Science-based management of New Zealand's Maui's dolphins

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Abstract

Hector's dolphins (*Cephalorhynchus hectori*) are New Zealand's only endemic cetacean. Gillnetting and trawling are the species' principal threat. Fishing has resulted in progressive population fragmentation and a 75 percent drop in abundance (29,000 to 7,270). On the west coast of New Zealand's North Island, the subspecies Maui's dolphin (*Cephalorhynchus hectori maui*) is now restricted to a remnant population of < 55 individuals one year and older (CV 0.15). Currently about 81 percent of Maui's dolphin habitat is unprotected against fishing methods known to cause dolphin mortality (85 percent including a corridor to the South Island). A recent risk analysis attributes 95.5% of human induced Maui's dolphin mortality to gillnetting and trawling. The associated mortality rate of 5 Maui's dolphins per annum is 75.5 times higher than the PBR (Potential Biological Removal) – which is one death in 10-23 years. Bycatch mortality removes about 9% of the Maui's dolphin population per year. It is estimated that under existing protection levels, Maui's dolphins will become functionally extinct by 2030.

At the 56th meeting of the IWC, the Scientific Committee recommended the immediate extension of the area protected against gillnet and trawl fisheries off New Zealand's North Island to approximately 80km south of the latest bycatch site and offshore to the 100m depth contour, including harbours. The SC further recommended protecting the north coast of the South Island to avoid further population fragmentation by providing a safe conservation 'corridor' between North and South Island populations. This paper provides an update on management decisions by the Ministry for Primary Industries and Department of Conservation, under Maui's Dolphin Threat Management Plan, comparing the current situation with the SC's recommendations and assessing the potential to achieve population recovery and avoid extinction.

1. Introduction

Hector's dolphins (*Cephalorhynchus hectori*) are the world's smallest marine dolphin and New Zealand's only endemic cetacean. Gillnetting and trawling are the species' principal threat. Since the 1970s, fishing has resulted in progressive population fragmentation (DOC & MFish 2007, Davies et al. 2008, Slooten & Dawson 2010; SC/64/ProgRepNewZealand) and an estimated 75 percent drop in abundance (29,000 to 7,270) (Slooten and Dawson 2010, Slooten et al. 2004). On the west coast of New Zealand's North Island, the subspecies Maui's dolphin (*Cephalorhynchus hectori maui*) is now restricted to a remnant population of about 55 individuals one year and older (Hamner et al. 2012). Maui's dolphins were found to be a separate subspecies of Hector's dolphins on the basis of genetic and morphological evidence in 2002 (Baker et al. 2002).

Population size for Maui's dolphin was estimated at around 1800 individuals in 1970, 135 in 1985 (Dawson and Slooten 1988), 111 in 2004 (Slooten et al. 2006) and 55 (individuals 1 year and older) in 2012 (Hamner et al. 2012). Risk analyses as far back as 1999 had warned that the North Island population was in decline, at an extremely high risk, and that abundance was predicted to decline further without improved protection (Martien et al. 1999).

Maui's dolphins are classified as 'nationally critical' in New Zealand and Critically Endangered' by the International Union for the Conservation of Nature (IUCN). The latter is defined as "facing an extremely high risk of extinction in the immediate future". Along with Amur Leopards (*Panthera pardus ssp. orientalis*), Cross river gorillas (*Gorilla gorilla ssp. diehli*), and the Vaquita *(Phocoena sinus)*, Maui's dolphins are one of the most endangered mammals on earth.

At its meeting in June 2012, the IWC Scientific Committee reviewed the conservation of Maui's and Hector's dolphins and concluded that weak protection on the west coast of South Island, a lack of protection on the north coast of South Island and 'exemption' areas in other regions are slowing or preventing species recovery (IWC 2012). In addition, there is continued bycatch from illegal gillnetting inside protected areas. The Scientific Committee expressed particular concern about the low abundance of Maui's dolphins, given the latest abundance estimate of 55 individuals one year and older (CV 0.15), based on a genetic mark-recapture analysis (Hamner et al., 2012).

The Scientific Committee recommended the immediate extension of the North Island protected area to approximately 80km south of the latest dolphin bycatch site (to Hawera on the Taranaki coastline), offshore to the 100m depth contour, including the harbours, for gillnet and trawl fisheries. The Scientific Committee stated that this would protect part of an area with high gillnet and trawl fishing effort between the North and South Islands, and commented that further population fragmentation could be avoided by also protecting the north coast of the South Island, providing safe 'corridors' between North and South Island populations (Hamner et al., 2012; IWC 2012).

On 2 January 2012, a Maui's dolphin was caught in a commercial gillnet off Cape Egmont, well south of the protected area off Taranaki. A public consultation on proposed interim measures to extend the southern limit of the protected area for gillnet and not trawling was initiated under the 'emergency procedures' of the NZ Fisheries Act in March 2012. Interim protection measures were implemented in July 2012 (see below for details). In its submission, the Department of Conservation (DOC 2012) did not consider that the proposed offshore boundary of 2 nautical miles (nm) adequately reduced the risk to Maui's dolphins. DOC argued further that the dolphins' distribution will be tied to biological factors such as prey distribution, which is more likely to be linked to depth than offshore distance. Instead DOC argued that a gillnet ban to 7 nm was appropriate. DOC criticized the Ministry of Fisheries (now part of Ministry for Primary Industries) by stating that the options proposed in the consultation paper "were inadequate", and that "none reflected the best available information on the biology of the dolphin". DOC also emphasized the need to protect the full Maui's dolphin range, including its extremes, as public sightings in the area and anecdotal sightings from fishers had confirmed the dolphins' presence in this area. "Given that the area under consideration is part of the dolphin's historic range, protection of this area is important to support recovery of the population to a level of long-term viability." Moreover, DOC noted the high level of support from submitters on increased protection for Maui's dolphins. Only 31 out of 23,347 submissions had been opposed to any restrictions on fishing and that support for more extensive protection measures than those included in the consultation document was considerable (1206 submissions for a 7 nm offshore limit, and 14,734 for a closure out to the 100 m depth contour).

This was followed by a second public consultation on permanent protection measures after the publication of a Maui's dolphin Risk Assessment Report and a Maui's Dolphin Threat Management Plan Review (Maui's TMP) in September 2012. The consultation process ended on 12 November 2012 and a decision was expected by the end of 2012. The Minister for Primary Industries currently is still considering whether to afford Maui's dolphins improved permanent protection in the southern part of their range. This paper examines the effectiveness of the interim protection measures and the management options and recommendations set out in the Maui's TMP, with respect to the Scientific Committee (SC) recommendations and the potential to facilitate population recovery.

2. The Science Perspective

Since the IWC SC reviewed the conservation status of Maui's and Hector's dolphins in June 2012 (IWC 2012), three other groups of scientists have examined the relevant research data, including those on the level of fisheries mortality. They include a Panel of Experts convened by New Zealand's Ministries for Primary Industries (MPI) and Department of Conservation (DOC), the IUCN Species Survival Commission's Cetacean Specialist Group, and the Society for Marine Mammalogy.

2.1. The Expert Panel Risk Assessment of Threats to Maui's Dolphins

In June 2012, MPI and DOC convened a scientific workshop to carry out a comprehensive risk assessment of the threats that face Maui's dolphins (Currey et al. 2012). The technical workshop was attended by nine scientists from NZ and the USA, including an invited representative of the fishing industry. The Panel's report was released in September 2012 to inform the public consultation on the now separately considered review of the Maui's dolphin section (Maui's TMP) of the Hector's and Maui's Dolphin Threat Management Plan (H&M TMP).

The Expert Panel determined that human impacts such as pollution, marine mining, boat strikes, disease, and tidal energy generation combined account for 4.5% of anthropogenic mortality amongst Maui's dolphins (Currey et al., 2012). Having identified substantial overlap between Maui's dolphins and fishing methods known to cause dolphin mortality, the Panel confirmed that gillnetting and trawling are the most significant causes of Maui's dolphin mortality, equating to 95.5% of all human induced mortalities (Currey et al. 2012). The Panel estimated that these fishing methods are responsible for an estimated five Maui's dolphin deaths per annum (median: 5.16, 95% CI: 0.28-8.13); median with industry expert score: 4.97, 95% CI: 0.28-8.13)

The Panel further determined that the estimated impact of this level of fisheries-related mortality is 75.5 times higher than the Potential Biological Removal or PBR, estimated in the Risk Assessment report as one individual every 10-23 years. Even though the estimate of 0.28 Maui's dolphin fatalities a year as a result of fishing advanced by the industry representative is significantly lower than that of the other eight panel members, it substantially exceeds the PBR. The

Panel concluded that the southern limit of Maui's dolphin distribution extends at least as far south as Whanganui, which is a further 70 km further than the current interim protection measures to Hawera (Currey et al. 2012).

2.2. The International Union for the Conservation of Nature

In 2012, the IUCN took up the issue of Maui's and Hector's dolphin conservation with its Species Survival Commission Cetacean Specialist Group (SSC CSG). At the World Conservation Congress in September 2012, the members of the IUCN voted in favour of full protection of Maui's and Hector's dolphins against gillnetting and trawling in waters up to 100m deep, throughout their range (IUCN 2012). The IUCN urged the New Zealand government to ban gillnet and trawl fisheries in all areas where Hector's and Maui's dolphins are found, including harbours (IUCN 2012). New Zealand alone opposed the Motion, which was adopted by a majority vote (government votes: 117 yes, 2 no (New Zealand's MPI and DOC), 18 abstentions; NGO votes: 459 yes, 0 no, 8 abstentions).

2.3. The Society for Marine Mammalogy

In February 2013, the President of the Society for Marine Mammalogy (SMM) wrote to the New Zealand Government on behalf of the Society's 2,000 academic members concerning the review of the Maui's TMP (Marsh, 2013). The letter was addressed to Prime Minister, Mr. John Key, the Minister for Primary Industries, Mr. Nathan Guy, and the Minister of Conservation, Mr. Nick Smith urging them to ban gillnets and trawling in Maui's dolphin habitat immediately to avoid their extinction.

The SMM concurred with the IWC Scientific Committee's recommendations from June 2012 and the IUCN resolution from September 2012, adding that "these actions are critical and without them this population is highly likely to decline towards extinction."

As the SMM letter points out, "Scientists from New Zealand and elsewhere have provided an exceptionally strong scientific basis for managing fisheries to prevent the extinction of Maui's dolphins. Any bycatch of Maui's dolphins is clearly unsustainable, You will appreciate the urgent need to act on that science and strengthen measures to protect these dolphins, which are endemic to North Island waters." The SMM's president notes that data on fishing effort presented in the Risk Assessment Report show that gillnetting and trawling still occur in areas inhabited by Maui's dolphins, that gillnets are also used up to the boundary of the current protected area, and that trawling continues inside and outside the protected area. The letter highlights that entanglement mortality removes about 9% of the estimated remaining population of 55 individuals over one year of age each year, and greatly exceeds the level of human-caused mortality that this small population of dolphins can sustain. "Scientific advice often involves a degree of uncertainty, but in a situation such as this one involving a critically endangered subspecies delay to resolve uncertainty could have dire, irrevocable results." The presidential SMM letter closes by encouraging the New Zealand authorities "to act quickly and decisively to provide the leadership in marine conservation that the world expects of your country".

3. Charting Extinction - the History of Maui's Dolphin Bycatch Management in New Zealand

Experts have pointed out since the 1990s that avoiding the use of fishing methods known to kill Maui's dolphins, throughout their habitat is essential to reverse their long-term decline (e.g. Martien et al. 1999; Dawson et al. 2001). This section charts the history of Maui's dolphin management against decades of such recommendations.

In 2003, the Minister of Fisheries, Pete Hodgson, created the first protected area for Maui's dolphins, introducing fishing restrictions to manage the impact of bycatch mortality by prohibiting the use of gillnets and trawling across parts of Maui's dolphin habitat (Figure 1). However, the restrictions for both fishing methods did not extend over the same geographical areas. Commercial and recreational gillnetting were prohibited to an offshore distance of 4 nautical miles (nm), but were still permitted inside harbours and in the southern part of Maui's dolphin range. This exemption had been granted after vigorous lobbying and threats of legal action by the fishing industry, who argued that the area fell outside of Maui's dolphin range. Trawling was prohibited to 2 nm offshore in some areas and to 4 nm in the central part of the dolphins' range.

In April 2007, the then Ministry of Fisheries (now part of the Ministry for Primary Industries, MPI) and the Department of Conservation (DOC) published their first Draft Hector's and Maui's Dolphin Threat Management Plan (M&H TMP) after a two and a half year consultation with stakeholders, which included the fishing industry, as well as NGOs (DOC & MFish 2007). The Draft M&H TMP identified bycatch mortality as the most significant threat to both Maui's and Hector's dolphins. Gillnetting was identified as the primary threat, followed by trawling. The Draft TMP was subject to a six month public consultation period, which actively engaged the fishing industry, recreational fishers and other stakeholders throughout New Zealand. None of the M&H TMP's three proposed management options, nor MPI's recommendations, included range-wide protection against gillnetting or trawling for Maui's or Hector's dolphins. The

consultation documents also did not provide a scientific rationale for the chosen range of options, nor did they provide qualitative or quantitative assessments of their anticipated conservation outcomes. At the conclusion of this process in October 2008, the offshore boundary of the North Island protected area was extended to 7 nm offshore.

By 2008, acoustic monitoring and other sightings had established that Maui's dolphins range well into the harbours within their habitat, just as Hector's dolphins do in the South Island (Rayment et al. 2011; Dawson et al. 2004). However, fishing restrictions for gillnetting and trawling were not extended to include harbours as a precautionary measure to prevent otherwise avoidable bycatch mortality amongst this small and declining population. Instead, the government positioned the boundary of the protected area just beyond the locations of the acoustic detections and visual sightings (for details see Rayment et al. 2011). This resulted in a small extension of the protected area into the entrance of the Manukau Harbour and even smaller extensions in the mouth of two other North Island west coast harbours. Although the PODs had also recorded Maui's dolphins well inside the large Kaipara Harbour, this area too remains unprotected (Rayment et al. 2011). On the open coast, the approach appears to be to extend fisheries protection well beyond the location of recent sightings or dolphin mortalities (e.g. the 80 km extension of the southern boundary). By contrast, inside of harbours the approach has been much less precautionary.

Despite detailed evidence from multiple sources that Maui's dolphins occur well beyond the southern boundary of the protected area, areal protection against fishing methods known to cause Maui's dolphin mortality was not extended to this coastal region, either in 2003 when the protected area was first created, nor in 2008 when it was extended further offshore. Video footage of a Maui's dolphin in the southern part of the distribution range, off Taranaki, collected by a recreational gillnet fisherman in 2009 (O'Donnell 2009), as well as sightings and strandings along this stretch of coast (e.g. Slooten et al. 2006; Russell 1999), were not deemed to provide sufficient evidence to warrant a southern extension of the protected area by the Ministry of Fisheries. Similarly, the sea between the North and South Island was left without protection.

Maui's dolphin abundance was estimated at 111 individuals (CV 0.44; Slooten et al. 2005) at this time (2004) with a PBR of 0.07-0.16 (Slooten and Dawson 2008) – approximately one human-induced death every 10 years.

Extensive overlap between Maui's dolphins and gillnets and trawling, the two fishing methods known to cause dolphin mortality, continued in the areas excluded from the 2003 and 2008 protection measures, as did Maui's dolphin bycatch. Following the death of a Maui's dolphin in a commercial gillnet off Taranaki in January 2012, the authorities initiated a public consultation on a range of potential interim emergency measures in March 2012 under the 'emergency procedures' of the NZ Fisheries Act. The proposed interim emergency measures were subject to public consultation. As in previous consultations, the range of proposed management options and MPI's recommendations did not include range-wide protection against either gillnetting or trawling. MPI and DOC did not provide a scientific rationale for either the chosen range of possible management options or their preferred recommendations. The associated consultation documents also did not offer qualitative or quantitative information about the anticipated effectiveness and conservation outcome of those options.

In July 2012, Ministers announced their decision to temporarily extend the protected area to some 80 km south of the location of the most recent dolphin death (Carter 2012). Unlike elsewhere, the offshore extension however went to only to 2 nm. Further north, the boundary of the protected area extends to 7 nm offshore. Eighty kilometres is considered to be the along shore home range of Maui's and Hector's dolphins (Rayment et al. 2009, Hamner et al. 2012). No added protection was provided against trawl fisheries, nor was the area between the North and South Island protected.

In September 2012, the government published the results of a Maui's dolphins risk assessment and a Review of the Maui's Dolphin Threat Management Plan. The Risk Assessment had been carried out by a panel of nine national and international experts appointed by MPI and DOC (Currey et al. 2012, see below). Both documents formed the backbone of a second round of public consultations to review and update the Maui's dolphin segment of the 2007 Hector's and Maui's Dolphin Threat Management Plan (TMP) (DOC, MPI 2007). The stated purpose of the MTMP review was to "reassess management measures on updated information on the Maui's dolphin population, the human-induced threats they are exposed to, and the vulnerability to those threats" (DOC, MPI 2012). As in previous consultations, the MDTMP review did not include range-wide protection against gillnetting or trawling amongst the range of proposed management options, the supporting documents did not provide a scientific rationale for the chosen range of management options or for MPI's recommended choices, nor did the consultation documents offer qualitative or quantitative information about the anticipated conservation outcome of those options. The consultation process ended on 12 November 2012. The Minister for Primary Industries (MPI) is currently considering whether to expand the southern limit of the protected area permanently. This decision had been expected by the end of 2012.

Since the 2008 protection measures were introduced, the number of stranded and reported bycatch cases has increased slightly (Slooten 2013). Between 1970 and 2008 an average of 1.00 entangled Maui's dolphin was recorded per year. This figure increased marginally to 1.33 dolphin deaths per annum between 2009 and 2012.

Currently some 81 percent of Maui's dolphin habitat is unprotected against fishing methods known to cause dolphin mortality (85 percent including a corridor to the South Island). Both gill netting and trawling continue, right up to the offshore boundary of the protected area but also well inside it (Fig 1). This is partly due to court action by the fishing industry, who initiated judicial reviews over the implementation of both the 2003 and 2008 protection measures. Protection measures were delayed while each of these court cases was resolved. For this reason, Fig 1 shows gillnet and trawl effort between 4 and 7 nm offshore.

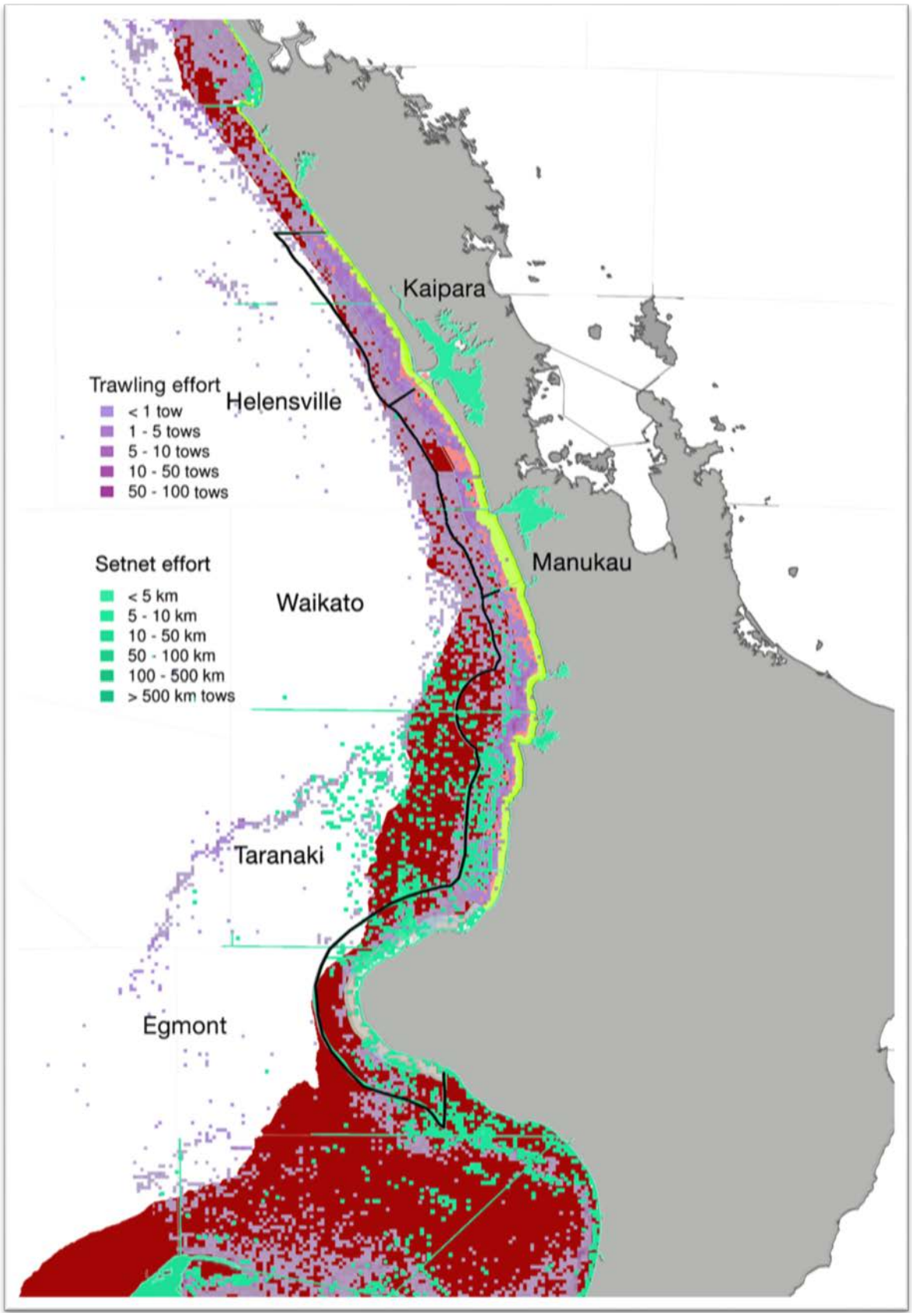

Figure 1 Setnet effort (green squares), measured in km of net set per year, per 1 square nautical mile, for the years 2008 to 2011. Existing and proposed areas closed to set net fishing are indicated in pink. Trawl effort (purple squares) from vessels less than 43 m long, measured in tows per year, per square nautical mile, for the years 2008 to 2011. The various existing areas closed to trawl fishing are indicated in yellow. The black outline marks the extent of the Marine Mammal Sanctuary, including the proposed southern extension. The red area indicates the 100m depth contour and Maui's dolphin habitat. Modified from Figures. A2.8 and A2.13 of the 2012 MTMP

4. The 2012 Review of the Maui's Dolphin Threat Management Plan

The government's Vision Statement (MPI, DOC 2012)) for the management of Hector's and Maui's dolphins includes: "Hector's and Maui's dolphins should be managed for their long-term viability and recovery throughout their natural range." According to the overview of the 2012 Maui's dolphin segment of the 2008 Hectors and Maui's Threat Management Plan (TMP) was developed as "part of a long-term strategy to achieve this vision, and because of public and government concern over the effect of human-induced mortality on these dolphins". The Maui's Dolphin Threat Management Plan Review (MPI & DOC 2012) therefore provided an excellent opportunity to ensure that effective protection measures are put in place for Maui's dolphins. MPI developed a range of management options and recommendations to manage the effects of fisheries-related Maui's dolphin mortality, which are summarised in Table 1. Over the years, the Ministry for Primary Industries (MPI) has progressively become the sole agency responsible for reviewing fisheries-related impacts under the Fisheries Act, limiting the Department of Conservation's (DOC) role to reviewing non-fishing-related threats under the Marine Mammals Protection Act.

Table 1 Fishing-related threat management options of the MTMP - Scientific and anecdotal information indicates fishing is the greatest known human-induced impact on Maui's dolphins. The risk of fishing-related mortality on Maui's dolphins is dependent on the degree to which fishing activity and Maui's dolphin distribution overlap. To address these risks a range of options to reduce the risk of fishing-related mortality for the Maui's dolphin population are considered, summarised below. After MPI, DOC 2012

Commercial and Amateur Set Netting (Coastal)	
Option 1	***Status quo*:** Keep existing management, including the interim measures to: • retain the set net ban between 0 and 2 nautical miles offshore from Pariokariwa Point to Hawera; • prohibit the use of commercial set nets between 2 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard, and; • pay for observer services costs with Crown-funding. The interim measures would be reviewed in 2015 to inform management going forward.
Option 2	Keep existing management, and put the interim measures in place via regulation to: • retain the set net ban between 0 and 2 nautical miles offshore from Pariokariwa Point to Hawera; • prohibit the use of commercial set nets between 2 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard, and; • require observer services costs to be cost-recovered from industry beginning 1 October 2013.
Option 3	• Extend the set net ban between 0 and 4 nautical miles offshore from Pariokariwa Point to Hawera. • Prohibit the use of commercial set nets between 4 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard.
Commercial and Amateur Set Netting (Harbours)	
Option 1	***Status quo*:** Keep existing management.
Option 2	Improve information on Maui's dolphin distribution and set net activity in the west coast North Island harbours, with a focus in the Manukau Harbour.
Option 3	• Extend the existing set net ban in the entrance of the Manukau Harbour further into the harbour. • • Improve information on Maui's dolphin distribution and set net activity in the west coast North Island harbours, with a focus in the Manukau Harbour.

Commercial Trawling	
Option 1	*Status quo*: Keep existing management.
Option 2	Put in place extensive monitoring coverage in the commercial trawl fishery between 2 and 7 nautical miles offshore from Maunganui Bluff to Pariokariwa Point.
Option 3	• Extend the trawl ban from 2 and 4 nautical miles offshore from Kaipara Harbour to Kawhia Harbour. • Put in place extensive monitoring coverage in the commercial trawl fishery between 2 and 7 nautical miles offshore from Maunganui Bluff to Pariokariwa Point

While MPI accepts the scientific basis for the 100m depth contour as an offshore boundary for the distribution of Hector's dolphins (including Dawson et al. 2004, Du Fresne & Matlin 2009, Rayment et al. 2010, 2011, Slooten et al. 2004, 2005, 2006), and DOC currently use it as a trigger for more stringent mitigation requirements in seismic survey operations for Hector's and Maui's dolphins, MPI does not use this information to implement science-based offshore boundaries for protected areas for Maui's dolphins.

As with past public consultations on changes to Maui's or Hector's dolphin protection, the Maui's Dolphin TMP review does not include range-wide protection against either gillnetting or trawling amongst the choice of proposed management options. Through the consultation process MPI requested public feedback on its proposed range of management options to mitigate fishing-related threats to Maui's dolphins. Furthermore, like the 2008 Hector's and Maui's TMP and all subsequent public consultations on Maui's and Hector's dolphin protection, the 2012 Maui's TMP Review provides neither quantitative nor qualitative information on the anticipated effectiveness or conservation outcomes of any of the proposed measures nor on MPI's recommendation. Thus, neither the public nor the Minister has ever been presented with a full range of bycatch management options, including a precautionary option, or with scientifically robust information about the effectiveness of the management options.

5. Abundance and Recovery

Hamner et al. 2012 estimate the Maui's dolphin abundance at 55 individuals one year of age and older. Based on age-structured population models for Hector's and Maui's dolphins (Slooten et al. 2000; also see IUCN 2008) the total Maui's dolphin population, including calves, is likely to number around 61 individuals. Hamner et al.'s estimate is based on research that was carried out in 2010/11. With an annual rate of decline of 9%, Maui's dolphins will have been subject to a further drop in abundance since then. Maui's and Hector's dolphins do not reach sexual maturity until the age of 4-7 years. The number of breeding adults is likely to be about half of the population of 61 individuals, and the number of breeding females is likely to be about a quarter (Slooten et al. 2000; IUCN 2008). In other words, there are on the order of 15 breeding females in the Maui's dolphin population, which has very serious implications for the risk of extinction and the potential for population recovery.

Even under the most optimistic assumption that a population of 61 individuals is able to achieve the maximum population growth rate of 1.018 (Slooten and Lad, 1991), Maui's dolphin numbers will decline to 10 breeding females within the next six years.

I examined a range of scenarios with regard to the timescale required for Maui's dolphins to increase to an effective population size of 250 mature individuals (500 individuals in total) in the absence of any human impacts. This would be the population size required to reach the threshold for reclassification from Critically Endangered to Endangered on the IUCN Red List of Threatened Species (IUCN 2001). The results of these projections show that even under the optimistic assumption that all human impacts can be removed; it will take an estimated 119 years for Maui's dolphins to increase to a population size of 250 mature individuals (500 total).

6. Legal Considerations

6.1. National Legislation

New Zealand's **Fisheries Act** requires MPI "To provide for the utilisation of fisheries resources while ensuring sustainability". The latter is defined as "(a) Maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations; and (b) Avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment". Decision makers are required to take into account that "associated or dependent species should be maintained above a level that ensures their longterm viability", that biological diversity is maintained and that habitat of particular significance for fisheries management should be protected. Under the Act decision-makers should therefore consider that their decisions should be based on the best available information and that that absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to achieve the purpose of the Act.

The purpose of the **Marine Mammals Protection Act** is the protection, conservation and management of marine mammals within New Zealand territorial and fisheries waters. It requires that threatened species should become non-threatened as soon as practicable and in any case within 20 years.

6.2. International Obligations

Section 5 of the Fisheries Act requires the Minister to act in a manner consistent with New Zealand's international obligations relating to fishing, specifically the management of fishing related threats to protected species. New Zealand is signatory to a number of international agreements that relate to the effects of fishing on the marine environment, including marine mammals. These include the Convention on Biological Diversity (CBD) and the United Nations Convention on the Law of the Sea.

As a signatory to the CBD New Zealand has made a formal commitment to the Convention's Strategic Goals for 2011 to 2020 (Aichi Biodiversity Targets). This includes the obligation to ensure that "the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained", and that the impacts of use of natural resources are kept "well within safe ecological limits." New Zealand's failure to act according to the best available information with regard to Maui's and Hector's dolphins conflicts specifically, with: Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society, Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use ecosystems, species and genetic diversity, and Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.

7. Other Threats

Climate change, pollution, coastal development, mineral exploration and mining create cumulative effects that are detrimental to the health of the marine environment and its inhabitants. DOC recognizes that while many threats might not impact the population through direct mortality, they can exert and indirect effect via decreased fitness, breeding success, prey availability and habitat degradation. Therefore the cumulative effects of threats such as oil, gas and mining activities, vessel traffic, marine tourism, pollution, coastal development, and research may result in high levels of disturbance, displacement, fragmentation of the population or population decline of Maui's dolphins.

There have been significant developments in this regard since the MTMP was published in September 2012. They include the start of ongoing seismic testing earlier this year and plans to commence what has been described as the world's largest marine iron ore sand mining operation in Maui's dolphin habitat.

7.1. Seismic Testing

Seismic testing in the dolphins' habitat has prompted a second letter of concern from the President of the Society of Marine Mammalogy on 19 April 2012. In its letter, the SMM urges the New Zealand government to reconsider the decision to allow this seismic testing in and near the protected area in light of the high risk to the Maui's dolphins. The SMM expresses its concerns that seismic testing is being allowed in the protected area not only because of the risk of direct harm to dolphin hearing but also because potential displacement from this habitat by Maui's dolphins could result in increased bycatch in unprotected areas. "Allowing this seismic testing thus appears inconsistent with the New Zealand Government's stated goal of enabling this subspecies to recover." Noise is a well known stressor, not just for marine mammals. This means seismic testing is potentially dangerous to Maui's dolphins, even if it doesn't kill them outright. Chronic stress can heighten susceptibility to other threats and slow down population recovery by impairing immunocompetence and reproductive performance (hormonal and behavioural) (Toates 1995 for a review). Maui's dolphins are already subjected to the synergistic impacts of stressors that will further aggravated by seismic airgun

surveys. If successful, these tests will lead to oil and gas exploitation, which bring with them a new host of significant threats to the area's marine life, including Maui's dolphins.

7.2. Sand Mining

According to recent news reports the firm Trans-Tasman Resources is searching for iron ore off the Taranaki coast, in the hope of applying for permission to start "the biggest seabed mining operation of its type in the world, as soon as next year". This type of seabed mining reportedly utilizes large suction pipes to collect sand from the seafloor onto a ship, where the iron ore is then separated before up to 90 percent of the sand is returned to the sea. According to the report, the company argues that "the area it wants to mine doesn't have any special environmental features".

The mitigation currently in use relies almost exclusively on ship-based visual monitoring as its primary means of mitigation. Yet it is well established that real-time visual shipboard monitoring is difficult for all marine mammal and sea turtle species, especially at night and during high sea states and fog, and particularly difficult for small cetaceans. For example, it has been estimated that in anything stronger than a light breeze, only one in fifty beaked whales surfacing in the direct track line of a ship would be sighted; as the distance approaches 1 kilometre, that number drops to zero (Barlow & Gisiner 2006). The U.S. Navy has estimated that, overall, the visual monitoring system it developed for real-time monitoring around a slow-moving, low-frequency source vessel would have only a 9 percent probability of citing marine mammal species (U.S. Department of the Navy 2001). And, of course, maintaining a narrow safety zone around a vessel – even if that were possible – would do virtually nothing to prevent the vast majority of impacts occurring more than a short distance away. (Parsons et al. 2009)

By contrast, time and place restrictions designed to protect high-value habitat are a critical means to reduce the potential impacts of noise and disturbance, including noise from oil and gas exploration. Indeed, there is scientific consensus that such restrictions are the most effective available means of reducing impacts, having been endorsed by, among others, the U.S. National Oceanic and Atmospheric Administration, the Helsinki Convention (OSPAR) and other intergovernmental bodies, and several expert workshops and papers (Lubchenco 2010, Agardy et al. 2007, Dolman et al. 2009, OSPAR 2009). It is consistent with this consensus that Maui's dolphin habitat should be closed to seismic exploration, with a buffer zone to reduce impacts from surveys occurring in surrounding waters.

8. Discussion

Hector's dolphins were named after the Scottish scientist Sir James Hector, who conducted geological surveys in New Zealand and described the first specimens in the early 1870s. Sir Hector had remarked that Hector's dolphins were the most common dolphins off the coast of New Zealand. A century later, in 1976, cetacean research pioneer David Gaskin, who had worked in New Zealand during the 1960s, first raised the alarm bells that Hector's dolphins seemed to be declining rapidly (Nathan & Varnham, 2008). Gaskin's suspicions have been confirmed.

Since the introduction of monofilament fishing nets in the 1970s, Hector's dolphin numbers have dropped from 30,000 to 7,270 (CV 0.16) and Maui's dolphin abundance has been subject to a 97% drop (Dawson et al. 2004; Slooten et al. 2004; Slooten and Dawson 2010; Davies et al. 2008; Slooten and Davies 2011). With just 55 (48-69) survivors one year and older, an estimated adult population of 61 individuals (between 53 and 67), and an annual rate of decline of nine percent as a result of fishing, Maui's dolphins are facing functional extinction within less than 20 years. I have defined functional extinction as the population declining below 3 breeding females.

Although the level of genetic diversity amongst the population is relatively low, it is higher than expected for such a small population (Hamner 2012). From a biological perspective, Maui's dolphins are not doomed, provided that human-induced mortality is substantially curtailed as a matter of urgency.

Commercial gillnetting alone has had a dramatic impact on Maui's dolphin (e.g. TMP, MTMP, Davies et al. 2008, Slooten & Dawson 2010, Slooten & Davies 2011; SC/64/ProgRepNewZealand).The pivotal role of gillnetting and trawling, as by far the most significant impediment to Maui's dolphins recovery, was again confirmed by a government appointed Expert Panel, which attributed 95.5 percent of anthropogenic mortality to these fishing methods (Currey et al. 2012).

The data on fishing effort presented in the Panel's Risk Assessment Report show that gillnetting and trawling still occur in the majority of areas inhabited by Maui's dolphins. Gillnets are also set immediately adjacent to the boundary of the current protected area, while trawling continues both inside and outside.

Currently some 81 percent of Maui's dolphin habitat is unprotected against fishing methods known to cause dolphin mortality (85 percent including a corridor to the South Island) (Fig. 1). Efforts to achieve population recovery must therefore focus on eliminating bycatch mortality. As the IWC SC, the IUCN, the SMM, and others have stated, this is

best achieved by avoiding the use of fishing methods that cause dolphin mortality throughout the full distribution range of Maui's dolphins. If such action is taken now, extinction is not inevitable. However failure to afford this remnant population immediate and full protection against gillnetting and trawling will result in the loss of the first marine cetacean as a result of human actions. The precarious population status of Maui's dolphins constitutes a conservation crisis that should trigger a zero tolerance response toward all avoidable known anthropogenic threats, including fishing. However, none of the management options and recommendations set out in the MTMP discussion paper are either precautionary or sufficient to result in population recovery.

Research on the effects of fisheries protection of Hector's dolphin off Banks Peninsula on the east coast of New Zealand's South Island have shown that removing the threat of gillnetting and trawling can result in measurable improvements (Gormley et al. 2012). However, while the Banks Peninsula Marine Mammal Sanctuary has resulted in a slower rate of decline, it is still too small to achieve recovery.

MPI and DOC state that the review of the MTMP "will reconsider the management strategies and/or research that will support the recovery of the Maui's dolphin population." (MPI & DOC 2012) However, none of the management options outlined in the government's proposals would reverse the dolphins' decline. Even the most conservation orientated options in the MTMP review would result in only a marginal increase in protection against harmful fishing methods and will fail to prevent further decline. If these proposals are adopted, against strong international scientific recommendations, extinction is the foreseeable outcome.

The Expert Panel's Risk Assessment report has provided clear guidance on the risks associated with human activities across the dolphins' range. However, this advice has not been used to inform the management options in the Consultation Paper (MPI & DOC 2012). Experts from New Zealand and elsewhere have provided an exceptionally strong scientific basis for effective fisheries management to prevent the extinction of Maui's dolphins. The management options for fisheries mortality presented in the MTMP are significantly less effective than those recommended by the IWC, IUCN, and SMM and inconsistent with the scientific advice in the Risk Assessment report (Currey et al. 2012). They would not be effective in reducing Maui's dolphin bycatch to a sustainable level, nor would they support the recovery of Maui's dolphins from their seriously depleted 'Critically Endangered' status to a lower risk classification.

New Zealand and international cetacean experts agree that fishing is the primary threat that impedes the recovery of Maui's dolphins, as reported in the Risk Assessment report (Currey 2012). By contrast, the MTMP and other material provided for the consultation process, states that "There is not enough evidence to pinpoint the exact reasons for the decline in the population." (MPI, DOC 2012c (submission guidance). This systemic disconnect between scientific information and management options means that the MTMP falls short of a science-based and outcome-focussed biodiversity management approach, as well as MPI's statutory obligations.

The stated goals of the H&MTMP include to "ensure that the long-term viability of Hector's and Maui's dolphins is not threatened by human activities", and to "further reduce impacts of human activities as far as possible, taking into account advances in technology and knowledge, and financial, social and cultural implications" (MPI, DOC 2012). MPI states that the options presented in the MTMP must strike a balance between "utilisation and sustainability" (MPI, DOC 2012). Ensuring "viability (including biological diversity) of the Maui's dolphin population" is but one factor in this decision making framework. "The nature and extent of additional management necessary to avoid, remedy, or mitigate the effects of fishing on Maui's dolphins, if any, will depend on the balance between sustainability and utilisation the Minister considers appropriate. The selection of the most appropriate suite of measures requires the Minister to weigh the benefits of more effective mitigation against the likely costs of those measures. "(DOC, MPI, 2012)

Balancing sustainable, science-based population management with factors such as their economic impact on commercial interest groups like the fishing industry has led to a *modus operandi*, which compromises scientifically established facts to the point where they become all but irrelevant. This in turn has resulted in the progressive mismanagement of the impact of fisheries-induced mortality on Maui's dolphins with the result that Maui's dolphins have been, and continue to be exposed to unsustainable levels of manageable threats that have caused their long-term decline and have set them on course for extinction.

The MTMP fails as a tool to manage Maui's dolphin mortality in a way that would prevent their extinction, because it:

a) Does not present a comprehensive range of management options or recommendations (i.e. range-wide protection against gillnetting or trawling is consistently excluded).
b) Fails to provide a scientific rationale for the chosen range of options
c) Does not provide any qualitative or quantitative assessments of the effectiveness and anticipated conservation outcomes associated with these options
d) Lacks objective, science-based, measurable management targets

e) Ignores the best available scientific advice
f) Uses the inevitable uncertainty associated with research on small populations as a reason to delay protection
g) Fails to provide essential information about the relative conservation costs and benefits of different management options to provide the Minister and other stakeholders with the information needed to make an rational, science-based decision

The government's Vision Statement for the management of Hector's and Maui's dolphins, includes: "Hector's and Maui's dolphins should be managed for their long-term viability and recovery throughout their natural range." The management options and recommendation presented in the MTMP are incompatible with this goal. According to Nicola Wheen, from the University of Otago's Faculty of Law, regulatory controls of fishing in response to fishing-related mortality of endemic marine animals in New Zealand waters has been weak and slow (Wheen, 2012). Wheen argues that "a legal framework that is almost wholly discretionary, allows fisheries interests to dominate decision-making and obscures and nullifies the intended effect of the precautionary approach" by giving more weight in practice to the duty to base decisions on the best available information. She recommends making some conservation measures for the most at-risk species mandatory, and also allowing the Minister to take 'reasonable' (rather than only 'necessary') measures for other threatened species, thus 'reducing external pressure' on the minister and 'making it easier' for effective measures to be taken. Furthermore, removing legislative requirements for the Minister of Primary Industries to approve all conservation measures, and instead enabling him and the Minister for Conservation, or either minister, to take measures after having consulted the other. Lastly, Wheen recommends a re-structuring and re-phrasing of the legislative reference to information principles, so that it 'better reflects the true meaning and intent of the precautionary approach' and the overall importance of the idea that 'absences of and uncertainties in information should not be used as reasons for failing to take measures to ensure sustainability."

The pace of conservation management for Maui's dolphin is out of step with what is required to facilitate recovery. Each step has been preceded by a lengthy periods of public consultation lasting up to three years. Judicial reviews and other challenges by the fishing industry have caused further delays. The Expert Panel made clear that recovery is still possible, but decisive management action is urgently needed. The scientific evidence available to MPI and DOC includes a detailed risk assessment, extensive peer-reviewed scientific publications, as well as detailed recommendations from three major scientific associations (IWC, IUCN, and SMM). Protection throughout Maui's dolphin habitat, out to the 100 m depth contour or the nearest offshore equivalent of 12 nm, would substantially increase the potential for population recovery while reducing the risk of further fragmentation.

Extinction is a conservation concern with global implications. To date, the Baiji, or Chinese river dolphin, is the only cetacean to become extinct as a result of human actions. With just a few dozen survivors and the absence of a science-based, outcome-focussed threat mamanegent plan, Maui's dolphins are poised to shortly follow suit.

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