Ministry of
Fisheries
Te Tautiaki i nga tini a Tangaroa

INITIAL POSITION PAPER

RECONSIDERATION OF MEASURES TO MANAGE FISHING-RELATED THREATS TO MAUI'S AND HECTOR'S DOLPHINS

New Zealand Government

Executive Summary

1. Ministry of Fisheries (MFish) is seeking tangata whenua and stakeholder information and views to inform a review of options for mitigating impacts on fishing on Hector's and Maui's dolphins within defined areas of the WCNI and ECSI.

2. A previous Minister of Fisheries made decisions to impose measures to avoid, remedy or mitigate the effect of fishing-related mortality on Hector's and Maui's dolphins in July 2008 and regulations to give effect to these decisions came into force on 1 October 2008.

3. In September 2008, the fishing industry brought judicial review proceedings in the High Court challenging six of these measures.

4. On 23 February 2010 the High Court issued its decision that two of these measures were to be referred back to the Minister for reconsideration. The two measures that have been referred back to the Minister are:

    a. the extension of the set net closure for commercial fishers on the WCNI to include the area between 4 and 7 nautical miles (nm); and
    b. the inclusion of the commercial targeted butterfish fishery in the closure of part of the ECSI to set net fishing.

5. The IPP contains a range of options for each area and analysis by MFish on the costs and benefits of those options.

6. The table below outlines the options MFish consider are available to avoid, remedy or mitigate the effects of fishing on Maui's dolphin for the area 4-7 nm off the West Coast of the North Island.

Option	Description
Option one	Allow set net fishing between 4-7 nm from shore
Option one (a)	Allow set net fishing between 4-7 nm and introduce Monitoring
Option two	Close smaller area beyond 4 nm
Option three	Retain closure of area between 4-7 nm

7 Prior to consultation, MFish has indicated an initial preference to maintain the closure between 4-7 nm for Maui's dolphins (Option three) given best available information on likelihood of interaction with fishing gear in this area and the consequence of any mortality from fishing on the Maui's dolphin population.

8 The table below outlines the options MFish consider are available in relation to allowing target butterfish fishing in a defined area at the top of the ECSI. MFish consider the following options are available.

Options	Description
Option one	Allow Exemption
Option two	Allow Exemption with Monitoring
Option three	Do Not provide for Exemption

9 Prior to consultation, MFish has a preference to allow an exemption to butterfish fishing by commercial fishers at the top of the ECSI (Option one), on the basis that likelihood mortality from fishing in this area is low given the size of the area and the type of fishing involved.

10 MFish is seeking submissions on the proposed reconsideration of measures to manage fishing-related threats to Maui's and Hector's dolphins in this paper. Submissions should be received by **Tuesday, 12 October 2010** and can be sent to Denise Ashley, Ministry of Fisheries, PO Box 1020, Wellington 6140, or hectors.dolphin@fish.govt.nz.

Purpose and scope

11 The purpose of this paper is to seek comment from interested parties to inform the Minister's reconsideration of whether measures are necessary to avoid, remedy, or mitigate the effect of fishing-related mortality on:

a. The West Coast of the North Island (WCNI) Maui's dolphin population from commercial set netting further than 4 nm from shore; and
b. the East Coast of the South Island (ECSI) Hector's dolphin population from commercial set netting targeting butterfish at the top of the ECSI.

12 Decisions on measures for these areas have been referred by the High Court back to the Minister of Fisheries (the Minister) for reconsideration.

13 The scope of this paper is limited solely to reconsideration of the two decisions that the High Court referred back to the Minister. In reconsidering these two particular decisions, this paper will:

a. address the advice found to be inaccurate;
b. present relevant material considered during the initial decision-making process;
c. incorporate any new (post the May 2008 Threat Management Plan (TMP) final advice) material that is relevant to the reconsideration; and
d. outline possible management options, based on the above information.

14 In terms of implications for amateur activity, whatever decision is ultimately made in relation to WCNI will apply to commercial and amateur fishing. In terms of the decision that is ultimately made in relation to ECSI, this process focuses solely on reconsidering whether to provide an exemption for commercial set netting for butterfish. Any decisions made on this exemption may have implications for amateur set netting and, if necessary, following decision on the commercial restrictions, a further process will be undertaken to consider the amateur restrictions as they relate to set netting for butterfish in the ECSI.

15 A wider review of the TMP will be undertaken in 2013 if warranted by available information.

16 This paper provides interested parties the opportunity to review and comment on the information being considered and possible management options.

Background

17 Hector's dolphin is classified as "endangered" and "nationally endangered" by the IUCN[1] and the Department of Conservation (DOC) (Baker *et al.* 2010) respectively, while Maui's dolphin is considered "critically endangered" and "nationally critical".

18 Under section 15(2) of the Fisheries Act 1996 (the Act), the Minister of Fisheries can impose such measures as he or she considers are necessary to avoid, remedy or mitigate the effect of fishing-related mortality on protected species. As dolphins are marine mammals for the purposes of the Marine Mammals Protection Act 1978, Hector's and Maui's dolphins are a protected species under the Act.

2008 Threat Management Plan, management measures and legal challenge

19 A previous Minister of Fisheries made decisions to impose measures to avoid, remedy or mitigate the effect of fishing-related mortality on Hector's and Maui's dolphins in July 2008 and regulations to give effect to these decisions came into force on 1 October 2008.

20 The decisions were based on consideration of advice from MFish, which incorporated the outcome of consultation undertaken in August 2007. The consultation process resulted in approximately 2500 submissions and demonstrated a very high level of public interest. MFish also consulted on the potential socio-economic impacts of the proposed measures and new scientific information that became available in early 2008.

21 The measures introduced included restrictions to a number of trawl, drift net and set net fisheries in specified areas covering the dolphins' known habitat range.

22 In September 2008, the fishing industry brought judicial review proceedings in the High Court challenging six of these measures:

i. the extension of the set netting prohibition further into the Manukau Harbour;
ii. the extension of the 4 nm set netting prohibition to 7 nm in the WCNI;
iii. the decision not to exempt targeted commercial fishing for butterfish in the set net closure at the northern end of the ECSI;
iv. the decision not to exempt targeted commercial fishing of butterfish in the Bluff area;

[1] http://www.iucnredlist.org/

v. the 4 nm set net closure outside Te Waewae Bay of the South Island; and
vi. the seasonal 2 nm set net prohibition on the West Coast of the South Island (WCSI).

23 On 26 September 2008, the High Court granted interim relief from the regulations to allow fishing in certain area subject to certain conditions. However, the High Court noted that, if a Hector's or Maui's dolphin was captured in a commercial set net in any of the areas where interim relief has been granted, the interim relief would end. The interim relief, related to measures (ii) and (iii) above, allowed:

a. set netting for rig and school shark between 1 September and 24 December between 4 nm and 7 nm from Maunganui Bluff to Pariokariwa Point (except between Port Waikato and the Manukau Harbour) on the WCNI; and,
b. set netting for butterfish in specific areas between Needles Point and Cape Jackson at the northern end of the ECSI.

High Court decision

24 On 23 February 2010 the High Court issued its decision in relation to the judicial review of the six measures. The Court upheld four out of the six measures. The other two measures were referred back to the Minister for reconsideration as the High Court's view was that the applicant's had shown that the Minister had been given inaccurate advice. The two measures that have been referred back to the Minister are:

a. the extension of the set net closure for commercial fishers on the WCNI to include the area between 4 and 7 nm; and
b. the inclusion of the commercial targeted butterfish fishery in the closure of part of the ECSI to set net fishing.

25 The interim relief applicable in relation to the above measures was ordered to continue pending reconsideration of the two measures and promulgation of any amendment to, or confirmation of, the regulations that may result.

Species considerations

26 MFish considers it is appropriate to consider the effects of fishing on these dolphins at a regional level as this addresses issues by distinct populations, thereby maintaining the genetic diversity within and across the populations of Hector's (and Maui's) dolphins. The proposed cost of measures and contextual information varies at this population level.

27 Fishing is the greatest cause of human-induced mortality of both Hector's and Maui's dolphins where cause of death is known. Fishing-related threats include entanglements in set nets, trawl nets, drift nets and cray pot lines. Non-fishing threats include disease, pollution, boat strike, tourism and entanglement in marine debris. Information on reported Hector's and Maui's dolphin mortality from 1921 onwards (including cause

where it can be determined) is collected and held by DOC in the DOC incident database. This information is summarised in Table 1.

28 Since 1921 there have been 115 known fishing-related mortalities out of a total 495 reported mortalities. However, MFish considers that reported mortalities do not necessarily provide a good indication of actual mortalities due to:

- a lack of independent monitoring, including low observer coverage of inshore commercial fisheries;
- no formal monitoring of recreational activity;
- poor incentives to voluntarily report incidents;
- cause of death is only established for 158 of the 495 reported mortalities in the DOC incident database; and
- sources of anecdotal information that indicate actual fishing-related mortalities are higher than reported (Cawthorn 1998, Dawson 1991, Russell 1999).

29 Key biological characteristics of Hector's and Maui's dolphins make them susceptible to the effects of human-induced mortality, including fishing-related mortality. The dolphins:

a. are relatively short lived (about 20 years);
b. have a low reproduction rate (a female has a single calf every 2-3 years);
c. become sexually mature at a relatively late age (about 7-9 years);
d. favour shallow waters less than 100 m deep ((Dawson 2009, Encyclopedia of Marine Mammals) and have a localised inshore distribution (i.e. an overlap with many human coastal activities);
e. have small population sizes which compound the potential impact of human–induced mortalities.

Maui's dolphins: West Coast of the North Island – beyond 4 nm offshore

30 This section outlines information and analysis to support reconsideration of the decision to close the offshore area, 4-7 nm between Pariokariwa Point and Maunganui Bluff on the WCNI (Figure 1).

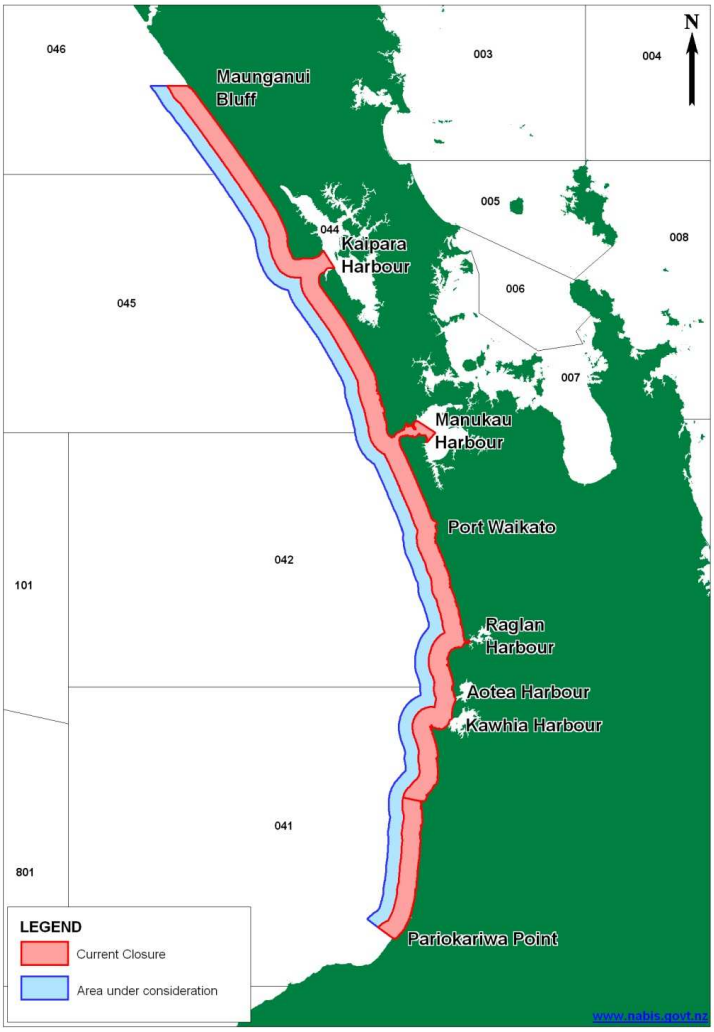

Figure 1. Plot showing the WCNI and the area under reconsideration (in red) and existing areas closed to commercial set net fishing (in blue). Statistical Area names are shown (in black) with their boundaries (in grey).

Court judgment

31 The High Court found that the Minister was provided inaccurate advice that was potentially material to his decision to extend the set net prohibition from 4 to 7 nm from shore on the WCNI. The Court was very specific about the information that was regarded to be inaccurate. This was identified as the "*advice that sightings of Maui's dolphins at 7 nm were reliable, and that this was a "confirmed" sighting, when there was one sighting (of three dolphins) and the team leader conducting the survey in which that sighting had been made had concerns about the survey as a whole*" (paragraph 278 of the High Court decision).

32 The High Court considered the correct advice was that "*the 7 nm sighting had been made by an observer considered to be reliable, but it was not necessarily reliable because it was not a duplicate sighting and it occurred in a survey about which the researchers had general concerns*" (paragraph 120 of the High Court decision).

33 The High Court further identified that the Minister was not informed "*that the other surveys that did not have the same concerns* [regarding accuracy] *had not recorded sightings this far out*" (paragraph 121 of the decision) and that this prevented the Minister from taking into account that his decision should be based on the best available information.

Assessment of the effect of fishing-related mortality

34 This section assesses the effect of fishing-related mortality from set net fishing within 4-7 nm from shore between Pariokariwa Point and Maunganui Bluff on the WCNI population. The assessment of the effect of fishing-related mortality is based on the following factors:

a. Biology of the Maui's dolphins, including:
    i. abundance and trends,
    ii. vulnerability of the population to human-induced impacts,
    iii. distribution,
    iv. known susceptibility of the population to fishing;
b. Assessment of the effect of set net fishing, including;
    i. characterisation of the fishing,
    ii. information on, or likelihood of, mortalities or interactions with Maui's dolphins in this area
c. Cumulative effect of fishing on Maui's dolphins,
d. Overall assessment of the effect of fishing-related mortality on Maui's dolphins on WCNI and whether it is necessary pursuant to s 15(2) of the Act for the Minister to impose measures in the area.

Biology of Maui's dolphins, characteristics and range

Abundance and trends

35 The most recent abundance estimate of population size for the Maui's dolphin is 111 (95% confidence interval (c.i.): 48 – 252) (Slooten *et al.* 2004 and Slooten *et al.* 2006 from line-transect aerial surveys in 2004). Abundance estimates from previous surveys are:

a. 134 (Dawson & Slooten 1988 from a small-boat survey in 1985);
b. 45 (Russell 1999 from a replicated small-boat transect survey); and
c. 75 (Ferreira & Roberts 2003 from aerial surveys in the 2000-01 and 2001-02 summers).[2]

[2] 95% confidence interval 48 – 130.

36 MFish acknowledges there is uncertainty associated with Maui's dolphin abundance estimates. However, all Maui's dolphin abundance estimates signal that the Maui's dolphin population is very small.

37 There are no comparative abundance surveys to establish trends over time but other information suggests abundance is smaller now than in the past.[3]

38 A series of modelling work in the scientific literature suggests that Maui's dolphin abundance has declined (Martien *et al.* 1999, Burkhart & Slooten 2003, Slooten 2007).[4] This modelling work is imprecise (and contentious) due to the considerable uncertainty about the extent of historical and current fishing-related mortality. However, even if the model estimates are uncertain they still corroborate the trend observed in the genetic analyses by Pichler & Baker (2002) and Baker (2002) that indicate the Maui's dolphin population has declined from higher levels of abundance.

39 The University of Auckland and DOC are currently conducting a microsatellite genotype biopsy study that aims to estimate abundance for the Maui's dolphin population. The study is designed to build on data collected in 2001 and 2006. This stud*y* will provide further information on abundance and trends of Maui's dolphins. Results from this study will be available in June 2011. While this additional information will be useful for further analysis of the impact of fishing on the population and any review of management measures, s 10 of the Act states that "*the absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act*".

Vulnerability of Maui's dolphins to human-induced impacts

40 Together with small population size, the life history characteristics of Maui's dolphin (see paragraph 28) make the population very susceptible to the effects of human-induced mortality. In addition, there may currently be very few breeding females in the population. Assuming an even sex ratio, the number of mature females may be less than one quarter of the population, resulting in extremely low productivity potential. Small population size coupled with low productivity may suppress the population growth rate even in the absence of human-induced mortality. Depensation and stochastic events (e.g. disease and catastrophic weather) may remain very real extinction threats.[5]

---

3 Pilcher & Baker (2000) and Pilcher (2002) detected a decline in the genetic diversity of the Maui's dolphin population that is more consistent with a recent decline in abundance than with other factors like sex bias or loss of populations. DNA from museum specimens and living dolphins indicates the population has lost two thirds of the maternal lineage of its mitochondrial DNA. Dolphin stranding records point to a contraction in alongshore distribution in recent history that is probably coincident with a decline in abundance. Russell (1999) reported 15 Maui's dolphin strandings from the New Plymouth area between 1970 and 1990 but only one in the decade since. Historically, the Maui's dolphin was probably more abundant because there is evidence the population occupied a much larger geographic range on the WCNI – including the Taranaki, Wanganui, and Wellington regions. There are also historical anecdotal reports of Maui's dolphins on the East Coast of the North Island.

4 Parameters in the modelling work typically include estimates of dolphin productivity, current abundance, and estimates of fishing-related mortality.

5 Depensation is a negative effect on population growth that becomes proportionately greater as population size declines. Populations experiencing depensation are prone to further reductions in size, even in the absence of exploitation, and therefore have a greater risk of extinction.

41 Potential Biological Removal (PBR) analysis provides an indication of the susceptibility of a population to the effects of fishing and other human-induced mortality. PBR analysis indicates that Maui's dolphin can sustain no more than 0.2 human-induced deaths per year (1 dolphin every 5 years). Whilst not in itself determinative, MFish considers that the PBR modelling generally indicates that fishing-related mortalities are not sustainable for the Maui's dolphin (the population is so small that one fishing-related mortality effectively constitutes an effect on the population). For more information about PBR values please refer to Appendix 1.

Distribution

42 Available information relating to the offshore distribution of Maui's dolphins includes:

a. research survey sightings, and
b. anecdotal public sightings information including:
    i. report by Russell (2008) analysing sighting records from various sources including the public, research surveys, MFish, and DOC;
    ii. DOC sighting catalogue. Regional DOC offices record sighting information from some independent research studies, DOC-led surveys, DOC and MFish staff and the public; DOC consolidated these sighting information sources into the DOC sighting catalogue as part of the TMP process.

Research sightings

43 There have been seven aerial research surveys across six years that considered areas of the WCNI further offshore than 4 nm. The years these surveys were conducted and the papers in which these are described are:

a. 2000-2002, Ferreira & Roberts (2003),
b. 2004, Slooten *et al.* (2005) and Slooten *et al.* (2006),
c. 2006, Scali *et al.* (2007),
d. 2007, Rayment & Du Fresne (2007) and Scali *et al.* (2008),
e. 2008, Childerhouse *et al.* (2008) and Scali *et al.* (2008), and
f. 2009, Stanley (2009).

44 Four of these surveys, conducted across 4 years, sighted Maui's dolphins beyond 4 nm from shore; they were the surveys conducted in 2006 (Scali *et al.* 2007), 2007 (Rayment & Du Fresne 2007, Scali *et al.* 2008), 2008 (Childerhouse *et al.* 2008, Scali *et al.* 2008) and 2009 (Stanley 2009).

45 The only duplicate sighting of Maui's dolphins beyond 4 nm from shore occurred during the 2007 survey (Rayment & Du Fresne 2007, Scali *et al.* 2008), where two researchers saw the same 10 Maui's dolphins at 4.05 nm from shore.

46 Single researcher sightings of Maui's dolphins beyond 4 nm were made during the following research surveys in:

a. 2006, at 4.5, 6.9, 8.2, 9.2, 9.7 and 10.3 nm from shore (Scali *et al.* (2007);
b. 2007, at 4.3 nm from shore (Childerhouse *et al.* 2008, Scali *et al.* 2008); and
c. 2009, at 6.2 nm from shore (Stanley 2009).

47 The argument that Maui's make infrequent visits outside 4 nm is derived from a relatively small number of research sightings beyond 4 nm but this may be influenced by a range of factors, including:

a. small population size;
b. the snap shot nature of surveys (i.e. undertaken for a limited period);
c. the limited survey effort past 4 nm (more effort has been focused on alongshore distribution); and
d. the limited survey effort conducted in winter (Maui dolphin behaviour and distribution changes seasonally).

48 More detail on research surveys and sightings of Maui's dolphins beyond 4 nm from shore during these surveys is provided in Table 2 and Figure 2.

Public sightings

49 Public sightings records of Maui's dolphins have been collected by DOC and WWF for a number of years. As most recreational activities occur close to shore, there are relatively few public sightings that have been recorded beyond 4 nm from shore. Some public sightings have been subjected to a systematic validation procedure by interviews conducted either by DOC staff or an experienced marine mammal scientist. DOC holds their sighting information in the DOC sightings catalogue and other sources of public sightings are available in reports (e.g. Russell 2008, WWF 2010).

50 DOC's sightings catalogue includes one verified sighting beyond 4 nm from shore, of 4 Maui's dolphins at 8.65 nm from shore (9/2/2002, DOC catalogue #226). This catalogue also includes an unverified sighting of 7 Maui's dolphins at 5.33 nm from shore (4/4/2009, DOC catalogue #560) and an unverified sighting of 8 Maui's dolphins at 4.28 nm from shore (26/7/2004, DOC catalogue #202).

51 Russell (2008) provided limited information about two verified public sightings beyond 4 nm from shore, with the sighting the greatest distance from shore being at 7.7 nm.

52 WWF (2010) supplied information about recent verified public sightings from their public sightings network, which provided many of the earlier sightings reported by Russell (2008). One additional sighting was included in this report, at 5.0 nm offshore from Whale Bay, Raglan.

53 The DOC sighting catalogue (#47) and Cawthorn (1988) refer to a sighting of 30 Hector's dolphins in 1982 made from a naval survey vessel. While this sighting was not verified, Cawthorn (1988) did not doubt the identification as Hector's dolphins but did

note that the distance offshore was so great that this sighting must be considered exceptional.

54 More detail on public sightings beyond 4 nm from shore is provided in Table 3.

Information reliability

55 MFish considers that a scale of reliability can be applied to these sightings in order to enable better analysis on the offshore distribution of Maui's dolphins. This scale of reliability is a continuum from most reliable (and least uncertain) to least reliable (and most uncertain). The reliability scale for sightings information on Maui's dolphin is[6]:

a.	Most reliable	- Duplicate research sightings
b.		- Research sightings made by individual researcher
c.		- DOC or MFish staff sighting with GPS position
d.		- Verified public sighting with GPS position
e.		- Research sightings made by individual 'inexperienced' researcher
f.		- Unverified public sighting with GPS position
g.	Least reliable	- Any sighting without GPS position given.

56 Details of all sightings relevant to reconsideration of measures beyond 4 nm from shore between Pariokariwa Point and Maunganui Bluff on the WCNI are provided in Table 3 and Figure 2, along with characterisation of their reliability.

57 Research surveys are conducted by trained observers that are specifically looking for Maui's dolphins. Within research survey sightings, those made by two observers of the same individual dolphin or group of dolphins (known as a 'duplicate' sighting) provides the greatest level of certainty (e.g. Rayment & Du Fresne 2007).

58 The two initial surveys, as documented by Ferreira & Roberts (2003), Slooten *et al.* (2005), and Slooten *et al.* (2006) did not result in any sightings beyond 4 nm. However, these surveys predominantly sampled in summer and Maui's dolphins are considered to be distributed further offshore more during winter, than summer, by Slooten *et al.* (2006). The surveys were also predominantly only out to 5 nm from shore. These surveys were therefore limited in their ability to detect any Maui's dolphins offshore (beyond 4 nm).

59 The Scali *et al.* (2007) report detailed the aerial survey conducted in 2006[7], but the report expressed concerns about the survey as a whole. A subsequent report ('Final Progress Report' by Scali *et al.* (2008)) does not mention the 2006 survey. The High Court considered that this exclusion could confirm the concerns that the researchers had

---

6 Note that this reliability scale is not linear with research sightings considerably more reliable than DOC and Ministry staff sightings. Verified public sightings vary in their reliability depending on the category given during the verification process. Unverified public sightings and any without a GPS position are much less reliable than sightings made by researchers, or DOC and Ministry staff.

7 Note that Scali 2006 was referenced in the 2008 FAP and by the High Court, while in this document we refer to Scali *et al.* 2007. These were different versions of the same progress report on Scali's PhD research. However the text in these reports that refers to the 2006 aerial survey is identical.

regarding the 2006 survey. The High Court noted that a subsequent progress report would not necessarily report on data previously presented, but also noted it was unclear why this report would not refer to the 2006 survey when recalling previous surveys (paragraph 115 for the High Court decision). MFish considers that it is not possible to deduce the reasons for the exclusion of the 2006 survey from this report without clarification from the authors. This survey has not been formally peer reviewed, but both DOC and an independent researcher (Du Fresne 2010) consider the survey design to be consistent with the design of peer reviewed surveys that are considered reliable (e.g. Ferreira & Roberts 2003, Slooten *et al.* 2005, Slooten *et al.* 2006).

60 In a draft progress report, Scali *et al.* (2007) notes that two sightings (at 4.49 and 6.9 nm from shore) were made by researchers considered to be experienced.

61 Additional sightings beyond 4 nm from shore (at 8.2, 9.2, 9.8 and 10.3 nm from shore) made during the survey were considered unreliable by Scali *et al.* (2007) due to concerns about observer inexperience although they had undertaken some training.

62 Du Fresne (2010), who reviewed the available information on the distribution on Maui's dolphins, also noted the reduced observer experience on the 2006 survey.

63 MFish acknowledges the criticisms of the 2006 survey. MFish considers that this survey should not be dismissed in its entirety. As noted the design is consistent with other surveys and considered reliable. More weight should be given to sightings made by observers considered experienced (4.49 and 6.9 nm from shore). MFish considers the additional sightings (at 8.2, 9.2, 9.8 and 10.3 nm from shore) are less reliable than other research sightings and the uncertainty in the reliability of these sightings should be taken into account when considering offshore distribution.

64 Since the TMP final advice was presented in May 2008 there have been subsequent research surveys where dolphins have been observed beyond 4 nm from the WCNI (Childerhouse *et al.* 2008 and Stanley 2009). The design of these surveys is consistent with that of Ferreira & Roberts (2003). Du Fresne (2010) considers that both of these surveys were conducted by appropriately experienced observers. The resulting sightings are considered reliable in terms of survey protocols and the suitability of observers.

65 Verified public sightings are considered to provide the most robust anecdotal evidence about Maui's dolphin distribution because the sightings are subject to a systematic validation procedure by a marine mammal scientist or DOC staff. Sightings in the DOC catalogue typically receive less scrutiny, and some have been considered and excluded by Russell (2008). Discrepancies between the DOC sighting catalogue and those reported by Russell (2008) reflect the lack of a nationally coordinated standard operating procedure for documenting dolphin sightings.

66 Anecdotal public sightings are largely subjective and their robustness is more difficult to quantify than scientific information. Public sightings are used elsewhere (e.g. the United Kingdom (Speedie 2003)) as a cost effective means to identify areas that deserve detailed research attention, although it is noted that public sightings can have reliability issues such as the difficulty in assessing the effort that was expended to achieve the resulting sightings and animal identification (Speedie 2003). However,

those public sightings that have been subject to a systematic validation procedure by DOC staff or marine mammal scientist and given high scores are more reliable than unverified public sightings. Verification of public sightings considers whether evidence of the sighting is provided and previous track record of accurate sightings (Russell 2002).

Known susceptibility to fishing

67 Fishing is a demonstrated threat to Maui's dolphins in the WCNI region (Table 4). Records indicate there are two fishing-related mortalities out of a total 41 reported mortalities but MFish considers this represents the minimum level of fishing-related mortality because:

a. The cause of death is only firmly established for five of the 41 reported mortalities in the DOC incident database. MFish cannot discount that fishing may be responsible for some of the remaining mortalities where the cause of death is not firmly established (36). Clinical protocols used in necropsy require very conclusive signs of fishing-related mortality before fishing is recorded as the cause of death. At least three other mortalities in the database display evidence of net marks and other indications that suggest fishing could be responsible for death (Table 4). In addition, the incident database is probably better informed for more recent years (many older reported mortalities were not necropsied).
b. Reported mortality is likely to be an underestimate of total mortality. There are incentives to report mortalities (e.g. legal obligations and penalties) but there is a lack of independent monitoring to detect compliance. MFish also expects there have been incidents where fishers may be unaware their nets had entangled dolphins. For example, the two fishing-related mortalities mentioned above were not reported by the fishers responsible. One dolphin washed onto a beach and the other was found floating in the water.
c. Anecdotal information suggests actual fishing-related mortalities are higher than reported (Cawthorn 1988, Dawson 1991, Russell 1999). For example, Dawson (1991) interviewed fishers on the ECSI and estimated from the interviews that many fishing-related mortalities were not included on the incident database (i.e. not reported). MFish considers it reasonable to expect that similar incidences of non-reporting behaviour occurred at least historically on the WCNI.

Characterisation of the fishery

68 The following factors regarding fishing in areas offshore between Pariokariwa Point and Maunganui Bluff on the WCNI generate risk for any Maui's dolphins that venture beyond 4 nm from shore:

a. From commercial catch and effort records, 50-58 vessels annually have been commercially using set nets in 110 to 130 fishing events within the WCNI statistical areas 041, 042, 045 and 046 in the last three fishing years.
b. These vessels fish more from September to November with reduced effort throughout the rest of the year.

c. The total length of net set per fishing event ranged from 700 m to 4 km when fishing between 4-7 nm offshore and 500 m to 4 km when fishing between 7-12 nm offshore.

69 Figure 3 shows the distribution of commercial set net effort on the WCNI from November 2007 to October 2009. The maps illustrate that commercial set nets are deployed near the boundary of the set net prohibition in shallower waters more often in the winter.

Information on, or likelihood of, mortalities or interactions with Maui's dolphins in this area

70 The potential for interaction during winter is likely to be more pronounced as fishing effort moves further inshore (See Paragraph 68) at the same time as the dolphins move further offshore.

71 Due to the small population size of Maui's dolphins, and that it is considered likely these dolphins make infrequent visits to areas further than 4 nm from shore and the low level of fishing activity in these areas, the risk of interactions between Maui's dolphins and set net fishing beyond 4 nm from shore between Pariokariwa Point and Maunganui Bluff is low.

Cumulative effect of fishing on Maui's dolphins

72 MFish notes that there are other fishing methods and areas that may impact on Maui's dolphins. Trawling beyond the extent of the current closure (2 nm from shore between Pariokariwa Point and Maunganui Bluff and to 4 nm between Manukau Harbour and Port Waikato) and set netting south of Pariokariwa Point also pose some risk of interactions with Maui's dolphins. However MFish consider that given the very low occurrence of sightings south of the current closures for set net and trawling, (only a few verified public sightings south of Pariokariwa Point exist) and the lower likelihood of interactions of Hector's and Maui's dolphins with trawl fishing[8], that set netting within the 4-7 nm offshore area between Pariokariwa Point and Maunganui Bluff poses a greater likelihood of interactions with Maui's dolphins.

Overall assessment of the effect of fishing-related mortality

73 Key matters relevant to the Minister's decision on whether measures are necessary to avoid, remedy or mitigate the effect of fishing-related mortality on Maui's dolphin are as follows:

a. the WCNI Maui's dolphin population is very small and has probably declined from higher levels of abundance;
b. available information suggests that the dolphins are most abundant between the shore and 4 nm between Pariokariwa Point and Maunganui Bluff;

[8] Trawling has provided 16.5% (19 of the 115) known entanglements of Hector's and Maui's dolphins in the DOC incident database (see Table 1) while commercial set net fishing has provided 41.7% (48 of 115).

c. sightings information from various sources of differing reliability indicate that Maui's dolphins may make infrequent visits to areas beyond 4 nm between Pariokariwa Point and Maunganui Bluff on the WCNI;
d. Maui's dolphins are susceptible to entanglement in set nets. Fishing is the greatest known cause of human-induced mortality; and
e. Commercial set netting out to 4 nm between Pariokariwa Point and Maunganui Bluff on the WCNI is prohibited. Outside of this area commercial set net activity continues to occur.

74 Overall MFish consider the risk of interactions between Maui's dolphins and set net fishing beyond 4 nm from shore between Pariokariwa Point and Maunganui Bluff is low given:

a. the small population size of Maui's dolphins;
b. the distribution of Maui's dolphin - Maui dolphins are considered to visit offshore areas beyond 4 nm infrequently; and
c. the relatively low level of fishing activity in the area.

75 However, the consequence of any interaction between set net fisheries beyond 4 nm from shore between Pariokariwa Point and Maunganui Bluff and Maui's dolphins is very high; the Maui's dolphin population is extremely sensitive to human-induced impacts. Based on the earlier mentioned PBR analysis, the impact of even a single mortality to the Maui's dolphin would be significant and may be sufficient to limit the population from rebuilding to optimal size[9].

76 The Minister can impose such measures as he considers necessary to avoid, remedy or mitigate the effect of fishing-related mortality on Maui's dolphins on the WCNI. The Minister has considerable discretion around whether to impose measures. However, the Minister must take into account the environmental principles set out in s. 9 of the Act. In particular, that species should be maintained above levels that ensure their long term viability and that biological diversity should be maintained. MFish notes that commercial set netting in this area presents a risk to the long term viability of Maui's dolphin and this may justify a precautionary approach in determining whether measures are necessary.

[9] For more information about PBR values please refer to Appendix 1.

Options

77 This section outlines options to avoid, remedy or mitigate the effects of fishing on Maui's dolphin from 4 nm offshore between Pariokariwa Point and Maunganui Bluff. The table below outlines the options MFish consider are available.

Option	Description
Option one	Allow set net fishing between 4-7 nm from shore
Option one (a)	Allow set net fishing between 4-7 nm and introduce Monitoring
Option two	Close smaller area beyond 4 nm
Option three	Retain closure of area between 4-7 nm

78 The option chosen will depend on whether the Minister considers that the closure of this area is necessary to avoid, remedy or mitigate the effect of set net fishing on the WCNI Maui's dolphin population. Implicit in the Minister's decision is a careful consideration of the extent to which the Minister considers that sustainability of Maui's dolphins is threatened by fishing in this area.

Option one

79 Option one would allow commercial fishing using set nets to continue between 4 and 7 nm. MFish estimates the overall value of the fishery (present and capitalised future returns) is approximately $970,000 (details of how benefits were calculated are attached in Appendix 2).

Option one (a)

80 Under Option one (a) commercial fishers would be allowed to operate using set nets but would be required to carry an observer on board when fishing between 4 and 7 nm. Information from the monitoring programme would allow ongoing assessment of the effect of fishing-related mortality to inform decision making. MFish notes that it is difficult to assess the cost of such a programme as it depends on a number of factors, including; number of vessels that continue to operate in the area, level of cooperation of the fishers with the observer programme, spread of effort throughout the year and the choice of observer or electronic monitoring. As these factors can significantly influence the cost of such a monitoring programme it is difficult to provide an estimate in this report. MFish notes that there is potential for such a programme to make fishing in the area uneconomic. MFish requests submissions on the practicality and cost of a monitoring programme under this option.

Option two

81 Under Option two the regulations would be modified to reduce either the alongshore or offshore extent of the closure. MFish notes that the interim relief applies from 4-7nm between Port Waikato and Manukau Harbour. Within 4 nm of the shore Port Waikato and Manukau Harbour entrance is considered the area of greatest abundance of

dolphins. Retaining the set net closure in this area would create a lower level of risk of future effect than under Option 1 (removal of the closure). It is not possible to quantify this difference. Neither is it possible to quantify the difference in effect of fishing between Option two or three (statutory closed area) although intuitively the greater the extent of the closed area the more protection will be provided from impacts of fishing (depending on presence of dolphins). MFish notes that some of the research sightings beyond 4 nm have been outside of the smaller area closed under interim relief.

Option three

82 Option three provides the greatest level of protection for Maui's dolphins. Under this option the existing regulation (prohibiting set net fishing out to 7 nm) would be retained. This option takes a precautionary approach to the information which suggests that on balance Maui's dolphins are infrequent visitors to the waters beyond 4 nm.

83 Prohibiting set netting in this area would impact on commercial fishers. The estimated value of this fishery is set out in paragraph 78 and Appendix 2. However, the extent to which the industry can adjust to any closure is an important issue. The benefits noted above are based on the 2008/09 fishing year when targeted set netting for school shark and rig was allowed under interim relief between 4 and 7 nm for a 3 month period (1 September to 24 December). By using catch effort records that include GPS data, MFish was able to calculate the percentage of school shark and rig was caught in the 4-7 nm area subject to interim relief compared to all school shark and rig catch in statistical areas 040 to 046 (West Coast of the North Island). Only 3.5% of all school shark caught in these statistical areas was caught in the 4-7 nm area subject to interim relief. However, 34% of all rig caught in these statistical areas was caught in the 4-7 nm area subject to interim relief.

Initial preference

84 Prior to consultation MFish has a preference for Option three on the basis that:

a. The Maui's dolphin population is at a very low level and needs to rebuild at the fastest rate possible to provide best opportunity for long term survival;
b. The population has a PBR which indicates a population at extreme risk and that a precautionary approach to management of all human induced impacts including fishing is desirable[10];
c. Despite uncertainty in information MFish considers there is sufficient evidence to indicate that dolphins make infrequent visits to the area beyond 4 nm;
d. Set nets are known to pose the greatest risk of dolphin mortality; and
e. Despite the low probability of effect given infrequent presence of dolphins and relatively low level of fishing effort, the impact of any effect on the dolphins would be very high and therefore makes closure of this area desirable.

[10] See Appendix 1 for more detailed information on PBR.

Commercial butterfish fishery – northern end of ECSI

85 This section outlines information and analysis to support reconsideration of the decision not to exempt commercial butterfish target set net fishing at the northern end of the ECSI, from the prohibition on set net fishing along the ECSI to 4 nm from shore (Figure 4).

Status quo management and scope of reconsideration

86 In 2008, a previous Minister of Fisheries decided to close the ECSI out to 4 nm to commercial and recreational set net fishing. The rationale for that decision was:

a. The ECSI population is the second largest Hector's dolphin population. There is information to suggest that population size has probably declined from higher levels of abundance.
b. Hector's dolphins are known to be susceptible to entanglement in set nets,
c. PBR analysis indicates that the ECSI population is threatened by relatively low levels of human-induced mortality[11].
d. There were 86 known fishing-related mortalities out of a total of 255 reported mortalities recorded in the DOC incident database between 1948 and 2008. Reported mortalities probably only provide an indication of the nature of the threats to the dolphins-not the extent (updated figures are given in Table 5).
e. The level of reported mortalities between May 2009 and January 2010 was 3 but needs to be considered alongside the very low levels of independent fishery observer coverage.
f. There was clear overlap between dolphin distribution and fishing activity,
g. Dolphins are most prevalent within 4 nm of the shore.
h. Existing measures were not considered sufficient to manage the impact of fishing to a level the Minister considered necessary.
i. The Minister provided some exemptions to this overall ban in some small designated areas inside inner harbours around Banks Peninsula, and in the inner Queen Charlotte Sound between 1 April and 30 September on the basis that he considered risk of entanglement to be low in these areas and dolphins tended to move away from these areas in winter.
j. The Minister also considered whether he should provide an exemption for targeted butterfish fishing in certain areas, and subsequent to his preliminary decisions, whether he should provide an exemption to targeted butterfish fishing at the top of the South Island.

87 Only the decision not to exempt targeted commercial butterfish from a defined area was challenged in the High Court. The High Court referred the decision back to the Minister for reconsideration based on a view that the Minister was given inaccurate advice. However, the High Court also noted that, if a Hector's dolphin was captured in a commercial set net in the areas where interim relief has been granted, the interim relief would end.

[11] See Appendix 1 for more detailed information on PBR.

Court judgment

88 The High Court found that the Minister was provided inaccurate advice that was potentially material to the decision not to exempt targeted fishing for butterfish at the top of the ECSI. The Court was very specific about the advice that was regarded to be inaccurate. This advice was "*in attributing mortality risks for Hector's dolphins from amateur set netting for butterfish and moki with risks associated with targeted fishing for butterfish in the fishery at the top of the East Coast of the South Island*" (paragraph 278 of the High Court decision).

89 The judgment identified that the advice given to the Minister did not make it clear that:

a. "*commercial targeting of butterfish occurred close to shore (in the kelp areas) and not in open waters*" (paragraph 239 of the High Court decision); and
b. "*the known entanglements* [of Hector's dolphins] *were from amateur set netting*" (paragraph 239 of the High Court decision).

90 The High Court considered that the inaccuracy of the advice was compounded by the attribution of risks associated with amateur set netting for butterfish and moki to potential commercial butterfish fishing effort. This was considered inaccurate because the commercial and amateur fisheries do not necessarily present the same risk to the Hector's dolphin population.

91 The High Court found that advice that MFish provided to the Minster regarding the size of commercial butterfish nets "*may have erroneously reinforced the identified risk to dolphins from fishing for butterfish where the effort is significant (if limits on size/number of nets were not adhered to)"* (from paragraph 240 of the High Court decision).

Area under reconsideration

92 There have been various discrepancies between the butterfish areas described in the 2008 IPP, FAP, subsequently proposed by the NZ Federation of Commercial Fishers (July 2008) and that covered by interim relief granted by the High Court (see Figure 4 for details of these areas). For the purposes of this IPP, we have analysed the effect of an exemption for the area that is subject of the interim relief. We refer to this area as the "defined area". This defined areas extends 200 m from shore in the following areas:

a. Needles Point to Cape Campbell;
b. Rarangi to Oyster Bay;
c. Deep Bay to Cooper Point on Arapawa Island;
d. Little Waikawa Bay to Cape Jackson; and
e. All of Motuara Island, the Twins Islands, Motungarara Island, the Brothers Islands and White Rocks.

Assessment of effect of fishing-related mortality

93 This section assesses the effect of fishing-related mortality from target butterfish fishing in the defined area on the ECSI Hector's dolphin population. The assessment of the effect of fishing-related mortality is based on a consideration of the following factors:

a. Biology of ECSI Hector's dolphins:
    i. Abundance and trends;
b. Effect of commercial butterfish fishing in the defined area on the ECSI population:
    i. Characterisation of fishery;
    ii. Distribution of dolphins in the exemption area;
    iii. Observer information; and
    iv. Analysis of effect of target butterfish fishing;
c. Cumulative effect of fishing on the ECSI population; and
d. Overall assessment of the effect of fishing-related mortality and whether it is necessary pursuant to s 15(2) of the Act for the Minister to implement measures in the area based on the assessment of impacts of fishing on the population.

94 The impact of mortality on Hector's dolphins from set net fishing for butterfish in the area proposed for exemption from the ECSI set net prohibition is assessed against the ECSI Hector's dolphin population as a whole.

Biology of ECSI Hector's dolphins

Abundance and trends

95 Dawson et al (2004) estimated ECSI population at 1791 individuals. There is new information available on overall abundance of dolphins on ECSI that may have implications for the effect of fishing from butterfish in the defined area. A three year study of the Hector's dolphin population was undertaken from mid-2006 to mid-2009, in Clifford and Cloudy Bays (an area which lies in between the two sections of coast covered by the defined area) out to the 100 m depth contour. The study places the maximum abundance (during summer) for the survey area at 951 (95% c.i.: 573 - 1577) and the minimum abundance (during winter) at 188 (95% c.i.: 100 - 355) (Du Fresne & Mattlin 2009). This does not correspond to the specific area of the butterfish fishery that is the subject of this advice, but provides further insight into the population abundance and distribution.

96 This study could imply a greater abundance of Hector's dolphins along the ECSI than previously estimated. If the maximum abundance during summer from Du Fresne & Mattlin (2009) is used to replace the previous estimate (from Dawson *et al.* 2004) for the Clifford and Cloudy Bays area, the combined estimate of abundance for the ECSI becomes 2,653. This is not to say that the survey undertaken by Dawson *et al.* (2004) is incorrect, but that it did not go as far offshore (4 nm) as that undertaken by Du Fresne & Mattlin (2009). However given the lack of recent surveys in the remainder of the ECSI, it is difficult to conclude that this recent research represents an increase in the size of the total population or some movement within the sub-population.

97 MFish intends to commission an aerial survey of the Hector's dolphin population on the ECSI in the near future. The area covered by this proposed survey overlaps with only a small portion of the area proposed for exemption from the ECSI set net prohibition (from Cape Campbell to Needles Point), but will update the estimates of total abundance and distribution from Cape Campbell to Nugget Point. Final results from this survey will be available in late 2011, if the survey is started in summer 2010/11. While this additional information will be useful for further analysis of the impact of fishing on the population and any review of management measures, s 10 of the Act states that "*the absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act*".

Effect of butterfish fishing in the defined area on the ECSI population

98 Whether commercial set netting for butterfish in the defined area will have an effect (and the likelihood and consequence of that effect) on the dolphin ECSI dolphin population is dependent on:

a. Whether the type of fishing activity poses a risk to dolphins;
b. Whether dolphins are present in the area;
c. How many dolphins are present in the area and how often they are present; and
d. Consideration of cumulative effects of fishing-related mortality

Characterisation of the fishery

99 Only larger vessels are required to report the latitude and longitude of fishing positions on catch effort returns; therefore it is not possible to specify exactly the amount of catch and effort from the defined area at the northern end of the ECSI. Catch estimates can be calculated by assuming the same proportion of catch in the interim relief area for events that are and are not associated with GPS coordinates.

100 Annually 11-14 vessels have commercially fished for butterfish in Statistical Area 017 and 4-5 vessels in Statistical Area 018 during the period 2006/07 to 2008/09. The size of these vessels ranged from 3.5 to 14.9 m overall registered length in Statistical Area 017 and 5.1 to 15.3 m in Statistical Area 018 (for Statistical Area boundaries, see Figure 4).

101 The annual total number of butterfish targeted fishing events in Statistical Area 017 has increased from 141 in 2006/07 to 249 in 2008/09, and decreased in Statistical Area 018 from 89 to 13.

102 These fishing events targeting butterfish have occurred year round in Statistical Area 017, and have contracted to summer months, January to March, and spring months August and September in Statistical Area 018. The total length of net set per fishing event was recorded as ranging from 30 to 2000 m.

103 Commercial fishers submitted to the High Court that they use nets ranging in 30-60 m in length. One noted that he usually sets around 10-15 nets each day and that they need to haul in the nets by hand and his vessel size limited the amount of net he could set each day.

104 Observers placed on vessels that targeted butterfish with set nets confirmed that fishers set short nets ranging from 30-60 m long. These nets were set (often in multiples of between 6-10) in close proximity to each other, in shallow depths from 5-20 m, around sunken rocky outcrops on kelp beds. The observed fishers set their nets at various times during the day but hauled them at the same time, after dusk.

Information on distribution of dolphins in the defined area

105 There is no specific information available on distribution of dolphins in the defined area. More generally the ECSI Hector's dolphin population extends from Cape Farewell (near Golden Bay) to Slope Point (south of Waikawa Harbour on the Catlins Coast). Survey (e.g. Dawson *et al.* 2004, Du Fresne *et al.* 2001, Bejder & Dawson 2001, Clement *et al.* 2001) and genetic (Pilcher & Baker 2000, Pilcher 2002) research suggests the population is divided into larger concentrations connected by stretches of coastline containing small, isolated groups of dolphins. Surveys suggest the largest densities of Hector's dolphins are in (from north to south):

a. Cloudy and Clifford Bay;
b. Kaikoura;
c. Pegasus Bay;
d. around Banks Peninsula and north and south of the peninsula; and
e. between Timaru and Oamaru.

106 Smaller numbers are present in Queen Charlotte Sound (north) and Porpoise Bay (south). Hector's dolphins that have been sighted in the Queen Charlotte Sound may travel through the defined area.

107 Surveys also suggest that the ECSI population is most abundant close to shore inside 4 nm, and that dolphins are generally closer to shore in summer (e.g. Dawson & Slooten 1988, Bejder & Dawson 2001).

108 The three year study conducted by Du Fresne & Mattlin (2009) showed Hector's dolphins have a widespread distribution in Clifford and Cloudy Bays from close to shore out to 18 nm from land. This study did not specifically examine those areas relevant to the butterfish areas beyond Rarangi and Cape Campbell but does indicate that numerous Hector's dolphins are in nearby adjacent areas.

109 Photographic evidence has been provided by a researcher to MFish which shows at least two Hector's dolphins close to a rocky coast with seaweed visible, reported to be in the Bank's Peninsula area (Figure 5). These photos show that Hector's dolphins use areas close to rocky coasts with seaweed present.

Observer information

110 Approximately 90 hours of at-sea observer coverage have been achieved in the area proposed for exemption and subject to interim relief for commercial set net fishing targeting butterfish since October 2008. No sightings of Hector's dolphins occurred during this coverage. Observers covered 9 fishing days in November and December 2008, which covered a total of 103 sets with a total of 5,112 m of net set (the length of

nets used varied between 30 and 60 m), approximately 3.6% of the total number of fishing days that targeted butterfish in 2008/09. However, such a short period of observation is insufficient to prove whether Hector's dolphins are present or absent from areas used by commercial fishers targeting butterfish.

Analysis of effect of targeted butterfish fishing

111 There is no information to definitively indicate presence or absence of dolphins in the defined area. Dolphins have been seen in areas north and south of the area. It is intuitive to suggest that dolphins will at least transit through the defined area which may expose them to risk of mortality from nets set in this area.

112 The 2008 decision was based on an assessment that set nets (regardless of type and way they are used) are likely to have an adverse effect on the ECSI dolphin population within 4 nm.

113 The risk posed to dolphins from butterfish fishing operations may be less than other set net fisheries where nets are set in open areas. Nets set to target butterfish are short (30 to 60 m) and tend to be set close to rocks. There are no records of mortality of dolphins from commercial butterfish fishing operations. However, observer coverage has been low and there are poor incentives to report non-observed mortality.

114 There are 6 records of individual Hector's dolphin mortalities from recreational butterfish/moki nets set around Banks Peninsula in the 1980's (DOC and MAF 1994). However, recreational practices are somewhat different and therefore pose a greater level of risk of dolphin mortality. Recreational nets may be set in more open areas, be set deeper and use incorrect floatation etc. (DOC and MAF 1994). In addition, nets used to target moki only tend to be set in more open waters which pose a greater risk to dolphins.

Cumulative effect of fishing on the ECSI population

115 A further consideration for the Minister is the level of effect on the ECSI dolphin population being caused by fishing activity elsewhere on the ECSI. Given that the current measures will not be reviewed until, at least, 2013, it is important to understand the level of ongoing effect from other fisheries. Continued butterfish fishing in this area, combined with the overall effect from fishing may result in a cumulative adverse effect on ECSI dolphin population. Whilst there may be less justification for measures to address the effect of commercial butterfish set netting in this area, the Minister may consider that restrictions in this area are necessary given the cumulative effect of fishing on the dolphin population.

116 The result of the measures put in place in 2008 has been a reduction in the potential for an impact from fishing on the ECSI dolphin population. The level of reduction in effect/level of current effect cannot be accurately quantified at this time because:

a. Fisher reporting of mortality is low; and
b. Fisher-independent observer coverage of fishing activity is insufficient to allow quantification of current levels of mortality.

117 Three dolphin mortalities have been observed between May 2009 and January 2010, with relatively low levels of observer coverage (approximately 15.8% of total set net effort in the 2009 calendar year based on number of fishing days, although level of coverage achieved by area is variable). The mortalities occurred outside of the closed areas offshore from Kaikoura and Timaru.

118 The ECSI population is threatened by relatively low levels of human-induced mortality. PBR analysis suggests the population can sustain 2-4 deaths per year (not including natural mortalities). This analysis has a recovery factor built into it, meaning that at the levels of removals estimated by the analysis, the population should increase in size[12]. PBR analysis using a default recovery factor input value[13], suggest the population could sustain around 13 human-induced mortalities annually. The PBR analysis is expanded upon in Appendix 1.

119 As the level of observer coverage was low during the 2009 calendar year (approximately 15.8%), there is a risk that the actual level of mortalities of the ECSI Hector's dolphins may exceed the higher bound of the PBR.

120 The measures have not been in place long enough to indicate whether this level of mortality is likely to be ongoing and therefore whether there will be an ongoing effect on the population from fishing sufficient to significantly impact on its rebuild rate. Ongoing monitoring of fishing activity will provide information to support review of other ECSI measures in 2013. Robust estimation of mortality will require a higher level of fisher-independent observer coverage then achieved in 2009. The potential economic impacts of an increase in observer coverage are expanded upon later.

Overall assessment of the effect of fishing-related mortality

121 Key matters relevant to the Minister's decision on whether the effect of fishing-related mortality on Hector's dolphins in the defined area necessitates closure of this area are as follows:

a. The ECSI population is the second largest Hector's dolphin population. There is information to suggest that population size has declined from higher levels of abundance. MFish note that there is uncertainty about the extent, rate and timing of the decline of this population;
b. Hector's dolphins are known to be susceptible to entanglement in set nets;
c. There are 89 known fishing-related mortalities out of a total of 275 reported mortalities recorded in the DOC incident database since 1948 (Table 5). Reported mortalities probably only provide an indication of the nature of the threats to the dolphins, not the extent.
d. Dependent on the inputs used, PBR analysis suggests 2-13 mortalities per year would allow the population to rebuild or remain healthy (See paragraph 117). Three mortalities have been observed with relatively low levels of observer coverage in other set net fisheries along the ECSI in the 2009 calendar year;

[12] Recovery factor default value of 0.5; suggested for stocks of indeterminate status.
[13] The recovery factors are those developed for endangered species or for those species for which a faster recovery is desired.

e. Available information suggests that Hector's dolphins are most prevalent within 4 nm miles of the shore but, based on studies in other areas, may make infrequent visits to areas beyond 4 nm.

122 MFish considers that there is a relatively low likelihood of interactions between Hector's dolphins and commercial butterfish set net fishing in the defined area, due to:

a. the small size of the area proposed for exemption relative to the full range of the ECSI population;
b. the relative small size of the ECSI population (although new data indicates there may be a significant local population in adjacent areas, Clifford and Cloudy Bays, to the defined area under reconsideration); and
c. the level and nature of fishing activity with short nets used generally between kelp beds in rocky shore areas, less than 200 m from shore.

123 The potential impact of any resulting fishing-related mortality from butterfish fishing within the defined area under reconsideration is high as the Hector's dolphin population is sensitive to human-induced impacts and that the cumulative effect of set net fishing on the ECSI is likely exceeding the lower bound of the PBR estimate[14], at least in some years. MFish considers that the overall effect of fishing-related mortality on the ECSI dolphin population would not substantially increase if commercial set net fishing for butterfish in the defined area was allowed to continue.

124 However, any measures imposed within this defined area should not set a precedent for the regulation of other inshore areas within ECSI to fishing. While the risk of fishing-related mortality is deemed acceptable by MFish for this small defined area, the cumulative increase in risk of multiple small areas being opened to butterfish fishing may result in a level of risk to Hector's dolphins that is unacceptable.

Options

125 This section outlines options in relation to allowing target butterfish fishing in a defined area at the top of the ECSI. MFish consider the following options are available.

Options	Description
Option one	Allow Exemption
Option two	Allow Exemption with Monitoring
Option three	Do Not provide for Exemption

126 The option chosen will depend on whether the Minister considers that measures are necessary to avoid, remedy or mitigate the effect of set net butterfish fishing on the ECSI Hector's dolphin population in the defined area. Implicit in the Minister's decision is a careful consideration of the extent to which the sustainability of the ECSI Hector's dolphin population is threatened by fishing in this area.

Option one

127 Option one would allow commercial fishing using set nets in the defined area. MFish estimates the overall value of the butterfish fishery operating in the defined area

(present and capitalised future returns) is approximately $180,000 (details of how benefits were calculated are attached in Appendix 2).

Option two

128 Under Option two commercial fishers would be allowed to operate in the defined area and would be required to carry an observer on board. Information from the monitoring programme would allow ongoing assessment of effect (present and future) to inform decision making. MFish note that it is difficult to assess the cost of such a programme as it depends on a number of factors, including; number of vessels that continue to operate in the area, level of cooperation of the fishers with the observer programme, spread of effort throughout the year and the choice of observer or electronic monitoring. As these factors can significantly influence the cost of such a monitoring programme it is difficult to provide an estimate in this report. MFish notes that there is potential for such a programme to make fishing in the area uneconomic. MFish requests submissions on the practicality and cost of a monitoring programme under this option.

Option three

129 Option three takes a precautionary approach to managing the effect of fishing on the population given uncertainty in information on overlap between dolphins and fishing activity in the defined area. Under this option there would be no exemption for targeted commercial butterfish set netting in the defined area.

130 Prohibition of commercial set netting in this area would impact on commercial fishers. The estimated value of this fishery is set out at paragraph 126 and Appendix 2. The extent to which the industry can adjust to confirming the current regulations is an important issue. The cost impacts calculated above are based on the 2008/09 fishing year when targeted set netting for butterfish was allowed under interim relief in specific areas between Needles Point and Cape Jackson. By using catch effort records with GPS data, MFish was able to calculate the percentage of butterfish that was caught in the specific areas subject to interim relief compared to all butterfish catch in statistical areas 017 to 018 (top of the East Coast of the South Island). 24.2% of all butterfish caught in these statistical areas was caught in the specific areas subject to interim relief. By confirming the current regulations the impact will be to reduce the amount of butterfish caught in statistical areas 017 and 018 by a quarter.

Initial preference

131 Prior to consultation MFish has a preference for Option one because we consider the overall effect of fishing-related mortality on the ECSI dolphin population would not increase substantially if commercial fishing for butterfish was allowed in this area given that:

- the overall population size is relatively small (reducing chance of interactions); and
- the nature and type of fishing activity (small number of fishers with nets set in relatively shallow water close to rocks/reef areas).

Table 1: DOC incident database mortality records for Hector's and Maui's dolphin mortalities reported between 1921 and 2010. This summary does not include 9 reported incidents of entanglement but where the dolphin was released and 2 releases following strandings as survival after these incidents is unknown.

Description of incident	Incidents	Specifics	
Known entanglement - animal was known (from incident report) to have been entangled and died.	115	Commercial set net	45
		Recreational set net	21
		Unknown	24
		Trawl	19
		Cray	3
		Known set net bycatch	3
Not assessed - carcass was not necropsied or recovered, or the cause of death was not assessed (typical of historical mortalities)	91		
Not determinable - carcass too decomposed for necropsy	85		
Possible entanglement - net marks on the body and a mention of the net marks in the incident report; or the pathology report lists probable entanglement as cause of death	54		
Unknown - cause of death unexplained or not definitive (eg, "open" diagnosis in pathology report)	40		
Natural - cause of death deemed to be from natural causes	27		
Probable entanglement - net marks on the body and one other definite indication of capture such as mutilation; or the pathology report lists probable entanglement as cause of death	21		
Not available - necropsy or incident report not available	19		
Possible human interaction - no signs of net entanglement but indications of other types of human interaction such as marks that resemble knife wounds	10		
Trauma - unknown cause	11		
Human interaction - no sign of net entanglement but definite signs of other types of human interaction such as high degree of mutilation	9		
Harpooned	4		
To be confirmed	3		
Boat strike	1		
Possible maternal separation	1		
Probable septicaemia	1		
Reported by-catch but necropsy records saltwater drowning	1		
Euthanased	1		
No details available	1		
Sum	**495**		

Table 2. Research surveys conducted for distribution and abundance of Maui's dolphins relevant to areas beyond 4 nm from shore.

Year of survey	Season	Distance offshore	Area covered	Sightings beyond 4nm from shore?	Factor likely to influence offshore sightings	Author(s) and/or source
2000/01	Summer	5 nm	Paraparaumu – North Cape	No	Sampled during Summer and only to 5nm	Ferreira & Roberts (2003)
2001/02	Summer	5 nm	Paraparaumu – North Cape	No	Sampled during Summer and only to 5nm	Ferreira & Roberts (2003)
2004	Summer & Winter	5 or 10 nm	New Plymouth – Maunganui Bluff	No	Limited sampling beyond 5nm	Slooten *et al.* (2005 and 2006)
2006	Winter	10 nm	Carter's Beach - Muriwai	Yes, at 4.49 and 6.87 nm with 4 further sightings considered less reliable at 8.2, 9.2, 9.7 and 10.3 nm from shore.		Scali *et al.* (2007)
2007	Spring	10 nm	Carter's Beach - Muriwai	Yes, duplicate sighting at 4.05 nm from shore	Sampled during spring which may reduce offshore distribution	Rayment & Du Fresne (2007) and Scali *et al.* (2008)
2008	Winter	10 nm	Carter's Beach - Muriwai	Yes, at 4.3 nm from shore		Childerhouse *et al.* (2008) and Scali *et al.* (2008)
2009	Winter	10 nm	Carter's Beach - Muriwai	Yes, at 6.18 nm from shore		Stanley (2009)

Table 3. Sightings of Maui's dolphins further than 4 nm from shore between Pariokariwa Point to Maunganui Bluff on the WCNI with consideration of the sightings along a reliability scale.

Reliability scale	Type of sighting	Distance from shore (nm)	No. dolphins sighted	Date	Longitude	Latitude	Source	Comments
Most reliable	Duplicate research	4.05	10	28/10/2007	174.69	-37.64	Rayment & Du Fresne 2007	
	Single research	4.49	2	28/8/2006	174.65	-37.55	Scali *et al.* 2007	
		6.87	3	29/8/2006	174.30	-36.93	Scali *et al.* 2007	
		4.3	1	22/5/2008	174.50	-37.18	Childerhouse *et al.* 2008	
		6.18	1	24/6/2009	174.24	-36.77	Stanley 2009	
	DOC or Ministry staff sighting with GPS	-	-	-	-	-	-	None applicable
	Verified public sightings with GPS	8.65	4	9/2/2002	174.45	-37.27	DOC catalogue #226	
	Single research ('inexperienced observer')	9.2	2	29/08/2006	174.29	-37.00	Scali 2006 survey	Supplied by DOC
		8.2	5	29/08/2006	174.31	-37.00	Scali 2006 survey	Supplied by DOC
		10.3	2	29/09/2006	174.26	-37.03	Scali 2006 survey	Supplied by DOC
		9.7	3	29/09/2006	174.30	-37.10	Scali 2006 survey	Supplied by DOC
	Unverified public sightings with GPS	5.33	7	4/4/2009	174.58	-37.38	DOC catalogue #560	
		67.17	30	2/1982	173.08	-37.1	DOC catalogue #47	(Cawthorn 1988)
		4.28	8	26/7/2004	174.73	-37.75	DOC catalogue #202	
Least reliable	No GPS position given	7.7	?	?	?	?	Russell 2008	2 sightings with furthest at 7.7nm
		?	?	?	?	?	Russell 2008	
		5.0	2	2/2/2009	?	?	WWF (2010)	

Table 4. Reported WCNI Maui's mortalities between 1921 and 2010. Source is the DOC Hector's and Maui's Dolphin Incident database

Description of Incident	Incidents
Known entanglement - animal was known (from incident report) to have been entangled and died.	2
Probable entanglement - net marks on the body and one other definite indication of capture such as mutilation; or the pathology report lists probable entanglement as cause of death.	1
Possible entanglement - net marks on the body and a mention of the net marks in the incident report; or the pathology report lists probable entanglement as cause of death.	2
Not assessed - carcass was not necropsied or recovered, or the cause of death was not assessed (typical of historical mortalities).	23
Not determinable - carcass too decomposed for necropsy.	7
Unknown - cause of death unexplained or not definitive (eg, "open" diagnosis in pathology report).	1
Natural - cause of death deemed to be from natural causes.	3
Human interaction - no sign of net entanglement but definite signs of other types of human interaction such as high degree of mutilation.	1
Possible human interaction - no signs of net entanglement but indications of other types of human interaction such as marks that resemble knife wounds	1
To be confirmed - Incident or necropsy report pending	0
No details given	1
Total	**42**

Table 5. Reported ECSI Hector's dolphin mortalities between 1948 and 2010. Source is the DOC incident database.

Description of Incident	Mortalities	Specifics	
Known entanglement - animal was known (from incident report) to have been entangled and died.	89	Commercial set net Recreational set net Trawl Cray pot Unknown set net	44 12 15 3 15
Not assessed - carcass was not necropsied or recovered, or the cause of death was not assessed (typical of historical mortalities).	39		
Possible entanglement - net marks on the body and a mention of the net marks in the incident report; or the pathology report lists probable entanglement as cause of death.	34		
Not determinable - carcass too decomposed for necropsy.	37		
Unknown - cause of death unexplained or not definitive (e.g., "open" diagnosis in pathology report).	20		
Natural - cause of death deemed to be from natural causes.	12		
Probable entanglement - net marks on the body and one other definite indication of capture such as mutilation; or the pathology report lists probable entanglement as cause of death.	11		
Human interaction - no sign of net entanglement but definite signs of other types of human interaction such as high degree of mutilation.	5		
Not available - necropsy or incident report not available.	7		
Possible human interaction - no signs of net entanglement but indications of other types of human interaction such as marks that resemble knife wounds.	6		
Trauma unknown cause - as read from pathology report - trauma, with an unknown cause (ie, could be natural or human induced).	6		
Boat strike	1		
Harpooned	4		
Possible maternal separation	1		
Probable septicaemia	1		
To be confirmed - incident or necropsy report pending.	2		
Total	**275**		

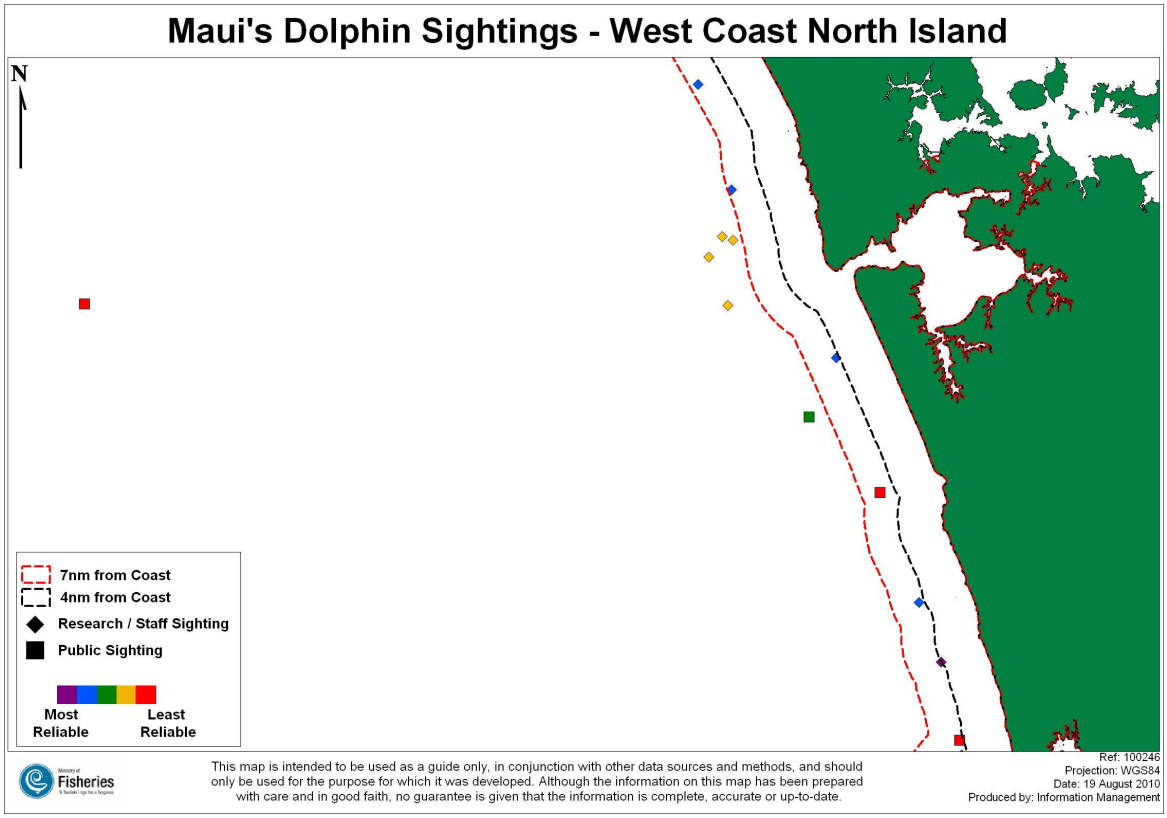

Figure 2. Sightings of Maui's dolphins further than 4 nm from shore between Pariokariwa Point to Maunganui Bluff on the WCNI. The colour of the marker represents the positioning of the sighting(s) along the reliability scale.

Figure 3. Plots of set net fishing effort for WCNI, for summer and winter in 2007-08 and 2008/09.

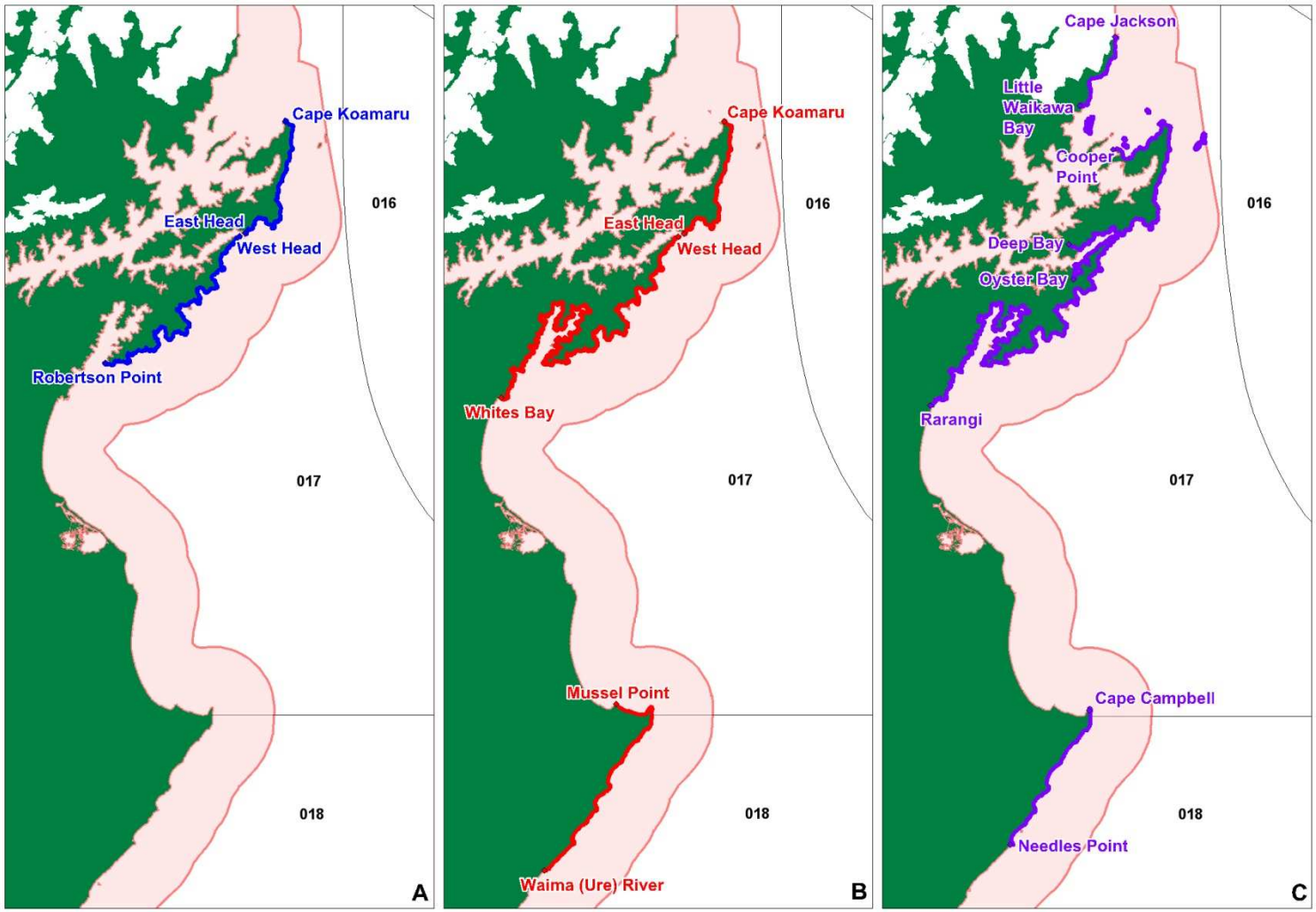

Figure 4. Various ECSI butterfish fishery areas proposed for exemption: (A) by the 2007 IPP and the July 2008 proposal from Federation of Commercial Fisheries; (B) by the 2008 FAP; and (C) the interim relief that applied from 2008.

Figure 5. Hector's dolphins near rocky coast of Bank's Peninsula. Photo supplied by Dr. L Slooten.

Appendix 1: Potential Biological Removal

132 The Potential Biological Removal (PBR) level is the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (Wade 1998). The PBR is calculated by the following formula:

$PBR = N_{MIN} \frac{1}{2} R_{MAX} F_R$

Where: N_{MIN} = the minimum population estimate of the stock;

$\frac{1}{2}R_{MAX}$ = one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and

F_R = a recovery factor between 0.1 and 1.0

133 The term Optimum Sustainable Population means, with respect to any population stock, the number of animals that will result in the maximum productivity (Maximum Net Productivity Level – MNPL) of the species, population, subpopulation or stock in question, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent part. For marine mammals, this level is thought to be between 50% and 85% of carrying capacity (K) and is more likely to be at the lower end of that range (Taylor & DeMaster 1993).

134 The minimum population estimate of the stock (N_{MIN}) is defined as the 20th percentile of a log-normal distribution based on an estimate of the number of animals in the stock. This is equivalent to the lower limit of a 60% 2-tailed confidence interval (Barlow *et al.* 1995).

135 The default maximum theoretical productivity rate (R_{MAX}) is 0.04 for cetaceans. This value is used as a default in the absence of species specific information. When data are available on the productivity rate, they should be used.

136 Earlier studies suggested an R_{MAX} of about 0.018. The Hector's dolphin Technical Working Group meeting of 31 August 2006 suggested that an R_{MAX} of 0.034 is appropriate based on the modelling work of Davies and Gilbert (2003).

137 The recovery factor is intended to compensate for uncertainty and possible unknown estimation errors. A recovery factor of 0.1 often is the default used for endangered stocks of marine mammals. A recovery factor of 0.5 has been suggested for stocks of indeterminate status (Wade & Angliss 1997). No decision has been made on a recovery factor for Hector's and Maui's dolphins.

138 The PBR approach can provide management advice across three possible goals and the choice of goals will influence inputs into the PBR equation. The MNPL goal of the PBR approach was developed to achieve the goals given in the US Marine Mammal Protection Act, i.e., to maintain the population above its maximum net productivity level. This level will be at 50% – 85% of carrying capacity[14].

[14] The PBR is a technique that was developed by the US National Marine Fisheries Service in response to the US Marine Mammal Protection Act. The PBR was never intended to be used to close a fishery; rather, it provides a trigger value, after which a Take Reduction Team was convened to identify ways to reduce the number of human caused marine mammal mortalities to a level below the calculated PBR value.

139 The Recovery-Rate goal allows a population known to be at a low level relative to its pre-exploitation level to recover at a rate close to its maximum as possible. Wade (1998) found that a recovery factor (F_R) of 0.15 will achieve the goal of not delaying the time to recovery by more than 10% with 95% probability.

140 As applied here, values calculated by the PBR approach should be seen as indicative only and should not be taken as absolute values of maximum allowable Hector's dolphin human caused mortality.

Appendix 2: Socio-economic Analysis

West Coast of the North Island – beyond 4 nm offshore

141 MFish estimates that retaining the closure of the area 4-7 nm from shore between Pariokariwa Point and Maunganui Bluff on the WCNI to commercial set net fishing (Option three) would reduce set net catches of school shark and rig on the WCNI by an estimated $0.15 million (landed revenue). Table 6 details the estimated annual income changes, based on this estimated loss in landed revenue, if the Minister retains the closure of this offshore area on the WCNI.

Table 6: Estimated annual income effects of confirming the current set net regulations on the WCNI

	Confirm Current Regulations
Direct harvesting income lost	$37,166.45
Processing income lost	$68,386.27
Indirect income lost	$83,252.85
Induced income lost	$60,952.98
TOTAL	**$249,758.56**

142 Table 7 presents MFish's estimate of the present value of retaining the closure of the area 4-7 nm from shore between Pariokariwa Point and Maunganui Bluff on the WCNI to commercial set net fishing (Option three).

Table 7: Estimates of present value of losses from confirming the current regulations on the WCNI

	Confirm Current Regulations
Quota value	$238,281.22
Direct harvesting	$156,290.67
Direct processing	$146,347.69
Indirect suppliers	$118,970.96
Induced	$60,952.98
TOTAL	**$720,843.52**

143 MFish estimates the overall value of the fishery (present and capitalised future returns) is approximately $970,000.

144 The extent to which the industry can adjust to the retention of the 4-7 nm closure to set net fishing in this area is an important issue. The cost impacts calculated above are based on the 2008/09 fishing year when targeted set netting for school shark and rig was allowed under interim relief between 4nm and 7nm for a 3 month period (1 September to 24 December). By using GPS data from catch effort returns, MFish was able to calculate the percentage of school shark and rig was caught in the 4nm to 7nm area subject to interim relief compared to all school shark and rig catch in statistical areas 040 to 046 (West Coast of the North Island). Only 3.5% of all school shark caught in these statistical areas was caught in the 4nm to 7nm area subject to interim relief. However, 34% of all rig caught in these statistical areas was caught in the 4nm to 7nm area subject to interim relief. By retaining the 4-7 nm closure to commercial set net fishing, the majority of the impact will be on those fishers who are targeting rig using set nets.

Commercial butterfish fishery – northern end of ECSI

145 MFish estimates that not providing the exemption in the defined area at the northern end of the ECSI to commercial butterfish set net fishing would reduce set net catches of butterfish on the ECSI by an estimated $19,000 (landed revenue). Table 8 details the estimated annual income changes, based on this estimated loss in landed revenue, if the Minster does not provide the exemption for commercial butterfish fishing at the northern end of the ECSI.

Table 8: Estimated annual income effects of not providing the exemption for commercial butterfish at the northern end of the ECSI.

	Confirm Current Regulations
Direct harvesting income lost	$4,752.23
Processing income lost	$8,744.11
Indirect income lost	$10,645.00
Induced income lost	$7,793.66
TOTAL	**$31,935.00**

146 Table 9 presents MFish's estimate of the present value of losses from not providing the exemption to commercial butterfish set net fishing at the northern end of the ECSI.

Table 9: Estimates of present value of losses from not providing the exemption for commercial butterfish at the northern end of the ECSI.

	Confirm Current Regulations
Quota value	$90,297.36
Direct harvesting	$17,105.81
Direct processing	$16,314.14
Indirect suppliers	$14,636.43
Induced	$7,793.66
TOTAL	**$146,147.39**

147 MFish estimates the overall value of the fishery (present and capitalised future returns) is approximately $180,000.

148 The extent to which the industry can adjust to a decision to not provide an exemption for commercial butterfish set net fishing in this area is an important issue. The cost impacts calculated above are based on the 2008/09 fishing year when targeted set netting for butterfish was allowed under interim relief in specific areas between Needles Point and Cape Jackson (see Figure 4). By using GPS data from catch effort returns, MFish was able to calculate the percentage of butterfish that was caught in the specific areas subject to interim relief compared to all butterfish catch in statistical areas 017 to 018 (top of the East Coast of the South Island). 24.2% of all butterfish caught in these statistical areas was caught in the specific areas subject to interim relief. By not providing an exemption for commercial butterfish set net fishing in the defined area the impact will be to reduce the amount of butterfish caught in statistical areas 017 and 018 by a quarter.

References

Baker, A. N.; Smith, A. H. and Pichler F. B. 2002. Geographic Variation in Hector's dolphin – recognition of new subspecies of *Cephalorhynchus hectori* Van Beneden 1881. Journal of the Royal Society of New Zealand 32 (4): 713-727.

Baker, C.S.: Chilvers, B.L.: Constantine, R. : DuFresne, S. : Mattlin, R.H.: van Helden, A. and Hitchmough, R.(2010) 'Conservation status of New Zealand marine mammals (suborders Cetacea and Pinnipedia), 2009'. New Zealand Journal of Marine and Freshwater Research, Vol. 44, Issue 2, 101-115.

Barlow, J., S.L. Swartz, T.C. Eagle and P. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Technical Memorandum NMFS-OPR-95-6. September 1995.

Bejder, L. and Dawson, S. 2001. Abundance, residency, and habitat utilisation of Hector's dolphins (*Cephalorhynchus hectori*) in Porpoise Bay, New Zealand. New Zealand Journal of Marine and Freshwater Research 35: 277- 287.

Burkhart, S. M. and E. Slooten. 2003. Population viability analysis for Hector's dolphin (*Cephalorhynchus hectori*): a stochastic population model for local populations. New Zealand Journal of Marine and Freshwater Research. 37: 553-566.

Cawthorn, M. W., 1988. Recent observations of Hector's dolphin *Cephalorhynchus hectori* in New Zealand Waters. Report of the International Whaling Commission (special issue 9): 303-314.

Childerhouse, S., Rayment, W., Webster, T., Scali, S., Du Fresne, S., 2008. Offshore aerial survey of Maui's dolphin distribution 2008. Department of Conservation (unpublished), Auckland, New Zealand. 6pp.

Clement, D.; Slooten, E.; Dawson, S.M.; DuFresne, S. 2001: Line-transect survey of Hector's dolphin abundance between Farewell Spit and Motunau. DOC Science Internal Series 22. Department of Conservation, Wellington. 15 p.

Davies, N.M. and D.J. Gilbert. 2003. A risk analysis of an endangered dolphin subspecies using a temporal-spatial age-structured model. Final report for MFish Research Project MOF2002/03D, Objectives 1, 2, & 3 (revised). November 2003.

Dawson, S. M. and Slooten, E. 1988. Hector's dolphin, *Cephalorhynchus hectori*; distribution and abundance. Report of the International Whaling Commission (Special Issue 9): 315-324.

Dawson, S., E. Slooten, S. DuFresne, P. Wade and D. Clement.2004. Small-boat surveys for coastal dolphins: line-transect surveys for Hector's dolphin (*Cephalorhynchus hectori*). Fishery Bulletin. 102 (3): 441-451.

Du Fresne, S., 2010. Distribution of Maui's dolphin (*Cephalorhynchus hectori maui*) 2000-2009. Department of Conservation (unpublished), Auckland, New Zealand.

Du Fresne, S., Mattlin, R., (2009). Distribution and abundance of Hector's dolphin (*Cephalorhynchus hectori*) in Clifford and Cloudy Bays. Final Report for NIWA project CBF07401. Marine Wildlife Research Ltd. 28p.

DuFresne, S., Dawson, S. and Slooten, E. 2001. Line-transect survey of Hector's dolphin abundance between Timaru and Long Point, and effect of attraction to survey vessel. Published client report on contract 3074, funded by Conservation Services Levy. Department of Conservation, Wellington. 19 p.

DOC and MAF, 1994. Review of the Banks Peninsula Marine Mammal Sanctuary, a paper for public comment, June 1994. Published jointly by Department of Conservation and Ministry of Agriculture and Fisheries, report held by DOC. Canterbury Conservancy Miscellaneous report Series No.3.

Ferreira, S.M.; Roberts, C.C. 2003: Distribution and abundance of Maui's dolphins (*Cephalorhynchus hectori maui*) along the North Island west coast, New Zealand. DOC Science Internal Series 93. Department of Conservation, Wellington. 19 p.

Martien, K. K., Taylor, B. L. , Slooten, E., Dawson, S. .M. 1999. A sensitivity analysis to guide research and management for Hector's dolphin. Biological Conservation 90: 183-191.

Pichler, F. B., 2002. Genetic assessment of population boundaries and gene exchange in Hector's dolphin. Department of Conservation Science Internal Series 44. Department of Conservation, Wellington 37 pp.

Pichler, F. B. and Baker, C. S. 2000. Loss of genetic diversity in the endemic Hector's dolphin due to fisheries-related mortality. Proceedings of the Royal Society of London Series B 267: 97-102.

Pichler, F. B., Dawson, S. M., Slooten, E. and Baker, C. S. 1998. Geographic isolation of Hector's dolphin populations described by mitochondrial DNA sequences. Conservation Biology 12(3): 676-682.

Pichler, F.B., Robineau, D., Goodall, R.N.P, Meyer, M. A., Olavarria C., and Baker C. S. 2001. Origin and radiation of Southern Hemisphere coastal dolphins (genus *Cephalorhynchus*). Molecular Ecology 10, 2215-2223.

Rayment. W., Du Fresne, S., 2007. Offshore aerial survey of Maui's dolphin distribution 2007. Department of Conservation (unpublished), Auckland, New Zealand. 6pp.

Rayment, W., S. Dawson, E. Slooten and S. Childerhouse. 2006. Offshore distribution of Hector's dolphin at Banks Peninsula. DOC Research & Development Series 232. Department of Conservation, Wellington. 23 pp.

Russell, K. 1999. The North Island Hector's dolphin: a species in need of conservation. Unpublished MSc. thesis, University of Auckland, Auckland, New Zealand.

Russell, K., 2002. Distribution of Public Sightings of Hector's Dolphins in North Island Coastal Waters. Report prepared for Ministry of Fisheries. 16pp.

Russell, K., 2008. Distribution of Maui's Dolphin sightings 2002-2007. Report for the Marine Conservation Unit, Department of Conservation, January 2008. DOCDM418409.

Scali, S., Dawson, S., Slooten, E., 2007. Habitat utilization of Maui's dolphin (*Cephalorhynchus hectori maui)*. Final Progress Report (unpublished), held by Department of Conservation, DOCDM 176479.

Scali, S., Dawson, S., Slooten, E., 2008. Habitat utilisation of Maui's dolphin (*Cephalorhynchus hectori maui*). Final Progress Report (unpublished), held by Department of Conservation, DOCDM 379814.

Slooten, E. 2007. Conservation Management in the face of uncertainty: Effectiveness of four options for managing Hector's Dolphin bycatch. Presented at NZ Marine Sciences Society Conference, International Marine Mammal Conference (San Diego) and IUCN workshop to review red list of threatened marine mammal species.

Slooten, E., Dawson, S.M., Rayment, W.J., 2004. Aerial surveys for Hector's dolphins: abundance of Hector's dolphins off the South Island west coast, New Zealand. Marine Mammal Science. 20 (3): 477-490.

Slooten, E., Dawson, S.M., Rayment, W.J., Childerhouse S.J., 2005. Distribution of Maui's dolphin, *Cephalorhynchus hectori maui*. New Zealand Fisheries Assessment Report 2005/28. 21 p.

Slooten, E., Dawson, S.M., Rayment, W.J., Childerhouse S.J., 2006. A new abundance estimate for Maui's dolphin: What does it mean for managing this critically endangered species? Biological Conservation. 128 (4): 576.

Speedie, C.D., 2003. The value of public sightings recording schemes in relation to the basking shark in the United Kingdom. *Cybium* 27(4): 255-259.

Stanley, M., 2009. Maui's Winter Offshore Aerial Survey June/July 2009. Unpublished report DOCDM 495949. Department of Conservation, Auckland, New Zealand. 10pp.

Taylor, B.L. and D.P. DeMaster. 1993. Implications of non-linear density dependence. Marine Mammal Science 9: 360-371.

Wade, P.R., 1998. Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. Marine Mammal Science 14(1): 1-37.

Wade, P.R., Angliss, R.P., 1997. Report of the GAMMS workshop: April 3-5, 1996, Seattle, Washington, NOAA Technical Memorandum NMFS-OPR-12.

WWF, 2010. WWF-New Zealand Updated Information on the WWF Maui's Dolphin Sighting Network to Inform Conservation Management Decisions. Letter to Ministry of Fisheries, 21 June 2010.