphin habitat off of Taranaki (Lucke *et al.* 2019; **Fig. 8**). Otherwise, there are currently no restrictions on permits for coastal and offshore mineral extraction exploration or production in New Zealand waters.

There are several minerals found in New Zealand waters, such as cobalt and manganese (**Fig. 8**), which are currently in high demand for the manufacture of rechargeable batteries, and, although these are not currently being exploited, this may change in the near future.

There are increasing concerns about the potential impacts of seabed mining on cetaceans, not only for the high levels of noise such mining activities are predicted to produce, but also the potential ecosystem impacts of seabed degradation and sediment plume production (Williams *et al.* 2012; Thompson *et al.* 2023). The lack of regulation of seabed mining and the potential for long-lasting environmental impacts led to the Scientific Committee of the International Whaling Commission to express their concerns (Rose *et al.* 2024; IWC 2024c). Therefore, this could be a future issue for Māui's dolphins.

2.3.2.1.3 Oil and gas extraction

The Taranaki Basin is currently the only oil and gas producing area in New Zealand, with over 400 onshore and offshore exploration and production wells drilled to date (MacDiarmid *et al.* 2011). Although the New Zealand Government announced in 2018 that it would not be issuing any further oil and gas exploration permits, existing permits will continue. Lucke *et al.* (2019) noted 22 oil and gas exploration permits within the Taranaki Basin and the west coast of the North Island, as well as the east coast of the North Island and southeast coast of the South Island adjacent to Hector's dolphin habitat (**Fig. 9** and **Fig. 10**). However, the last oil and gas exploration permit outside of the Taranaki Basin area (**Fig. 10**) expired in 2021 (Watson 2021).

Moreover, there are seven active drilling permits within the Taranaki Basin, including one active platform within the West Coast North Island Marine Mammal Sanctuary (**Fig. 11**). Despite seabed mining technically being banned within the West Coast North Island Marine Mammal Sanctuary, oil drilling is nevertheless allowed within the sanctuary area.

In 2024, the New Zealand Government announced that it was considering repealing the oil and gas exploration ban and suggested that it may issue oil and gas exploration permits in the near future (Jones 2024).

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[11] https://www.epa.govt.nz/public-consultations/decided/trans-tasman-resources-limited-2023-reconsideration/.

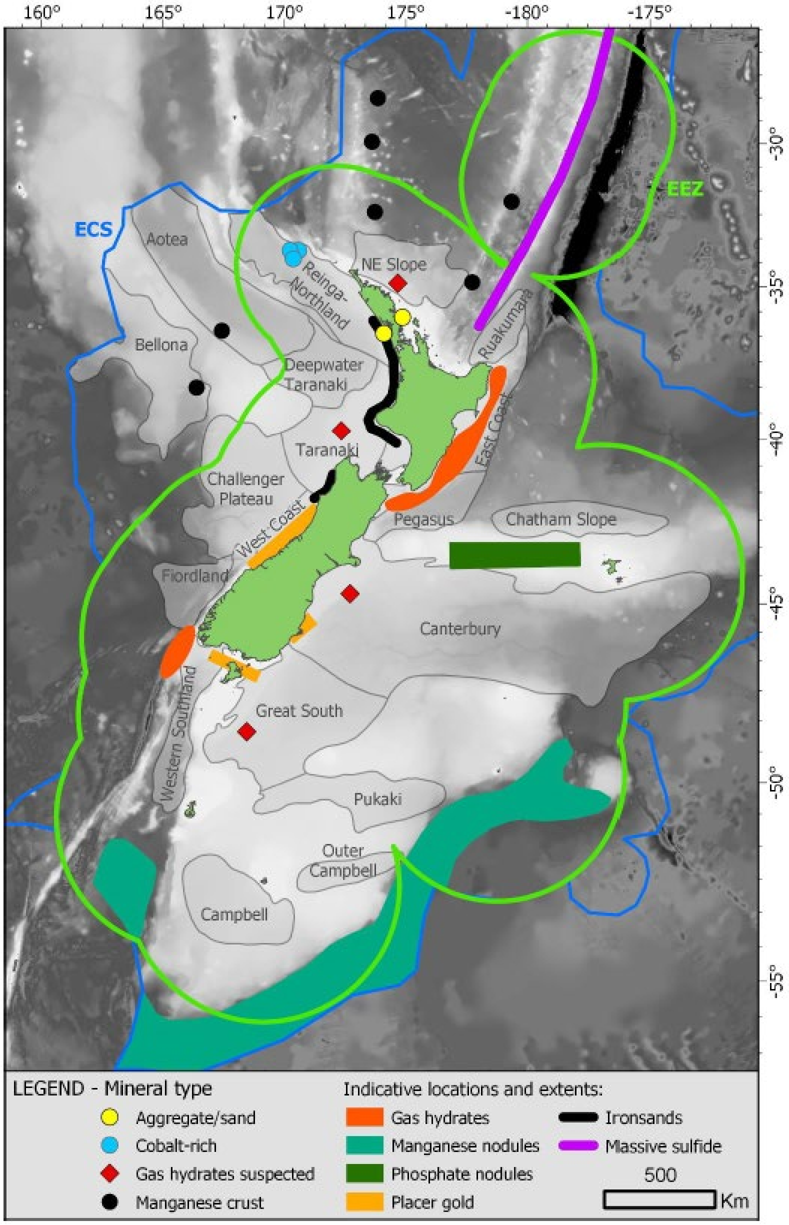

Figure 8. The location of mineral and hydrocarbon resources in New Zealand waters (from Lucke *et al.* 2019; reproduced with permission from the NZ Department of Conservation).

Exploration for oil and gas reservoirs, as well as monitoring the status of these reservoirs, involves high intensity sound production in the form of seismic surveys (see **Section 2.3.2.4.3.1**). Oil drilling operations involve other sources of noise (e.g., pile driving and drilling; see **Section 2.3.2.4.3.2**), increased levels of boat traffic to service the platforms, and environmental degradation from toxic chemicals (such as drill lubricants) and sedimentation (Lucke *et al.* 2019), as well as carry the potential for oil spills.

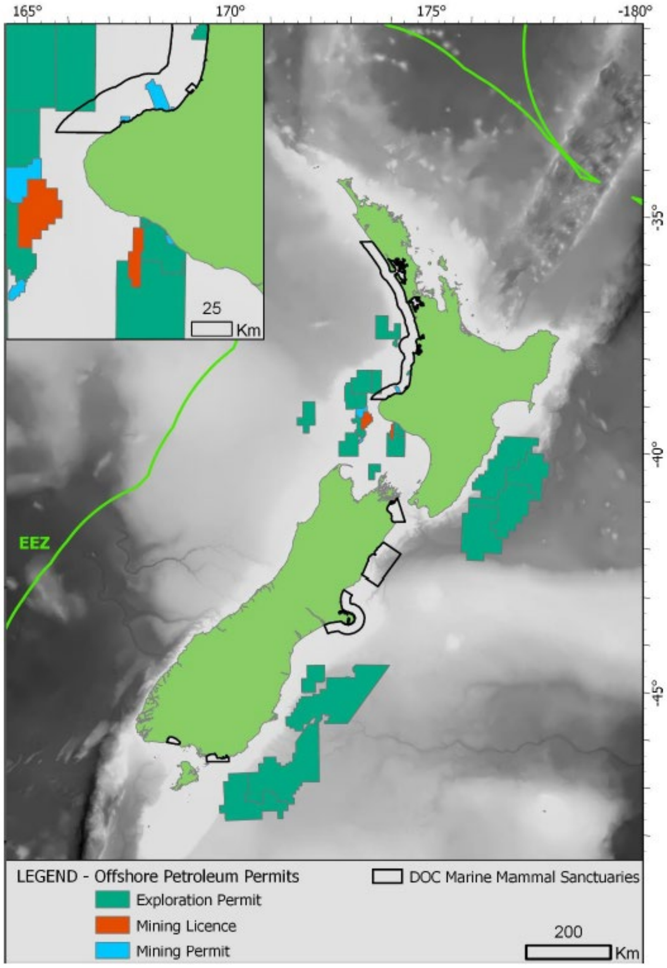

Figure 9. Areas permitted for mining and oil and gas exploration (from Lucke *et al.* 2019; reproduced with permission from the NZ Department of Conservation).

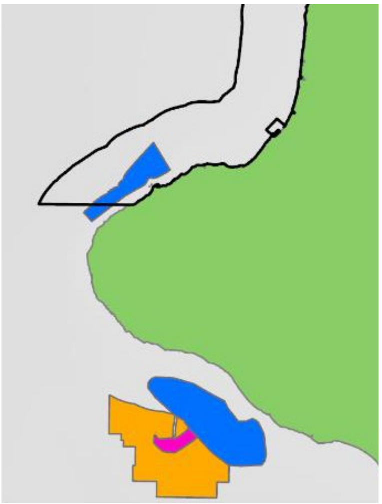

Figure 10. The locations of mineral exploration (blue), mining license (orange), and permit (magenta) blocks within and adjacent to the West Coast North Island Marine Mammal Sanctuary (Lucke *et al.* 2019; reproduced with permission from the NZ Department of Conservation).

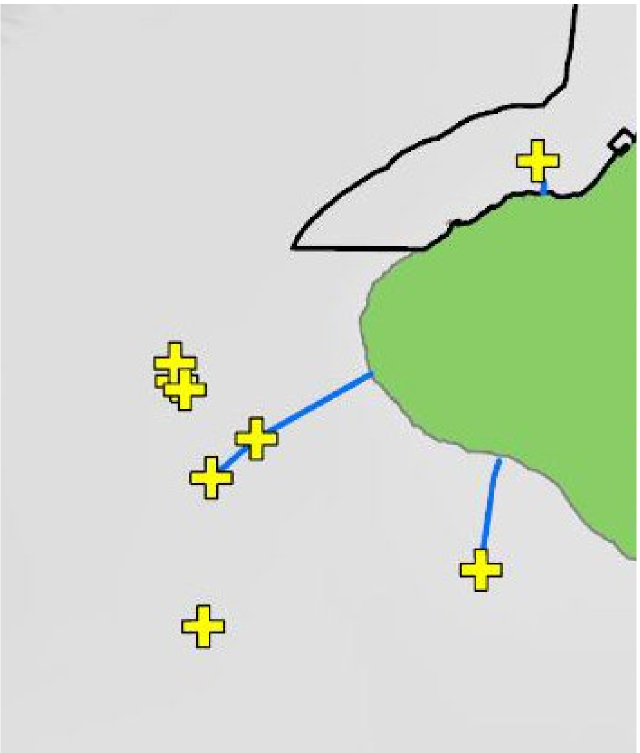

Figure 11. Oil wells in operation off of the coast of Taranaki. The border of the West Coast North Island Marine Mammal Sanctuary is shown (from Lucke *et al.* 2019; reproduced with permission from the NZ Department of Conservation).

The Deepwater Horizon oil spill in April 2010 is probably the best-documented example of the potential impacts of oil spills on cetaceans. Ackleh *et al.* (2012) reported that sperm whale abundance and acoustic detections decreased substantially around the spill site. Moreover, during and immediately after the spill, 122 cetaceans stranded, a rate more than three times the annual average over the following three years (Stachowitch *et al.* 2014), although it has been suggested that the actual mortality may have been an order of magnitude higher than this (Williams *et al.* 2011).

An analysis of stranding patterns after the spill found the highest stranding rates ever recorded in Louisiana in 2010-11, high levels in 2011 for both Mississippi and Alabama, and hotspots of strandings in multiple locations around the Gulf of Mexico in early 2013 (Venn-Watson *et al.* 2015a). Stranded animals were much more likely to show signs of pneumonia (which was often a likely cause of death) and a thin adrenal cortex (indicating animals under stress; Venn-Watson *et al.* 2015b). Oil inhaled by the cetaceans had likely lead to pneumonia and/or damaged their immune systems (Venn-Watson *et al.* 2015b). After the spill, reproductive rates in dolphins impacts by the spill declines by a third to three-quartets (Lane *et al.* 2015; Kellar *et al.* 2017) and elevated levels of lung disease were observed in dolphins four years after the event (Smith *et al.* 2017). In particular, dolphins in Barataria Bay, Louisiana, an area that received heavy and prolonged oiling, showed several disease conditions consistent with oil exposure. Dolphins showed evidence of adrenal toxicity and were five times more likely to have moderate to severe lung disease (Schwacke *et al.* 2014). Moreover, dolphin calves exposed to the Deepwater Horizon spill were more likely to have died *in utero* or very soon after birth (Colegrove *et al.* 2016).

With active drilling of oil to the southwest of the main habitat of Māui's dolphin, there is a potential risk of oil spills, which could have major long-term effects on the dolphin subspecies.

2.3.2.1.4 Climate change

The frequency of marine heatwaves in New Zealand coastal waters has increased over the past decade. The heatwave that occurred in summer 2017/18, for example, led to a 3.7°C increase in water temperatures in the Tasman Sea (Salinger *et al.* 2019). However, between 2022 and 2023, oceanic and coastal waters around New Zealand reached the highest annual temperatures recorded to date. The western North Island, the main habitat for Māui's dolphins, experienced heatwave conditions for 89% of 2022 (Corlett 2024).

Between 1982 and 2023, sea-surface temperatures increased on average 0.16-0.26ºC per decade in oceanic waters and between 0.19-0.34ºC per decade in coastal waters.[12] The rate of ocean surface warming around New Zealand is double that of the global average of 0.18ºC per decade (Corlett 2024).

Ogilvy *et al.* (2022) noted a shift in stable isotope signatures in Māui's dolphins during the heatwave, indicating a potential shift in prey species consumption. Temperatures such as those measured during summer 2017/2018 are likely to be typical temperatures under even the most moderate climate change predictions[13]for the latter decades of the century (Salinger *et al.* 2019).

Therefore, it is likely that the current prey of Māui's dolphins will shift into cooler offshore and/or deeper waters as temperatures increase. This could lead to a corresponding shift in the distribution of dolphins into more offshore waters, where they may not have protection from entanglement in fishing gear.

Ogilvy *et al.* (2022) was of the opinion that Māui's dolphins could adapt to changes in climate by switching prey species (**Section 2.3.1.1.4** and **Section 2.3.1.6**). However, in other areas where seabirds and marine mammals have switched prey species due to changing climatic regimes or anthropogenic activities, new prey species have been nutritionally poorer than the original prey (Rosen and Trites 2000; Trites and Donnelly 2003; Österblom *et al*. 2016). If this is also the case with Māui's dolphins, it may have an impact on their health and fitness.

The impacts of climate change on prey availability and distribution, turbidity, weather conditions, productivity, water temperature, and other Māui's dolphin habitat parameters, are currently unknown and need to be evaluated. Likewise, the possible effects of climate change on the diet and nutritional status of Māui's dolphins is an area of research that may be warranted.

2.3.2.1.5 Summary

At present, pollution and oil extraction are additional stressors to Māui's dolphins. Existing pollutant levels have the potential to increase the dolphins' vulnerability to disease and to negatively affect reproductive rates. Likewise, ongoing mining and oil extraction activities are adding to physical and acoustic degradation of existing and potential Māui's dolphin habitat. With active oil production in the Taranaki Basin, there is also the potential risk of oil spills in the southern portion of Māui's dolphin habitat.

Although the potential impacts are currently unknown, the rapid temperature increases observed in New Zealand coastal and oceanic waters may cause shifts in distribution of Maui's dolphins or their prey.

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[12] Stats New Zealand (2024) https://www.stats.govt.nz/indicators/sea-surface-temperature-data-to-2023/.

[13] Salinger *et al.* (2019) state that the heatwave temperatures may be typical of average New Zealand summer climate for 2081–2100 under the RCP4.5 (1.8ºC warming by 2080-2100; range 1.1-2.6 ºC) or RCP6.0 (2.2ºC warming by 2080-2100; range 1.4-3.1 ºC) climate change scenarios. In comparison, for ESA decisions involving species impacted by climate change, NMFS uses climate indicator values projected under the IPCC's Shared Socioeconomic Pathway (SSP) 3-7.0 (i.e., 3.6ºC warming by 2080-2100 range 2.8-4.6 ºC).

These impacts could quickly become significant if dolphins move into areas where they are not protected from entanglement in fishing gear or if a shift in prey species results in poorer health and fitness, and should be further investigated.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

2.3.2.2.1 Commercial utilization – harvesting and trade

No threats related to overutilization have been identified for this subspecies since it was listed in 2017 (Manning and Grantz 2017).

2.3.2.2.2 Dolphinwatching

When the subspecies was listed in 2017 (Manning and Grantz 2017), there was some evidence that commercial dolphin-watching vessels and swim-with-dolphin operations were causing changes in the behavior of SI Hector's dolphins (Bejder *et al*. 1999; Constantine 1999; Martinez 2010; Martinez *et al*. 2010). However, there is notably less dolphin-related tourism within the range of Māui's dolphins. Dolphin-related tourism could, however, disturb Māui's dolphins and add an additional stressor within their habitat (Currey *et al.* 2012). Moreover, there is the risk that tourism vessels could strike and injure, or even kill, dolphins (Parsons 2012). However, dolphinwatching was not considered to be a major threat to Māui's dolphins (Currey *et al.* 2012; Manning and Grantz 2017). Dolphin-related tourism is more common in the coastal waters of the South Island and there are active industries in several areas of key SI Hector's dolphin habitat (Martinez 2010). Therefore, dolphinwatching is more of concern for SI Hector's dolphin populations (see **Section 2.4.2.2.1).**

2.3.2.2.3 Scientific monitoring

No threats related to scientific monitoring have been identified for this subspecies since it was listed in 2017 (Manning and Grantz 2017).

2.3.2.3 Disease or predation

2.3.2.3.1 Disease

The disease toxoplasmosis has been identified as a possible factor causing death or reduction in reproductive capability in Māui's and SI Hector's dolphins. Roe *et al.* (2013) identified an atypical strain of *Toxoplasma gondii* and named this as the cause of death in seven dolphins, two of which were Māui's dolphins. Subsequently, a third infected individual has been found (Roberts *et al*. 2021).

T. gondii is a protozoan (single-celled) parasite that is most commonly found in cats. It is a zoonotic parasite, able to pass to other hosts, including domesticated animals, marine mammals and humans (Dubey 2010; Tenter *et al.* 2000). The parasite has been detected in New Zealand sea lions (*Phocarctos hookeri*) (Michael *et al.* 2016; Roe *et al*. 2017). Human populations often have a quarter or more of the population infected with the parasite, with rates sometimes as high as 90% (Aguirre *et al.* 2019). In New Zealand, human infection rates are 35% - 50% (Zarkovic *et al.* 2007). The parasite has been reported in several dolphin species in the Mediterranean (Di Guardo *et al.* 2010; Traversa *et al.* 2010; Grattarola *et al.* 2016; Bigal *et al.* 2018) and the coast of South America (Gonzales-Viera *et al.* 2013; Costa-Silva *et al.* 2019), as well as in captive dolphins (Dubey *et al.* 2009; Herder *et al.* 2015). Moreover, there is evidence of at least one human contracting brucellosis from an infected marine mammal (Brew *et al.* 1999).

Although toxoplasmosis can affect reproductive rates by causing fetal abnormalities and stillbirths (Tenter *et al*. 2000), it can also be fatal in cetaceans (Herder *et al.* 2015; Dubey *et al.* 2020). Generally, the parasite only causes disease in animals with compromised immune systems. It has been suggested that the strain detected in New Zealand could be highly pathogenic (Department of Conservation 2020), but other factors may compromise marine mammal immune systems, such as trace element exposure (Bennett *et al*. 2001; Cámara Pellissó *et al*. 2008); organochlorine pollutants (Aguilar and Borrell 1994; Ross 2002 Schwacke *et al.* 2012; Hall *et al*. 2018); and chronic stress (Curry 1999), such as that caused by anthropogenic noise exposure (Wright *et al.* 2009, 2011; Rolland *et al.* 2012). A lack of genetic diversity in Māui's dolphins could also make them more vulnerable to disease – a condition that has negatively affected other threatened mammal populations (e.g., Miller *et al.* 2011; Murchison *et al.* 2012; Dobrynin *et al.* 2015).

The parasite can be spread into the marine environment by the waste of feral or outdoor cats being transferred into the ocean via surface runoff (Shapiro *et al*. 2019), or from cat litter deposited in landfills or flushed into the sewage system (Department of Conservation 2021).

New Zealand has one of the highest levels of cat ownership in the world – 44% of households own at least one cat (Department of Conservation 2020), with nearly 90% of these cats allowed outside by their owners (Department of Conservation 2021). This is in addition to a large stray/feral cat population. However, as noted, humans can also carry the parasite undetected, and human sewage can be a secondary source of the pathogen.

Detection of the pathogen in dolphins requires fresh carcasses (which are relatively rarely discovered in New Zealand) or a pathogen detection and health assessment research program on wild animals – there is no such program in New Zealand at present (Roberts *et al.* 2021). Therefore, the extent of the problem in Māui's dolphins is currently unknown. However, even a single additional mortality, or a reduction in the rate of successful reproduction, could be critical for this subspecies.

Roberts *et al.* (2019b) estimated that toxoplasmosis could be responsible for approximately two (range: 0.5-3.3) Māui's dolphin deaths per year. Cooke *et al.* (2019) also predicted that toxoplasmosis could have significant impacts on Māui's dolphins and, even without mortalities from bycatch and other anthropogenic factors, mortalities from this disease alone could potentially cause a decline in the subspecies.

The New Zealand Government has produced a toxoplasmosis action plan[14] to mitigate the risk of the pathogen to Māui's dolphins. The approaches in the plan essentially revolve around reducing the transfer of toxoplasma from cats to the environment and from the environment into the ocean. The former involves reducing the feral cat population while trying to encourage cat owners to keep their pets indoors and dispose of cat litter appropriately. The latter approach involves reducing runoff into the ocean by restoring wetlands, planting vegetation next to rivers, and better managing and treating stormwater.

However, Slooten and Dawson (2021b) noted that while several Māui's and SI Hector's dolphins have died of toxoplasmosis (Roe *et al.* 2013), they considered the impact of this disease to be substantially overstated. Moreover, they thought the Government's toxoplasmosis plan would have little effect – while culling the cat population might benefit urban bird populations, it was not clear that this would be of major benefit to Māui's or Hector's dolphins (Slooten and Dawson 2021b). It was also likely that the New Zealand public would oppose a feral cat cull. Also, if there was a cull of feral cats, the large population of outdoor pet cats would still exist.

In addition, the pathogen *Brucella* has been isolated in Māui's and SI Hector's dolphins and it is believed to be the cause of death of an adult female SI Hector's dolphin and a stillborn Māui's dolphin

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[14] https://www.doc.govt.nz/nature/pests-and-threats/diseases/toxoplasmosis-and-hectors-and-maui-dolphin/toxoplasmosis-action-plan/.

calf (Buckle *et al*. 2017). Several studies have described the presence of the *Brucella* bacterium in marine mammals (Ewalt *et al.* 1994; Foster *et al.* 1996; Ross *et al.* 1996; Jepson *et al.* 1997; Foster *et al.* 2002; Maratea *et al.* 2003; Ohishi *et al.* 2003). *Brucella* spp. infection can lead to lesions in a variety of cetacean tissues and organs, including the digestive system, muscle, heart, liver, lung, brain, and reproductive tissues (González *et al*. 2002; Jauniaux *et al.* 2010; Olsen and Palmer 2014; Venn-Watson *et al.* 2015; Colegrove *et al.* 2016), which can be fatal (Foster *et al.* 2002; Dagleish *et al*. 2007). Of the 27 dead SI Hector's and Māui's dolphins examined by Buckle *et al.* (2017), 26% of SI Hector's dolphins had tissues that tested positive for the presence of *Brucella* DNA, and 37% displayed lesions consistent with *Brucella* infection. Two animals had lesions in reproductive tissues, indicating the potential for the pathogen to damage reproductive rates, even if it is not fatal to infected individuals.

2.3.2.3.2 Predation

Predation of Hector's dolphins (both subspecies) by several shark species, such as seven-gill sharks (*Notorhynchus cepedianus*) and blue sharks (*Prionace glauca*), is known to occur; however, predation rates are not known (Slooten and Dawson 1988). Manning and Grantz (2017) did not consider predation to be a factor affecting the survival of Māui's dolphins and no significant new information on predation has been published since this initial status review.

2.3.2.4 Other natural or manmade factors affecting its continued existence

2.3.2.4.1 Bycatch and entanglement by fishing gear

2.3.2.4.1.1 Gillnet fisheries

Concern about Māui's dolphins dying at unsustainable rates in set gillnet fisheries was first raised in the late 1990s (Martien *et al.* 1999) and early 2000s (Slooten *et al.* 2000; Dawson *et al.* 2001). Consequently, in 2003, the West Coast North Island Marine Mammal Sanctuary was established. The Sanctuary extended from Maunganui Bluff in Northland to Oakura Beach in Taranaki, from the coast to 12 nautical miles (nm) or 22.2km offshore. Within the Sanctuary boundaries, set gillnets (both recreational and commercial) were initially prohibited out to 4nm (7.4km) from the coast, which was subsequently extended to 7nm (13km) (**Fig. 12**). In addition, restrictions were imposed on seismic surveys and mining within the Sanctuary (**Section 2.3.2.1.2, Section 2.3.2.1.3** and **Section 2.3.2.4.3.1**).[15] Moreover, driftnets have been banned throughout New Zealand waters.[16]

In January 2012, a possible Māui's dolphin was by-caught in a set gillnet off Cape Egmont, Taranaki, in an area outside the Sanctuary, prompting additional action on fisheries bycatch. Consequently, in 2012, the New Zealand Government convened an expert panel to discuss the bycatch of Māui's dolphins; the subspecies' bycatch rate was estimated to be 4.97 Māui's dolphins per year (95% confidence interval: 0.28–8.04; Currey *et al*. 2012; Wade *et al.* 2012). The Potential Biological Removal (PBR)[17] for Māui's dolphins was estimated at one death every 10–23 years (0.044–0.1/year; Currey *et al*. 2012; Wade *et al.* 2012). Since 2013, there have been 10 reported Māui's dolphin deaths,[18] although none were linked to fisheries interactions. However, actual mortality is likely to have been much higher,

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[15] Marine Mammals Protection (West Coast North Island Sanctuary) Notice 2008.

[16] Driftnets are banned via the Fisheries (Commercial Fishing) Regulations 2001.

[17] The number of human-induced deaths that a species can sustain without impacting its ability to rebuild to its optimum sustainable size (Wade 1998).

[18] One died in 2013, four in 2018, two in 2021, and three in 2023. The most recent was in December 2023. In: https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/marine-mammals/hectors-maui-incidents/hectors-maui-incidents.xlsx.

as it has been estimated that only 10% of carcasses are recovered and reported (Cooke *et al.* 2019).

As a result of the Māui's dolphin gillnet entanglement in 2012, there were two extensions to the areas closed to gillnetting. In 2012, gillnets were banned out to 2nm (3.7km) from the coast in an area extending from Pariokariwa Point to Hawera. In 2013, the ban was extended to 7nm (13km) between Pariokariwa and New Plymouth (Smith and Guy, 2013; Slooten 2020; **Fig. 12** and **Fig. 13**).[19]

Moreover, there is a fishing-related mortality limit of one animal (which applies to both recreational and commercial fishing) within defined Māui's dolphin habitat.[20] This latter habitat zone extends from Cape Egmont to Cape Reinga, including harbors, and 12nm (22.2km) offshore. If a dolphin death is linked to fisheries within that zone, the Minister for Oceans and Fisheries has the authority to prohibit any or all fishing methods in an area.

In 2020, the prohibition on gillnets was extended from 7nm to 12nm (13km-22.2km) from the coast between Maunganui Bluff and New Plymouth, in the main part of the Marine Mammal Sanctuary. The prohibition was also extended from 2 to 7 nautical miles in the region of New Plymouth to Hawera. In the north, a prohibited zone out to 4nm (7.4km) was added that extended from the Marine Mammal Sanctuary to as far north as Cape Reinga. A similar 4nm (7.4km) zone was added from Hawera extending southwards to Wellington (**Fig. 12** and **Fig 13**).

However, the gillnet prohibition extension only increased the area of Māui's dolphin habitat protected from gillnetting from 16% to 19% (Slooten 2014). Taking into account the additional protected area, Slooten (2014) estimated that, although the estimated bycatch rate had been reduced (to 3.72; 95% confidence interval: 3.28–4.16), it was nevertheless still 54 times the sustainable level (i.e., the PBR – see **Section 2.3.2.5.3**) and the extended fishing restrictions were insufficient to fully protect Māui's dolphins (Slooten 2014). The Scientific Committee of the International Whaling Commission echoed this concern at their 2014 meeting (IWC 2015; **Section 2.3.2.5.1**).

In 2015, a dolphin by-caught in a recreational gill net on the east coast of the North Island was entered into a New Zealand Government sightings database[21] (Sea Shepherd 2020; **Fig. 7**; **Section 2.3.1.5**). This is an area with no regulations prohibiting gill net use to protect dolphins.

More recently, in order to evaluate the status of Māui's dolphins, the New Zealand government developed a "spatially explicit fisheries risk assessment" (SEFRA) approach to estimate the "Population Sustainability Threshold" (PST) (Roberts *et al.* 2019; **Section 2.3.1.5**). The SEFRA model estimates the risk that fishing gear poses to Māui's dolphins.[22]

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[19] The gillnet prohibitions are enacted via the Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986, the Fisheries (Central Area Commercial Fishing) Regulations 1986, and the Fisheries (Amateur Fishing) Regulations 2013 and the Marine Mammals Protection Act 1978 and Marine Mammals Protection (West Coast North Island Sanctuary) Notice 2008.

[20] Set via the Fisheries (Commercial Fishing) Regulations 2001 and Fisheries (Amateur Fishing) Regulations 2013.

[21] Institute of Water & Atmospheric Research Ltd (NIWA) sightings database.

[22] A median risk ratio of 0.28 for commercial set nets and 0.00 for inshore trawl nets was estimated in Roberts *et al.* (2019), as opposed to 36.2 for set nets and 18.3 for trawls in the PBR-based estimate from the 2012 TMP risk assessment in Currey *et al.* (2012).

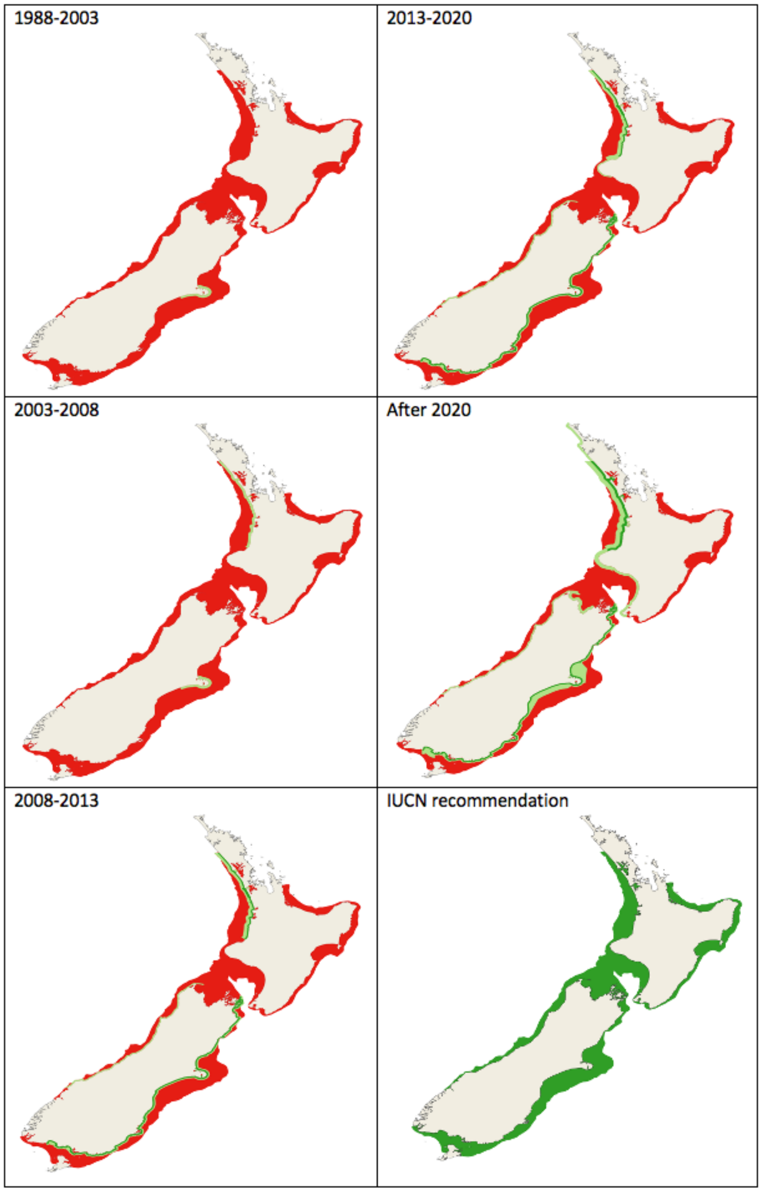

Figure 12. Areas where fishing has been prohibited around the coast of New Zealand. Light green areas denote areas where set gillnet fishing were prohibited, dark green areas denote where trawl fishing was prohibited or limited (trawling vessels may only use a low headline net). The red area denotes coastal waters to the 100m depth contour. The final map shows the area of fishing prohibition recommended by the 2012 IUCN resolution and IWC (2015) Scientific Committee (see **Section 2.3.2.5.1**) (from Slooten and Dawson 2021b; reproduced with permission from Drs E Slooten & S Dawson).

Annual captures estimated by the SEFRA model (a median of 0.10 annual deaths from set gillnets and zero deaths from inshore trawl fishing; Roberts *et al.* 2019) were much lower than those estimated by the expert panel assembled in 2012 (Currey *et al.* 2012). By using fishery observer data in the model, rather than the estimates from the panel, the level of risk was reduced by a factor of 20, and changes in calibration factors and other parameters led to a 100-fold reduction in the estimated risk posed by commercial set net and trawl fisheries for Māui's dolphins (Roberts *et al.* 2019a).

In contrast, Cooke *et al.* (2019) fitted an individual-based population model to genetic identification data and produced an estimated average annual bycatch mortality rate of 1.5–2.4. Although this bycatch rate is about a third of the rate estimated in the early 2000s, it is still substantially higher than the 0.1 per annum estimate of Roberts *et al.* (2019).

Cooke *et al.* (2019) suggested that the Māui's dolphin population continues to decline – albeit at a slower rate, presumably because fisheries restrictions have been introduced. However, fishing-related mortality needs to decrease by a minimum additional 50% in order to stop the population decline and avert extinction (Cooke *et al.* 2019; IWC 2020a).

Additionally, results from a different individual-based model for Māui's dolphins (de Jager *et al.* 2019; Slooten *et al.* 1999; Slooten *et al.* 2021) estimated that the current bycatch of Māui's dolphins is on the order of one dolphin per year in gillnet fisheries. This is ten times higher than PBR, ten times that estimated by Roberts *et al.* (2019) and ten times higher than New Zealand's maximum allowable level of bycatch (PST).

2.3.2.4.1.2 Trawl fisheries

The West Coast North Island Marine Mammal Sanctuary had banned trawling out to a distance of 2 nautical miles (nm) (3.7km) throughout the northern part of the sanctuary (with a stretch where trawling was banned to 4nm (7.4km) in front of Manukau Harbor) southwards to the Waiwhakaiho River, with the prohibited zone stopping just before the port of New Plymouth (**Fig. 14**). This was eventually increased to 4nm (7.4km) throughout in 2020[23] and extended southwards slightly, to also include the waters in front of New Plymouth (**Fig. 12** and **Fig 14**).[24]

Slooten (2020) noted that although protections against set gillnet fisheries were extended in 2012 and 2013 (to 7nm or 13km), there was no similar extension of the protected area from trawling. Even in 2020, when the prohibited area for trawling was extended, it was still considerably smaller than the areas in which gillnet fishing was prohibited (**Fig. 12**). Fishing effort is much higher in trawl fisheries than set gillnet fisheries (**Fig. 15**), but there has been little monitoring of inshore fisheries, with scant observer coverage to assess bycatch levels (Slooten and Dawson 2021a, 2021b). SI Hector's dolphins are, however, known to associate with trawlers, especially those working in shallow (<30 m) waters trawling for flatfish (Rayment and Webster 2009). SI Hector's dolphin mortality in this type of gear is common – for example, in February 2024, four SI Hector's dolphins were killed in trawl nets.[25] Therefore, one would expect the potential for Māui's dolphin mortalities in trawling gear.

In 2012, the expert panel assembled by the New Zealand Government to assess the impacts of fisheries bycatch (**Section 2.3.2.4.1.1**) predicted annual bycatch from trawl fisheries, albeit at a lower level than set gillnet fisheries (Currey *et al.* 2012).[26] However, Roberts *et al.* (2019a) adopted a median risk ratio of 0.00 for inshore trawl fisheries, i.e., that there was essentially no bycatch in trawl fishing gear. Roberts *et al.* (2019) used data from a 1996-1997 fisheries observer program, during which there was only one observed incidence of bycatch in trawling gear. However, new information from camera monitoring (Slooten *et al.* 2024) suggests that Roberts *et al.* (2019) under-estimated levels of trawling bycatch.

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[23] Between Maunganui and just before the Tapuae Marine Reserve in Taranaki.

[24] The use of trawl gear is restricted under the Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986 and the Fisheries (Central Area Commercial Fishing) Regulations 1986.

[25] https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/marine-mammals/hectors-maui-incidents/hectors-maui-incidents.xlsx.

[26] Currey *et al.* (2012) estimated a risk level of 18.3 for trawls in their PBR-based estimate, with a risk of 36.2 for set nets.

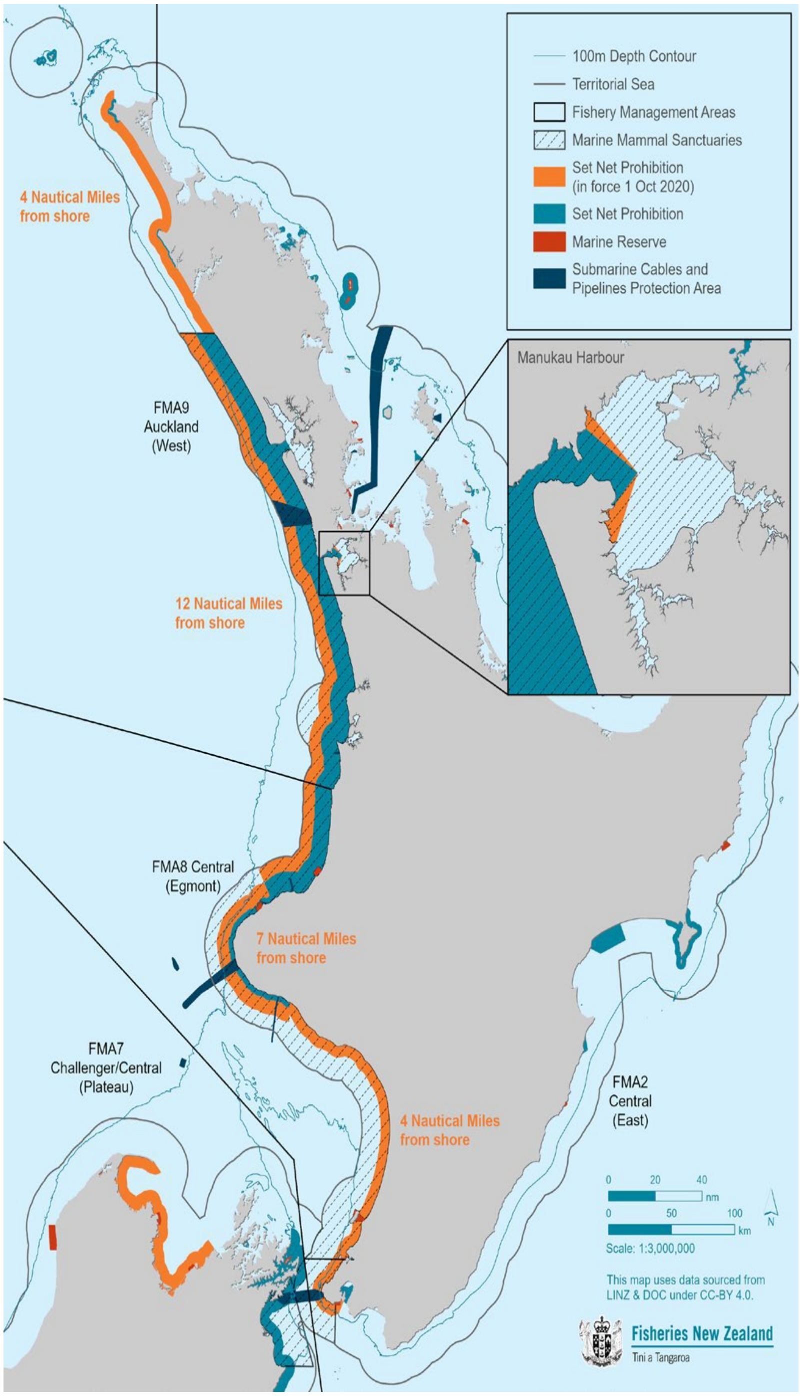

Figure 13. Commercial and recreational set net prohibition areas off the west coast of the North Island (from Department of Conservation and Fisheries New Zealand 2020; reproduced with permission).

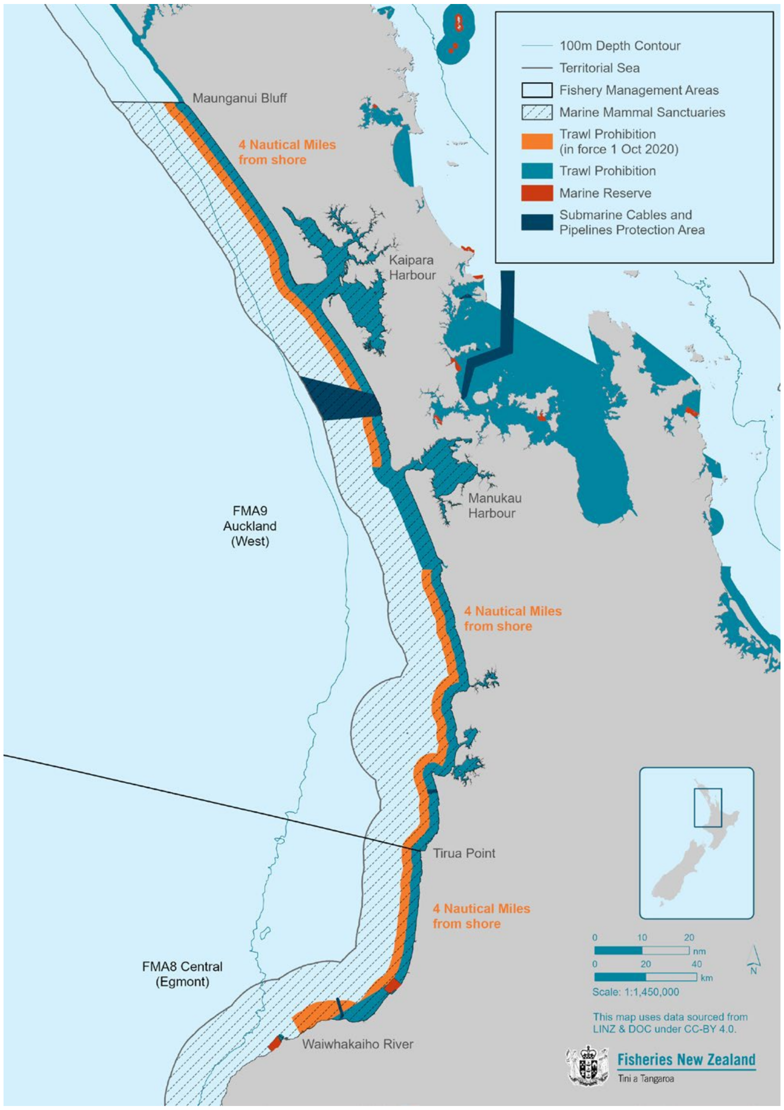

Figure 14. Commercial trawl prohibition areas off the west coast of the North Island (from Department of Conservation and Fisheries New Zealand 2020; reproduced with permission).

2.3.2.4.1.3 Fisheries monitoring

In addition to the fisheries measures noted above (**Section 2.3.2.4.1.1** and **Section 2.3.2.4.1.2**), since November 2019[27] on-board cameras have been required on any set gillnet or trawl vessel (between 8 m and 29 m in length) that operates in certain fisheries areas (**Fig. 16**).

Historically, it has been estimated that about 1% of fisheries bycatch was reported (Slooten *et al.* 2024). For example, despite an estimated 123 entanglements in the 2014-2017 fishing seasons, there was only one by-caught animal reported (i.e., 0.8%; Slooten *et al.* 2024). McGrath (2020) noted that fishers admitted to sinking bycaught carcasses at sea to avoid detection.

Recognizing the low rate of fisheries observer coverage, in 2012, the IUCN passed a resolution that stated that the New Zealand Government should:

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[27] As required by the Fisheries (Electronic Monitoring on Vessels) Regulations 2017.

> *…increase immediately the level of monitoring and enforcement with an emphasis on requiring 100 per cent observer coverage of any gill net or trawling vessels allowed to operate in any part of the range of Hector's and Maui's Dolphins…*[28]

Currently, there are eight gillnetting vessels with on-board cameras operating on the west coast of the North Island and 17 on the South Island, comprising approximately 22% of gillnetting vessels. Many gillnetting vessels are smaller than 8m and are excluded from the monitoring regulation. Trawling vessels, however, tend to be larger and are, therefore, more likely to have camera monitoring. However, Slooten *et al*. (2024) note that in core Māui's dolphin habitat only 4% of gillnetting vessels have cameras, and fisheries observer coverage is just 1-5%. Fisheries observer coverage is similar on trawling vessels (i.e., 1-5%), but the proportion of vessels with cameras is higher (n=29). However, there is no gillnet fishery monitoring inside harbor areas, which are hotspots of fishing effort on the North Island west coast: approximately double the amount of fishing effort in these areas compared to the open coast (Slooten *et al.* 2024).

At present, approximately 21%–27% of fishing vessels in Māui's dolphin habitat have onboard cameras for monitoring (Slooten *et al*. 2024). However, as noted, only 4% of the vessels from the most problematic fishery have cameras, and areas with the most intense fishing effort (i.e., harbors) have no monitoring.

The monitoring to date has illustrated that within roughly a 4-month period, nine Hector's dolphin deaths (including a mother and calf) were reported in trawl fisheries around Banks Peninsula and Timaru (Slooten *et al.* 2024). Roberts *et al.* (2019) predicted an annual bycatch rate of six dolphins in trawl nets (95% confidence interval 0.28-31.12) for the entire east coast of the South Island. Therefore, the actual rate of trawl fishery bycatch is likely much higher than has been predicted to date.

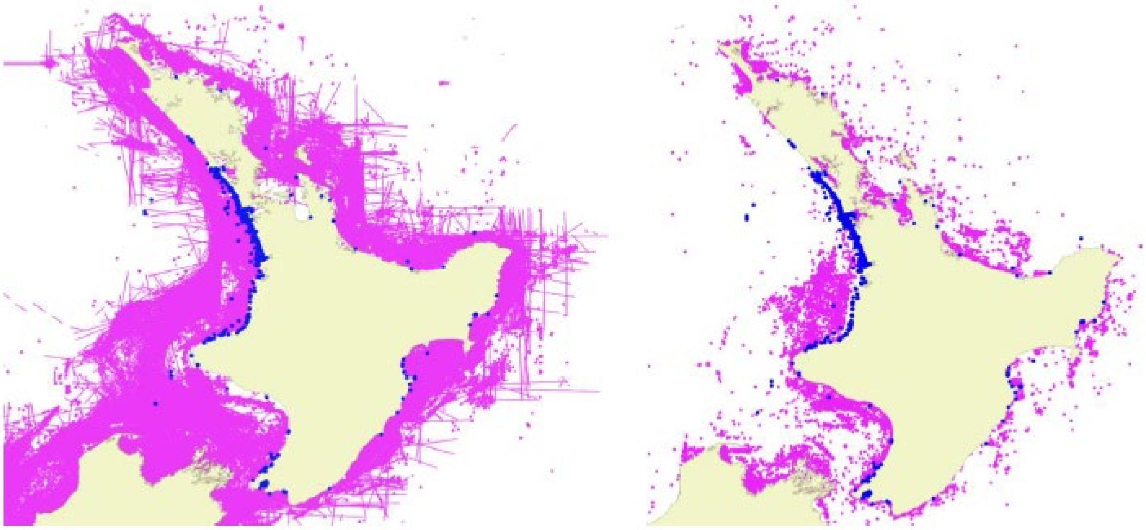

Figure 15. Māui's dolphin sightings (blue dots) and trawl fishing effort (purple lines; left) during 2009-2017 and set net fishing effort (purple lines; right) during 2009-2017 (from Sea Shepherd 2020; Available from: https://www.regulations.gov/document?D=NOAA-NMFS-2019-0013-0055).

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[28] https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2012_REC_142_EN.pdf.

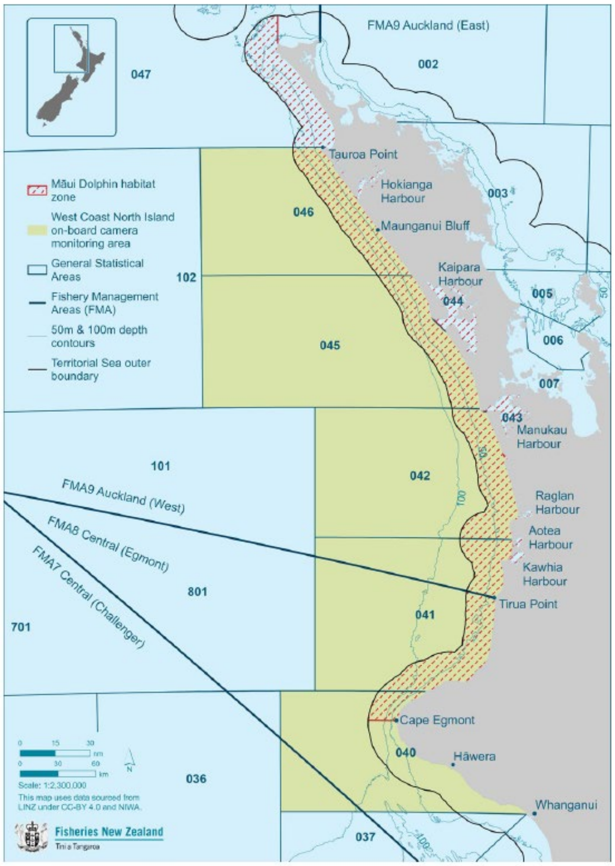

Figure 16. West Coast North Island on-board camera monitoring area (Fisheries statistical areas 040, 041, 042, 045 and 046) (from Department of Conservation and Fisheries New Zealand 2020; reproduced with permission).

2.3.2.4.2 Vessel strikes

There is no new information on vessel strikes since the previous 5-year status review for Māui's dolphins (Manning and Grantz 2017).

2.3.2.4.3 Acoustic disturbance

The impacts of underwater noise and acoustic disturbance on cetaceans are both well-studied and an issue of international concern (Richardson *et al.* 1995; Weilgart 2007; Nowacek *et al*. 2007; Tyack 2008; Hildebrand 2005, 2009; Simmonds *et al.* 2014; Williams *et al.* 2020). Māui's dolphins, like all odontocete cetaceans, rely upon acoustic communication to find mates, warn against predators, and cooperate when foraging. Mothers also rely on acoustic signals to rear their calves safely and echolocation is vital for these dolphins to find their prey and navigate within their environment – especially as their habitat often encompasses turbid waters where vision is obstructed.

At present, one of the anthropogenic activities that could have the greatest acoustic impacts on Māui's dolphins is seismic surveys.

2.3.2.4.3.1 Seismic surveys

Seismic surveys are conducted to analyze the geology below the seafloor; e.g., to determine the location of oil and gas deposits under the seabed or to select suitable sites for offshore renewable energy platforms. To achieve this, these surveys use a variety of different methods to produce high intensity pulses of sound of varying frequencies (Pei *et al.* 2019). Methods currently used in marine seismic surveys include air guns (100Hz-1.5kHz), water guns (20Hz-1.5kHz), "sparkers" (50Hz-4kHz), "boomers" (300Hz-3kHz), and "chirp" systems (500 Hz-12 kHz, 2-7 kHz, 4-24 kHz, 3.5 kHz, and 200 kHz). These pulses penetrate the seabed, reflect off different layers of rock in different ways, and are then recorded by towed arrays of hydrophones at the surface to reveal the structure of the seabed and positions of probable fossil fuel deposits. Depending on the method being used, and the number of sound sources, seismic surveys can produce sound levels of 225-235 dB, up to 270 dB, re 1µ Pa. The sounds produced by seismic surveys can be the most intense of all anthropogenic sound and have been detected more 3000 km from their source (Nieukirk *et al.* 2004).

The reported effects of seismic surveys include: changing whale acoustic behavior (Clark and Gagnon 2006; Di Iorio and Clark 2010; Blackwell *et al.* 2013, 2015; Castelotte *et al.* 2012); altering diving and swimming behavior (Richardson *et al.* 1986, 1995; Miller *et al.* 2009; Robertson *et al.* 2013, 2016; Dunlop *et al.* 2015); causing "startle" reactions (Stone, 2003); and producing avoidance behavior (Richardson *et al.* 1986, 1995, 1999; McDonald *et al.* 1995; Goold 1996; MacCauley *et al.* 1998; Weller *et al.* 2002; Bain and Williams 2006; Calambokidis and Osmek 1998; Stone 2003; Stone and Tasker 2006; Weir 2008a). For example, McCauley *et al.* (1998, 2000) reported that resting female humpback whales (*Megaptera novaeangliae*) showed an avoidance response to seismic survey sound sources at an estimated 7-12 km away with other whales showed avoidance behavior at a distance of 4-8 km. McCauley and Duncan (2001) reported that blue whales (*Balaenoptera musculus*) avoided airguns at distances of up to 20km away and they displayed behavioral changes that were observed at tens of kilometers from seismic sources. Harbor porpoises (*Phocoena phocoena*) appear to be particularly sensitive to seismic survey noise, responding to seismic noise at distances of more than 70 km away (Bain and Williams 2006). Acoustic injury, resulting in temporary hearing impairment[29] was reported in a captive harbor porpoise exposed to airgun noise (Lucke *et al.* 2009; Kastelein *et al.* 2017) and Gedamke *et al.* (2011) estimated that temporary hearing impairment in baleen whales was plausible at ranges up to several kilometers from seismic survey sound sources. Moreover, researchers trying to record cetaceans in the mid-Atlantic have found that whale calls were frequently obscured, or "masked," by high levels of continuous sound produced by seismic surveys up to 3000 km away (Nieukirk *et al.* 2004).

Seismic surveys have been linked to several cetacean stranding events (Malakoff 2002; Engel *et al.* 2004; Palacios *et al.* 2004) and decreases in cetacean abundance (Parente *et al.* 1997). An atypical mass stranding of 56 beaked (*Ziphius cavirostris* and *Mesoplodon bidens*) and long-finned pilot whales (*Globicephala melas*) along the UK and Irish coasts occurred during, or just after, a series of seismic surveys in nearby waters, also led to concerns that this mass mortality event might have been caused by oil and gas exploration (Dolman *et al.* 2010). However, these instances are lacking definitive evidence that they were caused by seismic surveys.

Moreover, Gray and Van Waerebeek (2010) reported an observation of a pantropical spotted dolphin (*Stenella attenuata*), which displayed signs of distress, before rolling over and sinking beneath the ocean surface. The researchers presumed that the dolphin had suffered internal injuries leading to its

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[29] Temporary Threshold Shifts, a sound-induced temporary decrease in hearing sensitivity. TTS was reported at a sound level of 140 dB $\mathrm{SEL_{cum}}$ (Lucke *et al.* 2009).

death. At the time of this incident, the dolphin was approximately 600m from a seismic survey airgun. Gray and Van Waerebeek (2010) stated that: “as behaviour was spatially and temporally closely associated with firing seismic airguns, we suggest a cause–effect relationship. Differential diagnoses of pre-existing morbidity, senescence, or intoxication are considered possible but unlikely” (p. 363).

Previously, based primarily on levels expected to damage their hearing, managers and regulators have opined that there would be negligible impacts to marine mammals beyond a radius of 0.5-1 km from a seismic survey.[30] However, studies on seismic survey sound received by tagged whales have shown that in the complex environment of the oceans, received sound levels did not match those predicted by mathematical models (Madsen *et al*. 2006). Madsen *et al.* (2006) found that sound levels from a seismic survey decreased between 5 km and 9 km from the sound source, but then *increased* at distances between 9 km and 13 km. This meant that whales could be impacted at ranges of more than 10 km from seismic survey vessels (Madsen *et al*. 2006). Importantly, this is a distance farther than on-board marine mammal observers on seismic survey vessels can monitor (Madsen *et al*. 2006). Hermannsen *et al*. (2015) also found that in shallow water seismic survey sound could travel farther than predicted, and expressed concerns that there could be implications for the impacts of this activity on coastal cetaceans.

Gordon *et al*. (2004), in their review of seismic survey impacts, concluded that effects on marine mammals can occur at distances of tens to hundreds of kilometers and, when behaviors such as feeding, hazard avoidance, migration, or social behavior are changed due to noise exposure, there could be population-level impacts.

Seismic surveys are generally prohibited within the West Coast North Island Marine Mammal Sanctuary, although there are exceptions.[31] A seismic survey that qualifies for an exemption is required to comply with the 2013 “Code of conduct for minimizing acoustic disturbance to marine mammals from seismic survey operations”.[32] However, seismic surveys with airguns less than 150 cubic inches capacity, or that use sparkers, pingers, or boomers as a sound source, are allowed and such surveys may be conducted without needing to adhere to the code of conduct. Likewise, companies that have already been granted permits to conduct oil and gas exploration are allowed to conduct seismic surveys **(Section 2.3.2.1.3)**. Locations where seismic surveys and oil and gas exploration are permitted can be seen in **Fig. 9** and **Fig. 10,** and areas where seismic surveys have been conducted are summarized in **Fig. 17** and **Fig. 18**. Both include several areas within, or adjacent to, core habitat of the Māui’s dolphin (**Fig. 18**). In 2018 the New Zealand Government announced that it would not be issuing any additional permits for oil and gas exploration, although projects that had already received permits could continue. In 2021 the last oil and gas exploration permit outside of the Taranaki Basin area (**Fig. 10**) expired (Watson 2021). However, in 2024 the New Zealand Government announced that it was considering repealing this oil and gas exploration ban and suggested that it might be issuing oil and gas exploration permits in the near future (Jones 2024).

Currey *et al.* (2012) considered the impacts from oil exploration and mining noise to be the second greatest threat to Māui’s dolphins. In the spatial risk assessment of Māui’s and SI Hector’s dolphins by Roberts *et al.* (2019), the risk of seismic surveys was incorporated using information from Lucke *et al.* (2019) on the distribution of oil and gas exploration and production, in conjunction with sound

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[30] For example, in JNCC (2004).

[31] These exemptions include: the operators have an existing permit to conduct surveys; if urgent hazard assessment is required; if it is for the decommissioning of infrastructure; if it is deemed a nationally significant activity and has approval from the Minister of Conservation and the Minister of Energy and Resources; and “Level 3” category seismic surveys as per the seismic surveying code of conduct.

[32] https://www.doc.govt.nz/Documents/conservation/native-animals/marine-mammals/seismic-survey-code-of-conduct.pdf

modelling data from MacPherson *et al.* (2019). Roberts *et al.* (2019) noted that historically seismic survey activity likely overlapped with areas of high concentration of both subspecies of dolphins. Lucke *et al.* (2019) concluded that underwater noise from seismic surveys and offshore pile driving was a risk to the dolphins, potentially causing auditory damage, with behavioral reactions considered the most probable effect (Lucke *et al.* 2019).

As noted above, seismic surveys can displace cetaceans at distances of tens of kilometers and could potentially cause changes in behavior, and affect acoustic abilities, at even greater distances. Therefore, seismic surveys conducted outside of the sanctuary area could lead to acoustic impacts within the sanctuary and other Māui's dolphin habitat. The potential impacts could vary depending on the method and sound source level used, as well as the location. Moreover, in-field assessments of sound levels are necessary to ground truth the propagation of seismic survey noise in complex oceanic and coastal environments (e.g., Madsen *et al*. 2006).

It should also be noted that oil and gas exploration (and other maritime activities) may also use other high intensity sound sources that could be injurious to cetaceans. For example, in 2008, a mass stranding of 100 melon-headed whales (*Peponocephala electra*) in northwest Madagascar was initially thought to be the result of exposure to seismic surveys being conducted by an oil company contractor. However, it was determined that the most likely cause of the stranding was actually sound produced by a multi-beam echosounder[33] system, which was being utilized during oil and gas exploration (IWC 2013; Butler 2013; Southall *et al.* 2013). Therefore, attention should be paid to the impact of *all* high intensity sound sources, not just seismic survey equipment.

2.3.2.4.3.1.1 Seismic survey guidelines

As noted above, companies conducting seismic surveys are required to adhere[34] to the guidelines in the 2013 "Code of conduct for minimizing acoustic disturbance to marine mammals from seismic survey operations"[35]. The guidelines require the submission of an environmental impact assessment before seismic surveys are conducted. As part of this assessment, operators should calculate the lowest practicable power levels for the acoustic source they are using, so that their geophysical objectives can be met while minimizing the amount of sound put into the marine environment.

The guidelines note that "marine seismic surveys will not be planned in any sensitive, ecologically important areas or during key biological periods where Species of Concern are likely to be breeding, calving, resting, feeding or migrating," although, as noted above, the sounds produced by seismic surveys can travel considerable distances. Therefore, excluding surveys from the sanctuary is likely insufficient to prevent significant sound levels from traveling into Māui's dolphin habitat.

Forney *et al.* (2017) expressed concerns that the New Zealand seismic survey guidelines and their associated mitigation measures to prevent impacting Māui's dolphins were "unrealistic and ineffective (p. 397). For example, seismic survey sound sources are to be shut down if a cetacean is observed by a qualified observer within 0.5km, or 1km if it is a mother-calf pair. Forney *et al.* (2017) criticize this as a mitigation method as 3 trained and experienced observers, using 25× and 7× binoculars, can only

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[33] The multi-beam signal was at 12 kHz and the melon headed whales were estimated to be exposed to a received level of approximately 120 dB re:1μPa (Southall *et al.* 2013).

[34] Regulations created under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 - any seismic survey in the New Zealand Exclusive Economic Zone (EEZ) must comply with the Department of Conservation code of conduct for seismic surveying.

[35] https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/marine-mammals/seismic-survey-code-of-conduct.pdf.

detect 40 - 50% of small dolphins even in moderate weather conditions during marine mammal surveys (sea state 3 on the Beaufort scale or lower) – which drops to just 20% in rough seas (Beaufort 5; Barlow 1995). Therefore, the likelihood of detecting Māui's dolphins with a single person is low even in the best weather conditions.

Passive acoustic monitoring or PAM (listening for cetacean vocalizations) is often suggested as a monitoring method in addition to visual surveys, or in replacement of visual surveys in poor weather conditions (Gordon and Tyack 2002). In the New Zealand seismic survey guidelines, two qualified PAM operators must also be on board at all times, with one on duty in addition to the visual observers. Forney *et al.* (2017) also raised concerns about this method of detection as it only works if animals are vocalizing. Moreover, the high frequency vocalizations of both subspecies of Hector's dolphins (**Section 2.4.1.1.8**) only have a very short range and would, therefore, only be detected if the dolphins were very close to the sound source.

Other suggested mitigation measures in the guidelines include a "soft start" – the gradual increase of the sound source's power (over a period of at least 20–40 minutes) – as it is assumed that this gradual increase will allow cetaceans to become aware of the seismic sound source and to habituate or swim away from the source (Parsons *et al.* 2009).

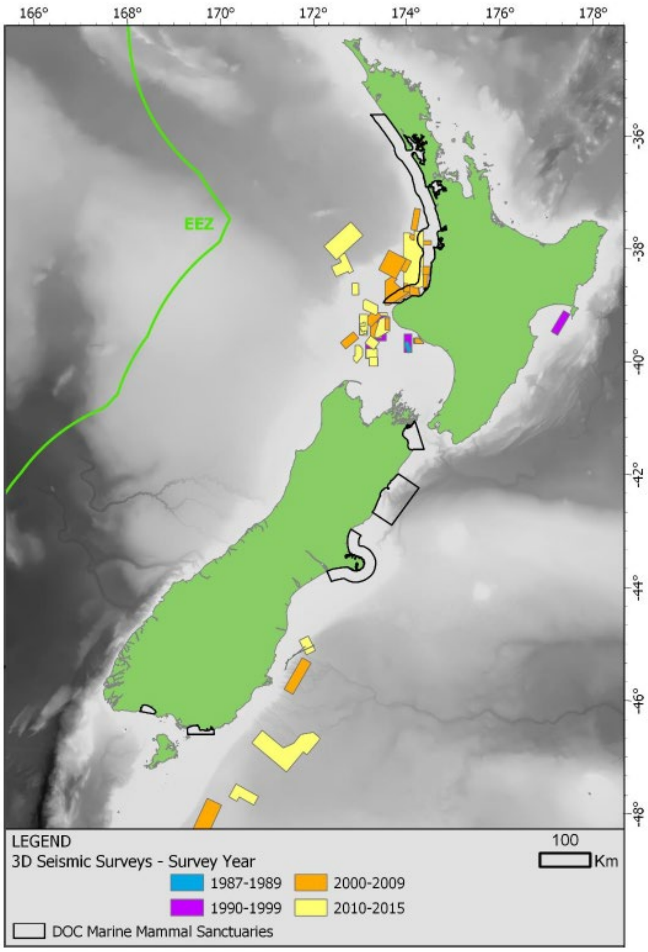

Figure 17. Areas where seismic surveys have been conducted around the New Zealand coastline (from Lucke *et al.* 2019; reproduced with permission from the NZ Department of Conservation).

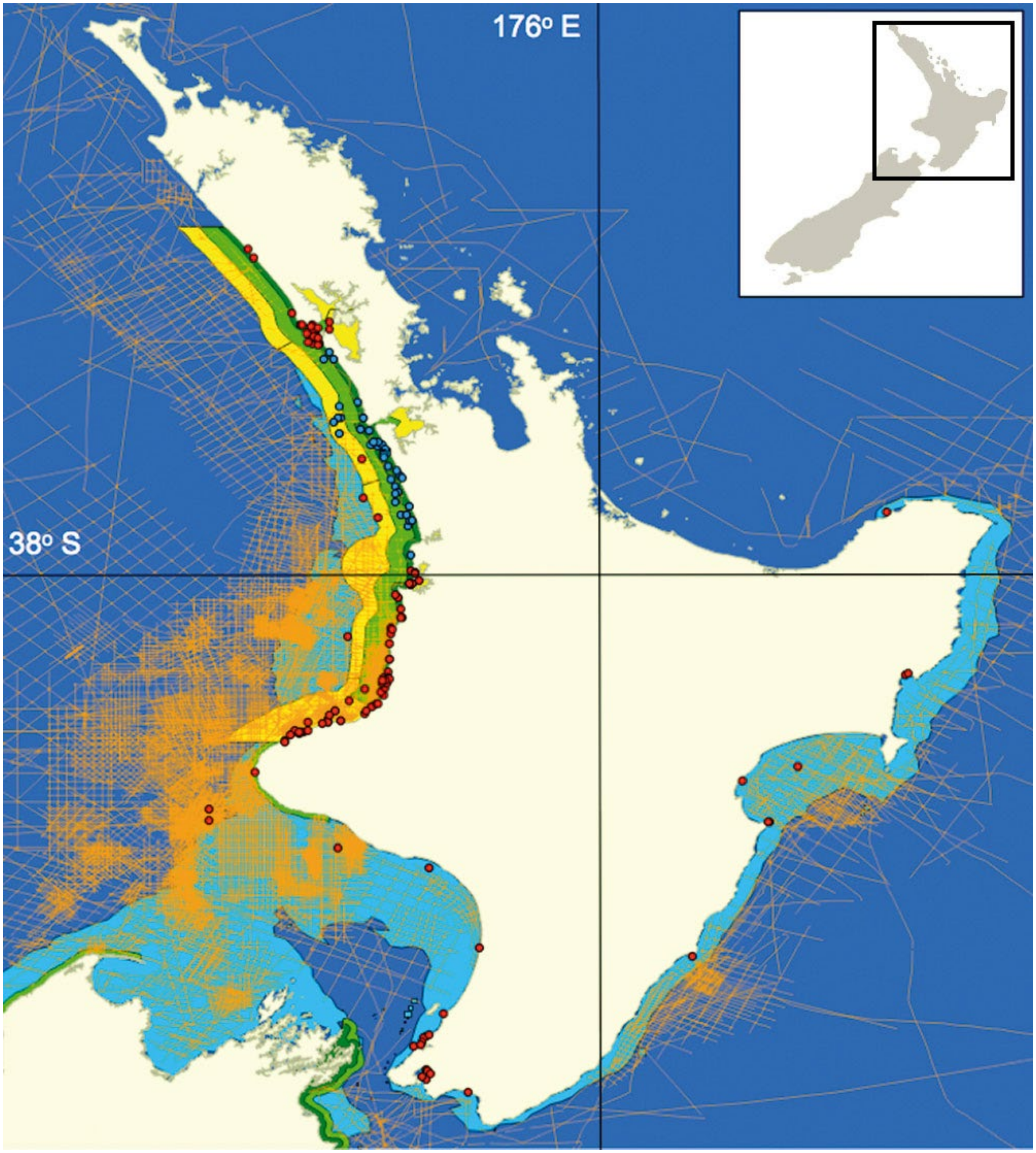

Figure 18. Distribution of Māui's dolphins on the coast of North Island, New Zealand, based on research sightings (blue dots) and public sightings (red dots). Seismic survey routes are shown in orange. The Marine Mammal Sanctuary is shown in yellow. Gillnet ban areas before 2020 are shown in light green for gill net bans and dark green for gillnet and trawl bans. Light blue areas are waters less than 100m deep; dark blue areas are waters greater than 100m deep (from Forney et al. (2017) reproduced with the permission of Drs E Slooten and S Dawson).

2.3.2.4.3.2 Oil and gas production

The Taranaki Basin is currently the only oil and gas producing area in New Zealand, a location immediately to the southwest of Māui's dolphin habitat. There are ongoing and approved permits for oil and gas exploration for this area (**Fig. 9 and Fig 10**; **Section 2.3.2.1.3**). However, the last permit to conduct oil and exploration outside the Taranaki Basin expired in 2021 (Watson 2021).

Although, in 2018 the New Zealand Government decided not to issue any new permits for offshore exploration of oil and gas extraction, it was recently suggested that the Government will reverse this ban (Jones 2024). It is possible, therefore, that additional permits for oil and gas extraction will be issued. Oil and gas extraction involve noise-producing activities such as pile driving, drilling, and increased vessel traffic (Lucke *et al.* 2019). The ongoing noise of oil platform operations can affect the behavior of whales (Blackwell and Greene 2006; McDonald *et al.* 2012). This is in addition to the potential threats that oil spills might pose to cetaceans (**Section 2.3.2.1.3**).

2.3.2.4.4 Summary

Bycatch in fishing gear is the most pressing threat at present for Māui's dolphins (**Section 2.3.2.4.1**), in particular entanglement in set gillnets (**Section 2.3.2.4.1.1**). However, the threat of entanglement in trawl nets is also significant (**Section 2.3.2.4.1.2**). To gain more accurate information on bycatch rates, onboard cameras have been introduced. However, only 4% of the vessels from the most problematic fishery have cameras, and several areas with intense fishing effort (such as harbors) have no monitoring (**Section 2.3.2.4.1.3).** Any entanglements of Māui's dolphins in fishing gear could endanger the survival of the subspecies and it is essential that any instances are reported so that emergency conservation actions can be taken.

In addition to the direct threat of entanglement and death in fishing gear (**Section 2.3.2.4.1**), the fact that New Zealand's main oil and gas production area is adjacent to Māui's dolphin habitat is concerning. Seismic surveys are conducted adjacent to marine mammal sanctuaries to monitor oil and gas reserves (**Section 2.3.2.4.3.1**) - it is likely that the intense sounds from these surveys will enter dolphin habitat, despite a ban on seismic surveys within marine mammal sanctuary waters. This high intensity sound could add a significant stressor. If the New Zealand Government issues new permits for oil and gas exploration (e.g., Jones 2024), the threat from this anthropogenic activity will likely increase.

2.3.2.5. Inadequacy of existing regulatory mechanisms

The primary law protecting cetaceans in New Zealand is the Marine Mammals Protection Act of 1978,[36] which outlaws the harassment, injury and killing of cetaceans, and makes the reporting of any capture of marine mammals compulsory. In addition, the Marine Mammals Protection Regulations of 1992[37] set regulations for human behavior in the vicinity of marine mammals, including regulations for whale watching vessels and aircraft. Regulations under the Fisheries Act 1996 have been used to restrict or prohibit the use of set gill nets or trawl nets to protect Māui's and SI Hector's dolphins. Māui's dolphin is currently classified as "Nationally Critical" in the New Zealand Threat Classification System (Baker

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[36] https://www.legislation.govt.nz/act/public/1978/0080/latest/DLM25111.html.

[37] It should be also noted that under the New Zealand Conservation Act of 1987*,* the Department of Conservation (DOC) is responsible for the conservation of New Zealand's natural and historic heritage. Section 4 of the Conservation Act 1987 requires DOC to uphold the principles of the 1840 Treaty of Waitangi, the founding document of governance for New Zealand signed by the British Crown and the by representatives of the Crown and Māori iwi (peoples, tribes or nations). The Act required the DOC to protect Māori taonga or 'treasures', which includes important species such as Māui's and Hector's dolphins.

et al. 2019). In addition, *Cephalorhynchus hectori* is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which, therefore, includes both Māui's dolphin and the SI Hector's dolphin.

2.3.2.5.1 Extent of protection from fisheries bycatch

As noted above (**Section 2.3.2.4.1.1**), since 2020 there has been a 4 nautical mile (nm) (7.4km) set gillnet prohibition zone extending along the west coast of the North Island, from Cape Reinga in the north to Wellington in the South. The ban extends to 12nm (22.2km) in the area of the West Coast North Island Marine Mammal Sanctuary (between Maunganui Bluff and New Plymouth) and to 7nm (13km) offshore between New Plymouth and Hawera (**Fig. 12** and **Fig. 13**). Since 2020, trawling has been banned from the coast to 4nm (7.4km) in the West Coast North Island Marine Mammal Sanctuary, a zone that was extended in 2020 to also include a 4nm zone between Maunganui Bluff to just before the Tapuae Marine Reserve in Taranaki (**Fig. 12** and **Fig. 14**). It should be noted that gillnet use is allowed within harbors, which are also part of the Māui's dolphin range (Rayment *et al.* 2011).

While the fishing prohibition zones overlap some hotspot areas of dolphin distribution, much of their predicted range falls well outside of the current protection zones (de Jager *et al.* 2019). This suggests that Māui's dolphins continue to be exposed to potential entanglement risk despite the fishing prohibition zones.

Most protective measures for Māui's dolphins are based on scientific surveys and public sightings that occur in the austral summer months – their winter distribution remains largely unknown. Although the majority of summer sightings (75%) during aerial surveys have been within 1 nm (1.8km) of shore, this proportion dropped to just 33% in the winter, so there is a significant seasonal shift into offshore waters (Slooten *et al.* 2005). There is some evidence of animals more than 12 nm (13.8miles, 22.2km) from the coast (Slooten *et al.* 2005, 2006; Du Fresne 2010; Rayment *et al.* 2011; Currey *et al.* 2012; Palka and Leslie 2014). SI Hector's dolphin distribution can also extend farther offshore during the austral winter than during the summer (Bräger and Bräger 2018; Constantine 2019). Therefore, it is likely that Māui's dolphins similarly extend into more offshore waters outside of protected areas and into areas with significant fishing effort (**Fig. 19**). Moreover, there have been recent sightings, and even one reported bycatch, in a recreational gillnet on the east coast of the North Island (**Fig. 7**; Sea Shepherd 2020). If these sightings are not a previously undocumented population of Māui's dolphins, but rather transient individuals from the west coast, this suggests that animals may be travelling into unprotected waters. The assumption that there is no significant presence of Māui's dolphins on the east coast needs to be tested.

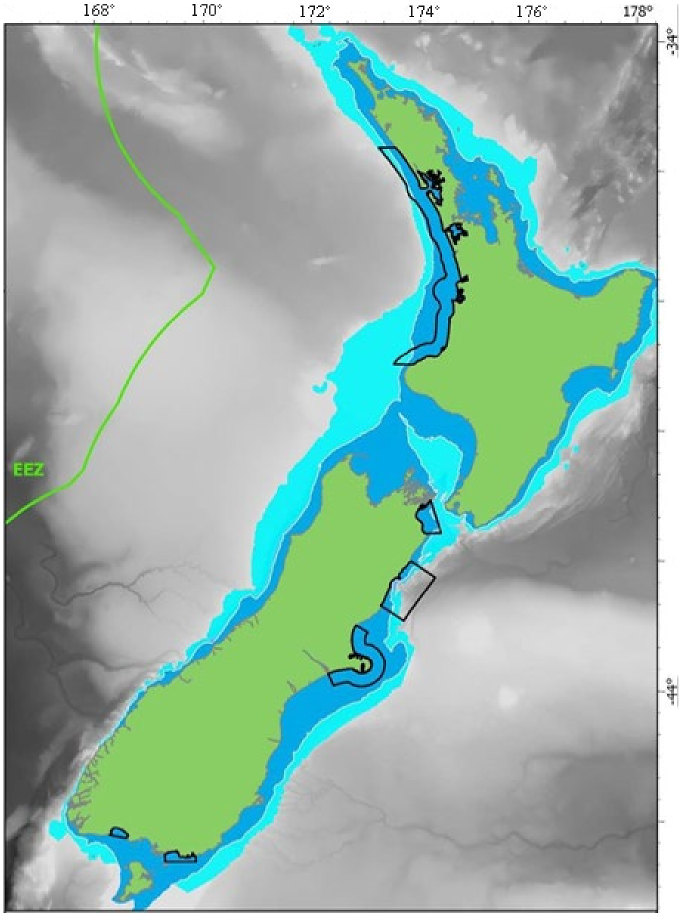

Figure 19. Potential SI Hector's/Māui's dolphin habitat considered by the Hector's/Māui dolphin Threat Management Plan (TMP) is shown in dark blue. Slooten (2013) proposed potential Hector's/Māui's dolphin habitat from the coast to the 100 m depth contour, shown in light blue. Marine mammal sanctuaries are represented with a black outline (from Lucke *et al*. 2019; reproduced with permission from Fisheries New Zealand).

Slooten (2013, 2014, 2020) proposed that both the SI Hector's and Māui dolphins' habitat should be considered to extend from the coast to the 100 m depth contour, calling for protection from both set gill nets and trawl nets within this zone. This area is nearly four times larger than the current no-gillnet zone, and is an even larger area with regard to (**Fig. 12** and **Fig. 19**). A recommendation for protecting the dolphins further offshore has also been echoed in international fora.

For example, in September 2012, at its World Conservation Congress, the IUCN passed a Resolution (Rec. 142) that urged the New Zealand Government to ban gillnet use and trawling both in harbors and out to the 100m depth contour.[38] International Whaling Commission (IWC)[39] Scientific Committee also called for banning both types of fishing gear out to the 100m depth contour (IWC 2015). Noting that "*the human-induced death of even one dolphin would increase the extinction risk for this subspecies*" the IWC also stated that the then-recently adopted extensions to gillnet prohibitions "*fall significantly short of those previously recommended* [by the IWC]" (IWC 2015). Since then, the IWC Scientific

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[38] https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2012_REC_142_EN.pdf

[39] The International Whaling Commission is the international competent authority for the management of whales - both baleen whales (mysticete) and toothed whales (odontoceti), which includes dolphins.

Committee has made nearly annual recommendations and expressions of concern about Māui's dolphin (e.g., IWC 2023).

The Society for Marine Mammalogy similarly expressed concerns that the area where set gillnet and trawling was banned was insufficient to protect Māui's dolphins and sent a number letters to New Zealand's Prime Minister and the Minister for Conservation.[40] The Minister for Conservation replied that there were concerns about the negative impacts of wider fishing gear bans on the New Plymouth fishing industry, although it was noted that there would be some extension to the gillnet bans (as noted in **Section 2.3.2.4.1.1**).

While the area protected from gillnetting was slightly increased in 2020, there is still a large area of potential Māui's dolphin habitat that is currently unprotected, including the east coast of the North Island.

2.3.2.5.2 Lack of comprehensive bycatch data

Recent camera monitoring (Slooten *et al.* 2024) suggests that bycatch of SI Hector's dolphins may be higher than estimates used for management (e.g. Roberts *et al.* 2019; **Section 2.3.2.4.1.3**). Therefore, it is possible that Māui's dolphin mortalities may also be higher than estimated. Moreover, historic catches of both Māui's and SI Hector's dolphins in trawl fisheries may have been underestimated (Slooten *et al.* 2024) or actively hidden (McGrath 2020). There have been multiple instances of SI Hector's dolphin bycatch in trawl nets reported in recent years (**Section 2.4.2.4.1**; **Table 7**) but, as noted above (**Section 2.3.2.4.1.2**), Roberts *et al.* (2019) assume a negligible rate (e.g., a 0.00 risk ratio) of trawl fishery bycatch for Māui's dolphins.

Moreover, Simmons *et al*. (2015) reported that more than half of New Zealand's fishing effort is not reported, with poor reporting from commercial fisheries and a lack of information from recreational and traditional fishing. This lack of comprehensive and transparent reporting has implications for the management of fisheries impacts on cetaceans, including direct impacts (e.g., bycatch) and indirect impacts (e.g., reduction of prey availability). In addition, there are no estimates for entanglements in other types of fishing gear, such as craypot lines, aquaculture nets, and discarded or "ghost" fishing gear. Craypot lines are known to entangle SI Hector's dolphins (**Section 2.4.2.4.1**; **Table 7**); thus, some entanglement of Māui's dolphins could be occurring.

The report of a bycaught Māui's dolphin in a recreational gill net from the east coast of the North Island in 2015 (Sea Shepherd 2020) does not seem to appear in the Department of Conservation database for stranding incidents. Roberts *et al.* (2019) noted a population size of 10 dolphins from the east coast, suggesting that Fisheries New Zealand and/or the Department of Conservation were aware of the east coast sightings in the NIWA[41] database, so information on this bycaught dolphin should have been recorded.

2.3.2.5.3 Potential underestimation of bycatch risk

Currey *et al.* (1995) estimated an annual mortality of five Māui's dolphins in fishing gear. However, it has been suggested that this may likely be an underestimate due to low rates of reporting stranded dolphins (see also McGrath 2020), low fishery observer coverage, and the low likelihood of all dead animals being found or sighted (Slooten and Dawson 2017, 2018).

Slooten and Dawson (2018) estimated a maximum potential biological removal (PBR)[42] of 0.05–0.12,

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[40] https://marinemammalscience.org/species/mauis-dolphin/.

[41] National Institute for Water and Atmospheric Research.

[42] The 1994 amendments to the 1972 US Marine Mammal Protection Act created the potential biological removal

or one Māui's dolphin death every 8 to 20 years, was more than the population could sustain. Therefore, virtually any bycatch was problematic. In contrast, the risk assessment conducted on behalf of the New Zealand Government stated that bycatch rates have declined, with estimated mortality from fisheries of 0.12 deaths per year (Richards *et al.* 2019). Moreover, it was concluded that the current rate of bycatch was not likely to be impeding the recovery of dolphins (Roberts *et al.* 2019).

However, Cooke *et al.* (2019) noted that if a different set of assumptions was used for the Roberts *et al.* (2019) model, the mortality rate could be 15-20 times higher (1.5–2.4 deaths annually in recent years).

Results from the individual-based Model for Māui's dolphins (de Jager *et al.* 2019; Slooten *et al.* 2021) estimated that the current bycatch of Māui' dolphins is still on the order of one dolphin per year. This is approximately an order of magnitude higher than the PBR.

Instead of using PBR to calculate how many dolphins could be bycaught before impeding the recovery of the dolphins, Roberts *et al.'s* (2019) spatially explicit fisheries risk assessment (SEFRA) calculates a "Population Sustainability Threshold" (PST).[43] There are several factors that result in a PST value being higher than a PBR value; the PST calibration coefficient is a higher value than the PBR recovery factor would be for Māui's dolphins,[44] and PST does not use a *minimum* abundance estimate.[45] Both PBR and PST are also strongly affected by the rate of growth (r_{max}) value used, and, as noted in **Section 2.3.1.1.3**, there is some argument over the value used in Roberts *et al.* (2019) (see, for example, IWC 2024a, 2024b). In summary, the maximum allowed human-caused mortality to ensure recovery would be higher when using the PST versus the PBR calculation (see also **Section 2.3.1.5, Section 2.3.2.5.2, Section 2.3.2.4.1.1** and **Section 2.4.2.5.3.3**).

Slooten and Dawson (2020, 2021b) also criticized the assumptions made in the Roberts *et al.* (2019) model. They noted that the dolphin reproductive and calf survival rates used in the model, as well as population estimates, were potentially too high (see also discussion in **Section 2.4.2.5.3.2** and **Section 2.4.2.5.3.3**). In particular the intrinsic rate of growth value used by Roberts *et al.* (2019) is somewhat controversial (**Section 2.3.1.1.3, Section 2.4.1.1.3.1, Section 2.4.1.1.3.3** and **Section 2.4.2.5.3.2**).

Moreover, due to low levels of observer coverage and gaps in fisheries data (in particular, trawling data; **Section 2.3.2.4.1.2**, **Section 2.3.2.4.1.3** and **Section 2.3.2.5.2**), and several assumptions made in the SEFRA model (**Section 2.3.3.1.5, Section 2.3.2.4.1.1** and **Section 2.3.2.5.2**), the estimates of the impacts of fisheries on Māui's dolphins are likely to be underestimated.

(PBR) approach to determine the human-caused mortality limits that would allow the recovery of imperiled marine mammal populations. The PBR formula is calculated by multiplying the minimum estimate for the population size of marine mammals by 50% of the maximum intrinsic rate of population growth (r_{max}; **Section 2.3.1.1.3**) and a recovery factor (F_R), which is usually between between 0.1 and 1.0 depending on the status of the species. For an endangered species such as Māui's dolphins the recovery factor is set at 0.1.

[43] The PST is essentially derived via the same calculation as PBR, except it uses a mean rather than a minimum population estimate, and a tuning factor φ is substituted for the recovery factor (F_R). Abraham *et al.* (2017) used a φ value of 0.5 for their risk assessment of marine mammals in New Zealand, which would be the equivalent of the recovery factor used for a threatened species in the United States.

[44] The PST tuning factor for Māui's dolphins is 0.5 in Abraham *et al.* 2017 and 0.2 in Roberts *et al.* (2019), as opposed to a 0.1 recovery factor for a PBR calculation for an endangered species (Wade 1998), which in itself would double the level of allowable bycatch.

[45] Roberts *et al.* (2019), on page 7, stated that "the latest approved population size estimates" were used, as opposed to the lower 20th percentile of the log normalized distribution for the most recent estimate of abundance used in PBR caluculations (Wade 1998).

2.3.2.6 Summary

Although there have been some extensions in protection against fisheries bycatch since the previous status review of Māui's dolphins (**Section 2.3.2.4.1.1**, **Section 2.3.2.4.1.2**, and **Section 2.3.2.5.1**), there are still concerns that these protections do not sufficiently cover the dolphin's habitat (**Section 2.3.1.5** and **Section 2.3.2.5.1**). More information is required on the movements and habitat use of Māui's dolphins on the east coast of the North Island, as well as the distribution of dolphins in the winter months to ensure that animals are not moving into unprotected areas. Moreover, there are concerns that monitoring of fisheries interactions is insufficient to detect all bycatch (**Section 2.3.2.4.1.3** and **Section 2.3.2.5.2**). The IWC (2016) concluded that observers or cameras are needed on all fishing vessels, in addition to the monitoring of recreational gillnetting. Considering the very small population size and current impact that disease is having on the dolphins (**Section 2.3.2.3.1**), any human-caused mortality is critical for the subspecies. International bodies such as the IUCN, IWC, and the Society for Marine Mammalogy have all recommended a ban on gillnet and trawl net fishing throughout Maui's dolphin habitat to prevent further mortalities (**Section 2.3.2.5.1**).

The potential impacts of the oil and gas industry (**Section 2.3.2.1.3** and **Section 2.3.2.4.3.2**), notably oil spills and the sound produced by seismic surveys (**Section 2.3.2.4.3.1**), also require more study and represent substantial data gaps. In particular, there is a need to conduct field research on the levels of underwater seismic noise entering Māui's dolphin habitat during seismic surveys, and the efficacy and detection limits for observers on seismic survey vessels.

2.4. Updated information and current species status of the South Island Hector's dolphin (*Cephalorhynchus hectori hectori*)

2.4.1. Biology and habitat of South Island Hector's dolphin

In this section, new information produced since the initial status review on South Island Hector's dolphins (Manning and Grantz 2017) is presented.

The SI Hector's dolphin (*Cephalorhynchus hectori hectori*) was recognized as a separate subspecies by Baker *et al.* (2002). Throughout this report, the species as a whole, *C. hectori*, will be referred to as Hector's dolphin. Technically, *C. hectori hectori* retained the common name Hector's dolphin when the species was split into two subspecies (Baker *et al.* 1992). Brownell *et al.* (2024) suggested that the species as a whole (i.e., *C. hectori*) could be referred to as the Aotearoa dolphin to recognize the species' endemism in New Zealand. However, this name has yet to be officially recognized by the marine mammal science community. To avoid confusion with the overarching species, in this report *C. hectori hectori* will be referred to as the South Island (SI) Hector's dolphin.

The SI Hector's dolphins inhabits three discrete locations on the western, eastern and southern coasts of the South Island, with each region having a distinct genetic profile (Hamner *et al.* 2012; Constantine *et al.* 2021; **Fig. 20**). They are most abundant off the east (between Malborough Sounds and the Otago peninsula, especially around the Banks Peninsula) and west coasts (between Jackson Bay and Kahurangi Point) of the South Island (Dawson *et al.* 2004; Slooten *et al.* 2004; MacKenzie and Clement 2014, 2016). The Banks Peninsula Marine Mammal Sanctuary (**Fig 21**) was the first protected area for cetaceans in New Zealand, designated in 1988 to protect the major SI Hector's dolphin population in that region.

There is also a genetically discrete population (Hamner *et al.* 2012; Constantine *et al.* 2021) on the south coast of the South Island in Te Waewae Bay, Southland and between Toetoes and Porpoise Bay (Dawson *et al.* 2004; Slooten *et al.* 2004). The Te Waewae Bay and the Caitlin's Coast Marine Mammal Sanctuaries were established for these fragmented and relatively isolated populations (**Fig. 21**).

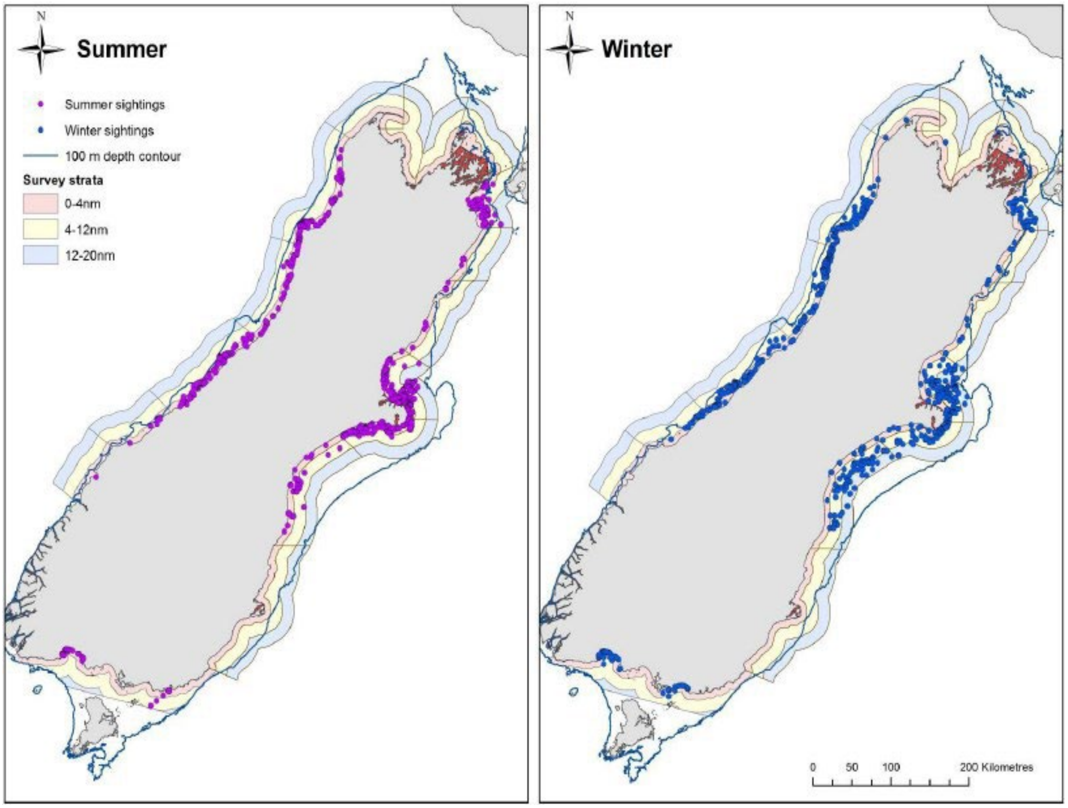

Figure 20. Summer and winter sightings of SI Hector's dolphins during separate aerial surveys conducted between 2010 and 2015. Shaded areas indicate the boundaries of the surveys (from MacKenzie and Clement 2016; reproduced with permission from Fisheries New Zealand).

Another small, relatively isolated population occurs in Clifford and Cloudy Bay (MacKenzie and Clement 2014). A Marine Mammal Sanctuary has also been designated to encompass this population (**Fig. 21**). The Te Rohe o Te Whānau Puha/Kaikōura Whale Sanctuary is roughly a third of the way between the Clifford and Cloudy Bay Sanctuary and the Banks Peninsula Marine Mammal Sanctuary, and although there are fewer SI Hector's dolphins in this area, the latter Sanctuary could provide protection for dolphins in this area between the two sanctuaries.

Figure 21. Marine Mammal Sanctuaries for Māui's and SI Hector's dolphins (from Department of Conservation and Fisheries New Zealand 2021; reproduced with permission).

In the previous status review of SI Hector's dolphins, Manning and Grantz (2017) considered the SI Hector's dolphin to have a moderate risk of extinction, noting that Slooten (2007) had estimated that the SI Hector's dolphin population declined by about 73% between 1970 and 2007, and that there would likely be further declines unless bycatch mortality was drastically reduced (Davies *et al*. 2008; Slooten & Davies 2012, Slooten 2013).

Gormley *et al.* (2012) estimated that one of the largest SI Hector's dolphin populations (the Banks Peninsula population), despite residing within a Marine Mammal Sanctuary, would continue to decline at a rate of about 0.5% per year. Assuming an existing population abundance of 14,849 SI Hector's dolphins (range: 11,923–18,492 dolphins), this rate of decline would result in a 50% reduction in the population in about 140 years and an 80% reduction in about 320 years. However, it was highlighted that this calculation was overly simplistic, was based on limited bycatch data, had little data on other types of mortality, and did not take into account that different populations may have differing rates of decline (Manning and Grantz 2017).

Because of actions taken to protect the subspecies from bycatch (such as areas where gillnets were prohibited and the establishment of Marine Mammal Sanctuaries), Manning and Grantz (2017) concluded that the threat to SI Hector's dolphins had been reduced. However, because of a historical and continuing decline in the SI Hector's dolphin numbers, coupled with a low growth rate and fragmented populations, in conjunction with the number of other stressors facing the subspecies, Manning and Grantz (2017) concluded that there was moderate risk of extinction for SI Hector's dolphins.

2.4.1.1 New information on the species' biology and life history

2.4.1.1.1 Life history

No substantive new information has been presented since the initial status review on SI Hector's dolphins (Manning and Grantz 2017). Berry *et al.* (2022) reanalyzed growth layers in tooth dentine from SI Hector's dolphins and noted one female and one male that were at least 20 years of age. However, photo-identification data from 1984-2024 suggests that there are a small number of individuals that are approximately 30 years of age, although less than 2% of the population reach this lifespan (Gormley 2009; Rayment *et al.* 2009; Webster *et al*. 2009; Gormley *et al.* 2012; Constantine *et al*. 2021; Bennington 2024; Wickman 2024).

2.4.1.1.2 Survival

Estimates for survival rates for SI Hector's dolphins summarized in the initial status review (Manning and Grantz 2017) were relatively consistent (i.e., 0.77–0.89; Slooten and Lad 1991; Cameron *et al.* 1999; Slooten *et al.* 1992) and were similar to those of Māui's dolphins at the time (i.e., 0.83; Hamner *et al.* 2012; see **Section 2.3.1.1.2**).

The Banks Peninsula Marine Mammal Sanctuary was New Zealand's first marine mammal sanctuary, established in 1988 (**Fig. 21**). Its location was a hotspot for SI Hector's dolphins. Initially 1140 km^2 in size, it was extended in 2008, now encompassing a total area of approximately 14,310 km^2, and it extends from the southern boundary of the Te Rohe o Te Whānau puha Kaikōura Whale Sanctuary, south to the Waitaki River and 20 nautical miles out to sea.

Cameron *et al.* (1999) estimated survivorship of Hector's dolphins before and after the establishment of the sanctuary, calculating a pre-sanctuary survival rate of 0.93 (i.e., a 93% chance of survival each year; standard error: 0.04) and a post-sanctuary survival rate of 0.79 (i.e., a 79% chance of survival each year; standard error: 0.06). However, the statistical power of this analysis was low, and a more sophisticated study with a larger dataset estimated an initial survival rate of 0.86, increasing to 0.92 post-sanctuary (Gormley *et al.* 2012).

More recently, Wickman (2018) calculated a mean survival rate of 0.89 (95% confidence interval: 0.8791 - 0.9073; SE=0.0072) for SI Hector's dolphins around the Banks Peninsula, i.e., a relatively high annual mortality rate of 11% and a decrease in survivorship when compared to Gormley *et al.* (2012). Wickman (2024), based on 14 years of data, calculated a slightly higher adult survival rate of 0.909 (95% confidence interval: 0.868 – 0.950) or a 10.1% annual mortality rate. Comparing survival estimates before and after the creation of the Banks Peninsula Marine Mammal Sanctuary shows an increase in survival of 0.023 or 2.3%. Slooten (2004) notes, however, that this current survival rate, in one of the most protected parts of the SI Hector's dolphin range, is still too low to result in a stable population, let alone a recovering population.

In their SI Hector's dolphin risk assessment (see **Section 2.3.1.5** and **Section 2.3.2.5.3**), Roberts *et al.*

(2019) used a range of non-calf survival estimates (0.87–0.96) based on Banks Peninsula SI Hector's dolphin data (from Gormley *et al*. 2012) and estimates of optimal non-calf survival by Edwards *et al.* (2018). This survival rate might be considered an overestimate, considering the lower estimate by Wickman (2018) for the Banks Peninsula.

Moreover, outside the sanctuary, in areas with lower levels of protection, lower survival rates might be expected.

2.4.1.1.3 Reproduction and growth

2.4.1.1.3.1 Sexual maturation

Slooten (1991) estimated that Hector's dolphins have their first calf at age 7-9 years. Gormley (2009) estimated mean age at sexual maturity for females as 7.55 years (n = 117, 95% confidence interval: 6.71–8.41) based on an analysis of carcasses and mark-recapture data.

However, Edwards *et al.* (2018) estimated an age at maturity of 6.9 years (95% confidence interval: 5.8–8.2). This was calculated by plotting body size and reproductive rate across a wide variety of mammal groups (as in Duncan *et al.* 2007) and extrapolating the age at first reproduction based on the body size of SI Hector's dolphins (**Fig. 22**).

This approach was criticized by Slooten and Dawson (2020) because the pattern illustrated in Duncan *et al.* (2007) is very general. As can be seen in **Fig. 22,** there is considerable variety amongst the various cetaceans plotted and Hector's dolphins could be an outlier.

The International Whaling Commission (IWC) Scientific Committee (2024b) also stated that the method used by Edwards *et al.* (2018) had poorer reliability for estimating the age of sexual maturity.

This revised age of sexual maturity would be close to the extreme lower end of the range from previous studies and has yet to be verified with biological data from SI Hector's dolphins.

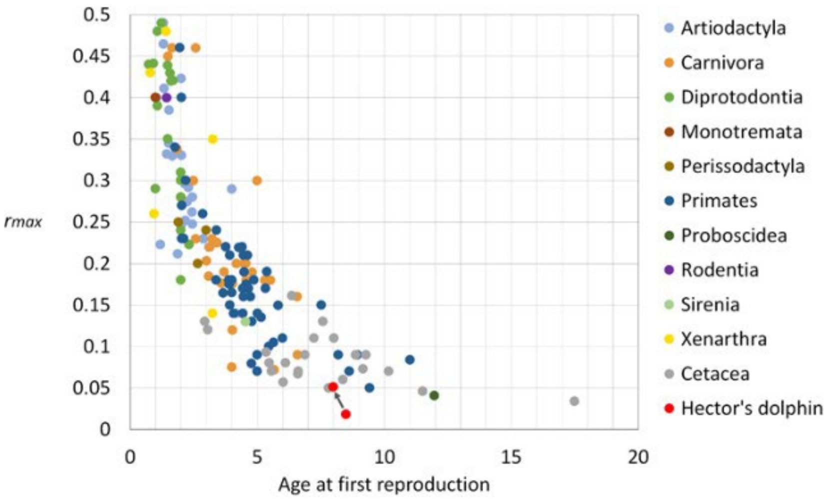

Figure 22. A comparative plot of r_{max} against age at first reproduction for a variety of mammalian groups (Duncan *et al.* 2007). For SI Hector's dolphin, the age of first reproduction by Gormley (2009) is noted, together with the value estimated by Edwards *et al.* (2018) - from Roberts *et al.* (2019); reproduced with permission from Fisheries New Zealand.

2.4.1.1.3.2 Calving interval and reproductive output

Female SI Hector's dolphins give birth in the austral spring and early summer (November-February;

Slooten and Dawson 1988, 1994). They typically produce single calves every 2 to 4 years (Slooten and Dawson 1994). These calves remain with their mothers for 1 to 2 years, with 2 years more common (Slooten and Dawson 1994).

Analyzing data from 1985-2006, Gormley (2009) estimated the annual fecundity (rate of offspring production) for SI Hector's dolphins off Banks Peninsula as 0.205 (95% confidence interval = 0.129 – 0.324), or roughly one fifth of females breed every year. More recently, Bennington (2024) analyzed photo-identification data from 1985-2024 and estimated that the proportion of mature females observed with a calf was 0.298 (standard deviation: 0.013), i.e., approximately a third of the mature females breed in any given year. Bennington (2024) estimated that the average proportion of calves in the SI Hector's dolphin population was 4.1% (95% confidence interval: 0.036 – 0.047), although there was a high level of variation with the proportion of calves varying from less than 1% in 2020 (i.e., less than one calf per 100 individuals) to just over 8% in 1995.

2.4.1.1.3.3 Maximum rate of increase

Currey *et al.* (2012) calculated an intrinsic rate of growth (or r_{max}) - the percentage increase in the population due to successful reproduction – for Māui's dolphins as 0.018 (i.e. a 1.8% increase per year). Roberts *et al.* (2019), in their risk assessment for SI Hector's dolphins, used a revised r_{max} value for SI Hector's dolphins of 0.050 (i.e. 5% per year), based on the age at first reproduction estimated by Edwards *et al.* (2018).

As noted above (**Section 2.4.1.1.3.1)**, the age at sexual maturity used by Edwards *et al.* (2018) was criticized by Slooten and Dawson (2020). In addition to the criticisms detailed above, they noted that SI Hector's dolphins are the world's smallest dolphin (and thus would have a relatively high surface area to volume ratio, which would increase the rate at which they lost body heat), living in cool temperate waters. As such, one would expect that their calves would need to be relatively large and well-insulated in order to survive. Therefore, females would need to invest larger amounts energy into each calf, which could delay their age at first parturition, as well as reduce their reproductive rate.

Slooten and Dawson (2020) also note a lack of empirical evidence to support the revised-upwards estimate of r_{max} for Hector's dolphins, highlighting that, during the 2019–2020 field season, a relatively small proportion of calves were observed – which did not seem to fit with the high rate of population growth estimated.

2.4.1.1.4 Feeding and diet

Ogilvy *et al.* 2023 looked at stable isotope levels in skin samples from SI Hector's dolphins from the north coast of the South Island – specifically Golden Bay in the west, and Queen Charlotte Sound and Cloudy Bay in the east. There were significant differences in isotope levels between the sites, with carbon isotope levels higher in the two eastern sample sites and, conversely, higher nitrogen isotope levels in the western sample populations. The isotope ranges for Queen Charlotte Sound compared to Cloudy Bay suggest that dolphins in the former location may feed on a subset of the prey targeted by dolphins in the latter. Another possibility might be that dolphins in Cloudy Bay are feeding on a wider variety of prey due to climate change-related shifts in species abundance. Ogilvy *et al.* (2023) noted that some (n=6) of the samples suggested dolphins had been eating under "marine heatwave" conditions. Although the isotope profiles were different between the west and east, they suggest that the dolphins are all feeding at the same trophic level. The difference in the western population might be due to feeding on species at slightly greater depth (as they live closer to deeper water areas) or the levels might be influenced by runoff of terrestrial material from land.

Miller *et al.* (2013) noted significant differences in the diets between west and east coast SI Hector's dolphins. Although demersal and benthopelagic species such as red cod (*Pseudophycis bachus*) and ahuru (*Auchenoceros punctatus*) were widely eaten, west coast dolphins also ate javelinfish (*Lepidorhynchus denticulatus*), a mid- to deepwater species, presumably because there are deep water areas close to the west coast of the South Island.

In addition, Brough *et al.* (2019a) used a recreational grade echo-sounder to investigate schools of epipelagic fish and link their distribution to predators such as SI Hector's dolphins, in the coastal waters of Banks Peninsula. Schools of these fish were more abundant in nearshore waters in the summer compared to the winter, which reinforced the hypothesis that the distribution of SI Hector's dolphin matches their prey, with a nearshore distribution in the summer and an offshore one in the winter. The most common species in the epipelagic schools observed with feeding SI Hector's dolphins were the slender sprat (*Sprattus antipodum*), New Zealand pilchard (*Sardinops neopilchardus*), and yellow-eyed mullet (*Aldrichetta forsteri*).

2.4.1.1.5 Social Structure

No substantive new information on SI Hector's dolphin social structure and behavior has been published since the initial status review on the Māui's dolphin (Manning and Grantz 2017).

2.4.1.1.6 Behavior

There have been questions about the behavior of SI Hector's dolphins during storms and rough weather, such as whether they leave their shallow coastal and harbor habitats for deeper water during storms. Dittmann *et al.* (2016) investigated the effect of swell height on visual sightings and acoustic detections of SI Hector's dolphins in Akaroa Harbour (Banks Peninsula). They found that sighting and acoustic detection rates were significantly lower on days after big swell events, as well as after swell events from the south. The assumption is that during these rough weather events dolphins move further offshore to avoid being buffeted by the waves in shallow coastal areas. If this is the case, it could have implications for conservation as dolphins may move into offshore waters where there are no fishing gear prohibitions, and may be vulnerable to bycatch. Moreover, as climate change leads to more frequent and more intense serious storms (e.g., Emanuel 1987; Webster *et al.* 2005; Hoyos *et al.* 2006; Walsh *et al.* 2012; Kossin *et al.* 2013; Hashim and Hashim 2016; Patricola and Wehner 2018), more frequent swell events could cause a shift in dolphin distribution and habitat use (Dittmann *et al.* 2016).

2.4.1.1.7 Movement

2.4.1.1.7.1 Resightings and distance travelled

Most information on SI Hector's dolphin movements comes from the Banks Peninsula population, where Bräger *et al*. (2002) reported that animals on average ranged 31km in a straight line, with most animals moving less than 60 km. The longest straight-line distance between 2 sightings of a dolphin was 106 km (Bräger *et al*. 2002). Generally, 95% of Hector's dolphins from the Banks Peninsula stayed within a 50km area (Rayment *et al*. 2009). Stone *et al*. (2005) also reported on three tagged Hector's dolphins from the Banks Peninsula. The maximum distance between positions for the three dolphins ranged from 50.9–66.5 km, but they were generally within a radius of just 10.4–13.8km.

Bräger and Bräger (2018) investigated the movements of dolphins in several locations on both the east and west coasts of the South Island, based on sightings and resightings of identifiable individuals. Within their home ranges, Hector's dolphins appeared to use smaller subareas over a matter of days. The distances that dolphins covered between being resighted were relatively short, with more than half the movements under 5 km – 38% moved just 5 to 20 km. There were no dolphins reported that moved distances greater than 62 km. However, one identifiable individual covered 4.8 km in 30 min, i.e. 9.6 kmph, in waters off Westport.

Distances and speeds differed significantly between locations (**Table 4**; Bräger and Bräger 2018), with shorter distances travelled on the east coast (mean: 5.4 km ± 0.38 SE) than the west coast (mean: 13.2 km ± 1.5 SE). At Kaikōura, for example, dolphin speeds and distances between sightings were lower. This may be due to the deep-water Kaikōura Canyon acting as a barrier and limiting dolphin movement.

Kaikōura Canyon can be found between Kahutara River in the north and Haumuri Bluffs in the south, where the canyon comes close to shore, reaching a depth of 500m–1km deep. This canyon is divided into two areas of shallow coastal habitat, with 55 dolphins found reliably in the northern area, and 16 in the south. Over a period of eight years, only six dolphins moved north to south over the 15km-wide canyon, and just two moved south to north (Bräger and Bräger 2018). One dolphin moved from the south to the north, and back again, over a period of 9 months. This barrier effect may be causing population fragmentation and reducing genetic mixing in the Kaikōura population (Bräger and Bräger 2018).

Table 4. Mean distances and speeds between consecutive sightings for four populations of SI Hector's dolphins studied in Bräger and Bräger (2018).

	Mean distance between sightings ± SE (km)	Mean distance between sightings per day± SE (km/d)
Kaikōura	3.9 ± 0.58 (*n* = 81)	0.1 ± 0.03 (*n* = 73)
Moeraki	6.3 ± 0.45 (*n* = 107)	1.5 ± 0.24 (*n* = 107)
Westport-Greymouth	17.7 ± 2.36 (*n* = 38)	4.0 ± 1.38 (*n* = 38)
Jackson Bay	10.8 ± 1.89 (*n* = 70)	2.2 ± 0.75 (*n* = 70)

Bräger and Bräger (2018) noted that populations move inshore in spring and offshore in the autumn, presumably because their preferred prey tend to move to depths of 30–100m in the summer, but are less common in these shallow waters in the winter.

On the west coast, dolphins tended to swim faster and longer distances (Bräger and Bräger 2018). This may be because on the west coast there is a narrower strip of shallow water habitat and warmer water temperatures, with deep water areas closer to the coast, resulting in greater distances moved and higher speeds. Moreover, on the west coast the dolphin's prey are less diverse but more pelagic; therefore, animals may have to move greater distances when foraging.

Bräger and Bräger (2018) noted little sign of mixing between populations, which, together with deepwater areas like Kaikōura Canyon acting as a barrier to movement, has implications for the fragmentation and genetic isolation of populations.

Deep water areas of Fiordland (southeast coast of the South Island) and Cook Strait (22km at its narrowest point and 140m deep on average; the strait separates the North and South Island) have been assumed to be barriers to dolphin movement. The deterrent to movement caused by the 15km-long Kaikōura Canyon seems to confirm that deep waters act as a barrier to movement to this species. However, the small number of SI Hector's dolphins (Hamner *et al*. 2014; Constantine *et al.* 2021; see **Section 2.3.1.3**) travelling 400km to the North Island demonstrates that some deep water movement can happen. However, the conservation implications of population fragmentation and lack of movement should be considered – not only in terms of lack of genetic diversity but also in terms of possible Allee effects and vulnerability to stochastic events in the small SI Hector's dolphin populations.

2.4.1.1.7.2 Tagging studies and offshore movement

A recent tagging trial study (Clement *et al.* 2024) attached suction cup tags to 11 SI Hector's dolphins in Cloudy Bay (Te Koko-o-Kupe). The suction cup tags were attached for up to 24 hours. Although the study was a pilot project to investigate the efficacy of the method, with a small sample size, nevertheless it revealed important new information about the movements of SI Hector's dolphins (**Fig. 23**).

(1) One of the dolphins foraged in water deeper than 100m, indicating that the subspecies is not limited to coastal waters less than 100m deep.

(2) The dolphins travelled further from the coast than previously assumed, with two animals moving approximately 6.3nm (11.7km) from the nearest land.

(3) Only three of the tagged dolphins remained predominantly within 2nm (3.7km) of the coast.

The results of this study illustrate that SI Hector's dolphins travel farther from shore than previously assumed.

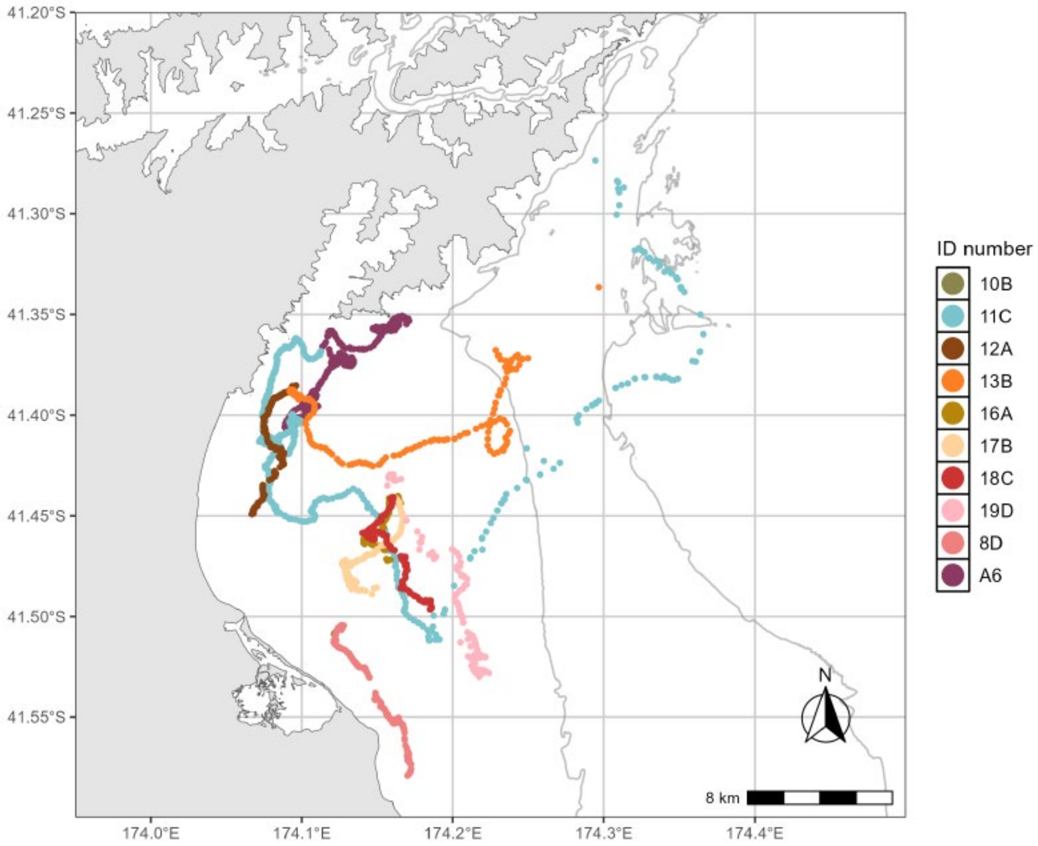

Figure 23. GPS tracks of tagged SI Hector's dolphins in Cloudy Bay (Te Koko-o-Kupe). The 50m and 100m bathymetric contours are shown as continuous grey lines (Clement *et al.* 2024; reproduced with permission from Fisheries New Zealand).

2.4.1.1.8 Acoustic behavior

Nielsen *et al.* (2024) investigated the acoustic behavior of SI Hector's dolphins and compared them to other cetaceans. Most toothed whales (including dolphins) produce either broadband (a wide range of frequencies) or narrow band (a small range of frequencies) high frequency (above 100 kHz) clicks.

Nielsen et al. (2024) found that SI Hector's dolphins had both stereotypical high frequency clicks[46] but also more variable broadband calls.[47] To have both types of high frequency clicks is very unusual for a dolphin species. The source levels (i.e., loudness) of the narrowband clicks was estimated at 116 to 171 dB re 1 µPa at 1 m, with the broadband clicks, ranging from 138 to 184 dB re 1 µPa at 1 m.

2.4.1.2 Abundance, trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends

McGrath (2020) conducted a historical review of SI Hector's (and Māui's) dolphin distribution and abundance. Historically (albeit within the past century) both subspecies were widespread and were once the most common dolphin species in New Zealand waters, particularly within inshore waters. Historical descriptions note that the dolphins could be seen in large groups, sometimes with hundreds of animals (McGrath 2020). This is in stark contrast to group sizes of just one to three individuals usually seen today. They were frequently observed in harbors, rivers, and estuaries. In particular, there were large populations in Pelorus Sound, Marlborough Sound, and Cook Strait, but numbers started to decrease rapidly in the 1960s and 1970s as gillnet fishing with monofilament lines expanded. It appears that most of the subpopulations in Cook Strait, Tasman Bay, and adjacent areas on the north of the South Island have become heavily depleted or extirpated (McGrath 2020). As Hector's dolphins have declined in the northern parts of the South Island, they appear to have been replaced by dusky dolphins in their historic habitat in Cook Strait, as well as down the east coast until the Banks Peninsula (McGrath 2020).

By 1975, the estimated size of the SI Hector's dolphin population was 50,158 (95% confidence interval: 27,411–91,783; Slooten and Dawson 2016). The estimated population dropped to 7,270 Hector's dolphins (95% = 5,303–9,966; Slooten *et al*. 2004), based on survey data from 1997–2001. Estimates of SI Hector's dolphins are summarized in **Table 5**. The most recent total abundance estimate for the SI Hector's dolphin subspecies is 14,849 (95% confidence interval: 11,923–18,492; MacKenzie and Clement, 2014, 2016; **Fig. 24; Table 5**).

Although this estimate is significantly larger than the abundance estimate from Slooten *et al*. (2004), it is not due to an increase in population size, but rather because more recent surveys ranged to 20 nautical miles from the coast, whereas previous surveys ranged to just 4 nautical miles. Therefore, the more recent value represents a more inclusive estimate of the SI Hector's dolphin population size throughout its habitat. The estimate also illustrates substantive numbers of animals that were in waters 4–20 nautical miles from the coast.

Slooten and Dawson (2021b) expressed concerns that the broad-scale aerial surveys conducted by MacKenzie and Clement (2014, 2016, 2019), while providing large area data, may have missed small populations because of the methodology used. As these small populations may be at greatest risk of extirpation, this is problematic. For example, Slooten and Dawson (2021b) noted that there were no sightings off Otago by MacKenzie and Clement (2014, 2016), yet there is a population of about 42 Hector's dolphins in this area (95% confidence interval: 19–92; Turek *et al.* 2013). Similarly, MacKenzie and Clement (2014) only had one dolphin sighting from the North Coast, but the population there is estimated to be about 200 animals (Slooten and Dawson 2021b).

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[46] These clicks had a median frequency of approximately 130 kHz, with a 30 kHz bandwidth. When clicks were combined to produce "buzzes" or short "burst-pulses" they had a median frequency of 129.5 kHz and 130.3 kHz, respectively (Nielsen *et al*., 2024)

[47] With a slightly lower median frequency of approximately 124 kHz, but with a bandwidth of approximately 70 kHz. Like the narrowband clicks, when combined into "buzzes" and "pulse bursts" they also had lower median freuqncies, i.e., 120.7 kHz and 121.8 kHz, respectively (Nielsen *et al*., 2024).

However, in most areas, the MacKenzie and Clement (2014, 2016, 2019) surveys produced similar population estimates to previous surveys (e.g., Dawson *et al.* 2004; Slooten *et al.* 2004, 2006). However, Slooten and Dawson (2021b) noted that off the west coast of the South Island, the most recent population estimate is about 1000 animals fewer than the previous estimate by Slooten *et al.* (2004). This level of decline was attributed to continuing high levels of bycatch due to lack of protection on the west coast of the South Island (Slooten and Dawson 2021b).

There have been only a few new surveys to estimate abundance since the initial status review for SI Hector's dolphins (Manning and Grantz 2017). The most notable is that MacKenzie and Clement (2019), who completed the third in a series of coastal surveys for SI Hector's dolphins (MacKenzie and Clement 2014, 2016, 2019), covering the southern coast populations of Hector's dolphins. The estimated population size was 332 (95% confidence interval: 217–508) which is an increase on the previous 2010 estimate of 238 (95% confidence interval: 113–503).

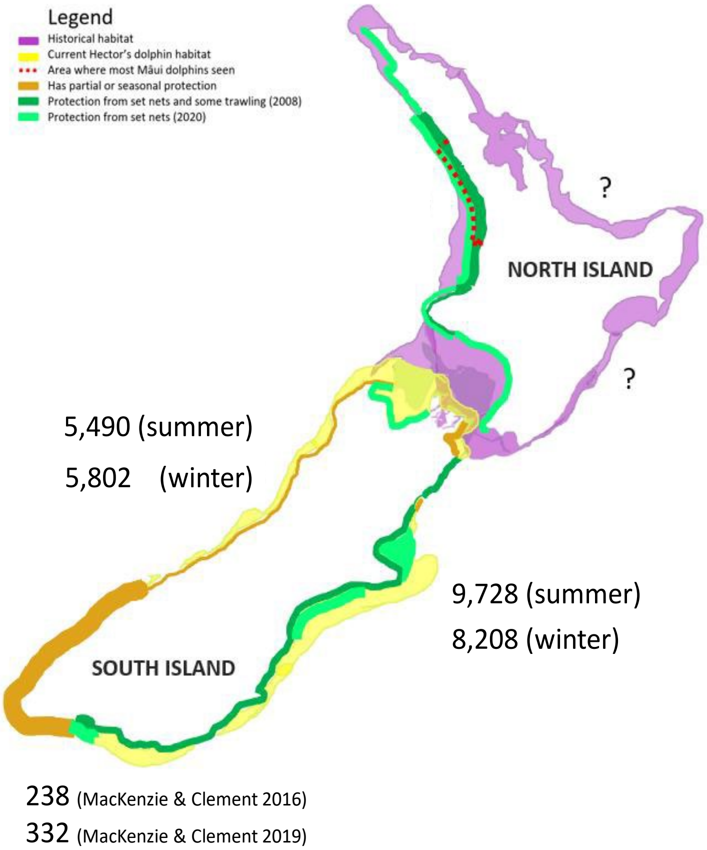

Figure 24. Population estimates for Hector's dolphins are from McKenzie and Clement (2016) unless otherwise stated (modified from McGrath 2020).

Harvey *et al.* (2024) investigated the size of the population of SI Hector's dolphins in Porpoise Bay, on the southern coast of the South Island. A photo-identification capture-recapture methodology was used during summer 2020. It was estimated that 63 Hector's dolphins (95% confidence interval: 46–79) used Porpoise Bay during the study period. Of those 63 animals, three were new calves (4.8% of the population). When compared to population estimates for the area in 1996–97, 2002–03, and 2008, there was no evidence of significant change in the size of the population (Harvey *et al.* 2024).

Aside from these two south coast population surveys (i.e., MacKenzie and Clement 2019; Harvey *et al.* 2024), there is little new information on SI Hector's dolphin abundance. Most of the broad-scale surveys for SI Hector's dolphin abundance are nearly a decade old. New surveys are required to assess trends in the SI Hector's dolphin status.

Table 5. Summary of abundance estimates for SI Hector's dolphins with the method used to calculate abundance. Because survey methodologies differ between studies (e.g., area covered) the results are not necessarily comparable.

Sampling Period	Location	Research Method	N	95% Confidence Interval	Reference
SOUTH ISLAND					
2010-2015	Coast to 20 nm	Aerial line transects	14,849	11,923 – 18,492	MacKenzie and Clement 2016
1997-2000	Coast to 10 nm	Boat and aerial line transects	7,270	5,303-9,966	Slooten *et al.* 2004 Dawson *et al.* 2004
1985	Coast to 0.43 nm	Boat, strip transects	3,274	N/A	Dawson and Slooten 1988
WEST COAST					
2014/2015	Farewell Spit to Milford Sound	Aerial line transects	5,490 (summer) 5,802 (winter)	3,319 – 9,079 3,879 – 8,679	MacKenzie and Clement 2016
2000-2001	Farewell Spit to Milford Sound	Aerial line transects	5,388	3,613 – 8,034	Slooten *et al.* 2004
EAST COAST					
2014-2015	Kaikōura	Genetic capture recapture	480	342-703	Hamner *et al.* 2016
2013	Kaikōura	Photo-ID mark- recapture	304	211–542	Weir and Sagnol 2015
2011-2012	Cloudy Bay	Genetic capture recapture	272	236 – 323	Hamner *et al.* 2013
2010-2011	Taiaroa Head to Cornish Head, Otago	Photo-ID mark- recapture	42 37	19–92 25-75	Turek *et al.* 2013
2006-2009	Cloudy and Clifford Bays	Aerial line transects	951 (summer) 315 (winter) 188 (spring)	573- 1,577 173- 575 100- 355	DuFresne and Mattlin 2009
1989-1997	Banks Peninsula	Photo-ID mark- recapture	1,119	744-1,682	Gormley *et al.* 2005
NORTH and EAST COAST					
2012-2013	Farewell Spit to Nugget Point	Re-analysis of Mackenzie and Clement 2014	9,728 (summer) 8,208 (winter)	7,001 – 13,517 4,888 – 13,785	MacKenzie and Clement 2016
2012-2013	Farewell Spit to Nugget Point	Aerial line transects	9,130 (summer) 7,456 (winter)	6,342 – 13,144 5,224 – 10,641	MacKenzie and Clement 2014

NORTH and	**EAST COAST**				
1998/99	Motunau to Long Point Timaru to Long Point	Boat line transect	1,597 399	1,175-2,171 279 - 570	DuFresne *et al.* 2001
NORTH, EAST and SOUTH COAST					
1997-2000	Farewell Spit to Long Point	Boat line transect	1,880	1,246 – 2,843	Dawson *et al.* 2004
SOUTH COAST					
2019	Long Point, Fiordland and Nugget Point, Otago	Aerial line transects	332	217–508	MacKenzie and Clement 2019
2010	Puysegur to Nugget Point, Otago	Re-analysis of Clement *et al.* 2011	238	113- 503	MacKenzie and Clement 2016
2010	Puysegur to Nugget Point, Otago	Aerial line transects	628	301- 1,311	Clement *et al.* 2011
2005/2006	Te Waewae Bay	Photo-ID mark- recapture	580 (summer) 380 (winter)	480-700 300-500	Rodda 2014
2004/2005	Te Waewae Bay	Photo-ID mark- recapture	403 (summer) 251 (autumn)	269-602 183-343	Green *et al.* 2007
1996- 1997	Porpoise Bay	Photo-ID mark- recapture	48	44-55	Bejder and Dawson 2001
2020	Porpoise Bay	Photo-ID mark- recapture	63	46–79	Harvey *et al.* 2024

2.4.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding)

Bennington *et al.* (in press) used environmental DNA[48] analysis to investigate the population structure of South Island Hector's dolphin populations. Water samples were collected from Banks Peninsula (mid-east coast), Timaru (mid-east coast) and Dunedin (southeast) on the east coast of the South Island. Scanning the samples for mitochondrial DNA, positive results were obtained for SI Hector's dolphins DNA in 77% of the water samples. Analyzing the genetic profiles of these samples, it was found that the Dunedin SI Hector's dolphin population was actually more closely related to south coast populations than to the other east coast populations. At present, there is a gap in dolphin occurrence between Dunedin and the south coast populations, which suggests that historically there may have been other interconnecting dolphin subpopulations between Dunedin and the south coast of the South Island, which have subsequently become extirpated.

2.4.1.4 Taxonomic classification or changes in nomenclature

Hector's dolphin was described in 1881 (as *Electra hectori*) by Belgian zoologist Pieter Jozef van Beneden (van Beneden 1881). The specimen was collected "on the north-east coast of New Zealand" [translated from French] (p. 882 in van Beneden 1881). Unfortunately this defining specimen was damaged during the Second World War (and subsequently lost), so it cannot be genetically analyzed. However, if the specimen did indeed come from the northeast coast of New Zealand, and assuming a similar distribution to today, it would make this original "type specimen" (or holotype) most likely a Māui's dolphin. The subspecies has been reported in Hawke Bay in northeast New Zealand (**Section 2.3.1.5; Fig. 9**), and it is possible that over a century ago the subspecies may have been more abundant

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[48] Environmental DNA (eDNA) is defined as DNA from organisms obtained from environmental samples, such as water.

in this region (McGrath 2020).

However, Brownell *et al*. (2024) argued that, due to the rarity of Māui's dolphin in the northeast of the North Island, the specimen may have been collected from the northeast coast of the South Island, making the type specimen most likely a SI Hector's dolphin. Brownell *et al*. (2024) went on to suggest that the name "Hector's dolphin" should refer specifically to the subspecies *Cephalorhynchus hectori*, and that the species *Cephalorhynchus hectori* as a whole (encompassing both subspecies) should be renamed the Aotearoa dolphin. However, the marine mammal science community has not yet officially recognized this proposed name change for the species.

2.4.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range)

Stephenson *et al*. (2020) developed a spatial distribution model for New Zealand cetaceans, using data from 3,688 sightings of SI Hector's dolphins, 1,051 sightings of Māui's dolphins, and environmental variables that included bathymetry, turbidity, productivity, and temperature. The results predicted the highest distribution of dolphins on the east coast of the South Island, notably in the shallow waters off Canterbury and the Banks Peninsula. However, there were also predicted hotspots on the south and north coasts. The relatively low abundance of animals on the north coast currently, compared to the predicted habitat, suggests that dolphins were more abundant in this region historically. This is supported by McGrath (2020), who suggested that the Hector's dolphin population of Cook Strait may have largely been extirpated.

Fisheries New Zealand has produced an online mapping portal that includes distribution data on SI Hector's and Māui's dolphins for the general public. However, the distribution appears to be largely a 5 nautical mile strip around the coast of the South Island (except the southwest), with a 14 nautical mile strip around the Banks Peninsula, and appears not to be based on bathymetry or other environmental factors, although some distribution hot spots – such as Te Waewae Bay on the South coast, Banks Peninsula, and the West Coast (Te Tai Poutini) – are noted (**Fig. 25**).

Brough *et al*. (2019b) analyzed the distribution of 9,000 sightings of SI Hector's dolphins made over 29 years of systematic surveys in the coastal waters of the Banks Peninsula. They found that approximately half of the sightings were made within just 21% of the survey area, but these distribution "hotspots" remained relatively consistent throughout the years (**Fig. 26B**). The distribution hotspots had significantly higher densities of dolphins during the summer months (**Fig. 26A**). The consistency of hotspots over time suggests that disturbance has not affected distribution of animals in these hotspot areas and/or the habitat quality has not degraded. However, there has been a shift towards the mouth of Akaroa Harbour, which seems to be linked to increasing levels of cruise ship traffic (see **Section 2.4.2.4.2.2**; Carome *et al.* 2023a).

When investigating these hotspots, Brough *et al.* (2020) reported higher instances of foraging behavior (indicated by acoustic patterns), suggesting that these hotspots are stable, but patchy, locations of prey species. Because foraging can be disrupted by human disturbance, such as underwater noise, Brough *et al*. (2019) suggested that because of this stability of distribution, and the importance of these areas for feeding, there should be additional conservation measures to protect these areas and the dolphins within them.

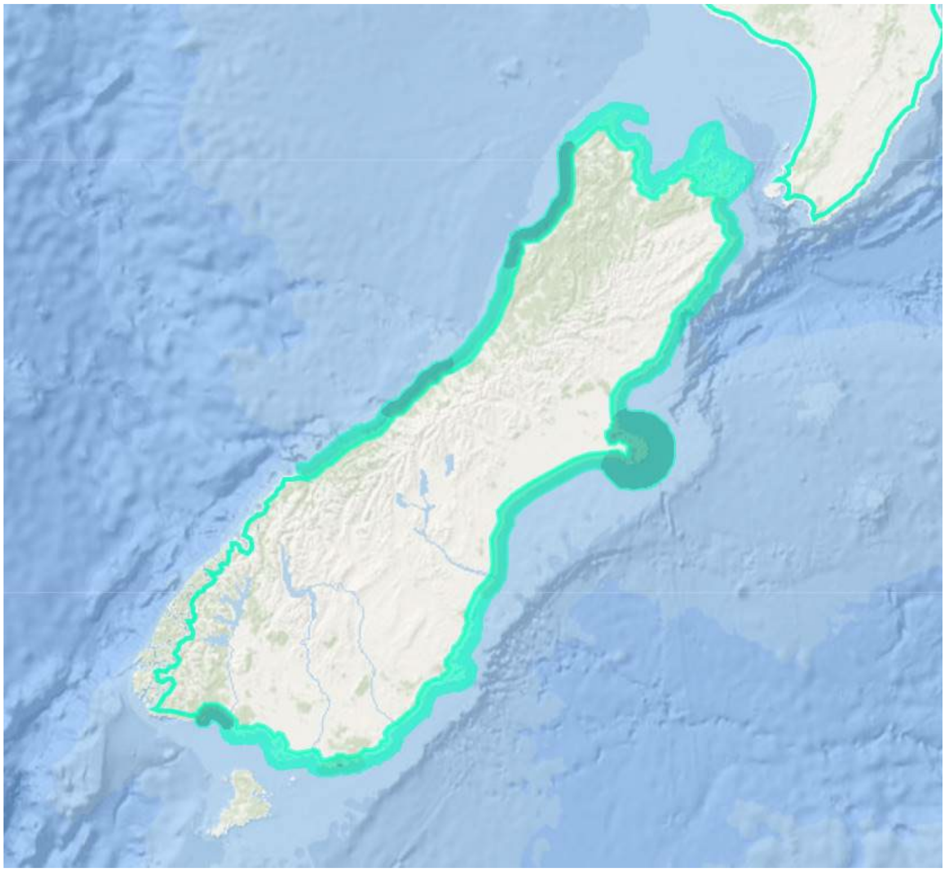

Figure 25. Hector's dolphin distribution map as delineated on the Fisheries New Zealand resource mapping site (https://mpi.maps.arcgis.com/).

To further investigate the nature of these distribution "hotspots" and to assess "what makes hotspots unique", Brough *et al*. (2023) compared environmental characteristics and prey with SI Hector's dolphin distribution[49]. Dolphin abundance was strongly correlated with prey abundance and a range of environmental variables. Preferred habitat appeared to consist of: sandy seabed substrate; shallow depth (12m-22m); high current; and low turbidity. Interestingly, other studies have used turbidity as major environmental variable influencing the distribution of SI Hector's dolphins (e.g., Deville *et al.* 2016; Roberts *et al.* 2019; Stephenson *et al.* 2020) associated higher turbidity with higher dolphin abundance – the opposite of what was found by Brough *et al*. (2023). Roberts *et al*. (2019) in particular used turbidity as a major environmental variable to predict Māui's and SI Hector's dolphin distribution and the overlap with fishing activity, in order to predict the bycatch risk for these subspecies. Weighting models with higher turbidity as a major variable affecting distribution could potentially skew Roberts *et al*.'s (2019) assumed dolphin distribution to more coastal and river-associated areas (i.e., areas with higher turbidity), as well as underestimating the number of animals in low-turbidity waters (see **Section 2.4.2.5.3.2** for discussion on this model).

Cross (2019) investigated the distribution of SI Hector's dolphins, and other species, in Queen Charlotte Sound (Tōtaranui). Cross's study involved historical sightings data (1995–2011) collected by three operators in a dolphin-watching company, as well as visual surveys (2011–2014) using dolphin-watching vessels as platforms of opportunity. Historical sightings data (n = 2,598 sightings) found that

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[49] Via a general additive modelsis general additive models and principal component analyses (Brough *et al.* 2023).

SI Hector's dolphins were distributed throughout the Sound, although sightings were denser in the middle and inner Sound, becoming more concentrated in the middle Sound over time. There was a higher density of sightings in the summer and autumn, with a lower density of sightings in the winter. Moreover, a decline in sightings was noted between 2007 and 2011. The distribution of the dolphins tended to be associated with warmer sea surface temperatures, but not with turbidity, which was previously considered to be a major environmental variable influencing the distribution of Hector's dolphins (e.g., Deville *et al.* 2016; Roberts *et al.* 2019; Stephenson *et al.* 2020).

Surveys using dolphin-watching vessels as platforms of opportunity (2011–2014) saw a similar concentration of SI Hector's dolphin sightings in the middle of the Sound (range size 10.6 km^2), with very few sightings in the inner sound area (Cross 2019). The overall range size of the dolphins was 58.8 km^2. The dolphins were more widespread and in greater densities during summer and autumn, a pattern similar to that determined from historical sightings. Notably, around Matapara/Pickersgill Island and south of Blumine Island/Oruawairua, there were dolphin hotspots in the summer months.

Cross (2019) also investigated the overlap in distributions of other dolphin species. There was some overlap with most species in the Sound, as SI Hector's dolphins were concentrated in the central part, while dusky dolphins and bottlenose dolphins tended to be distributed throughout the Sound.

Bennington *et al.* (2024), used SI Hector's dolphin data to test how well habitat models constructed using data from one area will transfer to other areas. Summer distribution data was collected from five populations. It was then tested whether models built with data from one location/population could predict the observed dolphin distribution in another location/population. The researchers found that in Banks Peninsula and Otago the models constructed were good at predicting dolphin distribution within these two particular areas, but when used for other areas, observed distribution matched poorly with the model predictions. If data from different locations was combined there were mixed results: combining some locations provided better results than combining other locations. In summary, the research suggested that SI Hector's dolphins in different areas had different habitat preferences and that a "one size fits all" approach was not correct when modelling SI Hector's dolphin data. The researchers emphasized that using models constructed with data from one location to predict distribution in a data poor areas was problematic. It should not be assumed that habitat preferences and distribution patterns are transferable between populations and locations.

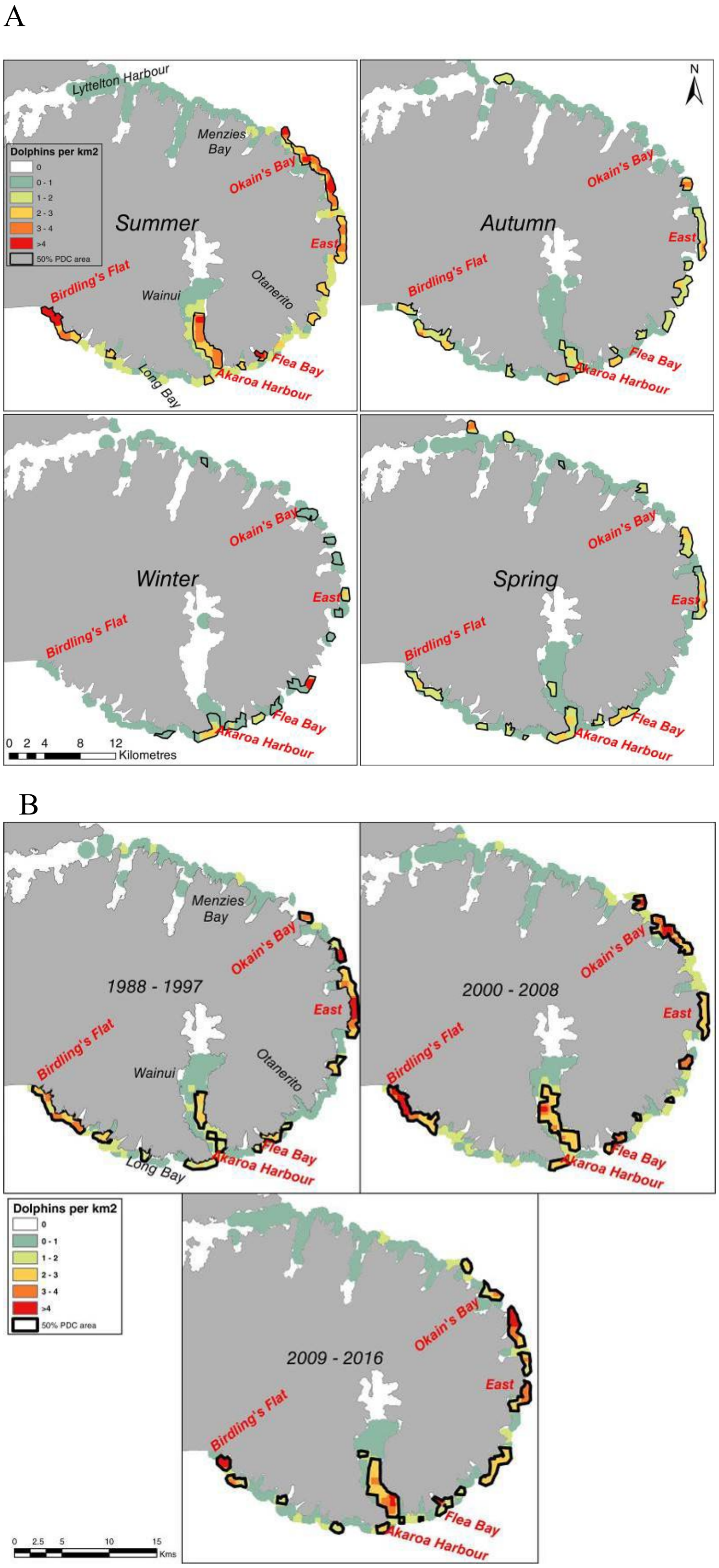

Figure 26. Fine scale distribution of the Banks Peninsula population of SI Hector's dolphins, showing (A) seasonal changes in distribution and (B) long-term stability of coastal hotspots (from Brough *et al.* 2019b; reproduced with permission from Drs E Slooten and S. Dawson).

2.4.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

In their research on the distribution of dolphins in Queen Charlotte Sound, Cross (2019) noted that sightings collected by dolphin-watching operators showed a shift in SI Hector's dolphins over time (1995 to 2011), with a decline in sightings in the inner Sound, and animals becoming more concentrated in the central regions of the Sound. Cross (2019) notes that this may be due to anthropogenic activities in the inner Sound increasing siltation and sedimentation in this area. Coastal development, road construction, and forestry plantations have increased coastal erosion, leading to several major landslides in the 1990s through 2000 in the inner Sound. In addition, larger and faster ferries have been in operation in the Sound since the 1990s.

Cross (2019) defined the habitat parameters of SI Hector's dolphins (and other species) in Queen Charlotte Sound. Water temperatures tended to be between 12–19°C (mean 15.5°). Bottom characteristics were gentle slopes and mid-depths, i.e., slopes between 0.1 and 14° degrees and depths between 7–67m (mean 44m). Distance from shore ranged from 50–970m. There was a significant effect of sea surface temperature and depth on the distribution of SI Hector's dolphins, much more so than with other species in the study. Cross (2019) suggested that this may be due to the dolphins foraging on bottom-dwelling and/or benthopelagic species.

SI Hector's dolphins also seemed to approach more closely to aquaculture sites (mean 4.2km) than other dolphin species in the Sound (Cross 2019), which may mean they are more exposed to aquaculture-related risks (**Section 2.4.2.1.1**).

One of the hotspots for SI Hector's dolphins in the middle Sound is Patten Passage, off of Blumine Island/Oruawairua. This area has strong tidal currents and many benthic invertebrates such as tubeworms, anemones, sponges, and bivalves that rely on this tidal flow (Davidson *et al.* 2011). These may in turn provide food and habitat for SI Hector's dolphins, sustaining a range of species up the food chain in the surrounding area that serve as the dolphin's prey. A number of demersal (seabed or near seabed) species, such as red cod (*Pseudophycis bachus*), sole (*Peltorhamphus* sp.), stargazer (*Crapatalus* sp.), and Bothiid and Pleuronectiid flounders (Davidson *et al.* 2011), are found in this area and are known, or potential, prey for SI Hector's dolphins (Miller *et al.* 2013).

However, Cross (2019) noted that SI Hector's dolphin habitat characteristics (e.g. temperature), and patches of high productivity, are quite dynamic and mobile, and rather than being focused on a specific area they may search for patches of high productivity and prey. During the summer there is a peak in chlorophyll in the region and the increased density of SI Hector's dolphins in the summer may reflect the increase in productivity (Cross 2019). Red cod (one of the dolphins' preferred prey species) move offshore during winter, which may be due to changes in sea surface temperature (Beentjes and Renwick, 2001). Therefore, SI Hector's dolphins' association with warmer sea surface temperatures may be due to seasonal movement patterns of their prey rather than temperature or other environmental factors *per se* (Bräger *et al*. 2003; Miller 2015).

While all studies found depth was an important habitat characteristic for SI Hector's dolphins (Bräger *et al.* 2003; Rayment *et al.* 2011; Weir and Sagnol 2015) and Māui's dolphins (Derville *et al.* 2016), animals studied in Cross (2019) favored deeper water and, moreover, turbidity in Cross (2019) was not such an important habitat variable.

In another study, Carome *et al.* (2023a) noted changes in SI Hector's dolphin habitat use in Akaroa Harbor, with animals shifting their distribution toward the harbor mouth and away from a previous core area. Carome *et al.* (2023a) considered this change in habitat use to be due to an increase in the number of cruise ships berthing in the middle stretches of the harbor – see **Section 2.4.2.4.2.2** for more details.

Leunissen *et al*. (2019) also noted a shift in habitat use related to anthropogenic activity, reporting that, in response to pile driving, dolphin acoustic detections decreased in the inner part of Port Lyttelton (Banks Peninsula). They increased in the middle part of the harbor – an area with approximately 10 times lower sound levels. See **Section 2.4.2.4.2.1** for details.

2.4.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.4.2.1 Present or threatened destruction, modification or curtailment of its habitat or range

2.4.2.1.1 Aquaculture

Aquaculture is becoming an increasingly important coastal industry in New Zealand (Aquaculture New Zealand 2019). The three main cultured species include the green-lipped mussel (*Perna canaliculus*), the Pacific oyster (*Magallana gigas*), and the king, or chinook, salmon (*Oncorhynchus tshawytscha*). There is an overlap between habitats of Hector's dolphins of both subspecies and potential sites for coastal aquaculture (Bath *et al.* 2022). Several important areas of Māui's and SI Hector's dolphin habitat have substantive aquaculture activity, including Auckland (Pacific oysters and mussels) on the North Island coast and Tasman and Golden Bays (mussels); Malborough Sound (salmon, mussels, and oysters); Banks Peninsula and the Canterbury coast (salmon and mussels); and Southland (salmon and mussels) on the South Island coast (Fisheries New Zealand 2020).

Several studies on New Zealand cetaceans have found that dolphins were excluded from coastal habitat by mussel farms in Admiralty Bay. For example, dusky dolphins (*Lagenorhynchus obscurus*) avoided areas with mussel farms (Markowitz *et al*. 2004; Duprey 2007) and it was suggested that the mussel lines prevented cooperative feeding activities (Markowitz *et al*. 2004; Vaughn *et al.* 2007).

Regarding SI Hector's dolphins specifically, Valdés Hernández *et al.* (2024) investigated the effect of mussel farms on their distribution in several bays within the Banks Peninsula Marine Mammal Sanctuary. Acoustic detectors were used to monitor dolphin presence and, similar to Markowitz *et al*. (2004) and Duprey (2007), dolphins were detected significantly more on the side of any bay that was opposite to aquaculture sites. Moreover, during winter months, there were significantly fewer dolphin detections in bays with aquaculture sites. Valdés Hernández *et al.* (2024) concluded that mussel farms appear to displace SI Hector's dolphins from their habitat and, therefore, caution was needed when siting these facilities.

There have been records of mysticete cetaceans becoming entangled in mussel lines in New Zealand but, to date, no dolphins are known to have become entangled (Bath *et al.* 2020). In a New Zealand Government report, Clement (2013) concluded that, if mussel farming did not overlap with breeding, migrating, and feeding habitats of protected species, few negative interactions would be expected. However, as most areas where SI Hector's dolphins are found are likely to represent feeding areas at least, and as aquaculture sites are likely to be sited in the shallow, sheltered waters that are prime SI Hector's dolphin habitat, there is likely to be an overlap. Siting additional mussel farms within the Banks Peninsula Marine Mammal Sanctuary is likely to lead to further displacement of SI Hector's dolphins from areas of this core habitat.

Finfish farms in New Zealand, in addition to housing fish in net pens, use anti-predator nets to prevent pinnipeds from eating their stock (Fisheries New Zealand 2020; Bath *et al*. 2022). Price *et al*. (2017) noted that aquaculture infrastructure resembles set gillnets and pot lines that are known to cause entanglement in Hector's dolphins and other cetaceans. There have been at least two fatal entanglements of SI Hector's dolphins in fish farm net pens (Forrest *et al.* 2007; Slooten *et al.* 2001; Clement and Elvines 2019; Bath *et al.* 2022), as well as of dusky dolphins (n = 7; Markowitz *et al*. 2004; Duprey 2007; Forrest *et al.* 2007; Clement and Elvines 2019; Bath *et al.* 2022) and New Zealand bottlenose dolphins (n = 4; Kemper and Gibbs 2001; Bath *et al.* 2022).

In addition to anti-predator nets, aquaculture facilities (particularly for salmon) can use acoustic harassment devices (AHDs), acoustic deterrent devices (ADDs), or "seal scarers" to displace marine mammals from aquaculture sites. However, these loud acoustic devices, which are designed to repel pinnipeds, can also act as deterrents to cetaceans, displacing them from important habitat or even potentially causing auditory damage (Johnston 2002; Morton and Symonds 2002; Olesiuk *et al*. 2002; Wursig and Gailey 2002; Johnston and Woodley 2008; Clement 2013; Findlay *et al*. 2018, 2021, 2024; Todd *et al.* 2021). The extent to which these devices are used in New Zealand waters is unknown, but they could be a cause for concern.

Other possible impacts of aquaculture (Wursig and Gailey 2002; Clement 2013; Price *et al.* 2017; Fisheries New Zealand 2020; Bath *et al.* 2022) include waste and fish food decomposing and causing anoxia near the sites (Gillibrand *et al.* 1996); the possible spread of marine pathogens or algal blooms that can be toxic to marine mammals (Flewelling *et al.* 2005; Broadwater *et al.* 2018) and can alter the local ecosystem by adding nutrients; escaped fish; and water flow alternation. In addition, aquaculture sites sometimes use anti-sea lice treatments that could be toxic to marine life, and they may also use antimicrobials and antibiotics, which could alter the microbial ecology of surrounding areas, including promoting antibiotic resistant bacterial strains (Okede *et al.* 2022).

Cross (2019) noted that SI Hector's dolphins in Queen Charlotte Sound were found closer to aquaculture sites than were other dolphin species, and thus may be at more risk than other species. Entanglement in aquaculture nets is a known risk of mortality that needs to be monitored when facilities are in SI Hector's dolphin habitat. However, as aquaculture develops, the potential loss of habitat and indirect ecosystem effects may also need assessing.

2.4.2.1.2 Mining

As noted in **Section 2.3.2.1.2**, the continental shelf area of New Zealand has a number of mineral resources that are potential targets for seabed mining (**Fig. 8**). On the west and south coasts, as well as part of the southeast coast, there are deposits of placer gold (Lucke *et al.* 2019). Placer gold entails small fragments, flakes, or nuggets of gold in sediments, alluvial deposits, or even beach materials, which have been liberated from gold-bearing rock deposits by weathering. There are currently more than 30 placer gold mines on the west coast of the South Island, as well as Otago and Southland (Christie 2019). These produce nearly US$100 million worth of gold a year.

There are several environmental impacts that coastal placer gold mines could have on the marine environment, including releasing sediments; changing the chemistry of water systems; and increasing turbidity (Ryan 1991; Krätz *et al.* 2010; Harding and Boothroyd 2004). Placer mining can also release heavy metals and other contaminants into the environment (Getaneh and Alemayehu 2006). In particular, gold rush era mines may have used mercury to extract gold, and these historic contaminants can be disturbed by modern placer mining (Clement *et al.* 2017). Coastal placer gold mines could, therefore, have impacts on SI Hector's dolphins and their habitats. Submarine deposits of placer gold (in oceanic sediments) may also become a target for seabed mining in the future.

On the northwest coast of the South Island, there are also deposits of iron sands (**Fig. 8**). As noted in the section on the impacts of mining on Māui's dolphins (**Section 2.3.2.1.2**), there are concerns about the impacts of iron sands mining on both dolphins and their habitat.

Mining of placer gold or iron sands deposits would entail large-scale seabed dredging, which not only would cause catastrophic damage to benthic ecosystems, but could also liberate vast amounts of sediment into the water column and produce high levels of underwater sound. Several studies have demonstrated that the noise produced by dredging operations can affect cetaceans and cause changes in behavior (Richardson et al 1985, 1990; Wartzok *et al.* 1989) or even displacement from their habitats (Bryant *et al.* 1984; Richardson 1984; Richardson *et al.* 1985, 1990; Wartzok *et al.* 1989).

2.4.2.1.3 Oil and gas extraction

As noted in **Section 2.3.2.1.3**, the Taranaki Basin is an oil and gas production area (**Fig. 9, Fig. 10** and **Fig. 11**; Lucke *et al.* 2019) and there are ongoing and approved permits for oil and gas exploration (**Section 2.3.2.1.3** and **Section 2.3.2.4.3.1**). Although currently exploited and potential oil and gas deposits are closer to Māui's dolphin habitat, there are potential sites north of the South Island that are adjacent to SI Hector's dolphin habitat. Should there be a major oil spill in the Taranaki Basin, it could be a major threat to Māui's dolphins, but depending on the location, it could also possibly affect SI Hector's dolphins.

Moreover, off the east coast of the South Island (**Fig. 8**) there are gas hydrate deposits (hydrocarbons trapped within a network of frozen water crystals), which could potentially be mined in the future.

2.4.2.1.4 Contamination/pollution

Stockin *et al.* (2010) investigated organochlorine contaminant levels in 27 SI Hector's dolphins (**Table 6**). Organochlorine concentrations in the blubber of reproducing female dolphins were lower than those of adult males, due to the transfer of pollutants from mothers to calves via the placenta and lactation (ΣDDT μg/kg wet weight – females: 93.7–8210; males: 252.4–57,390).

East coast SI Hector's dolphins had higher levels of DDT than those on the west coast (maximum values (μg/kg wet weight – east coast: 57,390; west coast: 9200; south coast: 3597), with a regression model in mature animals, showing that east coast animals had DDT levels three times higher than west coast animals. There were only two south coast animals in the sample, but their levels were comparable to west coast dolphins. The east coast area, including the Canterbury plains and Banks Peninsula, was one of the most intensively farmed areas historically and DDT was heavily applied to remove the grass grub (*Costelytra zealandi*) and porina caterpillars (*Wiseana* sp.). In addition, cadmium levels are likely to be high due to the use of cadmium-rich phosphate fertilizers historically (**Section 2.3.2.1.1**).

Baker (1978) reported DDT levels of 45 μg/kg in a single Hector's dolphin from the mid-1970s. Jones *et al.* (1999) investigated dioxin (μg.kg^{-1} wet weight – PCDF: 1.54; PCDD: 12.58) and PCB levels in six SI Hector's dolphins (PCBs: 750 – >l,000 μg/kg). The levels noted in Stockin *et al.* were 2.4 (males) or 1.6 (females) times higher than these previous PCB levels.

Considering the impacts that organochlorine pollutants can have on reproductive and immune systems (**Section 2.3.2.1.1**) and the potential risks that disease poses for SI Hector's dolphins, the levels of organochlorine pollutants in SI Hector's dolphins should be considered a synergistic threat that could potentially reduce reproductive rates and elevate the risk of disease mortality.

2.4.2.1.5 Climate change

Peters *et al.* (2022) conducted an analysis of the possible impacts of climate change on two New Zealand cetacean species, and found that climate change could lead to a 61% and 42% loss and/or decrease of suitable habitat for sperm and blue whales, respectively. To date, there has not been a similar assessment for SI Hector's dolphins. Cross (2019) found that SI Hector's dolphins in Queen Charlotte Sound were associated with sea surface temperatures of 12–19°C (mean 15.5°), although Cross (2019), as others have done, suggested that this was determined primarily by the distribution of their ectothermic epipelagic and demersal prey (**Section 2.4.1.1.4**; **Section 2.4.1.6**; Bräger *et al.* 2003; Miller 2015; Ogilvy *et al.* 2022, 2023).

Table 6. Summary of organochlorine contaminants reported in Hector's dolphins (Stockin *et al*. 2010). The notation "n.d." means the contaminant was not detectable.

Contaminant	Range (µg.kg^{-1} wet weight)
β-HCH	n.d.–10.0
γ-HCH	n.d.–0.58
HCB	5.7–90
Dieldrin	6.0–490
Heptachlor-epoxide	n.d.–38
α-Chlordane	n.d.–11.0
γ-Chlordane	n.d.–4.4
DDTs	93.7–57390
PCBs	45.5–5574

As noted in **Section 2.3.2.1.4**, the frequency of marine heatwaves in New Zealand coastal waters has increased over the past decade, with record coastal and oceanic water temperatures recorded in 2022 and 2023 (Corlett 2024). In particular, the waters off the east coast of the South Island had the highest average rate of coastal sea-surface warming (0.34ºC per decade)[50].

Ogilvy *et al.* (2022) noted a shift in stable isotope signatures in Māui's dolphins during a marine heatwave, indicating a potential shift in prey species consumption. Therefore, it is likely that the current prey of SI Hector's dolphins will also shift into cooler offshore and/or deeper waters as temperatures increase. This could lead to a corresponding shift in the distribution of dolphins into more offshore waters, where they may not have protection from entanglement in fishing gear.

Ogilvy *et al.* (2022) was of the opinion that Māui's dolphins could adapt to changes in climate by switching prey species. If this is also the case with SI Hector's dolphins, it may have an impact on their health and fitness as noted in **Section 2.3.2.1.4.** The effect of climate change on dolphin prey, diet, and nutritional status warrants further research and monitoring.

Dittmann *et al.* (2016) investigated the effect of swell height on visual sightings and acoustic detections of Hector's dolphins and found a decrease in abundance that was linked to increasing swell height (**Section 2.4.1.1.6**). As more frequent and more intense storms are predicted as a result of climate change in the southern Pacific (Emanuel 1987; Webster *et al.* 2005; Hoyos *et al.* 2006; Walsh *et al.* 2012; Kossin *et al.* 2013; Hashim and Hashim 2016; Patricola and Wehner 2018), this could lead to a change in SI Hector's dolphin distribution, with animals spending more time offshore, and in areas of potential entanglement risk.

2.4.2.1.6 Earthquakes

New Zealand is a hotspot of mass strandings, especially of pilot whales (*Globicephala melas*), and it has been suggested that its position on the edge of a tectonic plate and seismic events and earthquakes

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[50] Stats New Zealand (2024). https://www.stats.govt.nz/indicators/sea-surface-temperature-data-to-2023/.

may be a contributing factor (Hamilton 2018). New Zealand is seismically active and earthquakes are common. Most are minor, but occasionally major events occur, often in areas close to hotspots of SI Hector's dolphin abundance.

Little is known about the impacts of earthquakes on marine mammals. However, they are one of the most significant natural sources of underwater sound (Hildebrand 2005, 2009) and as such have the potential to cause acoustic injury or even mortality.

Raghunathan *et al.* (2013) suggested that earthquakes cause magnetic field shifts that might affect the navigational abilities of marine animals, as they can produce electromagnetic emissions (Freund and Stoic 2013). These could potentially lead to whale strandings. An earthquake off the coast of Myanmar caused a mass stranding of pilot whales on the same day, on the North Andaman coast over 350 km away (Raghunathan *et al.* 2013). Toxic gases such as carbon monoxide and carbon dioxide can also be released in large amounts during earthquakes and it has been suggested that this could also affect marine animals (Freund and Stoic 2013).

In contrast, Grant *et al.* (2105) found no correlation between marine mammal strandings and earthquakes over a six-year period in Washington and Oregon States; however, no major earthquakes (magnitude 6.5 or above) were recorded during the study. Moreover, unlike pilot whales, SI Hector's dolphins do not appear to mass-strand (Brabyn 1991).

Earthquakes can cause significant changes in cetacean behavior. Turner *et al.* (2014) reported that bottlenose dolphin behavior changed significantly 22 seconds before a 5.8 magnitude earthquake occurred 189 km away. The dolphins seemed to be able to detect fast travelling sound waves preceding the main earthquake tremor.

Earthquakes can also result in ecosystem changes and displacement of cetaceans from important habitat. For example, after a 7.8 magnitude earthquake struck New Zealand's South Island in Kaikōura in 2016, it triggered a massive (850 tonne) underwater mudslide in Kaikōura Canyon, sweeping away many marine seabed invertebrates in the canyon. This was associated with a significant change in behavior of local sperm whales (*Physeter microcephalus*), which spent 25% more time at the surface and hunted in deeper parts of the canyon for up to a year (Guerra *et al.* 2020).

To investigate whether there was any impact of this 2016 earthquake on SI Hector's dolphins in the Kaikōura region, Weir and MacKenzie (2021) compared abundance estimates (gathered by photo-identification capture-recapture models) before and after the earthquake. However, there was no statistically discernible difference in abundance during the two summers after the earthquake, compared to numbers of animals estimated before the earthquake event. Some of the resighted individuals were close to the areas where they were originally sighted, while others were substantial distances away from the original sighting area. Weir and MacKenzie (2021) suggested that there might have been some distributional changes, but the number of resightings was insufficient to draw any conclusions. Research on this issue could be warranted.

2.4.2.1.7 Summary

At present, pollution, aquaculture, mining, oil and gas extraction, and climate change are additional stressors to South Island Hector's dolphins. Aquaculture sites, especially finfish sites with anti-predator nets, have the potential to entangle animals (**Section 2.4.2.1.1**). Pollutant levels in east coast SI Hector's dolphins appear to be elevated due to the historical use of DDT in South Island agriculture. As noted in **Section 2.4.2.1.4**, the pollutant levels in the dolphins could make them more vulnerable to disease and negatively affect reproductive rates. At present, seabed mining is not a threat, but coastal mining for gold could degrade of coastal ecosystems (**Section 2.4.1.2.2**). With active oil production in the Taranaki

Basin, there is the potential risk of oil spills (**Section 2.4.2.1.3**), but this is potentially more of a threat for Māui's dolphins.

Brough *et al.* (2023), in their analysis of SI Hector's dolphin habitat (see **Section 2.4.1.5**), noted that preferred habitat tended to be areas that had high biodiversity and were less impacted by humans. For example, areas impacted by sedimentation had lower abundances of dolphins. Many human activities can also degrade habitat quality for the dolphins – for example coastal development may increase siltation and turbidity as well as decrease water current speeds. Brough *et al.* (2023) suggested that the management of SI Hector's dolphins should include management and protection of these habitat characteristics, as well as activities that might impact these characteristics.

2.4.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

2.4.2.2.1 Commercial utilization – harvesting and trade

No threats related to overutilization have been identified for this subspecies since it was listed in 2017 (Manning and Grantz 2017).

2.4.2.2.2 Dolphinwatching

In the New Zealand, there is an active and rapidly growing whalewatching industry, with boat-based and aircraft-based cetacean viewing, as well as swim-with dolphin activities (Hoyt 2001; O'Connor 2009). In 1987, there was only one permitted cetacean tourism vessel, which had increased to 63 operations by 1997 (Constantine 1999) and 76 by 2020 (Fumagalli *et al.* 2021). Of these permitted operations, 27 are allowed to conduct swim-with dolphin activities (Fumagalli *et al.* 2021). Moreover, there are also illegal tourism operations that take tourists to see dolphins without having a permit, in addition to so called "recreational whalewatchers", i.e., tourists with their own vessels that watch, swim-with or otherwise interact with dolphins (Parsons *et al*. 2006).

Dolphin-watching vessels and swim-with dolphin tourism have specifically been reported affecting the behavior of SI Hector's dolphins in several studies (Bejder *et al.* 1999; Constantine 1999; Nichols *et al.* 2001; Martinez 2010; Martinez *et al.* 2010). Concerns about this issue were raised in the previous status review for this subspecies (Manning and Grantz 2017). In particular, there have been concerns about impacts of swim-with dolphin tourism due to its more invasive nature (Martinez *et al*. 2010). Moreover, although there are regulations to manage whale and dolphin-watching under the New Zealand Marine Mammal Protection Act (**Section 2.4.2.5.2**), there is a high level of non-compliance with these regulations and many legal violations (Martinez 2010; Martinez *et al.* 2010; Fumagalli *et al.* 2021).

In Akaroa Harbour, SI Hector's dolphins are present year-round (Dawson *et al.* 2013) and there has been a rapid expansion of commercial dolphin tourism in the harbor (Martinez 2010; Martinez *et al.* 2010; Fumagalli *et al*. 2021). Currently, there five permitted operators in Akaroa Harbour but there are also several non-permitted operators, as well as frequent recreational whalewatchers (Fumagalli *et al.* 2021).

There has been a shift in dolphin distribution in the harbor, which has been linked to a quadrupling of cruise ship tourism (Carome *et al*. 2022, 2023a; **Section 2.4.2.4.2.2**). But there has also been an increase in other tourism-based boat traffic. In 2005–2008, commercial tourism vessels accounted for 22% of all vessel traffic in Akaroa Harbor, but this type of vessel was involved in 70% of interactions with dolphins (Martinez 2010). Carome *et al.* (2023b) monitored vessel traffic via an automated camera system off Nine Fathom Point, a core area of SI Hector's dolphin habitat. They noted that vessel traffic throughout the summer was dominated by dolphin-watching boats (mean per day: 26.9% ± 1.7 SE) and swim-with dolphin traffic (mean: 21.3% ± 1.4 SE), with recreational vessels comprising a major sector of boat traffic (mean: 26.5% ± 1.8 SE). The dolphin-watching vessels ranged from 8m to 20m in length and included a 15m sailing vessel.

Comparing vessel data from 1999–2000 (Nichols *et al*. 2001) and 2006–2008 (Martinez 2010), Carome *et al.* (2023b) noted that the percentage contribution of dolphin tourism vessels has significantly increased over time. Overall, summer vessel traffic has doubled, with the percentage contribution of dolphin tourism to overall vessel traffic also doubling. An increase in cruise ship visits to the harbor (Carome *et al.* 2022) appears to be linked with this increase in tourism traffic: operators ran significantly more dolphin trips on days when cruise ships were anchored in the harbor. Carome *et al*. (2023b) suggested that dolphin tourism vessel traffic at Nine Fathom Point has increased threefold since 2006–2008. Moreover, there is a tendency for dolphin tourism vessels to "hand-over" dolphin groups to other vessels, so that dolphin groups may be exposed to repeated and continuous bouts of dolphin-watching and swim-with-dolphin activity throughout a day (Martinez, 2010; Martinez *et al.* 2011; Fumagalli *et al*. 2021; Carome *et al*. 2023a). This high level of tourism activity may have adverse impacts. Dolphin-watching vessels produce underwater noise (**Section 2.4.2.4.2.2**) and cause changes in dolphin behavior that potentially may limit biologically important activities such as feeding, resting, and reproduction, in addition to potentially causing stress (Samuels *et al.* 2000; Parsons 2012; Parsons and Brown 2017, 2018; Parsons and Smith 2019; Gleason *et al.* 2019; Gray *et al.* 2022). This noise has also been increased by swim-with dolphin operators encouraging tourists to make noises[51] to try to attract dolphins to the swimmers (Martinez *et al.* 2012).

Many of the Hector's dolphinwatching activities in New Zealand involve putting human swimmers in the water with dolphin groups, which can evoke greater reactions in cetaceans than boat-based dolphinwatching (see Samuels *et al.* 2000). Research in New Zealand has shown that over time dolphins have shown increasingly negative reactions to swim-with tourism (Constantine 1999).

Samuels *et al.* (2000), in their report for the US Marine Mammal Commission, concluded that:

> *a conservative interpretation of available data indicates that swim-with activities clearly constitute "harassment" as defined in the U.S. Marine Mammal Protection Act* (p. 17).

Moreover, they noted that "even strict sets of regulations as in New Zealand may not be sufficient to safeguard the animals" (p. 17, Samuels *et al.* 2000). Therefore, increased management of dolphin tourism in Akaroa Harbor, and potentially other areas, may be warranted.

In the Bay of Islands Marine Mammal Sanctuary, there are restrictions on vessels and people approaching marine mammals – they must remain outside 300 m. In addition, there is a 5-knot speed limit in "safe zones" as a measure to reduce risks associated with boat traffic, especially tourist vessels. However, this sanctuary was established for bottlenose dolphins (*Tursiops truncatus*) and not SI Hector's dolphins. There are currently no special restrictions on vessel speed and activity in the other marine mammal sanctuary areas.

2.4.2.2.3 Scientific monitoring

No threats related to scientific monitoring have been identified for this subspecies since the initial status review (Manning and Grantz 2017).

2.4.2.2.4 Summary

The rapid expansion of boat-based dolphinwatching and swimming with wild dolphins is an issue warranting careful observation. Although these activities are regulated under the New Zealand Marine

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[51] Including banging stones together, singing, tapping on objects, and hitting the surface of the water with their hands (Martinez *et al*. 2012).

Mammals Protection Regulations,[52] the cumulative effect of exposure to high levels of even minor disturbance from vessels could have significant effects on the dolphins (e.g., Williams *et al.* 2006). The fact that many of the dolphin-watching activities involve tourists swimming with dolphins may be increasing the potential impacts, despite regulations, as noted by Samuels *et al.* (2000). Moreover, dolphin-watching activities can act synergistically with other more prominent threats, to increase overall stress on a population.

2.4.2.3 Disease or predation

2.4.2.3.1 Disease

As noted above (**Section 2.3.2.3.1**), two-thirds of SI Hectors and Māui's dolphins analyzed have been found to be positive for *Toxoplasma gondii* (Roe *et al*. 2013; Roberts *et al.* 2019). Five toxoplasmosis-related deaths were reported from the east coast and two from the west coast of the South Island, which may suggest that the parasite is widespread in the New Zealand marine environment. These fatal cases of toxoplasmosis were associated with necrotizing (tissue death) and hemorrhagic (bleeding) lesions in the lung, lymph nodes, liver, and adrenal glands (Roe *et al.* 2013).

In addition, 61% of the carcasses assessed by Roe *et al.* (2013) were positive for the presence of *T. gondii* DNA, suggesting infection rates are higher even if lesions are not apparent. As noted above (**Section 2.3.2.3.1**), the New Zealand Government has produced a toxoplasmosis action plan[53] to mitigate the risk of the pathogen to Māui's and SI Hector's dolphins.

However, as noted in **Section 2.3.2.3.1** there are arguments that the New Zealand Government's toxoplasmosis plan would likely be opposed by the public as it involves culling feral cats and the resources spent on the plan might be better spent on more effective conservation measures, such as reducing bycatch.

In addition to the issue of toxoplasmosis, both immunochemical signs of *Brucella* exposure, and its DNA, have been detected in SI Hector's dolphins (Buckle *et al.* 2017) and brucellosis is believed to be the cause of death of an adult female Hector's dolphin. For the potential risks posed by *Brucella*, see **Section 2.3.2.3.1**.

2.4.2.3.2 Predation

Although it is noted that there have been reports of killer whale (*Orcinus orca*) attacks on SI Hector's dolphins (D. Clement, pers. comm. in Cross (2019)) no details were supplied as to the extent of this predation. No other new information on predation of SI Hector's dolphins has been presented since the subspecies was listed in 2017 (Manning and Grantz 2017).

2.4.2.3.3 Summary

Although the largest direct cause of mortality of SI Hector's dolphins is fisheries bycatch, disease could be an important additional source of mortality. Moreover, pathogens such as *Brucella* could impact recovery as it can reduce the likelihood of successful pregnancy, reduce fertility, and thus lower reproductive rates. However, effective management options to minimize the mortality rate caused by disease may be limited. Therefore, disease continues to be a threat to the conservation status of SI Hector's dolphins.

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[52] For details about these regulations see: https://wwhandbook.iwc.int/en/country-profiles/new-zealand#:~:text=Keep%20at%20least%2050%20m,lions%20hauled%20out%20on%20shore.

[53] https://www.doc.govt.nz/nature/pests-and-threats/diseases/toxoplasmosis-and-hectors-and-maui-dolphin/toxoplasmosis-action-plan/.

2.4.2.4 Other natural or manmade factors affecting its continued existence

2.4.2.4.1 Bycatch and entanglement in fishing gear

As with Māui's dolphins (**Section 2.3.2.4.1**), bycatch in fishing gear is the major source of anthropogenic mortality for SI Hector's dolphins. The number of reported entanglements in fishing gear are summarized in **Table 7** and **Table 8**. In response to the high level of bycatch, the New Zealand Government has introduced prohibition zones for certain types of fishing gear (**Fig. 27**).

Table 7. Number of reported SI Hector's dolphin entanglements in fishing gear in New Zealand's national progress reports to the IWC Scientific Committee (from Slooten and Dawson (2020), with data from 2020 from the DOC strandings database).

Year	Reported bycatch
1985	3
1986	0
1987	15
1988	22
1989	6
1990	1
1991	0
1992	2
1993	3
1994	8
1995	0
1996	0
1997	2
1998	14
1999	5
2000	10
2001	13
2002	8
2003	0
2004	2
2005	11
2006	4
2007	1
2008	0
2009	2
2010	1
2011	0
2012	3
2013	1
2014	0

2015	3
2016	1
2017	3
2018	9
2019	3
2020	1
2021	0
2022	7
2023	4
2024	5*
Total	**139**

Table 8. Numbers of Hector’s dolphin deaths per year. (Data from the DOC strandings database. The “other” causes of death column includes boat strikes, gunshot, live strandings, and euthanized dolphins. *NB between 1 January and 29 February 2024 only and not an entire calendar year).

Year	**Gillnet**	**Trawl**	**Craypot**	**Possible bycatch**	**Other**	**Natural**	**Unknown**
1985	6			1			6
1986	12	1		1			2
1987	11	1		6			4
1988	8	4		3			14
1989	6		1	2			8
1990	1			2	1		7
1991	1						5
1992	2			5			11
1993	2			2			7
1994	4			5			7
1995	1			4			10
1996	4			2			14
1997	1	1	1	2			7
1998	10	1		6	1		6
1999		1		8			4
2000	2			7			8
2001	4			6			13
2002	8					4	12
2003	2			2		1	9
2004	1		1	1		3	9
2005	9			7	1	4	2
2006	1	3				3	7
2007	1			3		5	15
2008				2		3	12
2009	1					2	9
2010	2					3	5
2011						3	4
2012	6					8	12

2013						7	5
2014	1				5	3	2
2015	3				1		5
2016		1					
2017	3						
2018	5	4					1
2019		3					
2020	1						
2021							
2022		2	2				
2023	3	4					
2024		6*					
Totals	**121**	**32**	**5**	**77**	**9**	**49**	**241**

Using the spatial risk analysis conducted by Roberts *et al.* (2019), the New Zealand Department of Conservation and Fisheries New Zealand (2019) highlighted options for extending fishing gear prohibitions in order to reduce bycatch mortality rates for SI Hector's dolphins. **Table 9** summarizes the estimated SI Hector's dolphin bycatch rates estimated via Roberts *et al.* (2019) and the proposed mortality limits for fisheries bycatch. These limits aimed to maintain SI Hector's dolphin populations at, or above, 90 percent of the "unimpacted" population status. In addition, the east coast population was subdivided into five subpopulations (**Fig. 28**). Each of these subpopulations was allocated a fishery-related mortality limit and these are summarized in **Table 10** (Department of Conservation and Fisheries New Zealand 2019, 2020).

Table 9. South Island Hector's dolphin population estimates, estimated bycatch and bycatch mortality limits (from Department of Conservation and Fisheries New Zealand 2019).

	Population estimate	Estimated Bycatch	Mortality limit
East Coast	9728	51.2	48.6
West Coast	5482	5.5	27.4
South Coast	332	1.2	1.7
North Coast	214	1.0	1.1

Table 10. South Island Hector's dolphin subpopulation bycatch mortality limits (from Department of Conservation and Fisheries New Zealand 2019, 2020).

Population or Subpopulation	Fishing-related Mortality Annual Limit
East Coast	
Cloudy & Clifford Bays	5
Kaikōura	7
Banks Peninsula	18
Timaru	10
Otago	6

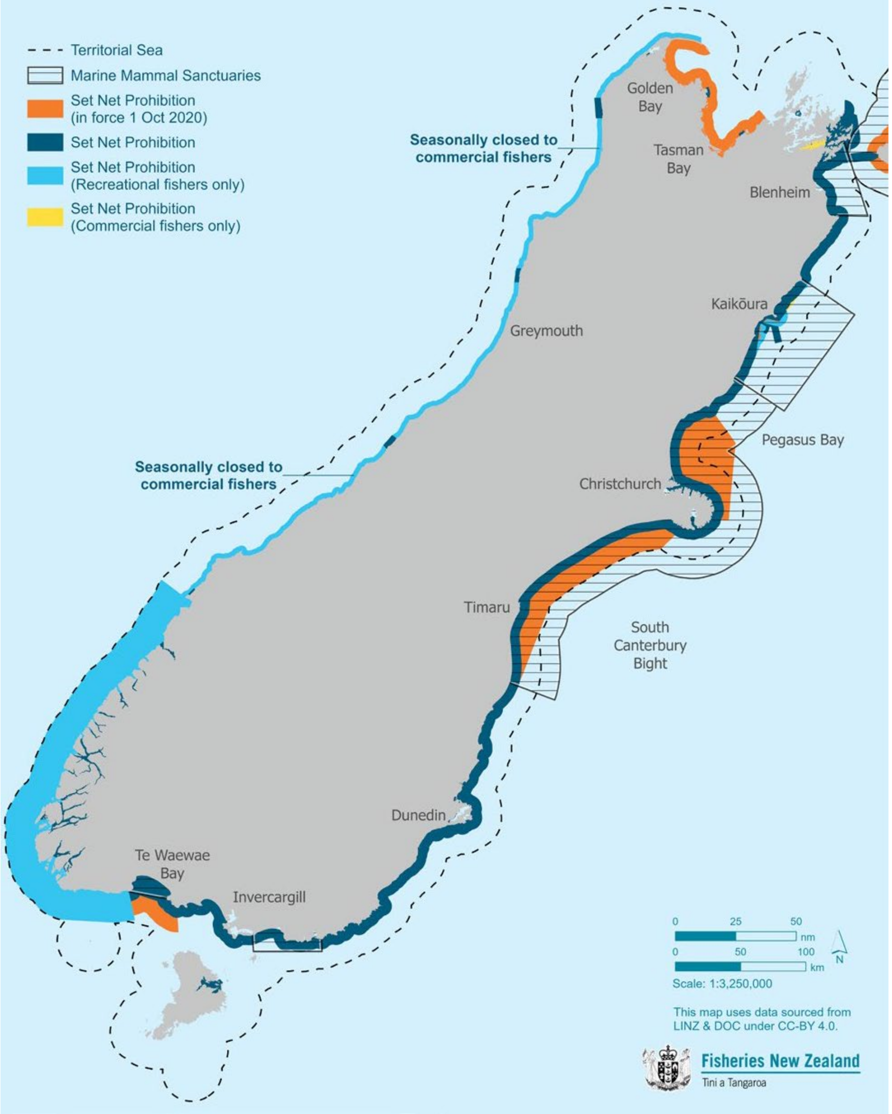

Figure 27. Map of the South Island indicating areas of set gill net prohibition and restrictions in 2020 (from Fisheries New Zealand 2020; reproduced with permission).

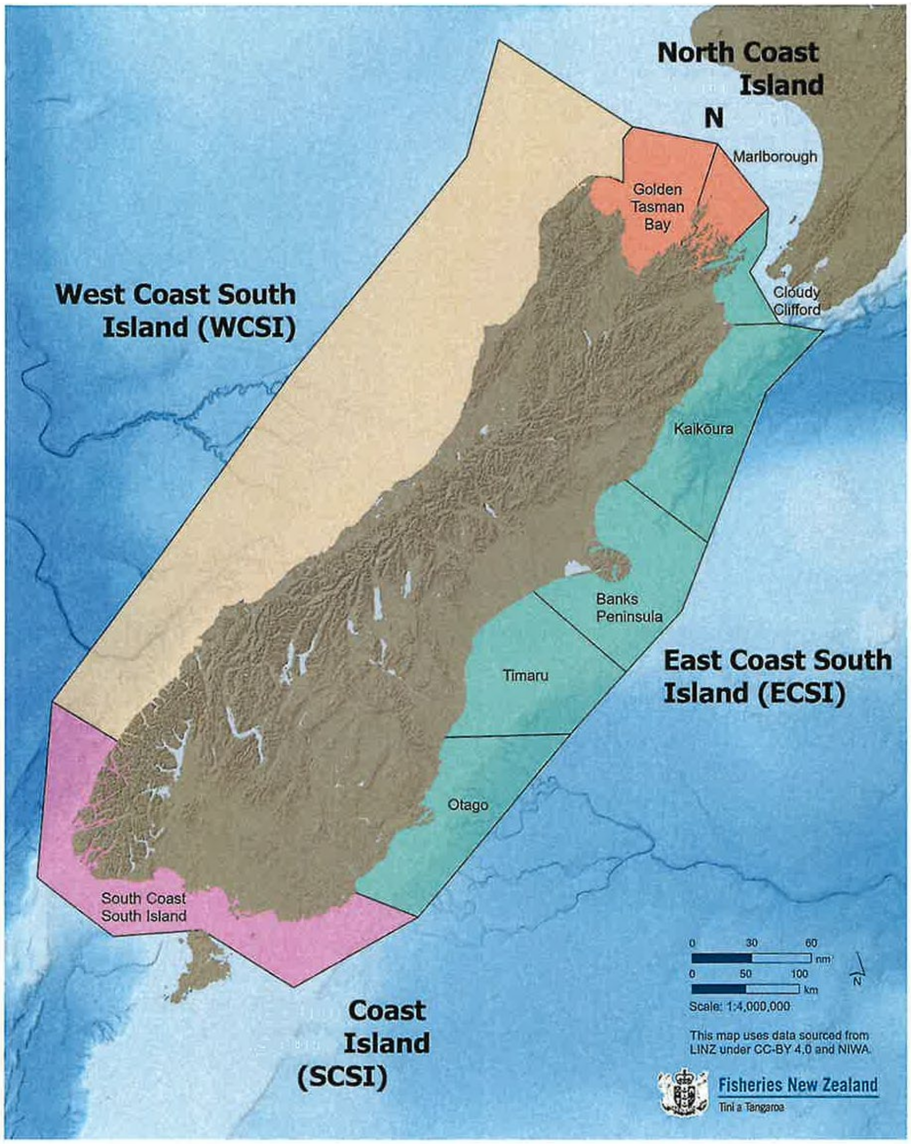

Figure 28. The demarcation of South Island Hector's dolphin subpopulations (from Parker 2022; reproduced with permission from Fisheries New Zealand).

There are several locations where set gillnets are prohibited to protect SI Hector's dolphins (**Fig. 27** and **Fig. 29**). Recreational set netting is prohibited out to a distance of 2 nautical miles on the west coast, extending to 12 nautical miles in the southwestern part of the South Island (**Fig. 27**). Set gillnets are prohibited up to 4 nautical miles along most of the east coast of the South Island. However, nets are allowed within estuaries and rivers. Moreover, gillnets for flounder are allowed from April to September within several harbors and bays that are important habitats in the Banks Peninsula for SI Hector's dolphins, such as Lyttelton and Akaroa Harbors.

Subsequent to the spatial risk analysis conducted by Roberts *et al.* (2019) and evaluation of potential expansions to fisheries prohibition areas conducted by the New Zealand Department of Conservation and Fisheries New Zealand (2019), in 2020 additional set net prohibitions[54] were put in place. After 2020, prohibited zones for gillnets were designated extending out to 4 nautical miles (nm) from the coast in Golden and Tasman Bays and out to 7 nautical miles in Te Waewae Bay. Prohibitions were also placed out to 4nm from Banks Peninsula to Timaru, as well as off Kaikōura. More substantially, a set net prohibition was placed in the entirety of Pegasus Bay, extending up to 20 nm from the coast in the midpoint of the bay (**Fig. 27**).

In 2022, in response to public consultations, additional bycatch reduction measures were introduced by the Minister of Fisheries and Oceans. These included extending the gillnet prohibition (commercial and recreational) around the Banks Peninsula from 4 nautical miles to 12 nautical miles from the coast (Parker 2022; **Fig. 29**).

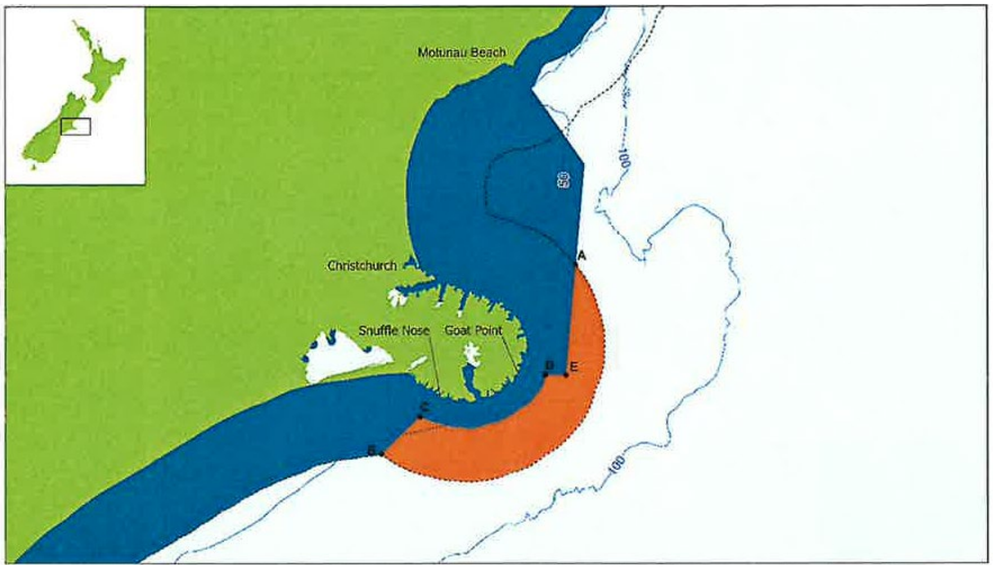

Figure 29. The extended set gillnet prohibition zone around the Banks Peninsula established in 2022 (after Parker 2022; reproduced with permission from Fisheries New Zealand).

Parker (2022) also pledged to have escalating responses for each bycatch event committed by a vessel, as well as escalating management responses relative to the specific limit for fishing-related mortality established for an area.

In addition, an on-board camera program was announced, which was to be operated on trawl vessels (32 m length) and set net vessels (8m length) on the north, east, and south coasts of the South Island from mid-2023 (Parker 2022).

In Dunedin, there is a small population of SI Hector’s dolphins (estimated at 41 in 2021; 95% confidence interval: 31–54; Williams *et al.* 2024). However, this Dunedin subpopulation of SI Hector's dolphins was considered to be part of the greater Otago population (which encompasses two other small subpopulations north of Dunedin – off Moeraki and Oamaru). The abundance estimate for this Otago

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[54] The use of commercial and recreational set net gear is restricted under the: 1986 Fisheries (Challenger Area Commercial Fishing) Regulations; 1986 Fisheries (South-East Area Commercial Fishing) Regulations; 1986 Fisheries (Southland and Sub-Antarctic Areas Commercial Fishing) Regulations; and 2013 Fisheries (Amateur Fishing) Regulations.

population was 638 dolphins (Fisheries New Zealand 2021). It was calculated that the population could sustain of 6.4 dolphin mortalities annually and, thus, a six animal bycatch limit was allocated to the Otago population (Roberts *et al.* 2019; Department of Conservation and Fisheries New Zealand 2019, 2020). However, if this limit was reached annually, there was concern that the subpopulation could become locally extinct within seven years (Williams *et al.* 2024). This was acknowledged by the Minister for Oceans and Fisheries (Parker 2022), and in 2022 the bycatch limit for the Otago region was reduced to two dolphins annually, while the mortality limits for the Banks Peninsula and Taimura were increased by two animals each (Fisheries New Zealand 2022; **Table 11**).

Table 11. Adjusted fishing-related mortality limits for East Coast subpopulations of Hector's dolphins (after Parker 2022).

Population or Subpopulation	Fishing-related Mortality Annual Limit
East Coast	
Cloudy and Clifford Bays	5
Kaikōura	7
Banks Peninsula	20
Timaru	12
Otago	2
South Coast	3 every 2 years

There are fewer prohibitions on trawling around the South Island than on set gillnets. Within a 2 nm strip along the east coast, trawling gear has to use a low headline height trawl net. In 2020, trawling prohibitions were put in place in Pegasus and Te Waewae Bay, as well as a 4 nm coastal prohibition zone south from the Banks Peninsula to Timaru (**Fig. 30**). In addition, there are trawl prohibitions within several small marine reserves on the west coast.

SI Hector's dolphins are known to frequently associate with trawlers and there are several instances of multiple dolphins dying in a single trawl (Rayment and Webster 2009; **Table 7**). For example, over the 2018/19 summer season, two lots of three Hector's dolphins were caught in the same trawl tows off Pegasus Bay, Canterbury (McGrath 2020).

Slooten *et al*. (2024) noted that there were nine dolphin deaths in trawling gear around Banks Peninsula and Timaru between September 2023 and the end of February 2024. This mortality level exceeds Roberts *et al.*'s (2019) estimate of six animals by-caught in trawling gear for an entire year of east coast fishing effort. It is, therefore, likely that the trawl fishing mortality rate will substantially exceed Roberts *et al.*'s (2019) estimate in 2024, especially as trawl net bycatches have been reported occurring in the austral winter when SI Hector's dolphins mover farther offshore into waters beyond the current fishing gear prohibition zones.

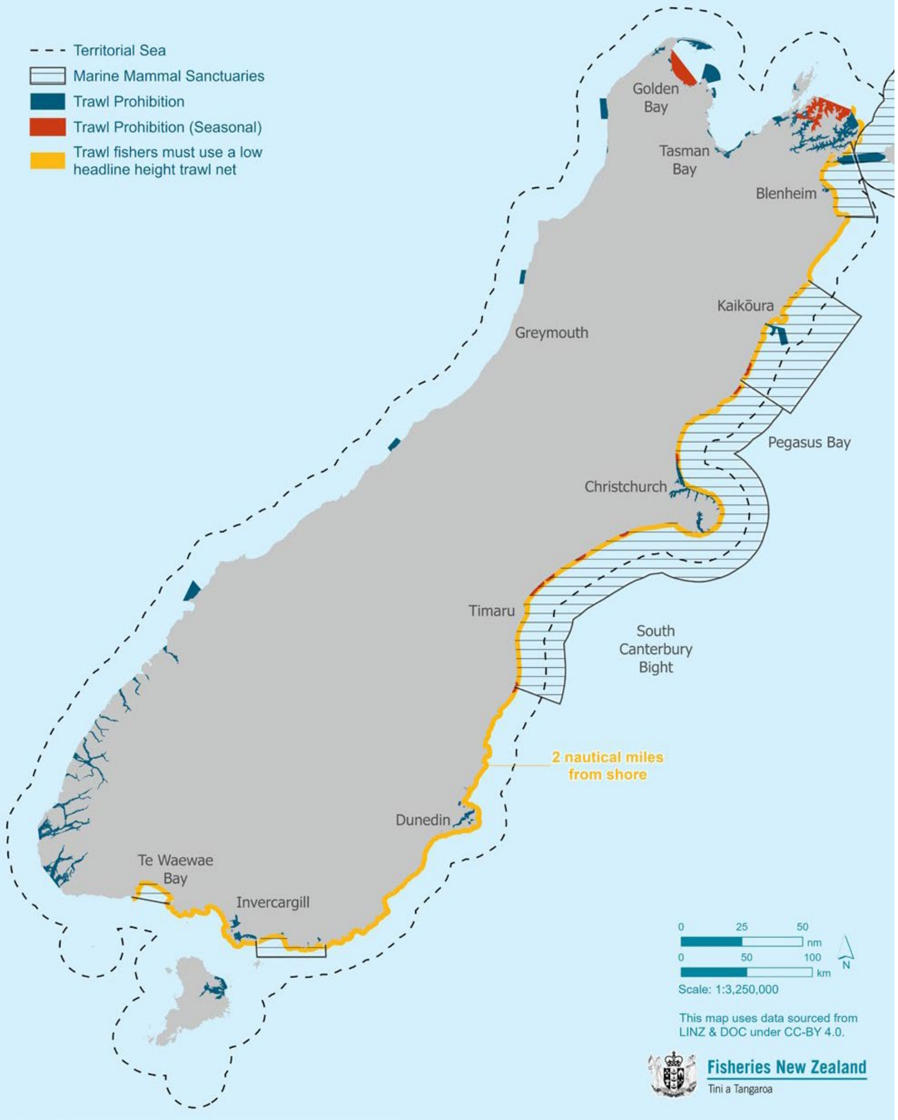

Fig 30. Map of the South Island indicating areas of trawl fishing prohibition and restriction in 2020 (from Fisheries New Zealand 2020; reproduced with permission).

2.4.2.4.2 Acoustic disturbance

2.4.2.4.2.1 Pile driving

There have been concerns about the potential impacts of pile-driving, as driving steel piles into the seabed can produce high levels of impulsive (intense, short duration) sounds; for example, noise levels of 205dB (re 1µPa)[55] at 100m from the pile driving sites have been reported with sound levels detectable above background levels out to 80km (Bailey *et al*. 2010). Decreases in abundance of harbor porpoises (*Phocoena phocoena*) have been reported at distances of 20km or more from pile driving activities (Carstensen *et al*. 2006; Tougaard *et al.* 2009; Haelters *et al.* 2015; Graham *et al.* 2019; Benhemma-Le

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[55] Maximum broadband peak to peak sound level.

Gall *et al*. 2021).

Leunissen *et al*. (2019) discovered that pile-driving related to construction in Port Lyttelton (Banks Peninsula) temporarily displaced the local SI Hector's dolphin population. Dolphin abundance decreased at an acoustic detector 1.3km from the piling site during pile-driving activity.[56] However, dolphin detections increased at a site 2km away from the pile-driving activity, in the mid-harbor area, where piling sound was an order of magnitude lower.[57] As levels of sound exposure increased, dolphin echolocations detected decreased further. Moreover, the longer the piling events, the longer this reduction lasted. After pile-driving stopped, it took 83 hours for dolphin detections to return to pre-pile-driving levels.

Leunissen and Dawson (2018) reported that there was an average of 125.5 min of pile-driving per day over 46 days. They calculated the maximum recorded sound level[58] and also used a sound propagation model to estimate the sound level at the source[59]. It was noted that because of the physical characteristics of the harbor and seabed, the sound did not propagate spherically, as is normally the case in deeper water, but rather cylindrically, meaning that sound could travel farther and was potentially louder than predicted. Leunissen and Dawson (2018) also estimated the distance at which hearing injury (temporary deafness) might occur. This was 26m from the pile driver if there was a single strike, but an hour of pile-driving noise could cause temporary deafness at a distance of 376m, or an area of 0.38 km^2 around the sound source. Sound levels that cause behavioral changes in dolphins were estimated to extend over an area of 33km^2, although it was noted that the noise in the harbor could overlay or mask the pile-driving noise a lot of the time. However, pile-driving noise would be louder than the ambient harbor noise more than half the time in an area of 28km^2.

Leunissen *et al.* (2019) noted that pile-driving could have a significant effect on SI Hector's dolphins, especially considering their very small home ranges. They argued for seasonal restrictions on pile-driving (i.e., avoiding summer months when animals are closer to shore) and using alternative piling technologies to reduce the impacts of this activity on dolphins.

2.4.2.4.2.2 Shipping noise

The sounds produced by shipping traffic are a major component of underwater noise and the potential impacts of this noise on cetacean behavior, communication, and echolocation are of concern (Richardson *et al*. 1995; Nowacek *et al.* 2007; Weilgart 2007; Hildebrand 2005, 2009). There have been relatively few studies investigating the potential impacts of disturbance by vessels on SI Hector's dolphins (Martinez 2010; Martinez *et al.* 2011) and these have mostly been focused on whalewatching vessel traffic (**Section 2.4.2.2.1**) or seismic survey operations (**Section 2.3.2.4.3.1** above and **Section 2.4.2.4.3.2**). Carome *et al.* (2022, 2023a) are some of the first studies to look at the potential impacts of disturbance caused by cruise ships on cetacean distribution.

In 2011, the earthquake in Christchurch led to damage to the city's port. Consequently, cruise ships diverted to Akaroa Harbor, with the number of annual visits by cruise ships quadrupling (Carome *et al.*

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[56] Sound Exposure Levels (SEL) at this site were an average of 127 and maximum of 137 dB re 1μPa2 s; mean SPL$_{0p:}$ 158 dB re 1μPa (Leunissen *et al.* 2019).

[57] Sound Exposure Levels (SEL) at this site were an average of 114 and maximum of 124 dB re 1μPa2 s; mean SPL$_{0p:}$ 145 dB re 1μPa (Leunissen *et al.* 2019). N.B. decibels are a logarithmic scale, such that a 10dB decrease is a tenfold decrease in sound pressure.

[58] Averaging 10 strikes a SEL of 158 dB re 1 μPa2s and a SPL0−p of 182 dB re 1 μPa at 370m from the source (Leunissen & Dawson 2018).

[59] SPL0−p of 213 dB re 1 μPa @ 1 m (Leunissen & Dawson 2018).

2022, 2023a). Akaroa Harbor is also an area used by SI Hector's dolphins. Carome *et al.* (2022, 2023a) investigated the effects of this increase in cruise ship traffic on dolphin distribution in the harbor and found that after 2011 dolphin distribution shifted to the outer harbor area, with only a 24% overlap with the dolphin's previous range (**Fig. 31**). Moreover, areas in the middle harbor, near the designated anchorage locations for large cruise ships, were no longer within the core habitat for SI Hector's dolphins (**Fig. 31**).

Peak tourism season, and therefore peak cruise ship activity, unfortunately coincides with Hector's dolphins both being closer to shore (Rayment *et al.* 2010; Dawson *et al.* 2013) and calving (Slooten and Dawson 1988), exacerbating the potential for impacts. In addition to the acoustic impacts cruise ships can have on cetaceans (Gabriele *et al.* 2018), there is the risk of vessel strikes (**Section 2.4.2.4.3**); the thrusters the ships use can cause damage to the seabed ecosystem and increase sedimentation; and their various waste discharges can add to local pollution (Commoy *et al.* 2005; Carić and Mackelworth 2014; Moscovici 2017).

Further investigating vessel traffic in Akaroa Harbor and its potential impacts, Carome *et al.* (2023b) used an automated camera system to monitor an area of core SI Hector's dolphin habitat for boat traffic, adjacent to Nine Fathom Point during the 2019/2020 austral summer. The highest levels of boat traffic were at midday, on weekends, and in January. They reported a mean of 41.9 vessel transits per day passing through the area. The highest amount of boat traffic recorded was 149 vessel transits within the studied area in one day. Carome *et al.* (2023b) suggested that vessel traffic in Akaroa Harbor approximately doubled between 2006–2008 and 2020, with a large portion of this vessel traffic being associated with dolphin tourism (**Section 2.4.2.2.1**; **Fig. 32**). During the pandemic lockdown, the vessel traffic dropped to just 3% of the previous numbers.

The rapid rise in boat traffic in an important area for SI Hector's dolphins is of concern and there appears to be a significant shift in dolphin distribution as the result of cruise vessel traffic. The management of dolphin-watching and recreational vessel traffic in the harbor may be warranted to reduce the impacts on SI Hector's dolphins.

2.4.2.4.2.3 Seismic surveys

As noted in **Section 2.3.2.4.3.1**, the sound produced by seismic surveys have been reported to cause changes in cetacean acoustic and swimming behavior (Richardson *et al.* 1986, 1995; Clark and Gagnon 2006; Miller *et al.* 2009; Di Iorio and Clark 2010; Blackwell *et al.* 2013, 2015; Castelotte *et al.* 2012; *Robertson et al.* 2013, 2016; Dunlop *et al.* 2015); avoidance of the sound source or even displacement from their habitat (Richardson *et al.* 1986, 1995, 1999; McDonald *et al.* 1995; Goold 1996; MacCauley *et al.* 1998; Weller *et al.* 2002; Bain and Williams 2006; Calambokidis and Osmek 1998; McCauley and Duncan 2001; Stone 2003; Stone and Tasker 2006; Weir 2008a); acoustic injury and temporary deafness (Lucke *et al.* 2009; Gedamke *et al.* 2011; Kastelein *et al*. 2017); obscuring or "masking" of communication calls (Nieukirk *et al.* 2004); possibly mass stranding events (Malakoff 2002; Engel *et al.* 2004; Palacios *et al*. 2004; Dolman *et al.* 2010); and even death (Gray and Van Waerebeek 2010).

There are four marine mammal sanctuaries[60] that have been established to protect SI Hector's dolphins in the coastal waters of the South Island. Seismic surveys have been prohibited within the sanctuary areas, but there are exemptions for exploration that has already been approved or permitted, and seismic surveys using lower energy systems such as "sparkers" (**Section 2.3.2.4.3.1**). The Banks Peninsula Sanctuary extends out to 20 nautical miles, but the other sanctuary areas do not extend as far. As noted in **Section 2.3.2.4.3.1,** the noise from seismic surveys can carry considerable distances. There are areas

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[60] Established under the Marine Mammals Protection Act 1978.

permitted for oil and gas exploration to the southeast and north of the South Island (Lucke *et al.* 2019; **Fig. 9** and **Fig. 17**). As with the Māui's dolphins (**Section 2.3.2.4.3.1**), there is the potential for the sounds of seismic surveys to pass into SI Hector's dolphin habitat, especially populations in Golden and Tasman Bay.

2.4.2.4.3 Vessel strikes

Because of their coastal and harbor distribution, there have been concerns that vessel strikes may potentially be an additional cause of mortality for SI Hector's dolphins (Slooten and Dawson 1988; Currey *et al.* 2012). Two Hector's dolphin calves are known to have been killed at the result of vessel strikes (Stone and Yoshinaga 2000). There is, however, only one incident of a vessel strike in the Department of Conservation's Māui's and Hector's dolphin mortality Incident Database – this is one of the calves reported in Stone and Yoshinaga (2000). It is, therefore, possible that there may be other instances of vessel strike that have not been noted in this database.

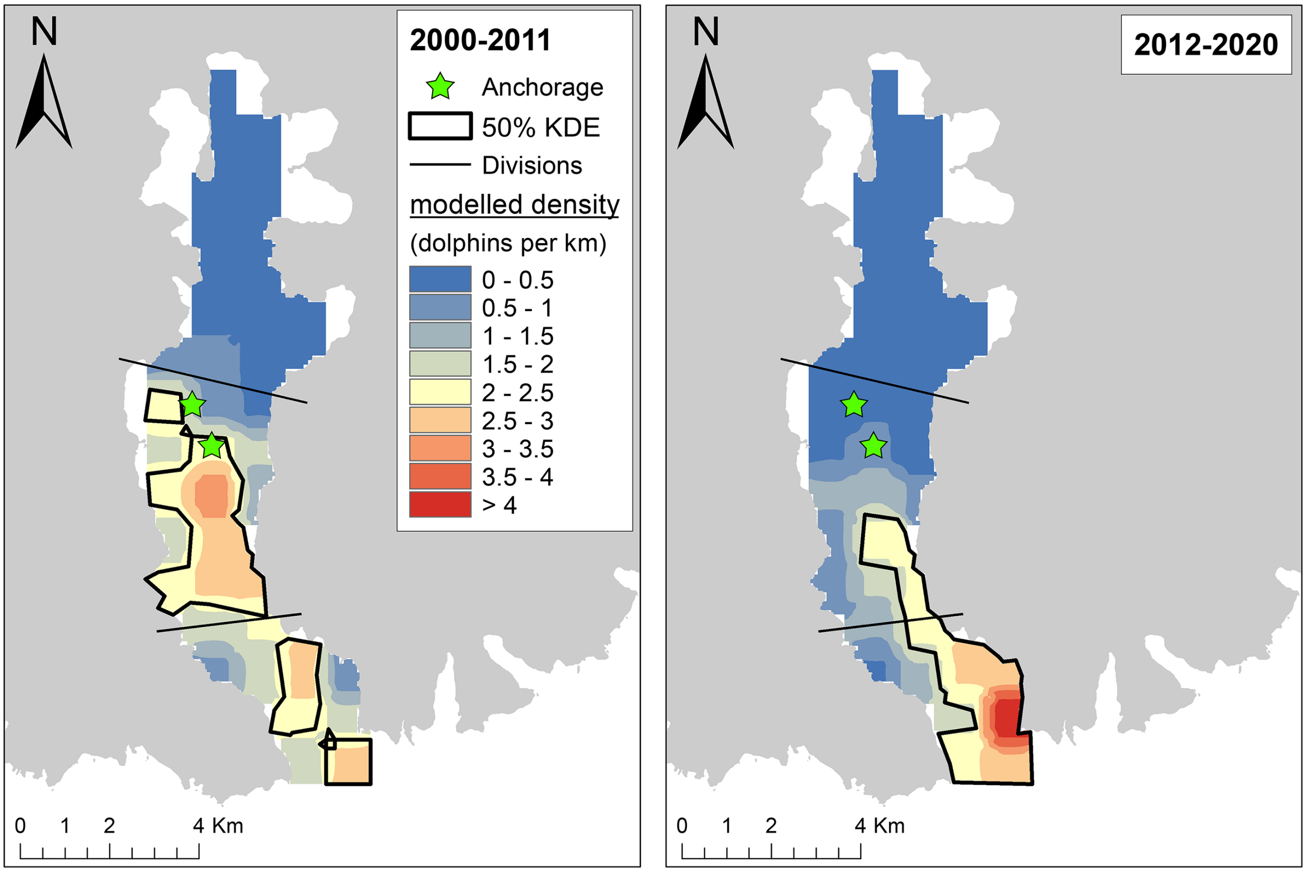

Figure 31. Changes in estimated SI Hector's dolphin density in Akaroa Harbor during the austral summer months, showing a shift in dolphin distribution linked to an increase in cruise ship visits after 2011 (from Carome *et al.* 2022, 2023a; reproduced with permission from Drs E. Slooten and S. Dawson). Green stars denote cruise ship anchorages. The black lines denote the inner, middle and outer harbor areas.

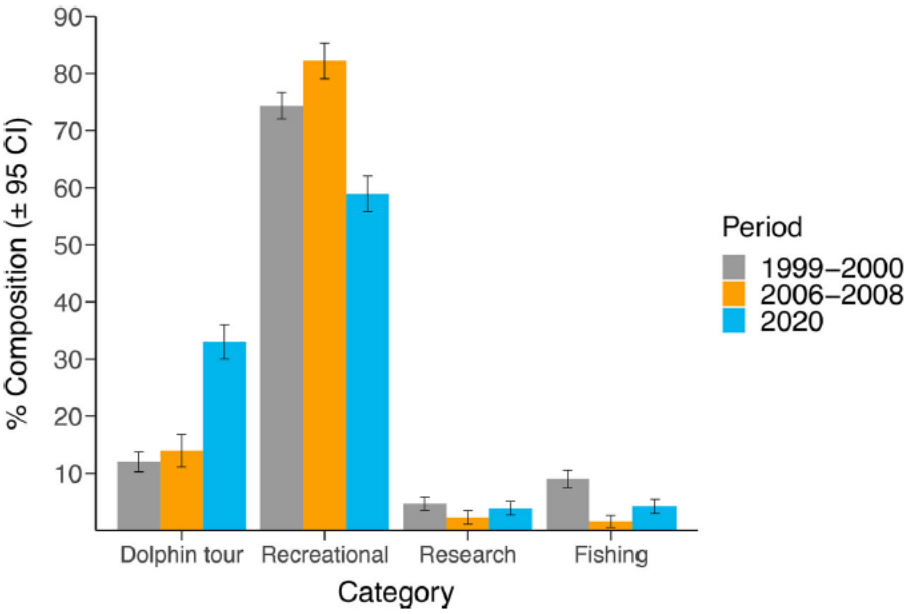

Figure 32. Percentage contribution of vessel traffic by vessel type near Nine Fathom Point in Akaroa Harbor (from Carome *et al.* 2023b; reproduced with permission from Drs E. Slooten and S. Dawson).

A recent controversy related to the threat of vessel strikes involved the SailGP catamaran race that was held within the waters of the Banks Peninsula Marine Mammal Sanctuary.

The 2023 race raised concerns from scientists, the harbormaster, and the local Māori iwi[61] that the catamarans (50 feet x 29 feet in size), which can travel at 60 mph, might collide with SI Hector's dolphins inhabiting the area. Therefore, a marine mammal management plan was developed, which included three dolphin-spotting vessels to watch for animals on the course and an agreement to halt the race if animals were sighted (Williams 2024a). However, when two SI Hector's dolphins were spotted during the final stage of the race, the race controller ignored calls by dolphin observers to halt the race (Williams 2023a, 2023b, 2023c).

The following year, racing on the first day was cancelled due to dolphins being sighted near the starting line (McMorran 2024), as required by the marine mammal management plan. However, this led to some race organizers and members of the public vocally criticizing the marine mammal management plan (e.g., Donnell 2024), which potentially diminishes the likelihood of adequate mitigation measures being implemented in future races.

Although this incident is just one specific event, the situation is illustrative of the difficulties with managing vessel traffic in New Zealand waters, even within one of the largest marine mammal sanctuaries.

This situation is an indicative, high profile, example of a larger issue related to boat traffic in SI Hector's dolphin habitat. The coastal areas where they are found have a high, and increasing, level of recreational and commercial boat traffic. This includes a quadrupling of cruise ship traffic (Carome *et al*. 2022, 2023a; **Section 2.4.2.2.2**; **Section 2.4.2.4.2.2**) and a large increase in tourism-related traffic. In particular, recreational vessels that are trying to get close to dolphins to view them (i.e., "recreational whalewatching; Parsons *et al*. 2006; Martinez *et al*. 2010 **Section 2.4.2.5.2**) are a concern as the operators of these vessels probably do not have training and experience of maneuvering near groups of

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[61] Nation or tribe.

dolphins: vessel strikes may be more likely to occur.

In the Bay of Islands Marine Mammal Sanctuary for bottlenose dolphins, there are restrictions and speed limits on approaching marine mammals (**Section 2.4.2.2.1**). However, there are no special restrictions on vessel speed and activity in the marine mammal sanctuary areas for SI Hector's dolphins despite high levels of vessel traffic.

2.4.2.5 Inadequacy of existing regulatory mechanisms

Hector's dolphins are listed under Appendix II of CITES. This limits the trade in specimens of these species; however, there is currently no evidence that international trade of South Island Hector's dolphins (or their products) is occurring and, therefore, international trade is not affecting the conservation status of the dolphins.

SI Hector's dolphins are protected under the New Zealand Marine Mammals Protection Act (NZMMPA), which prohibits "takes" of both subspecies of Hector's dolphins (actions that harm, harass, injure or attract animals). The NZMMPA also authorizes the designation of Marine Mammal Sanctuaries. In addition, the NZMMPA calls for the development of Population Management Plans for marine mammals, which can set maximum allowable levels of fishery-related mortality[62] (see current limits for SI Hector's dolphins in **Tables 8**, **9** and **10**). The NZMMPA requires these mortality limits to be set such that the particular species can recover as quickly as possible and within 20 years.[63] Hector's dolphins as a species were declared "threatened" in 1999. However, 25 years later, there is no sign of the SI Hector's dolphin subspecies reaching non-threatened status.

Listed below are several specific issues about existing regulatory and management measures undertaken by the New Zealand Government that potentially warrant consideration.

2.4.2.5.1 Marine Mammal Sanctuaries

As noted above, the NZMMPA allows the designation of marine mammal sanctuaries (**Section 2.4.2.5**). Four sanctuaries have been set up in the coastal waters of the South Island to protect SI Hector's dolphins: Banks Peninsula Marine Mammal Sanctuary; Clifford and Cloudy Bay Marine Mammal Sanctuary; Catlins Coast Marine Mammal Sanctuary; and Te Waewae Bay Marine Mammal Sanctuary.

The first of these (Banks Peninsula) was established in 1988, initially extending 4 nautical miles from the coast. It was extended in 2008 and again in 2020. It currently extends 20 nautical miles out from the coast from the Jed River in the North to the Waitaki River in the south.

At present these sanctuaries prohibit seismic surveys within the sanctuary areas. However, as noted in **Section 2.3.2.1.3**, **Section 2.3.2.4.3.1** and **Section 2.4.2.4.2.3**, there are exemptions for seismic surveys that were previously approved,[64] permitted, or related to an existing permit. Also, as noted in **Section 2.3.2.4.3.1** and **Section 2.4.2.4.2.3**, despite being conducted outside of sanctuary areas, seismic surveys could still impact SI Hector's dolphins within sanctuaries, as the noise seismic sources can produce may have behavioral impacts at distances of tens or even thousands of kilometers. Moreover, seismic surveys using smaller sound sources can still be conducted within sanctuaries, so long as seismic survey guidelines are adhered to (see discussion on guidelines in **Section 2.3.2.4.3.1** and **Section 2.3.2.4.3.1.1**).

Sanctuary status provides little other protection than from seismic surveys. As noted in **Section 2.4.2.2.1** and **Section 2.4.2.4.3**, the Bay of Islands Marine Mammal Sanctuary has distance restrictions when

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[62] Section 3F.

[63] Section 3F(a).

[64] Under the Crown Minerals Act 1991.

approaching marine mammals and speed limits, but this is a protected area for bottlenose dolphins and not SI Hector's dolphins.

Although there are some fishery prohibition zones that overlap with sanctuary areas, sanctuary status does not prohibit fishing or activities that introduce sound into the area. For example, **Section 2.4.2.4.1.1** notes pile driving activity within the Banks Peninsula sanctuary. **Section 2.4.2.4.3** reports on controversies over a high-speed race within the same sanctuary. There are gillnet prohibitions in the sanctuaries, but, as noted in **Section 2.4.2.4.1**, these are fisheries restrictions, not related to the sanctuaries themselves. It was only in 2022 that set gillnet prohibitions were extended to 12 nautical miles in the Banks Peninsula Sanctuary (with no prohibitions in the 8 nautical miles beyond this; **Section 2.4.2.4.1**). Clifford Bay, Cloudy Bay and Catlins Coast Marine Mammal Sanctuary only have gillnet prohibitions out to 4 nautical miles, and out to 7 nautical miles in the Te Waewae Bay Marine Mammal Sanctuary. There are even fewer prohibitions on trawling (**Section 2.4.2.4.1** and see below), with limits on headline height and little else in most marine mammal sanctuary areas. Regulations on other anthropogenic threats (e.g., noise, vessel traffic, tourism, and pollution) in marine sanctuary areas could help to reduce other anthropogenic impacts and stressors in core SI Hector's dolphin habitat.

2.4.2.5.2 Dolphinwatching

Section 18 of the New Zealand Marine Mammals Protection Regulations[65] requires that "Every commercial operation and every person coming into contact with any class of marine mammal" must comply with a series of requirements (**Table 12**).

As noted in **Section 2.4.2.2.1**, there are concerns about the increasing level of dolphinwatching activity focused on SI Hector's dolphins and its impacts on their behavior, health, and habitat use. Although the NZMMPA has substantive regulations for whale and dolphinwatching (**Table 11**), several studies have noted poor compliance with those dolphinwatching regulations (Lusseau 2004; Martinez et al. 2010; Meissner *et al.* 2015; Fumagalli *et al.* 2021). Meissner *et al.* (2015) reported swim-with dolphin tourism non-compliance with the area of operation; speed; number of vessels interacting with a single group; maximum time permitted interacting with the dolphins; and the prohibition on swimming with calves. In Doubtful Sound, two-thirds of tourism boat encounters with dolphins violated the regulations, with a third of encounters involving more than one violation (Lusseau, 2004). Failure to comply with speed restrictions within 300m of dolphins was the most common violation, accounting for nearly half of the violations (Lusseau, 2004). In Akaroa Harbour nearly a third of vessel encounters approached closer than 300m to SI Hector's dolphin groups (Martinez *et al.* 2010). Lusseau (2004) considered that dolphins were "at risk" once every 7 minutes when interacting with tourism boats – although he noted that dolphins were at risk once every 3 minutes when interacting with other vessels (Lusseau, 2004).

Meissner *at al.* (2015) and Fumagalli *et al.* (2021) note that in addition to swim-with-dolphin vessels, recreational vessels also approached groups and placed swimmers in the water. Such an activity is referred to by the IWC Whalewatching Subcommittee as "recreational whalewatching" (Parsons *et al.* 2006). This type of activity is very difficult to manage, as boat operators are regular members of the public and not whale watching operators – they do not need to apply for permits and are unlikely to know rules and regulation related to marine mammals. In Akaroa Harbour, nearly a third of vessels approaching dolphins are "recreational whalewatchers" (Martinez *et al.* 2010).

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[65] Available from: https://www.doc.govt.nz/globalassets/documents/about-doc/concessions-and-permits/marine-mammal-permits/marine-mammal-permits.pdf

Table 12. Marine Mammal Protection Regulations pertaining to dolphinwatching and use of boats in the vicinity of marine mammals.

Clause 18
Persons shall use their best endeavors to operate vessels, vehicles, and aircraft so as to not disrupt the normal movement of any marine mammal.
Contact with any marine mammal shall be abandoned at any stage if it becomes or shows signs of becoming disturbed or alarmed.
No person shall cause any marine mammal to be separated from a group of marine mammals or any members of such a group to be scattered.
No rubbish or food shall be thrown near or around any marine mammal.
No sudden or repeated change in the speed or direction of any vessel or aircraft shall be made except in the case of emergency.
Where a vessel stops to enable the passengers to watch any marine mammal, the engines shall be placed either in neutral or be switched off within a minute of the vessel stopping
No person shall disturb or harass any marine mammal.
No person, vehicle or vessel shall cut off the path of a marine mammal or prevent a marine mammal from leaving the vicinity of any person, vehicle or vessel.
Subject to paragraph (m) of this regulation, the master of any vessel less than 300 meters from any marine mammal shall use their best endeavors to move their vessels at a constant slow speed no faster than the slowest marine mammal in the vicinity, or at idle or "no wake" speed.
) Vessels departing from the vicinity of any marine mammal shall proceed slowly at idle or "no wake" speed until the vessel is at least 300 m from the nearest marine mammal, except that in the case of dolphins, vessels may exceed idle or "no wake" speed in order to outdistance the dolphins but must increase speed gradually and shall not exceed 10 knots within 300 m of any dolphin.
Clause 20
No vessel shall proceed through a pod of dolphins
…no person shall make any loud or disturbing noise near dolphins or seals.

It is important that dolphin-watching regulations are not only monitored but also evaluated and enforced, especially as a significant portion of the dolphin tourism in New Zealand focuses on swim-with encounters. This more invasive type of dolphinwatching involves a higher level of disturbance to dolphin groups, with vessels following and intersecting dolphin groups before placing tourists into the dolphins' habitat. As noted in **Section 2.4.2.2.1**, Samuels *et al.* (2000) concluded that swim-with-dolphin activities would, in fact, constitute "harassment" under the U.S. Marine Mammal Protection Act.

One of the main areas for watching SI Hector's dolphins is Akaroa Harbour (**Section 2.4.2.2.1**) and there are concerns about the impact of the level of this activity on the local dolphin population. In particular, the high level of swim-with dolphin trips are a cause of concern (**Section 2.4.2.2.1**). There have been some management actions to reduce the impacts of dolphinwatching in this area: in 2007 the amount of time tourists could swim with dolphins was reduced from an hour to 45 minutes; in 2008 there was a 5 year moratorium on issuing new dolphinwatching permits; in 2015 an annual training course was introduced for operators; and in 2016 - after a new permit was issued for another swim-with dolphin operation to start in the harbor - there was an additional 10 year moratorium on granting additional dolphinwatching permits (Fumagalli *et al.* 2021; Carome *et al.* 2022).

However, in 2008 the number of permitted operators was increased from 4 to 6[66], and operators were allowed to increase the number of trips they took by nearly 50%, from 25 a day to 37 a day (in 2016

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[66] There are currently 5 operators offering trips in the harbor (Carome *et al.* 2022).

this was voluntarily reduced to 34 trips a day; Fumagalli *et al.* 2021), increasing the amount of dolphinwatching activity that the local animals were exposed to.

Researchers have proposed a number of management suggestions including: reducing the cumulative amount of exposure to dolphinwatching vessels that dolphin receive; enacting temporal and spatial closures to dolphin watching in the Akaroa Marine Reserve; reducing the number of permits; developing education and outreach materials for recreational whalewatchers; and even banning tourism focused on SI Hector's dolphins completely (Nichols *et al*. 2001; Martinez *et al.* 2011, 2012; Martinez and Stockin 2012; Fumagalli *et al*. 2021).

More recently, Fumagalli *et al.* (2021) recommended: renewing the moratorium on issuing new dolphinwatching permits; establishing regulations on cruise ship tourism in SI Hector's dolphin habitat; revising dolphinwatching regulations to stop boats from "handing over" a group dolphins being encountered to an incoming dolphinwatching vessel (i.e., reducing the continuous exposure of dolphin groups to tourism vessels); to make recreational dolphinwatchers aware of regulations through educational programs; and to include the management of dolphinwatching in the New Zealand Government's Threat Management Plan for SI Hector's dolphins.

2.4.2.5.3 Inadequacy of bycatch regulations

Bycatch is the main threat to SI Hector's dolphins and the New Zealand Government has enacted a series of protective measures including prohibited areas and zones with gear restrictions (Section 2.4.2.4.1). These areas are based on data and reports produced primarily by Fisheries New Zealand, the Ministry of Primary Industries. Additional bycatch mitigation measures (such as fisheries closures) can be introduced by the Ministry in the case that specified levels of bycatch are exceeded. These bycatch limits are also calculated based on Governmentally-commissioned scientific reports and evaluations. Whilst ostensibly science-based, there are concerns about the comprehensiveness of analysis and assumptions made in these reports. This could mean that the establishment of fishing restrictions are suboptimal, allowing excessive levels of bycatch to occur. Moreover, there are concerns that potential levels of bycatch are currently being underestimated by the New Zealand Government, leading to a degree of bycatch that is unsustainable. This section highlights some areas of concern where current management and regulations are likely to leading to inadequate protection and unsustainable bycatch rates.

2.4.2.5.3.1 Extent of protection from fisheries bycatch

Slooten and Dawson (2021b) criticized the additional bycatch reduction measures introduced in 2020 (**Section 2.4.2.4.1**) by the New Zealand Department of Conservation and Fisheries (2019, 2020),[67] considering them insufficient to adequately reduce the bycatch of SI Hector's dolphins. For example, they noted that the New Zealand Government's plan extended gillnet protection farther out to sea in some areas, but there was little to no protection for several vulnerable, fragmented, small populations of SI Hector's dolphins on the northeast, southeast and west coasts of the South Island. For example, there are small populations off the Catlins, Otago, Dunedin, and in Cloudy Bay (Turek *et al.* 2013; Hamner *et al.* 2017; Williams *et al.* 2024; Bennington *et al*. in press). These small populations connect the larger populations in Te Waewae Bay and Canterbury, and if they become extirpated it will increase the fragmentation of the subspecies as a whole (Hamner *et al.* 2012).

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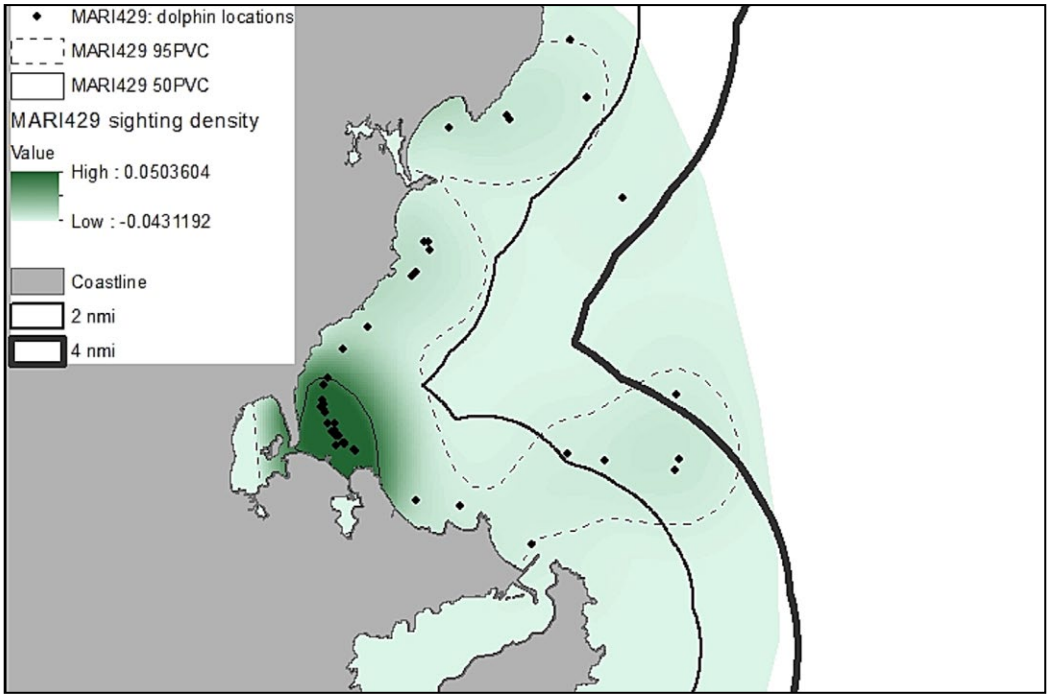
[67] The use of commercial and recreational set net gear is restricted under the: 1986 Fisheries (Challenger Area Commercial Fishing) Regulations; 1986 Fisheries (South-East Area Commercial Fishing) Regulations; 1986 Fisheries (Southland and Sub-Antarctic Areas Commercial Fishing) Regulations; and 2013 Fisheries (Amateur Fishing) Regulations.

The case of the Dunedin subpopulation is an example of the need to extend zones where bycatch should be prohibited. Williams *et al.* (2024) studied the vulnerability of a small subpopulation of SI Hector's dolphins to fisheries impacts off Dunedin (see **Section 2.4.1.3** about the genetic profile of this population). This population was estimated at 42 animals in 2012 (95% confidence interval: 19–92) and 41 in 2021 (95% confidence interval: 31–54). Therefore, the population's size has not increased, nor recovered, in nearly a decade. Boat-based surveys and passive acoustic monitoring showed that there was an overlap between dolphin distribution and fishing effort. For example, at an offshore mooring approximately 4.5 nautical miles from the coast, and outside the area in which gillnetting is prohibited (within 4nm of the coast), acoustic detections were made on more than a third of the study days. In addition, the fishing effort data (from the Ministry of Primary Industries) used in the study showed that vessels were probably fishing within the prohibited zone (**Fig. 33**). The risk that fishing still poses to the population, despite the no-gillnet zone, is illustrated by the fact that two dolphins were recently captured in gillnets in the area (April 30, 2023 and November 10, 2023), less than 400 m outside the boundary of the current no-gillnet zone.

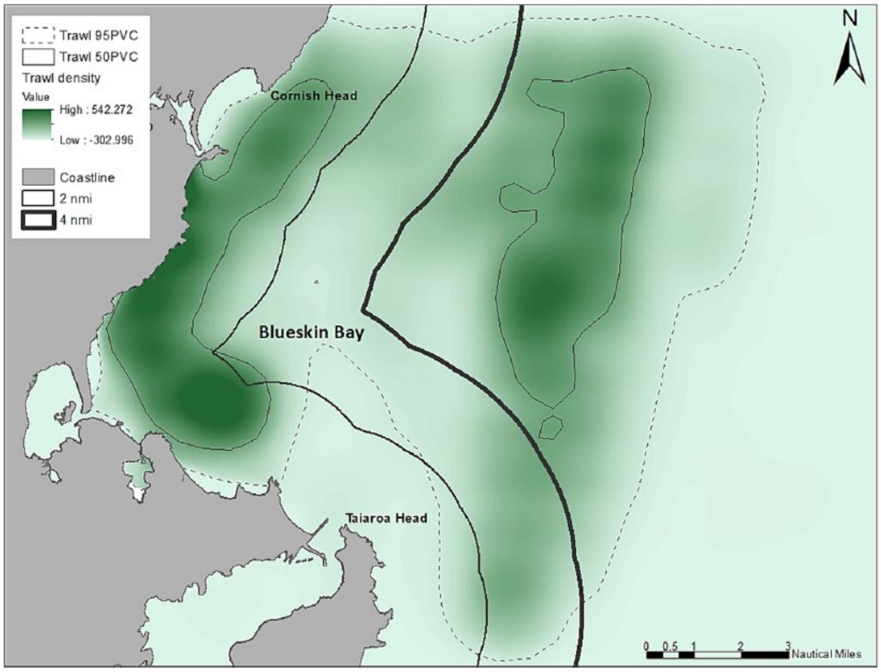
Moreover, Williams *et al.* (2024) reported that trawling effort (**Fig. 33B**) was concentrated in the area of highest dolphin density. Although the net has to have a headline height of less than 1.5 m in nearshore areas (within 2 nm of the coast), trawling is still allowed. Although this headline height restriction is supposed to prevent dolphin bycatch, there is no evidence to suggest that reducing headline heights actually reduces the capture risk for SI Hector's dolphins (Williams *et al.* 2024). Williams *et al.* (2024) found that SI Hector's dolphins were detected in this heavy trawling effort area on 94% of study days.

It should be highlighted that in 2023 two dolphins from this population were bycaught in gillnets outside of the 4nm limit (MacLean 2023; Slooten 2024), i.e., 5% of the local population. This illustrates the need to revise and extend the areas in which bycatch is prohibited. In particular, there is a need to fully ban trawling (a major source of bycatch mortality; **Section 2.4.2.4.1**) in SI Hector's dolphin habitat.

A


MARI429: dolphin locations
MARI429 95PVC
MARI429 50PVC
MARI429 sighting density
Value
High : 0.0503604
Low : -0.0431192
Coastline
2 nmi
4 nmi

B


Trawl 95PVC
Trawl 50PVC
Trawl density
Value
High : 542.272
Low : -302.996
Coastline
2 nmi
4 nmi
N
Cornish Head
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Taiaroa Head
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C

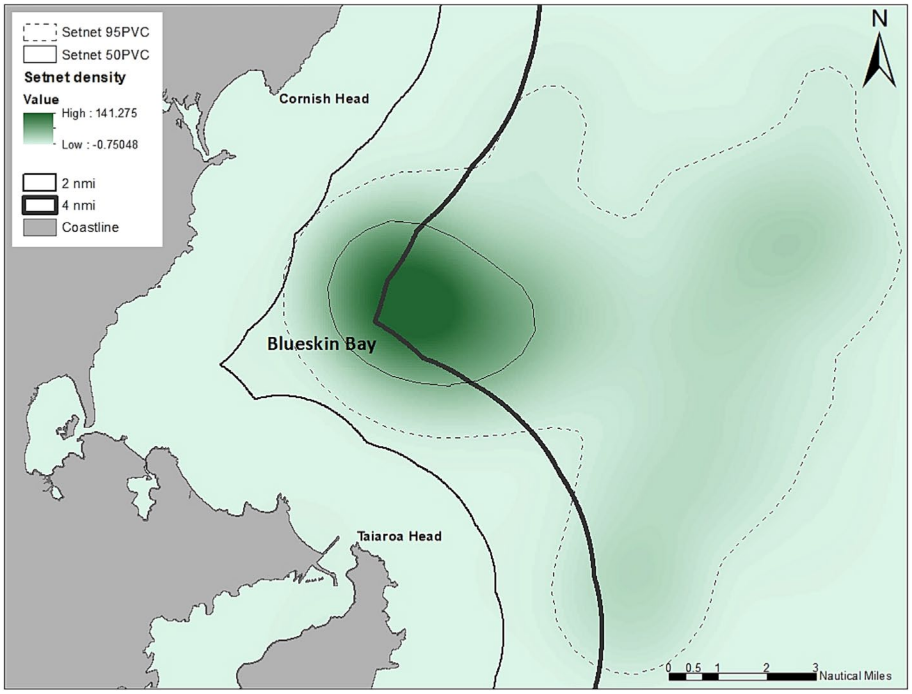


Figure 33. Map A shows a density map of sightings from dedicated boat surveys in 2020 and 2021 off Dunedin. Black circles indicate sightings and dark green areas are high densities of sightings. It should be noted that sightings occur outside of the 4nm gillnet prohibition area. Map B shows trawl fishing effort off of Dunedin. The area of highest trawling density overlaps with the area of highest dolphin density (see A). Map C shows gillnet fishing effort off Dunedin. There is very high fishing effort right on the boundary of the protected area and significant effort between 2 nm and 4 nm from the coast, within the area where gillnetting is prohibited. In addition, several sightings (see A) were made close to this area of high gillnet fishing effort (from Williams *et al.* 2024; reproduced with permission from Dr S. Dawson).

2.4.2.5.3.2 Potential underestimation of bycatch risk

As discussed in **Section 2.3.1.5**, **Section 2.3.2.4.1**, **Section 2.3.2.5.3,** and **Section 2.4.2.4.1**, Roberts *et al.* (2019) developed a Spatially Explicit Fisheries Risk Assessment (SEFRA) model that used SI Hector's dolphin aerial survey and environmental data to develop habitat models to predict the seasonal distribution and density of Māui's and SI Hector's dolphins. This model was then overlapped with fisheries data to produce a risk model for fisheries interaction, injury, and mortality (i.e., fisheries bycatch; **Section 2.3.2.4.1** and **Section 2.4.2.4.1**).

The spatial risk assessment by Roberts *et al.* (2019) was predominantly used to develop the Department of Conservation and Fisheries New Zealand's (2019, 2020) management regime for SI Hector's dolphins (**Section 2.4.2.4.1**).

There are several concerns related to the SEFRA model, as discussed previously (**Section 2.3.1.5**, **Section 2.3.2.4.1**, **Section 2.3.2.5.3, Section 2.4.1.5** and **Section 2.4.2.4.1)**.

One area of concern with the model was that high turbidity was a major environmental factor used to predict dolphin occurrence in the SEFRA model (Roberts *et al.* 2019), but recent field research into environmental factors affecting SI Hector's dolphin distribution, actually found more dolphins in less turbid environments (**Section 2.4.1.5**; Cross 2019; Brough *et al.* 2023). This may mean the predicted dolphin occurrence in Roberts *et al.* (2019) is skewed towards the wrong areas. Slooten (2024) expressed concerns that there was a lack of validation of the model with surveys and field data, i.e., the model makes assumptions about dolphin distributions which have not been verified by checking against "real world" distribution data.

There is also new habitat modelling data specifically for SI Hector's and Maui dolphins that challenge the results of Richards *et al.* (2019). For example, Brough *et al.* (2019b, 2020, 2023) used a database of more than 9,000 sightings of SI Hector's dolphins gathered during scientific surveys over a 28 year period. However, these modelling results, are not consistent with Roberts *et al.*'s (2019) habitat model (Slooten 2024).

The findings of Bennington *et al.* (2024) reinforces these concerns. Not only are they not consistent with the results of Richards *et al.* (2019), but the researchers noted that models constructed using dolphin distribution in one area did not necessarily predict distribution in other areas, i.e., habitat preferences for SI Hector's dolphins may be different for each population and a "one size fits all" assumption (such as used in Roberts *et al.* 2019) is incorrect when it comes to SI Hector's dolphins and habitat use. This suggests that the dolphin distribution predicted by the Roberts *et al.* (2019) model, and therefore the management recommendations based on this distribution, should be treated with caution.

Moreover, Roberts *et al*. (2019) overlaid historical and current fishing effort and bycatch rates with the spatial model to calculate the risk of bycatch (see **Fig. 34** and **Fig. 35** for maps of fishing effort). However, Slooten (2024) argues that there is insufficient bycatch data for a reliable model. It has been estimated that about only 1% of fisheries bycatch was reported historically (Slooten *et al.* 2024) and attempts were made by fishers to hide bycaught animals (McGrath 2020). In the past, there was only one period of robust fisheries observation for monitoring SI Hector's dolphin bycatch (i.e*.,* the 1997-1998 fishing season; Baird and Bradford 2000). Subsequently, less than 5% of gillnet and inshore vessels have had observers (Slooten and Dawson 2021b), with fewer than five observer days per year between 2011 and 2018 (Slooten and Dawson 2021b). GPS use on fishing vessels is relatively recent, and data from vessels is likely to be from larger vessels only, with positions of smaller vessels unreported (Taylor *et al*. 2018; Slooten *et al*. 2021b). The regulated video monitoring program currently in place could help accurately monitor bycatch rates but Slooten and Dawson (2021b) noted that, although an entanglement was recorded in a 2012–2013 camera monitoring trial, the video was only reviewed after the fishing vessel reported the entanglement, and less than 10% of video was reviewed for the other vessels involved in the trial. Video monitoring is only effective if the footage is actually reviewed. New Zealand Government delegates at the IWC Scientific Committee stated that currently 100% of video monitoring footage is being reviewed (IWC 2024a), but this is only the case for the 4% of North Island gillnetting boats that have video cameras, and trawling vessels that operate within 12nm of the west coast of the North Island (Slooten 2024; **Fig. 36**).

Currently, there are 17 gillnetting vessels with on-board cameras operating around the South Island, although many smaller gillnetting vessels (less than 8m) are excluded from the monitoring regulation (Slooten *et al*. 2024). The intention is to have 75% of gillnet vessels and trawling vessels with onboard cameras (**Fig. 38**). However, despite the intended camera coverage, the probability of bycatch being detected will still likely be low as the New Zealand Government's targets for viewing collected video data in many areas is only about a third, or less, of the video collected (n.b., these are targets for video viewed and not the actual amount of video currently viewed for bycatch occurrences; **Fig. 37**). For the Banks Peninsula, it is intended that only 5% of the video footage from trawling vessels will be viewed (**Fig. 37**; Slooten 2024), therefore it is very unlikely that bycatches would be detected. The projected roll out of camera monitoring of fisheries is summarized in **Fig. 39**).

However, the monitoring to date has documented that within a 4-month period, 9 Hector's dolphin deaths (including a mother and calf) were reported in trawl fisheries around Banks Peninsula and Timaru (Slooten *et al.* 2024). In contrast, Roberts *et al.* (2019) predicted an annual bycatch rate of 6 dolphins in trawl nets (95% credible interval 0.28–31.12), for the entire east coast of the South Island.

Using a similar methodology, Abraham *et al.* (2017) conducted a spatial analysis wherein they estimated nine bycatches in trawling gear (95% confidence interval: 1.1–26.6), which is closer to what has been observed to date.

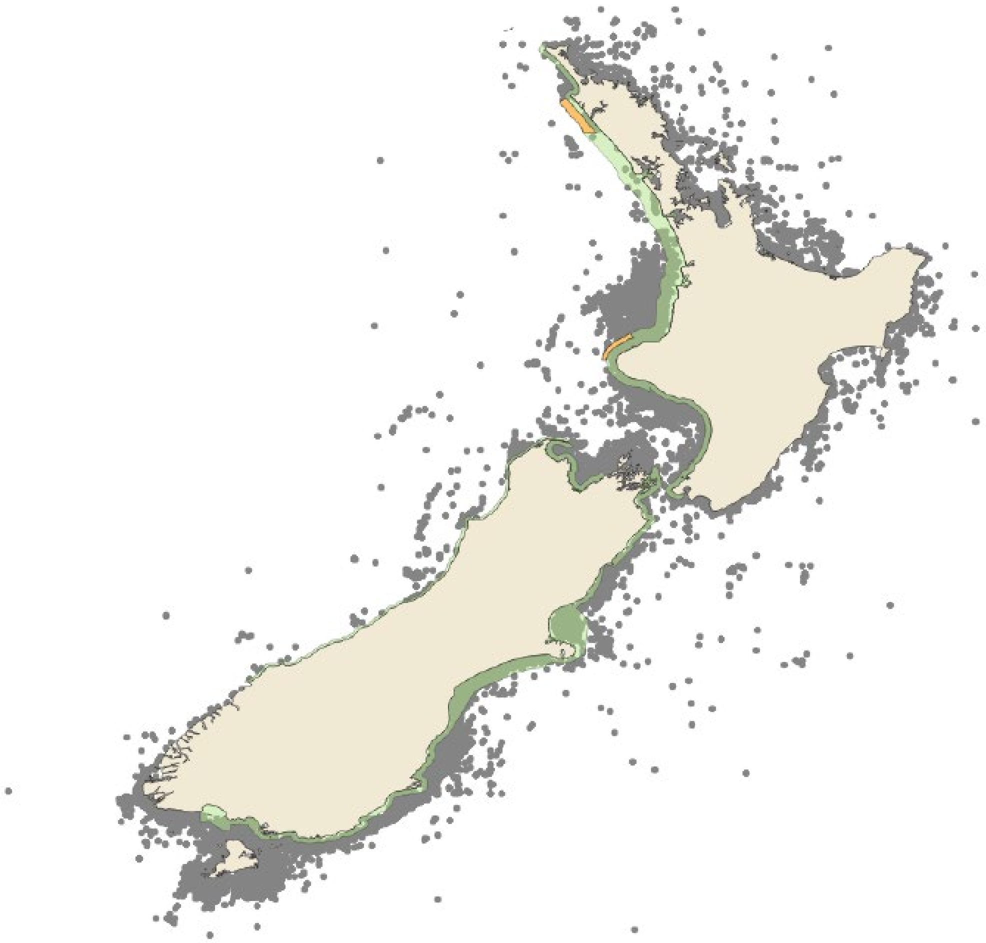
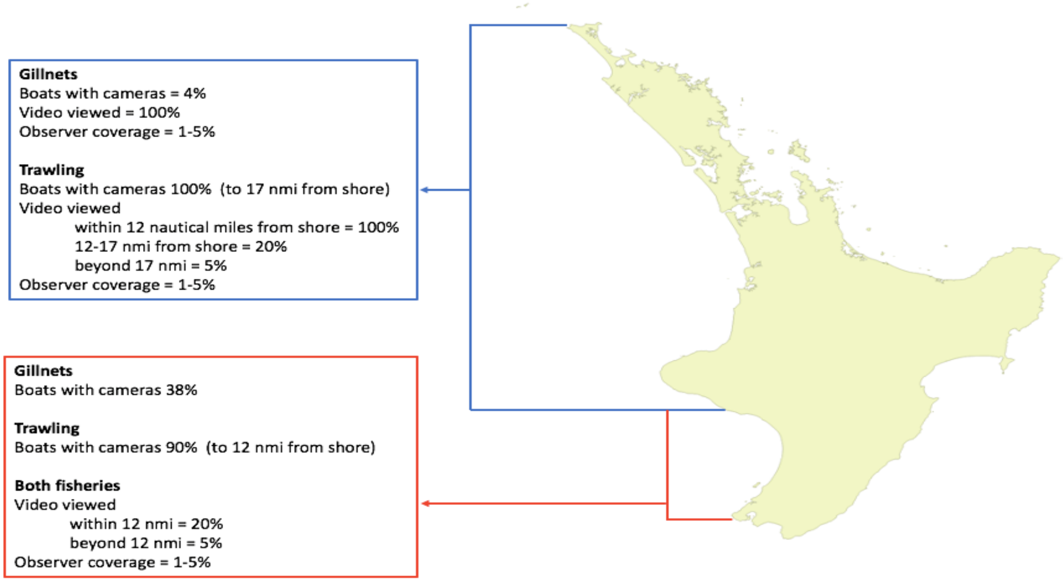


Figure 34. Map of set gillnet fishing effort (2009–2017; grey dots) – areas where commercial set gillnetting was prohibited in 2020 are shown in green. The area with fishery observer coverage for monitoring Māui's dolphin bycatch is in orange (from Slooten and Dawson 2021b; reproduced with permission).

Figure 35. Map of trawl fishing effort (2009-2017; grey dots) – areas where trawling was prohibited or limited (low head line required) in 2020 are shown in green. The area with fishery observer coverage for monitoring Māui's dolphin bycatch is in orange (from Slooten and Dawson 2021b; reproduced with permission).



Gillnets
Boats with cameras = 4%
Video viewed = 100%
Observer coverage = 1-5%

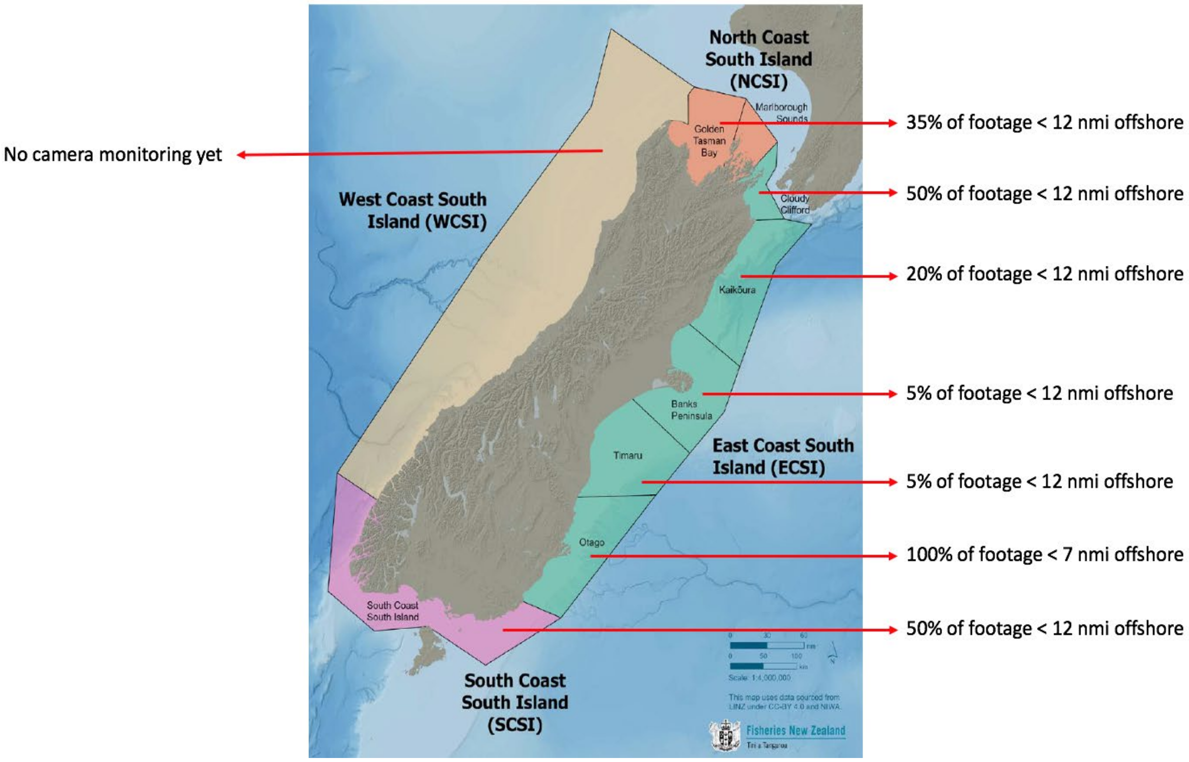
Trawling
Boats with cameras 100% (to 17 nmi from shore)
Video viewed
  within 12 nautical miles from shore = 100%
  12-17 nmi from shore = 20%
  beyond 17 nmi = 5%
Observer coverage = 1-5%

Gillnets
Boats with cameras 38%

Trawling
Boats with cameras 90% (to 12 nmi from shore)

Both fisheries
Video viewed
  within 12 nmi = 20%
  beyond 12 nmi = 5%
Observer coverage = 1-5%

Figure 36. Proportion of fishing vessels off the west coast of the North Island with onboard observers and onboard video cameras, noting the proportion of video data that is viewed by the New Zealand Government for instances of bycatch (Slooten 2024; reproduced with permission)



Target proportion of trawl video footage viewed

No camera monitoring yet

35% of footage < 12 nmi offshore

50% of footage < 12 nmi offshore

20% of footage < 12 nmi offshore

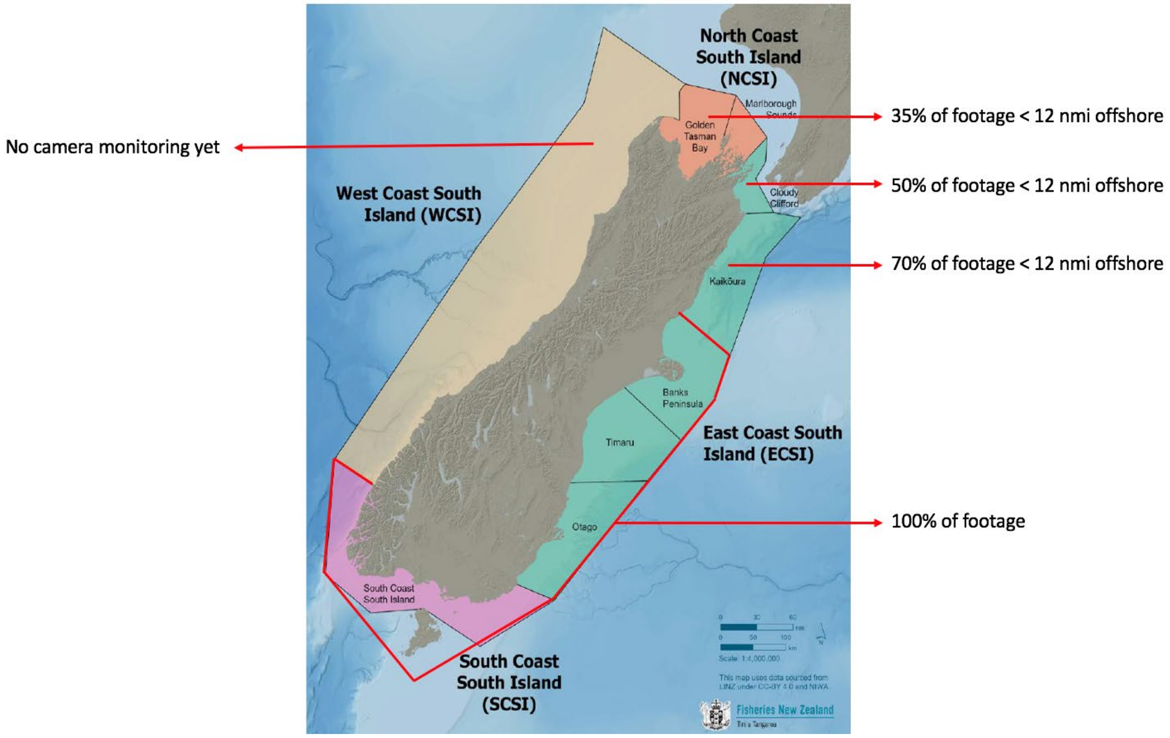
5% of footage < 12 nmi offshore

5% of footage < 12 nmi offshore

100% of footage < 7 nmi offshore

50% of footage < 12 nmi offshore

Target proportion of gillnet video footage viewed



No camera monitoring yet

35% of footage < 12 nmi offshore

50% of footage < 12 nmi offshore

70% of footage < 12 nmi offshore

100% of footage

Figure 37. Proportion targets for video footage data from onboard cameras that will be viewed by the New Zealand Government. Note that these are target values and not the actual proportion of video viewed (from Slooten 2024; reproduced with permission).

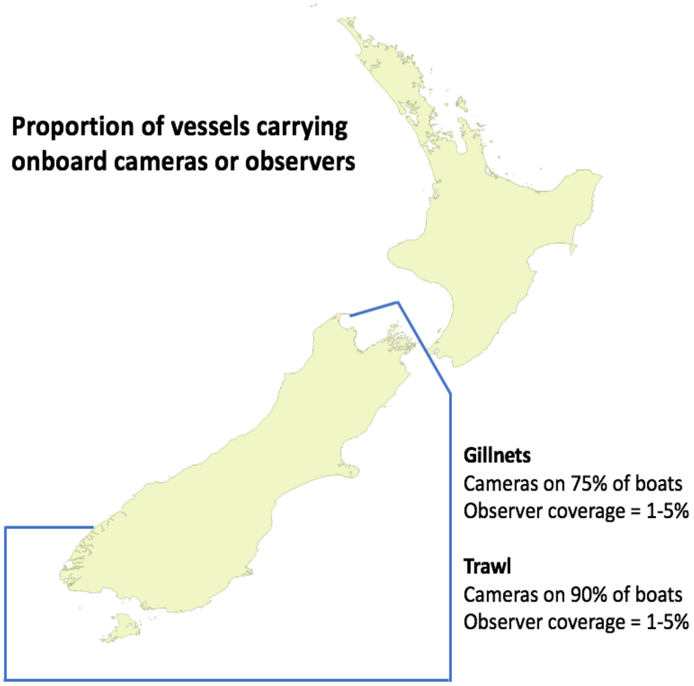
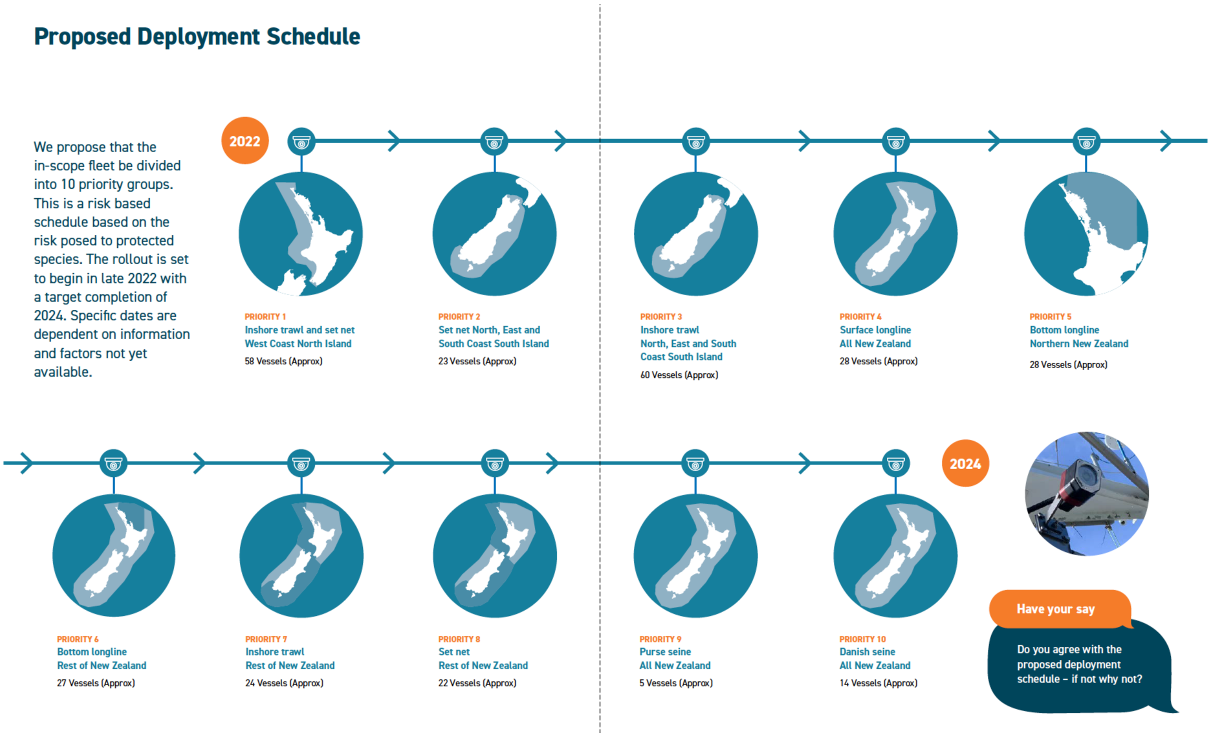


Figure 38. Proportion of fishing vessels off the east coast of the South Island with onboard observers and onboard video cameras (Slooten 2024; reproduced with permission).



Proposed Deployment Schedule

We propose that the in-scope fleet be divided into 10 priority groups. This is a risk based schedule based on the risk posed to protected species. The rollout is set to begin in late 2022 with a target completion of 2024. Specific dates are dependent on information and factors not yet available.

2022

PRIORITY 1
Inshore trawl and set net
West Coast North Island
58 Vessels (Approx)

PRIORITY 2
Set net North, East and
South Coast South Island
23 Vessels (Approx)

PRIORITY 3
Inshore trawl
North, East and South
Coast South Island
60 Vessels (Approx)

PRIORITY 4
Surface longline
All New Zealand
28 Vessels (Approx)

PRIORITY 5
Bottom longline
Northern New Zealand
28 Vessels (Approx)

PRIORITY 6
Bottom longline
Rest of New Zealand
27 Vessels (Approx)

PRIORITY 7
Inshore trawl
Rest of New Zealand
24 Vessels (Approx)

PRIORITY 8
Set net
Rest of New Zealand
22 Vessels (Approx)

PRIORITY 9
Purse seine
All New Zealand
5 Vessels (Approx)

PRIORITY 10
Danish seine
All New Zealand
14 Vessels (Approx)

2024

Have your say

Do you agree with the proposed deployment schedule – if not why not?

Figure 39. The proposed deployment schedule for video camera monitoring fishing vessels (from Fisheries New Zealand; reproduced with permission). The deadlines for priorities 8, 9 and 10 were extended to 26 June 2024, 3 December 2025 and 28 February 2025, respectively (Slooten 2024).

Roberts *et al*. (2019) relied on trawling bycatch data from a 1996-1997 fisheries observer program, during which there was only one observed incidence of bycatch in trawling gear (Baird and Bradford 2000; Starr and Langley 2000). Abraham *et al.* (2017) noted in their study that this is problematic and a source of uncertainty, due to the low level of coverage and reports during this program. Abraham *et al.* (2017) also pointed that there is a level of cryptic bycatch, as carcasses can fall out of nets and not be detected, which could be a third of all bycatches. In summary, the new information from camera monitoring of trawl fisheries (Slooten *et al.* 2024) suggests that Roberts *et al.* (2019) may have under-estimated levels of trawling bycatch.

In addition to the concerns raised by Slooten and Dawson (2021b) about the accuracy of fishing effort and historical bycatch data, Cooke *et al*. (2019) noted that the best fitting models suggested levels of bycatch 15–20 times higher than those estimated by Roberts *et al*. (2019).

Moreover, although the Roberts *et al.* (2019) model was estimated using set gillnet and trawl commercial fisheries data, there are other types of fishing activity for which there are few to no data, e.g. recreational gillnets, “customary” or “traditional” gillnets, and discarded “ghost” nets. Indeed, there are no data on illegal fishing activity. As noted in **Section 2.3.2.5.2**, there is a very high level of unreported fishing activity in New Zealand (Simmons *et al*. 2015) and, therefore, official bycatch data are likely an underestimate.

Slooten and Dawson (2021b) also raised concerns that management put in place based on the Roberts *et al*. (2019) model may lead to increased bycatch in the future. As noted above, Roberts *et al.’s* (2019) spatial analysis used recent data on fishing effort. Slooten and Dawson (2021b) argue that fisheries closures should be put in place where there is dolphin habitat rather than where fishing is currently being undertaken, as fishing effort can move –if one area is closed, fishing effort would likely shift to exploit open areas. This could theoretically lead to increased fishing effort in unprotected areas of SI Hector’s dolphin habitat. Therefore, Slooten and Dawson (2021b) argue that bans on fishing gear should be extended throughout SI Hector’s dolphin habitat to the 100m depth contour to ensure all populations are protected.

Although many of the concerns raised about the Roberts *et al*. (2019) model come from Slooten and Dawson (2021b), it should be noted that the International Whaling Commission Scientific Committee was not in agreement as to whether the methods, model variables, and data used in Roberts *et al.* (2019) were suitable to inform the management and conservation of Māui’s and SI Hector’s dolphins (IWC 2023a). Government delegates from New Zealand at the IWC Scientific Committee reported that the Roberts *et al.* (2019) spatial model is being updated and will incorporate data from camera monitoring of fisheries, and it will subsequently be presented to the IWC at their 2026 meeting (IWC 2024a).

2.4.2.5.3.3 Unsustainable bycatch limits

Roberts *et al.’s* (2019) spatially explicit fisheries risk assessment (SEFRA) estimated a “Population Sustainability Threshold” (PST), or an estimated limit on the number of dolphin deaths to prevent the decline of the subspecies. This is a method that has been developed in New Zealand, originally to set limits to seabird bycatch rates (Richard and Abraham 2017).

In comparison, in the U.S. the 1994 amendments to the 1972 US Marine Mammal Protection Act created the potential biological removal (PBR) approach to determine the human-caused mortality limits that would allow the recovery of imperiled marine mammal populations (Wade 1998)[68].

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[68] The aim or “standard” of the PBR is a 95% probability of reaching a population size that is 50% of the population’s carrying capacity within a hundred years and a 95% probability this stock remains above this level for a further 20 years

The PBR formula is calculated by multiplying the minimum estimate for the population size of marine mammals[69] by 50% of the maximum intrinsic rate of population growth ($r_{\max}$; see **Section 2.4.1.1.3.3**)[70] and a recovery factor (F_R), which is usually between 0.1 and 1.0 depending on the status of the species.[71]

The Potential Biological Removal (PBR) method has been thoroughly tested (Wade 1998; Brandon *et al.* 2027; Haider *et al.* 2017; Punt *et al.* 2018, 2020) and used for determining bycatch limits for cetacean populations outside the US (Berggren *et al.* 2002), including theoretically estimating bycatch limits in New Zealand (Slooten *et al.* 2006).

The PST essentially derived via the same calculation as PBR, except a mean rather than a minimum population estimate used, and a tuning factor φ is substituted for the recovery factor (F_R). Abraham *et al.* (2017) used a φ value of 0.5 for their risk assessment of marine mammals in New Zealand,[72] which would be the equivalent to the recovery factor used for a threatened species in the U.S.[73] Whereas, Roberts *et* al. (2019) used a value of 0.2, which would give a PBR value double that of an endangered species in the U.S. (see also **Section 2.3.2.5.3).**[74] The major difference between a PST and PBR calculation for SI Hector's dolphins would be with the use of a *minimum* population estimate for PBR.

Abraham *et al.* (2017) initially used expert opinions to produce a population estimate for SI Hector's dolphins (mean: 9926; 95% confidence interval: 4334 - 19274) but opted to use a higher value produced by aerial surveys (mean: 14 883; 95% confidence interval: 12 235 - 18 548; MacKenzie and Clement 2014, 2016). Therefore, the PST estimated was substantially higher than a PBR estimate based on a minimum population estimate based on the expert opinions.

As reported in **Section 2.4.1.1.3.1** and **Section 2.4.1.1.3.3**, Edwards *et al.* (2018) estimated age at maturity of SI Hector's dolphins as 6.9 years (95% confidence interval: 5.8 – 8.2) by plotting body size and reproductive rate for a variety of mammal groups (**Fig. 22**; **Section 2.4.1.1.3.1**). In their spatial model and risk assessment for SI hector's dolphins, Roberts *et al.* (2019) used the Edwards *et al.* (2018) estimate to calculate an intrinsic rate of growth (or r_{max}), an essential parameter to estimate the potential for SI Hector's dolphin recovery and for either of the PBR or PST calculations.

Their r_{max} estimate was criticized by Slooten and Dawson (2020) (**Section 2.4.1.1.3.3**), but also the IWC Scientific Committee (2024b), which noted that this "rule of thumb" extrapolation to estimate age at sexual maturity was the least reliable means of producing an estimate for intrinsic rate of growth. Using life history data from animals in the population, which the IWC considered the most reliable method for calculating rate of growth (IWC 2024b), produced an age at sexual maturity between 7 and 9 years of age (Slooten 1991; Gormley 2009). Roberts *et al.* (2019) used a revised growth rate value for SI Hector's dolphins of 0.05 (i.e., 5% per year), which is nearly three times the previously estimated r_{max} value (1.8% per year), from Currey *et al.* (2012). In contrast, Abraham *et al.* (2017), in a similar

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(Wade 1998).

[69] The lower 20th percentile of the (log normalized distribution) for the most recent estimate of abundance.

[70] In the U.S., an $r_{\max}$ value of 0.04 is often used for cetaceans as a default.

[71] For example, a recovery factor of 0.1 for an endangered species and 0.5 for a threatened species (Barlow *et al.* 1995; Wade 1998).

[72] Abraham *et al.* (2017) defined the goal of PST was to reach a population size at or above half of the carrying capacity, with 95% certainty, after 200 years. This is twice the length of time to recovery than the goal outlined by Wade (1998).

[73] A recovery factor of 0.5 is generally used for threatened species in the U.S. (Wade 1998).

[74] A recovery factor of 0.1 is generally used for endangered species in the U.S. (Wade 1998).

study for the New Zealand Government, used a value of 2.6% for SI Hector's dolphins.

The controversy over the intrinsic rate of growth, and the arguments that Roberts *et al.* (2019) may have overestimated it in their analysis, suggests that the ability of SI Hector's dolphins to recover may be lower than hypothesized and, thus, that the annual allowable levels of bycatch designated by the New Zealand Government, informed via PST calculations, may be too high (**Table 8**, **Table 9** and **Table 10**; **Section 2.4.2.4.1).** Moreover, Haider *et al.* (2017) express concern that for small populations, the Allee effect increases risk, therefore PBR levels should be approximately half to two third that of populations not experiencing the Allee effect. PST does not take into account small-fragmented populations as such, and levels of bycatch permitted by the New Zealand Government for the fragmented SI Hector's dolphin subpopulations may likely be too high to achieve recovery goals.

Slooten and Dawson (2020, 2021b) also noted that unlike the PBR methodology, the PST approach has not been published in a peer-reviewed scientific journal and has not received the academic scrutiny nor intensive testing that PBR has.

The key issue is that PST estimates are substantially larger than PBR values (Slooten and Dawson 2021b; e.g., **Table 13**). For example, Abraham *et al.* 2017 estimated a PST for SI Hector's dolphins of 95.4 and Roberts *et al.* (2019) estimated a PST of 74. In comparison Slooten and Dawson (2021b) calculated a PBR of just 11 dolphins (**Table 13**). Therefore, the New Zealand Government is likely to be allowing a level of bycatch that is unsustainable.

Table 13. Comparison of the PBR (from Slooten and Dawson 2021b) with the PST utilized by the New Zealand Ministry for Primary Industries (MPI) for national, regional and local populations of SI Hector's dolphin (Roberts *et al.* 2019; Department of Conservation and Fisheries New Zealand 2019, 2020).

	Estimated Bycatch	PST	PBR	PST/PBR
SI Hector's dolphins	59	74	11	7x
East Coast	51	49	7	7x
West Coast	6	27	4	7x
South Coast	1	2	0.2	10x
North Coast	1	1	0.1	10x
Sub populations				
Kaikōura	11	10	1	10x
Banks Peninsula	17	56	9	6x
Timaru	20	34	3	11x

In addition, once these bycatch limits are reached, management actions appear to be insufficient to prevent further bycatch. For the Otago subpopulation the bycatch limit is 2 animals. In April 2023 one animal death was reported in waters outside of the prohibited areas by an observer on a gillnet vessel (**Section 2.4.2.5.3.1**; MacLean 2023; Slooten 2024). The Ministry for Primary Industries consulted with the fishing industry to propose solutions and a small, temporary (5 month), voluntary fishing closure was designated (Slooten 2024). In November 2023, a second dolphin was reported to have been bycaught in a gillnet just 11nm away from where the former dolphin was captured (MacLean 2023).[75]

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[75] The bycaught dolphin was initially reported as a dusky dolphin (*Lagenorhynchus obscurus*) and the carcass was discarded at sea. However, the vessel was fitted with a camera and the video showed that it was a SI Hector's dolphin

Again, a small, temporary, voluntary closure was put in place rather than a more complete closure of the fishery (MacLean 2023). As noted in **Section 2.4.2.5.3.1** there are concerns that the fishing prohibition zones do not extend far enough offshore to protect this small fragmented subpopulation, and the high rate of known bycatch on this small (~40 animals) population is problematic.

2.4.2.5.4 Summary

Management actions by the New Zealand Government (Department of Conservation and Fisheries New Zealand 2019, 2020) are heavily influenced by the SEFRA spatial analysis of SI Hector's dolphin distribution and its overlap with fishing effort (Roberts *et al*. 2019). The bycatch limits estimated by this analysis aim to maintain SI Hector's dolphin populations at, or above, 90 percent of the "unimpacted" population status (Roberts *et al.* 2019). However, there are notable concerns about the methodology of this analysis (**Section 2.4.2.5.3.2**). After decades of unsustainable levels of bycatch, several areas appear to have experienced extirpation of Hector's dolphin populations (McGrath 2020) and several of the remaining fragmented subpopulations continue to be at risk (**Section 2.4.2.5.3.1**). There are concerns that the Roberts *et al*. (2019) analysis underestimated the potential risk that fisheries bycatch poses to SI Hectors dolphins and that the proposed limits on bycatch are too high (**Section 2.4.2.5.3.2**, **Section 2.4.2.5.3.2** and **Section 2.4.2.5.3.3**).

Although the designation of prohibited areas for set gillnets may help to reduce bycatch levels, there appears to be some continuing fishing effort in these areas (e.g. see **Section 2.4.2.5.3.1**). Moreover, there are particular concerns about the high level of bycatch in trawl fisheries, as illuminated by the increased video monitoring of vessels, but there are a lack of protected areas that prohibit this type of fishing (**Section 2.4.2.4.1**).

There are instances of dolphin mortalities from (**Section 2.4.2.3.1**), and while disease undoubtedly can kill dolphins, the extent of toxoplasmosis mortality significantly less than the threat posed by bycatch at present. There are other threats in addition to bycatch and disease, but management of these threats is appears to be inadequate. For example, high speed catamaran races (**Section 2.4.2.4.3**), cruise ship mooring (**Section 2.4.2.4.2.2**), swim-with dolphin tourism (**Section 2.4.2.2.1**), pile driving (**Section 2.4.2.4.1.1**) and aquaculture (**Section 2.4.2.1.1**) all occur in the Banks Peninsula Marine Mammal Sanctuary, but the sanctuary appears to have little ability to manage additional stressors beyond seismic surveys (Section 2.4.2.5.1). The latter (as noted in **Section 2.3.2.4.3.1** and **Section 2.4.2.4.2.3**) can produce such high intensity sound, and can travel such great distances, that seismic survey noise could still enter the sanctuary boundaries despite the prohibition on surveys within the boundaries.

(MacLean 2023).

2.5 Synthesis

2.5.1 Māui's dolphin, *Cephalorhynchus hectori maui*

The Endangered Species Act (ESA) calls for a review of listed species every five years[76] in order to make a determination whether to change the listing status of the species under the Act[77].

The ESA defines an endangered species as one that is in danger of extinction throughout all, or a significant portion, of its range".[78] The conclusion of this 5-year review is that the Māui's dolphin remains at risk of extinction and/or extirpation of its component populations due to: (i) the present or threatened destruction, modification, or curtailment of its habitat or range; (ii) disease; (iii) inadequacy of existing regulatory mechanisms; (iv) small subpopulation sizes, inbreeding and lack of genetic diversity; and (v) bycatch in fishing gear. [79]

The most recent population estimate (2020-2021) for Māui's dolphin is 54 animals (95% confidence interval: 48-66) more than a 14% reduction since 2015-2016 (63; 95% confidence interval: 57-75) (**Section 2.3.1.2**). However, the effective population size (i.e., the number of potentially reproductive individuals that could contribute to producing the next generation) is considerably lower for the Māui's dolphin. In 2001–2007, this was estimated to be 69 animals (95% confidence interval: 40–168; Baker *et al*. 2013), decreasing to 35 in 2020–2021 (95% confidence interval: 21–67; Constantine *et al*. 2021) (**Section 2.3.1.2**).

The small population size makes it vulnerable to catastrophic local events (e.g., a major oil spill or similar environmental event), or disease outbreaks (potentially exacerbated by low genetic diversity**; Section 2.3.1.3**). Moreover, the dolphins may be vulnerable to the ecological phenomenon known as the "Allee effect" (**Section 2.3.1.2.1**) which may reduce the subspecies' ability to recover.

The greatest threat to Māui's dolphin is bycatch in fishing gear (especially set gillnets and trawl nets; **Section 2.3.2.4.1**). Despite additional areas being designated where set gillnetting has been prohibited in recent years, the effective population size of Māui's dolphin is critically low and any mortality at all, whether anthropogenic or natural, could quickly bring the subspecies closer to extinction.

However, there are concerns that the New Zealand Government's regulations and conservation measures are inadequate to protect Māui's dolphin from the risk of bycatch due to: fishing restrictions not covering their entire range (**Section 2.4.2.5.3.1**); a lack of comprehensive bycatch data (**Section 2.3.2.5.2**); and the potential underestimation of bycatch risk (**Section 2.3.2.5.3**).

There are regular sightings, and even a report of a bycaught Māui's dolphin, on the east coast of the North Island (**Section 2.3.1.6, Section 2.3.2.4.1.1 and Section 2.4.2.5.3.1**), but there are no protections in place if the dolphins move into these waters. The IUCN, IWC and Society for Marine Mammalogy have recommended that gillnet (and trawling) prohibitions should be extended to the 100m depth contour around the entire coast of the North Island, including harbor areas.

In particular, there are many assumptions and potential biases made in the New Zealand Government's recent spatial analysis and bycatch risk analysis that make it likely that bycatch rates are underestimated, whereas the ability of the subspecies to sustain takes is overestimated (**Section 2.3.2.4.1.1, Section 2.3.2.5.2**, **Section 2.3.2.5.3** and **Section 2.3.3.1.5**).

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[76] ESA Section 4(c)(2)(A)

[77] ESA Section 4(c)(2)(B).

[78] ESA Section 3(6).

[79] i.e., ESA Section 4(a)1 parts (A), (C), (D) and (E).

The Māui's dolphin core habitat is adjacent to New Zealand's primary oil and gas production area (**Section 2.3.2.1.3**). In addition, there are several areas that are potential mineral resources in dolphin habitat (**Section 2.3.2.1.2**). Although the New Zealand Government banned further drilling and oil and gas exploration in 2018, the New Zealand Government is considering reversing this ban (Jones 2024). This could initiate more seismic surveys in waters immediately adjacent to Māui's dolphin habitat (**Section 2.3.2.4.3.1**), and there could be potential acoustic impacts on this vulnerable subspecies (**Section 2.3.2.4.3.2**). This is additional to the risk that oil spills pose (**Section 2.3.2.1.3**).

Disease is a natural factor that poses a risk to the Māui's dolphin, in particular the disease toxoplasmosis has resulted in several dolphin mortalities (**Section 2.3.2.3.1**). Coupled with the mortalities caused by entanglement in fishing gear, this poses a major threat to the continued existence of the subspecies.

New Zealand's legislation requires that fisheries mortality should be low enough to allow species to recover from threatened to non-threatened within 20 years[80]. The New Zealand Government declared Māui's dolphin a separate, critically endangered subspecies in 2002, but more than 20 years later there is no evidence of recovery. Indeed, the outlook for the subspecies has arguably worsened.

Based on the demographic and threat factors described above, the subspecies continues to be highly vulnerable to extinction, and the Māui's dolphin continues to meet the definition of "endangered" under the ESA.

2.5.2 South Island Hector's dolphin, *Cephalorhynchus hectori hectori*

The ESA defines a "threatened species" as any species which is likely to become an endangered species[81] within the foreseeable future throughout all, or a significant portion, of its range.[82]

The conclusion of this 5-year review is that the South Island Hector's dolphin continues to meet the definition of a threatened species due to: (i) the present or threatened destruction, modification, or curtailment of its habitat or range; (ii) disease; (iii) inadequacy of existing regulatory mechanisms; and (iv) bycatch in fishing gear. [83]

Due to the infrequency of surveys (with consistent methodologies) to assess SI Hector's dolphin abundance, there is currently little information on the current trend for this species (**Section 2.4.1.2**). The most recent estimate for the subspecies as a whole is 14,849 (95% confidence interval: 11,923–18,492; MacKenzie and Clement, 2014, 2016). This is less than a third of the estimated abundance for the subspecies in the 1970s (Slooten and Dawson 2016).

As with Māui's dolphins, bycatch in fishing gear is the major source of anthropogenic mortality for SI Hector's dolphins (**Section 2.4.2.4.1**). There have been consistent reports of bycatch in both set gillnet and trawl fishing gear, and although gillnet bycatch has decreased in recent years, it still occurs. Numbers of bycaught dolphins in trawl nets has increased (**Table 7** and **Table 8**; **Section 2.4.2.4.1)**. Echoing the comments above for Māui's dolphins (**Section 2.5.1**), there are also major concerns about New Zealand's fishing regulations and the degree of protection they give SI Hector's dolphins (**Section 2.4.2.4.1** and **Section 2.4.2.5.3**). The extent of fishing restrictions (**Section 2.4.2.5.3.1**), the New Zealand Government's potential underestimates of the level of bycatch (**Section 2.4.2.5.3.2**), and the proposed

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[80] New Zealand MMPA 1978; 3F(a).

[81] An endangered species one that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6)).

[82] ESA Section 3(20).

[83] i.e., ESA Section 4(a)1 parts (A), (C), (D) and (E).

limits on bycatch mortality for SI Hector's dolphins (**Section 2.4.2.5.3**) are of particular concern. The bycatch limits utilized by the New Zealand Government (the population sustainability threshold or PST) are much higher than the estimated annual potential biological removal (PBR) levels for the subspecies (**Section 2.4.2.5.3**). It is, therefore, likely that ability of the subspecies to sustain takes due to bycatch may be overestimated. PBR is a tried and tested methodology for progressing towards the recovery of endangered and threatened species. By allowing a level of bycatch that is sometimes an order of magnitude higher than the PBR it is unlikely that the SI Hector's dolphin will recover sufficiently to be delisted from the ESA in the near future (**Section 2.4.2.5.3**).

In particular, there is evidence that trawling is a major cause of mortality but there is very little in the way of mitigation or protection, beyond headrope height requirements in a narrow strip of coastline (**Section 2.4.2.4.1** and **Section 2.4.2.5.1**). There is a very high level of trawl fishing effort, particularly within high density areas of SI Hector's dolphin distribution (**Fig. 35**; **Section 2.4.2.5.3.2**).

Recent tagging studies suggest that SI Hector's dolphins travel further offshore than assumed (**Section 2.4.1.1.7.2**). This indicates that existing regulatory measures are likely insufficient to address the threat of bycatch, as this new data indicates that there is a risk of SI Hector's dolphins entering waters with set gillnets and trawling activity (**Section 2.4.2.5.3.2**).

The historical research on SI Hector's dolphin distribution by McGrath (2020) suggests that subpopulations of SI Hector's dolphins have been extirpated in several areas and there is a risk that several more of the small fragmented sub-populations that remain are also at risk of extirpation (**Section 2.4.1.5**).

Despite marine mammal sanctuaries having been designated to protect SI Hector's dolphins, multiple activities that are a risk to the dolphins, and that can degrade their habitat, are allowed within these areas (**Section 2.4.2.5.1**). These include: aquaculture (**Section 2.4.2.1.1**), vessel traffic (**Section 2.4.2.4.2.2**), pile driving (**Section 2.4.1.4.2.1**), high speed boat races (**Section 2.4.2.4.3**) and tourism (**Section 2.4.2.2.**1 and **Section 2.4.2.5.2**). Swim-with-dolphin tourism is particularly invasive and harassing to animals but there appears to be high levels of non-compliance with dolphin-watching regulations in many locations (**Section 2.4.2.2.1** and **Section 2.4.2.5.2**).

In addition, there is a legacy of organochlorine and heavy metal pollution in agricultural areas adjacent to SI Hector's dolphin core habitat and these pollutants could not only impact the health of contaminated animals but could also reduce reproductive rates (and therefore dolphin recovery; **Section 2.4.2.1.4**). In addition, these contaminant burdens could potentially make animals more vulnerable to disease (**Section 2.4.2.1.4**). Climate change is an additional stressor, as SI Hector's dolphins are also situated in one of the fastest warming areas of New Zealand coastal waters (**Section 2.4.2.1.5**). However, the degree of impact on this subspecies, caused by a changing environment, is not yet known. Disease poses an additional source of mortality or SI Hector's dolphins with reported fatalities due to toxoplasmosis and brucellosis (**Section 2.4.2.3.1**). However, mortality rates from disease are lower than from anthropogenic causes, such as bycatch in fishing gear.

In summary, there is not an appreciable sign of recovery for the SI Hector's dolphins, and many factors still threaten both the subspecies and its habitat. Therefore, we conclude that the South Island Hector's dolphin continues to be at risk of becoming endangered in the foreseeable future, and recommend that it remain listed as "threatened" under the ESA.

3.0 RESULTS

3.1 Recommended Classification

3.1.1 Māui's dolphin, *Cephalorhynchus hectori maui*

______Uplist to Endangered

______Delist *(Indicate reason for delisting per 50 CFR 424.11):*

______The species is extinct

______The species has recovered to the point at which it no longer meets the definition of an endangered species or a threatened species

______New information that has become available since the original listing decision shows the listed entity does not meet the definition of an endangered species or a threatened species

_______New information that has become available since the original listing decision shows the listed entity does not meet the definition of a species

__X___No change is needed

3.1.2 South Island Hector's dolphin, *Cephalorhynchus hectori hectori*

______Uplist to Endangered

______Delist *(Indicate reason for delisting per 50 CFR 424.11):*

______The species is extinct

______The species has recovered to the point at which it no longer meets the definition of an endangered species or a threatened species

______New information that has become available since the original listing decision shows the listed entity does not meet the definition of an endangered species or a threatened species

_______New information that has become available since the original listing decision shows_the listed entity does not meet the definition of a species

__X___No change is needed

3.2 New Recovery Priority Number

Not Applicable

3.3 Listing and Reclassification Priority Number

Not Applicable

4.0 RECOMMENDATONS FOR FUTURE ACTIONS

The range of both the Māui's dolphin and SI Hector's dolphin falls solely outside the jurisdiction of the United States. Therefore, this review recommends actions the New Zealand Government should consider to better monitor the status of the two subspecies and the threats that they face. Moreover, this review has identified several areas where regulations may be better implemented or improved in order to aid the recovery of these dolphins and reduce the risk of extinction.

4.1 Recommendations for monitoring and further research

To be better able to assess trends in abundance, and quickly identify declines in subpopulations, aerial surveys covering the entirety of SI Hector's dolphin habitat should be regularly conducted. Moreover, in conjunction with these broad-scale surveys, conducting photo-identification studies and/or genetic capture/recapture studies in small fragmented populations of SI Hector's dolphins will help monitor and assess their status and alert managers about the potential extirpation of these small populations.

For Māui's dolphins, there is a need to determine how far the dolphins move offshore and the extent to which they use the waters of the east coast of the North Island. Therefore, surveys and/or tagging studies may be useful to close this data gap.

Accurate information on bycatch and all types of mortality is another data gap. Monitoring of set gillnet and trawl fisheries should be increased in areas where Māui's and SI Hector's dolphins occur. In addition, monitoring should be extended to other fisheries that are known to have caused dolphin entanglements, including aquaculture facilities.

4.2 Recommendations for bycatch reduction

The New Zealand Government should strengthen bycatch reduction measures to further reduce bycatch to levels necessary to prevent further decline of Maui's and Hector's dolphins. Measures to consider include:

- Extending fishing prohibitions out to the 100 m depth contour, as recommended by the IUCN, IWC, the Society for Marine Mammalogy, and other international bodies and fora.
- Implementing trawling prohibitions in coastal waters, as trawl fishing is a major cause of SI Hector's dolphin bycatch.
- Implementing fishing restrictions in harbor areas inhabited by Maui's and SI Hector's dolphins, including prohibitions on recreational gillnetting.
- Improving the accuracy of methods used to calculate bycatch limits, such as using a PBR calculation (Section 2.4.2.5.3.2).

4.3. Recommendations for Protected Areas

Additional regulations, prohibitions, and codes of conduct should be developed in Marine Mammal Sanctuaries to reduce pollution and the risk of disturbance and injury from boat traffic, tourism activities and sources of underwater noise. In particular, additional restrictions on swim-with dolphin tourism and high speed vessels (including races) appear warranted. Similar restrictions should be introduced in harbors inhabited by Māui's and SI Hector's dolphins to reduce the impact of vessel traffic and tourism outside of designated Marine Mammal Sanctuaries.

It has been suggested that "refuges" would be a good method to reduce tourism and vessel traffic impacts (Lewandowski 2005; Hoyt 2005). Such refuges can be spatial (i.e., a specific location) or temporal (i.e., a period during the day). Refuge areas within sanctuaries and harbors could potentially allow animals to engage in important behavior (such as feeding, resting, or nursing) without disturbance. Expanding prohibited areas for seismic surveys around Marine Mammal

Sanctuaries would also ensure that significant levels of sound will not ensonify key dolphin habitat. Finally, as frequent violations of regulations have been reported (**Section 2.4.2.2.1** and **Section 2.4.2.5.2**) compliance with regulations should be monitored and enforced.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW

Māui's dolphin (*Cephalorhynchus hectori maui*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

☐ Downlist to Threatened
☐ Uplist to Endangered
☐ Delist
☒ No change is needed

Review Conducted By (Name and Office):

Chris Parsons - Office of Protected Resources

LEAD OFFICE APPROVAL:

Director, Office of Protected Resources, NOAA Fisheries

Approve____ Date: ________

Cooperating Regional Administrator, NOAA Fisheries

☐ Concur ☐ Do Not Concur ☐ N/A

Signature____ Date: _______

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

☒ Concur ☐ Do Not Concur

Signature____ Date: _______

NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW

South Island Hector's dolphin (*Cephalorhyn*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

☐ Downlist to Threatened
☐ Uplist to Endangered
☐ Delist
☒ No change is needed

Review Conducted By (Name and Office):

Chris Parsons - Office of Protected Resources

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve____________________________________ Date: ________

Cooperating Regional Administrator, NOAA Fisheries

☐ Concur ☐ Do Not Concur ☐ N/A

Signature____________________________________ Date: _______

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

☒ Concur ☐ Do Not Concur

Signature RAUCH.SAMUEL.DEAN.1365850948 Digitally signed by RAUCH.SAMUEL.DEAN.1365850948 Date: 2024.11.04 12:48:36 -05'00' Date: _______