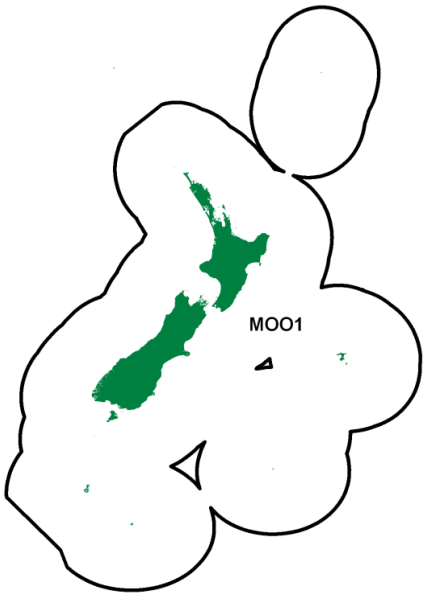
MOONFISH (MOO)

(Lampris guttatus)



1. FISHERY SUMMARY

Moonfish were introduced into the QMS on 1 October 2004 under a single QMA, MOO 1, with the TAC equal to the TACC (Table 1).

Table 1: Recreational and Customary non-commercial allowances, TACCs and TACs (all in tonnes) of moonfish.

Fishstock	Recreational Allowance (t)	Customary non-commercial Allowance (t)	Other mortality (t)	TACC (t)	TAC (t)
MOO 1	0	0	0	527	527

Moonfish were added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14.

1.1 Commercial fisheries

Most moonfish (70%) are caught as bycatch in surface longlines fisheries (the eighth most common bycatch species in the surface longline fishery; table 13). The main fisheries catching moonfish by surface longlining are targeting bigeye tuna (*Thunnus obesus*) and, to a lesser extent, southern bluefin tuna (*T. maccoyii*), albacore (*T. alalunga*) and yellowfin tuna (*T. albacares*). Mid-water trawling accounts for 18% of the catch, bottom trawling 8% and bottom longlining 1%. The main target fisheries using mid-water trawling are for southern blue whiting (*Micromesistius australis*) and hoki (*Macruronus novaezelandiae*), and bottom trawling for hoki and gemfish (*Rexea solandri*).

When caught on tuna longlines most moonfish are alive (79.8%). Most moonfish catch is kept and landed, as there is a market demand. It is likely that landing data for moonfish reasonably represents actual catches, although it may include small amounts (less than 1%) of the less common *Lampris* spp. and the more southerly occurring species (*Lampris immaculatus*) because of misidentification. Most of the catch taken by the tuna longline fishery was aged 2 to 14 years, and most (71%) of the commercial catch appears to be of adult fish. Figure 1 shows the historic landings and longline fishing effort for moonfish inside and outside the New Zealand EEZ.

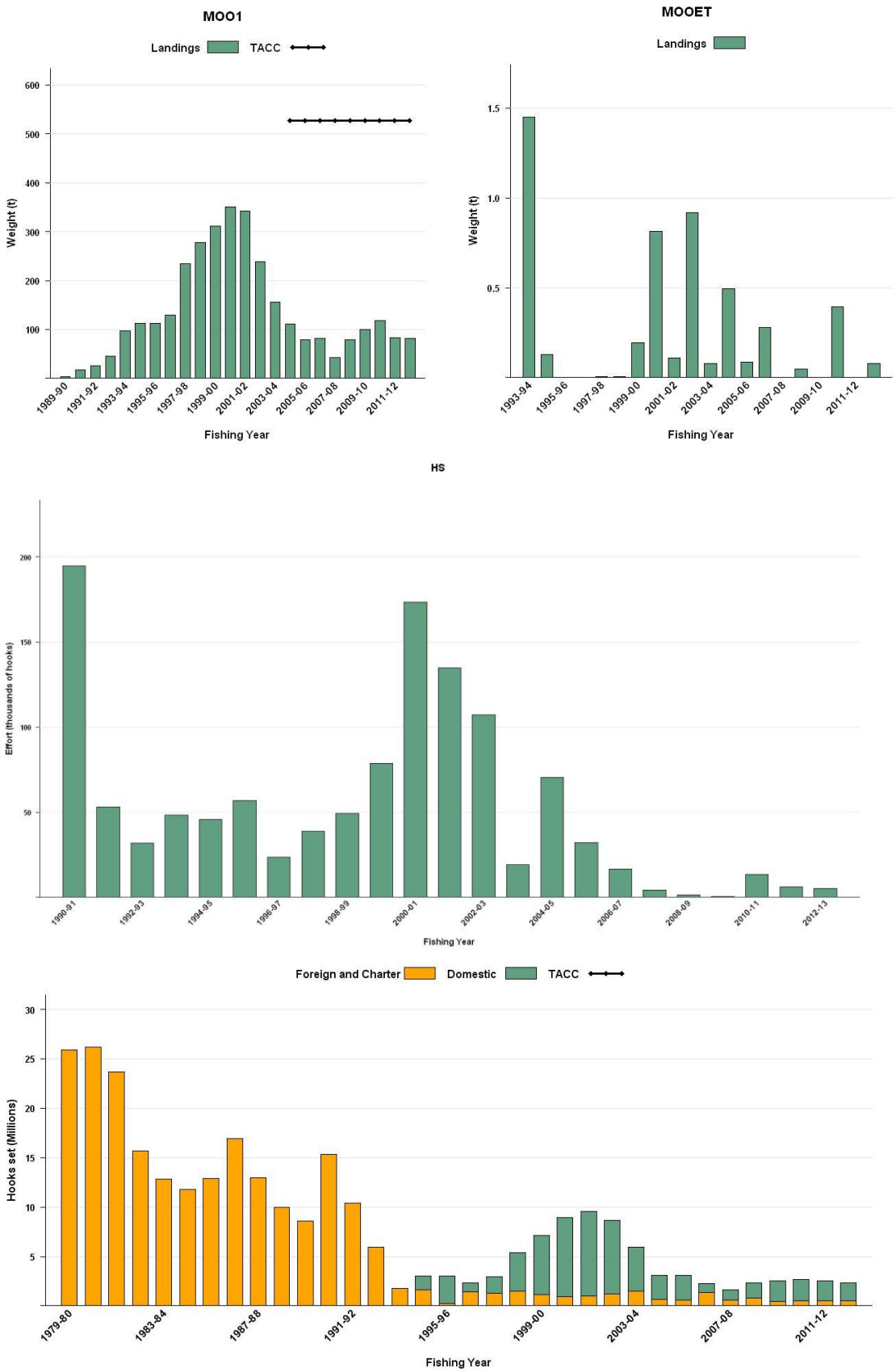


Figure 1: [Top] Moonfish catch from 1989–90 to 2012–13 within New Zealand waters (MOO 1) and 1993–94 to 2012–13 on the high seas (MOO ET). [Middle] Fishing effort (number of hooks set) for all high seas New Zealand flagged surface longline vessels from 1990–91 to 2012–13. [Bottom] Fishing effort (number of hooks set) within New Zealand EEZ for domestic and foreign vessels (including foreign vessels chartered by New Zealand fishing companies), from 1979–80 to 2012–13.

Reported landings in New Zealand increased each year from 3 t in 1989–90 to a maximum of 351 t in 2000–01, but have declined since then as a result of decreasing effort in the surface longline fishery (Table 2). From 2005–06 to 2011–12 landings have averaged around 84 t. New Zealand landings of moonfish appear to represent about 70% of the reported catch of moonfish in the wider South Pacific area based on Food and Agriculture Organisation of the United Nations statistics. However, this may reflect general non-reporting of bycatch.

Table 2: Reported landings (t) of moonfish (CELR, CLR and LFRR data from 1989–90 to 2000–01, MHR data from 2001–02 onwards).

Fishing year	MOO 1 (all FMAs)
1989–90	3
1990–91	18
1991–92	26
1992–93	46
1993–94	97
1994–95	112
1995–96	112
1996–97	130
1997–98	234
1998–99	278
1999–00	311
2000–01	351
2001–02	342
2002–03	239
2003–04	156
2004–05	112
2005–06	80
2006–07	82
2007–08	43
2008–09	80
2009–10	100
2010–11	118
2011–12	84
2012–13	81

The majority of moonfish are caught in the bigeye tuna (77%) and southern bluefin tuna (13%) surface longline fisheries (Figure 2). Across all longline fisheries albacore make up the bulk of the catch (32%) (Figure 3). Longline fishing effort is distributed along the east coast of the North Island and the south west coast of the South Island. The west coast South Island fishery predominantly targets southern bluefin tuna, whereas the east coast of the North Island targets a range of species including bigeye, swordfish, and southern bluefin tuna (Figure 4).

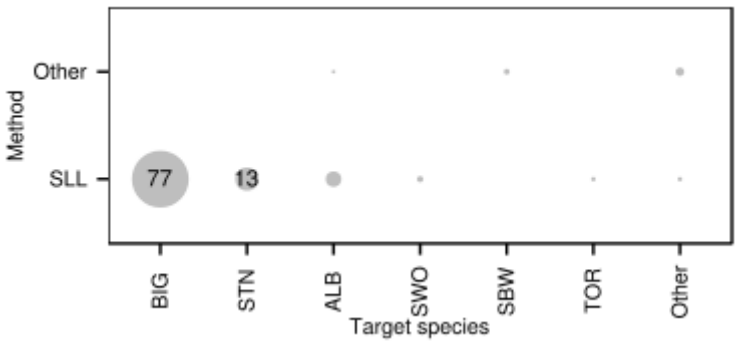


Figure 2: A summary of the proportion of landings of moonfish taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage. SLL = surface longline (Bentley et al 2013).

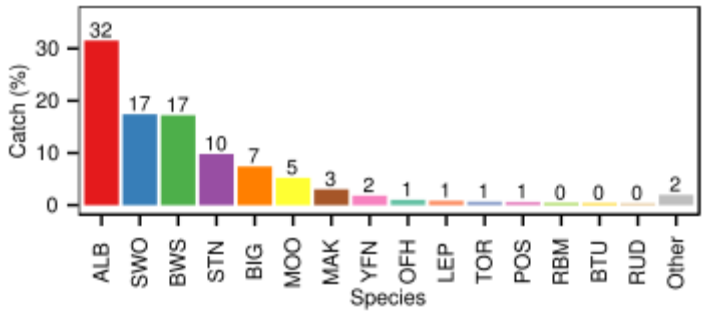


Figure 3: A summary of species composition of the reported surface longline catch. The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).

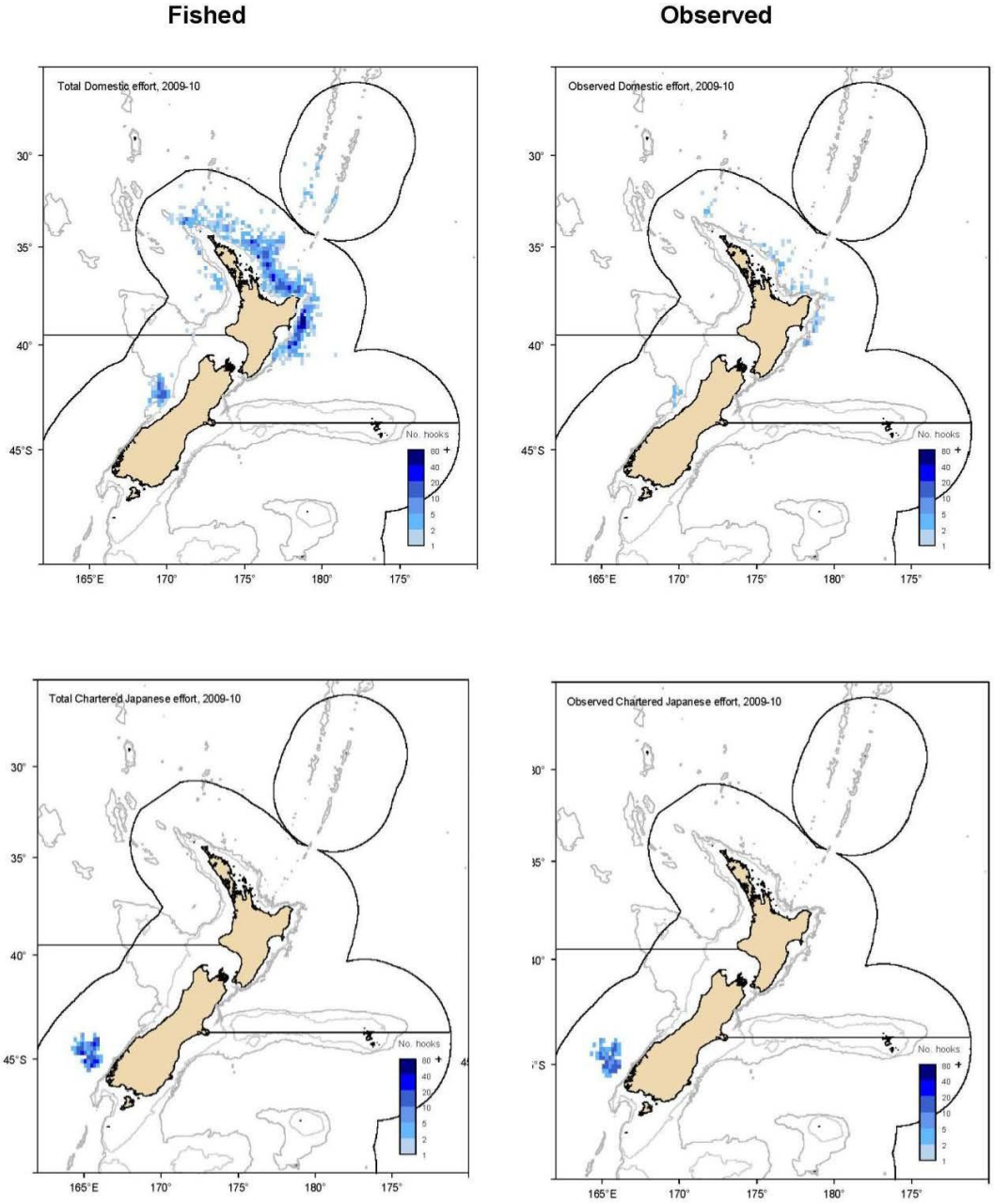


Figure 4: Distribution of fishing positions for domestic (top two panels) and charter (bottom two panels) vessels, for the 2009–10 fishing year, displaying both fishing effort (left) and observed effort (right).

Across all fleets in the longline fishery 79.8% of the moonfish were alive when brought to the side of the vessel (Table 3). The domestic fleets retain around 96.5–100% of their moonfish catch, while the foreign charter fleets retain a slightly lower percentage range (92–100%) of moonfish, the Australian fleet that fished in New Zealand waters in 2006–07 retained 100% of their moonfish catch (Table 4).

Table 3: Percentage of moonfish (including discards) that were alive or dead when arriving at the longline vessel and observed during 2006–07 to 2009–10, by fishing year, fleet and region. Small sample sizes (number observed < 20) were omitted (Griggs & Baird 2013).

Species	Year	Fleet	Area	alive	% dead	Number
Moonfish	**2006–07**	Australia	North	80.0	20.0	20
		Charter	North	85.2	14.8	472
			South	84.2	15.8	114
		Domestic	North	65.6	34.4	180
		Total		**80.4**	**19.6**	**786**
	2007–08	Charter	South	100.0	0.0	41
		Domestic	North	78.4	21.6	97
		Total		**84.8**	**15.2**	**138**
	2008–09	Charter	North	100.0	0.0	60
			South	100.0	0.0	30
		Domestic	North	72.6	27.4	201
		Total		**81.1**	**18.9**	**291**
	2009–10	Charter	South	98.6	1.4	69
		Domestic	North	71.5	28.5	333
		Total		**76.0**	**24.0**	**408**
	Total all strata			**79.8**	**20.2**	**1 623**

Table 4: Percentage of moonfish that were retained, or discarded or lost, when observed on a longline vessel during 2006–07 to 2009–10, by fishing year and fleet. Small sample sizes (number observed < 20) omitted (Griggs & Baird 2013).

Year	Fleet	% retained	% discarded or lost	Number
2006–07	Australia	100.0	0.0	20
	Charter	91.6	8.4	616
	Domestic	97.2	2.8	180
	Total	**93.0**	**7.0**	**816**
2007–08	Charter	100.0	0.0	41
	Domestic	100.0	0.0	96
	Total	**100.0**	**0.0**	**137**
2008–09	Charter	100.0	0.0	107
	Domestic	98.5	1.5	201
	Total	**99.0**	**1.0**	**308**
2009–10	Charter	100.0	0.0	76
	Domestic	96.5	3.5	345
	Total	**97.1**	**2.9**	**421**
Total all strata		**95.7**	**4.3**	**1 682**

1.2 Recreational fisheries

There is no information on recreational catch levels of moonfish. Moonfish has not been recorded from recreational surveys conducted by the Ministry for Primary Industries (MPI).

1.3 Customary non-commercial fisheries

There is no information on customary catch, although customary fishers consider moonfish good eating and may have used moonfish in the past.

1.4 Illegal catch

There is no known illegal catch of moonfish.

1.5 Other sources of mortality

There is no information on other sources of mortality although moonfish are occasional prey of blue and mako sharks in New Zealand waters, suggesting there may be some unobserved shark depredation of longline caught moonfish.

2. BIOLOGY

Until recently, little was known about the biology of moonfish in New Zealand waters. Studies have examined growth rates, natural mortality, and maturity for moonfish.

Age and growth of moonfish (*Lampris guttatus*) in New Zealand waters was assessed using counts of growth bands on cross sections of the second dorsal fin ray. MPI observers working on tuna longline vessels collected fin samples. Observers also collected maturity data, and length-frequency data were obtained from the longline observer database.

Thin sections were cut from fin rays 3.5–4 times the condyle width above the fin base. Sections were read blind (without knowing the fish length) by two readers. Readability scores were poor and the four readers who examined the fin rays came to two different interpretations.

Length-at-age data did not show any marked differences between males and females. Von Bertalanffy growth curves were fitted to the age estimates of both readers individually, and also to the mean ages of the two readers. The mean age provides the best available age estimate for moonfish samples. However, because of differences between readers, and the un-validated nature of the estimates, the growth curves must be interpreted with caution, especially for younger fish.

The growth curves suggest rapid early growth. The maximum age estimated in this study was 13 or 14 years depending on the reader, but this is probably an underestimate of true longevity. Using a maximum age of 14 years, Hoenig's method provides an M estimate of 0.30. If moonfish live to 20 years, this would reduce to 0.21. The Chapman-Robson estimate of Z is 0.13–0.14 for ages at recruitment of 2–4 years. However, the sample was not randomly selected and so this is probably unreliable. The best estimate of M may be around 0.20–0.25.

Length and age-at-maturity could not be accurately determined due to insufficient data, but it appears that fish longer than about 80 cm fork length are mature. The corresponding age-at-maturity would be 4.3 years. Sexual maturity may therefore be attained at about 4–5 years. A few spawning females were collected in the Kermadec region, and at East Cape, suggesting that moonfish spawn in northern New Zealand. Identification of the location and timing of spawning are important areas of further research and are a pre-requisite for obtaining good estimates of length and age at maturity.

Moonfish in New Zealand waters may be a species complex of *L. guttatus* and a new species, large eye moonfish. This needs clarification in New Zealand.

3. STOCKS AND AREAS

There is no information on the stock structure of moonfish.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was updated for the November 2013 Fishery Assessment Plenary after review by the Aquatic Environment Working Group. This summary is from the perspective of moonfish but there is no directed fishery for them and the incidental catch sections below reflect the New Zealand longline fishery as a whole and are not specific to this species; a more detailed summary from an issue-by-issue perspective is available in the Aquatic Environment and Biodiversity Annual Review where the consequences are also discussed (http://www.mpi.govt.nz/Default.aspx?TabId=126&id=1644) (Ministry for Primary Industries 2012).

4.1 Role in the ecosystem

Moonfish (*Lampris guttatus*) are a mid-water pelagic fish, found between 50 and 400 m depth. They often exhibit vertical behaviour like many other large pelagic visual predators, including swordfish and bigeye tuna, with deeper day and shallower night depth distributions (Polovina et al 2008). While no published data exists on the diet of *L. guttatus* in the South Pacific, a study on the diet of southern moonfish (*Lampris immaculatus*) along the Patagonian Shelf showed they had a narrow range of prey items with the most common being the deepwater onychoteuthid squid (*Moroteuthis ingens*) (Jackson et al. 2000; Polovina et al 2008). Large pelagic sharks such as great white and mako are thought to prey on moonfish.

4.2 Incidental catch (seabirds, sea turtles and mammals)

The protected species, capture estimates presented here include all animals recovered onto the deck (alive, injured or dead) of fishing vessels but do not include any cryptic mortality (e.g., seabirds caught on a hook but not brought onboard the vessel).

4.2.1 Seabird bycatch

Between 2002–03 and 2011–12, there were 731 observed captures of birds across all surface longline fisheries. Seabird capture rates since 2003 are presented in Table 5 and Figures 5 and 6. While the seabird capture distributions largely coincide with fishing effort they are more frequent off the south west coast of the South Island (Figure 7). The analytical methods used to estimate capture numbers across the commercial fisheries have depended on the quantity and quality of the data, in terms of the numbers observed captured and the representativeness of the observer coverage. Ratio estimation was historically used to calculate total captures in longline fisheries by target fishery fleet and area (Baird 2008) and by all fishing methods but recent estimates are either ratio or model based as specified in the tables below (Abraham et al 2010).

Through the 1990s the minimum seabird mitigation requirement for surface longline vessels was the use of a bird scaring device (tori line) but common practice was that vessels set surface longlines primarily at night. In 2007 a notice was implemented under s 11 of the Fisheries Act 1996 to formalise the requirement that surface longline vessels only set during the hours of darkness and use a tori line when setting. This notice was amended in 2008 to add the option of line weighting and tori line use if setting during the day. In 2011 the notices were combined and repromulgated under a new regulation (Regulation 58A of the Fisheries (Commercial Fishing) Regulations 2001) which provides a more flexible regulatory environment under which to set seabird mitigation requirements.

Table 5: Number of observed seabird captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, by species and area. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Potential Biological Removals, PBR (from Richard and Abraham (2013) where full details of the risk assessment approach can be found). It is not an estimate of the risk posed by fishing for moonfish using longline gear but rather the total risk for each seabird species. Other data, version 20130305.

Albatross Species	Risk Ratio	Kermadec Islands	Northland and Hauraki	Bay of Plenty	East Coast North Island	Stewart Snares Shelf	Fiordland	West Coast South Island	West Coast North Island	Total
Salvin's	Very high	0	1	2	6	0	0	0	0	9
Southern Buller's	Very high	0	3	2	27	0	278	33	0	343
NZ white-capped	Very high	0	2	0	3	10	60	27	0	102
Northern Buller's	High	0	0	0	1	0	0	0	0	1
Gibson's	High	4	16	0	17	0	6	2	1	46
Antipodean	High	12	9	1	8	0	0	0	1	31
Northern royal	Medium	0	0	1	0	0	0	0	0	1
Southern royal	Medium	0	1	0	0	0	4	0	0	5
Campbell black-browed	Medium	2	9	2	29	0	3	3	1	49
Light-mantled sooty	Very low	0	0	0	0	0	0	1	0	1
Unidentified	N/A	38	2	0	2	0	0	0	1	43
Total	**N/A**	**56**	**43**	**8**	**93**	**10**	**351**	**66**	**4**	**631**
Other seabirds										
Black petrel	Very high	1	10	1	0	0	0	0	1	13
Flesh-footed shearwater	Very high	0	0	0	10	0	0	0	2	12
Cape petrel	High	0	0	0	2	0	0	0	0	2
Westland petrel	Medium	0	0	0	2	0	1	6	0	9
White-chinned petrel	Medium	2	3	3	3	1	19	3	3	37
Grey petrel	Medium	3	4	3	38	0	0	0	0	48
Grey-faced petrel	Very low	12	5	1	2	0	0	0	0	20
Sooty shearwater	Very low	1	0	0	8	3	1	0	0	13
Southern giant petrel	-	0	0	2	0	0	0	0	2	0
White-headed petrel	-	2	0	0	0	0	0	0	0	2
Unidentified	N/A	0	1	0	0	0	1	0	0	2
Total	**N/A**	**21**	**23**	**10**	**65**	**4**	**22**	**9**	**8**	**158**

Table 6: Effort, observed and estimated seabird captures by fishing year for the New Zealand surface longline fishery within the EEZ. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures; the capture rate (captures per thousand hooks); and the mean number of estimated total captures (with 95% confidence interval). Estimates are based on methods described in Thompson et al (2013) and are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002–03 to 2010–11 are based on data version 20120531 and preliminary estimates for 2011–12 are based on data version 20130305.

	Fishing effort			Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 764 588	2 195 152	20.4	115	0.052	2 033	1 577–2 737
2003–2004	7 380 779	1 607 304	21.8	71	0.044	1 345	1 044–1 798
2004–2005	3 676 365	783 812	21.3	41	0.052	601	472–780
2005–2006	3 687 339	705 945	19.1	37	0.052	790	585–1 137
2006–2007	3 738 362	1 040 948	27.8	187	0.18	936	720–1 344
2007–2008	2 244 339	426 310	19	41	0.088	513	408–664
2008–2009	3 115 633	937 233	30.1	57	0.061	593	477–746
2009–2010	2 992 285	665 883	22.3	135	0.203	921	732–1 201
2010–2011	3 185 779	674 572	21.2	47	0.07	696	524–948
2011–2012†	3 069 707	728 190	23.7	64	0.088	808	596–1 168

†Provisional data, model estimates not finalised.

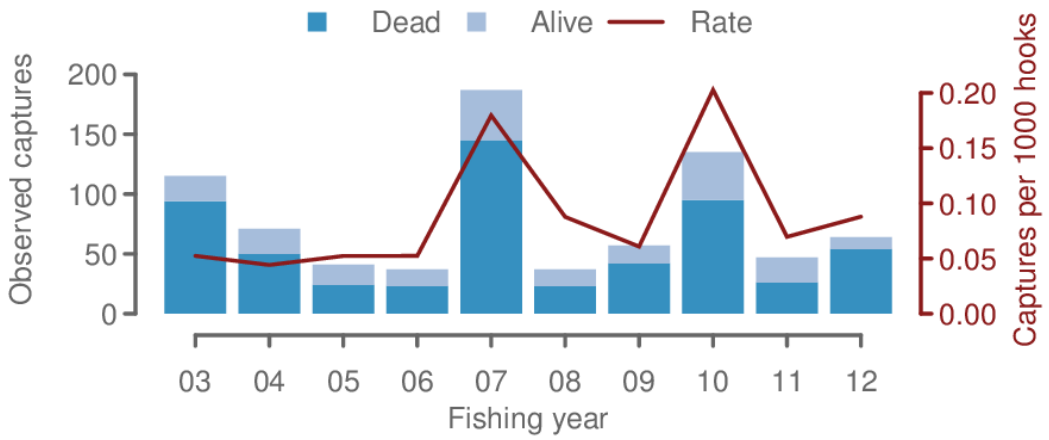


Figure 5: Observed captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

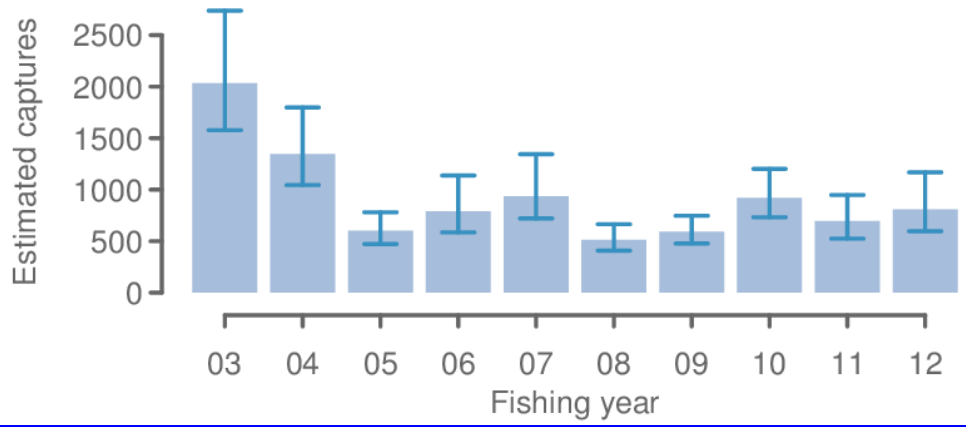


Figure 6: Estimated captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

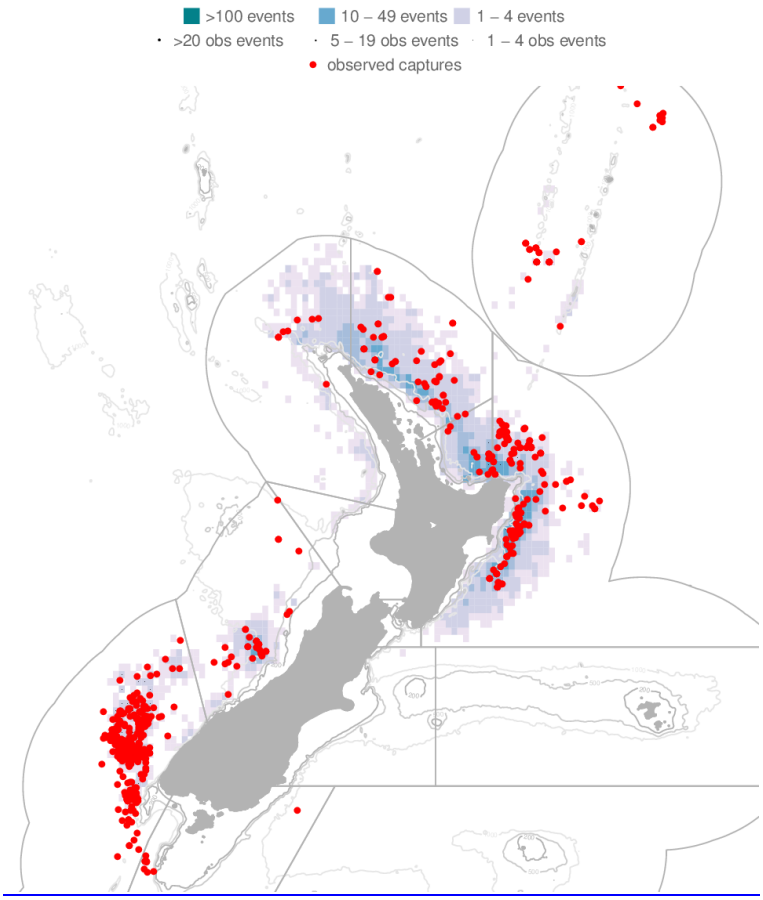


Figure 7: Distribution of fishing effort in the New Zealand surface longline fisheries and observed seabird captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.1% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.2 Sea turtle bycatch

Between 2002–03 and 2011–12, there were 13 observed captures of sea turtles across all surface longline fisheries (Tables 7 and 8, Figure 8). Observer records documented all but one sea turtle as captured and released alive. Sea turtle capture distributions predominantly occur throughout the east coast of the North Island and Kermadec Island fisheries (Figure 9).

Table 7: Number of observed sea turtle captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	Bay of Plenty	East Coast North Island	Kermadec Islands	West Coast North Island	Total
Leatherback turtle	1	4	3	3	11
Green turtle	0	1	0	0	1
Unknown turtle	0	1	0	0	1
Total	1	6	3	3	13

Table 8: Effort and sea turtle captures in surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data see Thompson et al (2013).

	Fishing effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 764 588	2 195 152	20.4	0	0
2003–2004	7 380 779	1 607 304	21.8	1	0.001
2004–2005	3 676 365	783 812	21.3	2	0.003
2005–2006	3 687 362	705 945	19.1	1	0.001
2006–2007	3 738 362	1 040 948	27.8	2	0.002
2007–2008	2 244 339	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	2	0.002
2009–2010	2 992 285	665 883	22.3	0	0
2010–2011	3 185 779	674 572	21.3	4	0.006
2011–2012	3 069 707	728 190	23.7	0	0

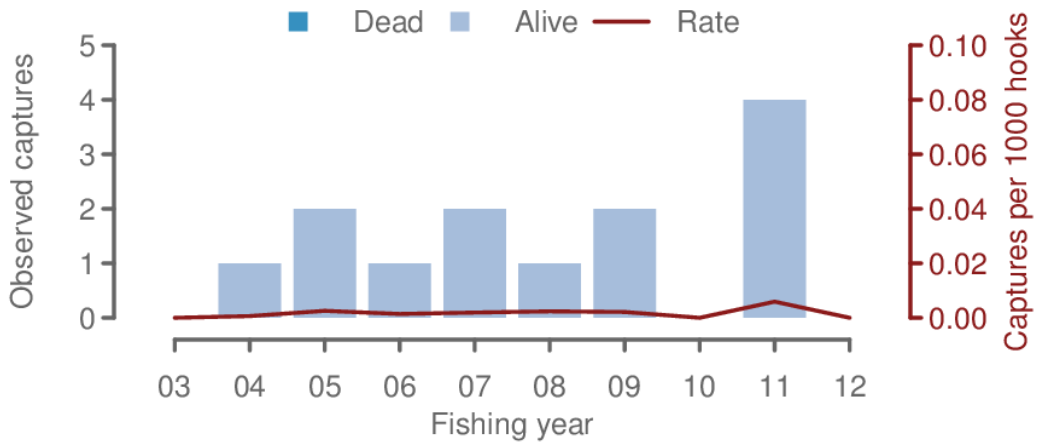


Figure 8: Observed captures of sea turtles in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

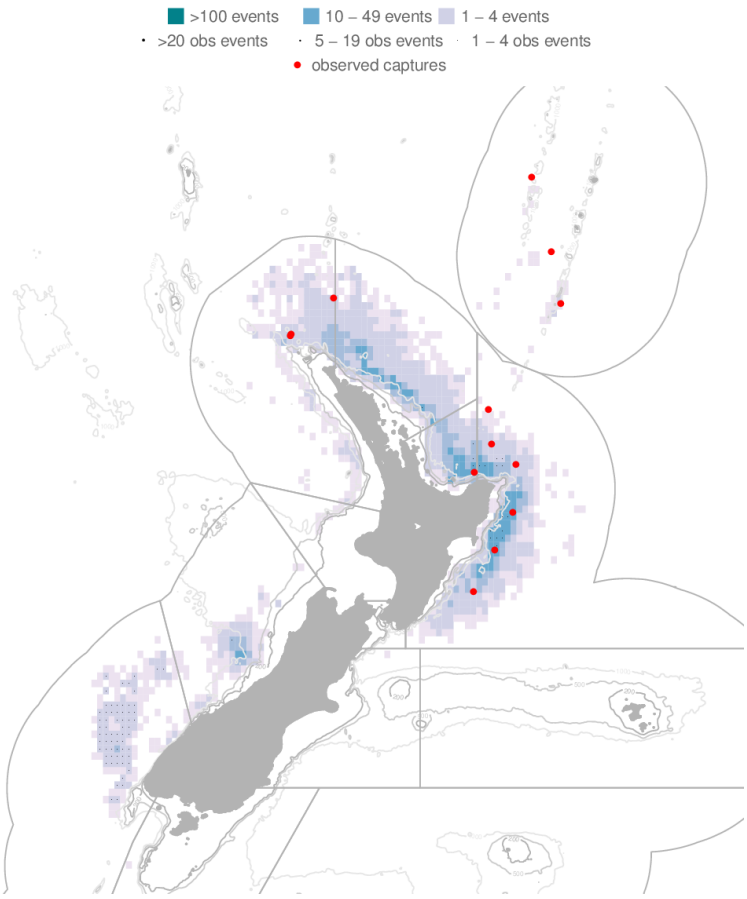


Figure 9: Distribution of fishing effort in the New Zealand surface longline fisheries and observed sea turtle captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.1% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.3 Marine Mammals

4.2.3.1 Cetaceans

Cetaceans are dispersed throughout New Zealand waters (Perrin et al 2008). The spatial and temporal overlap of commercial fishing grounds and cetacean foraging areas has resulted in cetacean captures in fishing gear (Abraham & Thompson 2009, 2011).

Between 2002–03 and 2011–12, there were seven observed captures of whales and dolphins in surface longline fisheries. Observed captures included 5 unidentified cetaceans and 2 long-finned Pilot whales (Tables 9 and 10, Figure 10) (Thompson et al 2013). All captured animals recorded were documented as being caught and released alive (Thompson et al 2013). Cetacean capture distributions are more frequent off the east coast of the North Island (Figure 11).

Table 9: Number of observed cetacean captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	Bay of Plenty	East Coast North Island	Fiordland	Northland and Hauraki	West Coast North Island	West Coast South Island	Total
Long-finned pilot whale	0	1	0	0	0	1	2
Unidentified cetacean	1	1	1	1	1	0	5
Total	1	2	1	1	1	1	7

Table 10: Effort and captures of cetaceans in surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data, see Thompson et al (2013).

	Fishing effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 764 588	2 195 152	20.4	1	0.0005
2003–2004	7 380 779	1 607 304	21.8	4	0.002
2004–2005	3 676 365	783 812	21.3	1	0.001
2005–2006	3 687 339	705 945	19.1	0	0
2006–2007	3 738 362	1 040 948	27.8	0	0
2007–2008	2 244 339	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	0	0
2009–2010	2 992 285	665 883	22.3	0	0
2010–2011	3 185 779	674 572	21.2	0	0
2011–2012	3 069 707	728 190	23.7	0	0

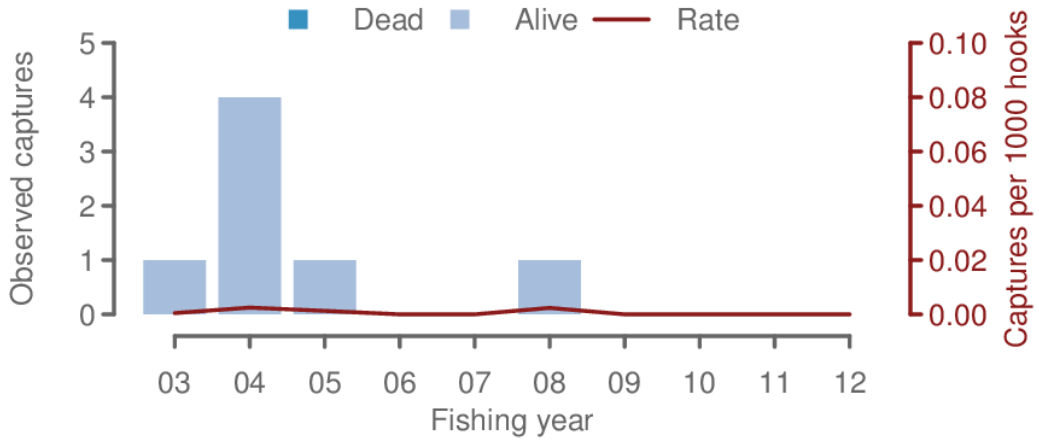


Figure 10: Observed captures of cetaceans in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

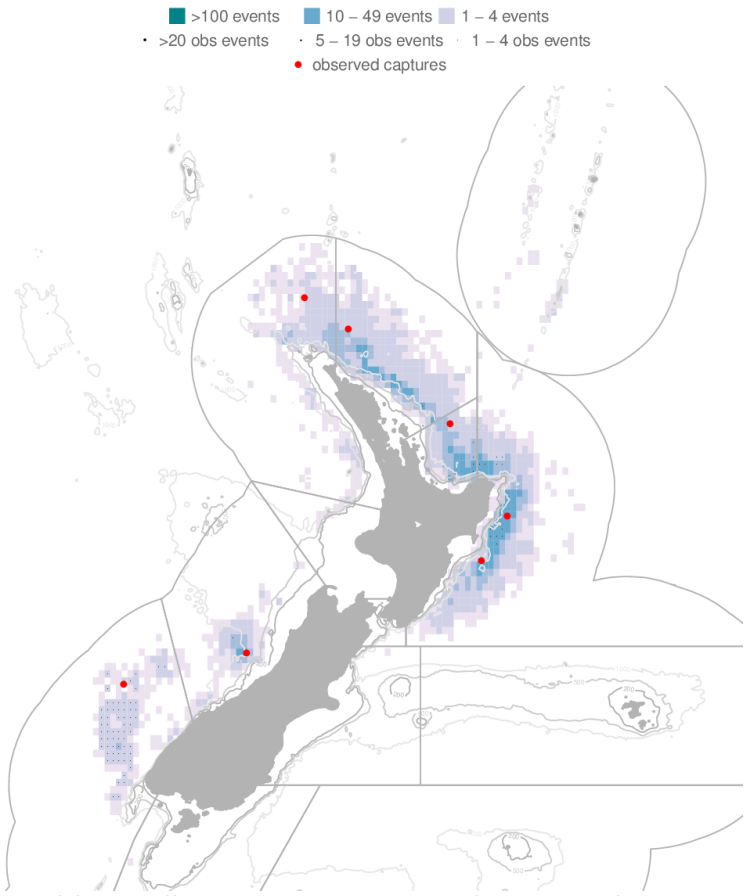


Figure 11: Distribution of fishing effort in the New Zealand surface longline fisheries and observed cetacean captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.1% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.3.2 New Zealand fur seal bycatch

Currently, New Zealand fur seals are dispersed throughout New Zealand waters, especially in waters south of about 40º S to Macquarie Island. The spatial and temporal overlap of commercial fishing grounds and New Zealand fur seal foraging areas has resulted in New Zealand fur seal captures in fishing gear (Mattlin 1987, Rowe 2009). Most fisheries with observed captures occur in waters over or close to the continental shelf, which around much of the South Island and offshore islands slopes steeply to deeper waters relatively close to shore, and thus rookeries and haulouts. Captures on longlines occur when the seals attempt to feed on bait or fish from the line during hauling. Most New Zealand fur seals are released alive, typically with a hook and short snood or trace still attached.

New Zealand fur seal captures in surface longline fisheries have been generally observed in waters south and west of Fiordland, but also in the Bay of Plenty-East Cape area when the animals have attempted to take bait or fish from the line as it is hauled. These capture rates include animals that are released alive (100% of observed surface longline capture in 2008–09; Thompson & Abraham 2010). Bycatch rates in 2011–12 were, low and lower than they were in the early 2000s (Figures 12 and 13). While fur seal captures have occurred throughout the range of this fishery most New Zealand captures have occurred off the Southwest coast of the South Island (Figure 14). Between 2002–03 and 2011–12, there were 246 observed captures of New Zealand fur seal in surface longline fisheries (Tables 11 and 12).

Table 11: Number of observed New Zealand fur seal captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

	Bay of Plenty	East Coast North Island	Fiordland	Northland and Hauraki	Stewart Snares Shelf	West Coast North Island	West Coast South Island	Total
New Zealand fur seal	10	16	139	3	4	2	32	206

Table 12: Effort and captures of New Zealand fur seal in the New Zealand surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). Estimates are based on methods described in Thompson et al (2013) are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002–03 to 2010–11 are based on data version 20120531 and preliminary estimates for 2011–12 are based on data version 20130305.

	Fishing effort			Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 764 588	2 195 152	20.4	56	0.026	157	138-178
2003–2004	7 380 779	1 607 304	21.8	40	0.025	116	99-133
2004–2005	3 676 365	783 812	21.3	20	0.026	77	63-93
2005–2006	3 687 339	705 945	19.1	12	0.017	70	55-85
2006–2007	3 738 362	1 040 948	27.8	10	0.010	52	40-66
2007–2008	2 244 339	426 310	19.0	10	0.023	45	34-56
2008–2009	3 115 633	937 233	30.1	22	0.023	57	46-69
2009–2010	2 992 285	665 883	22.3	19	0.029	78	64-94
2010–2011	3 164 159	674 522	21.3	17	0.025	57	45-69
2011–2012†	3 069 707	728 190	23.7	40	0.055	96	81-111

†Provisional data, model estimates not finalised.

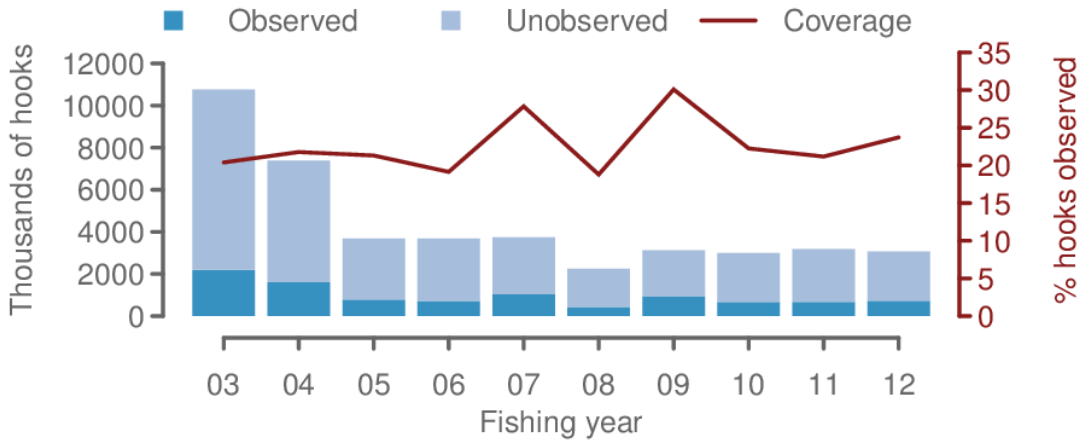


Figure 12: Observed captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

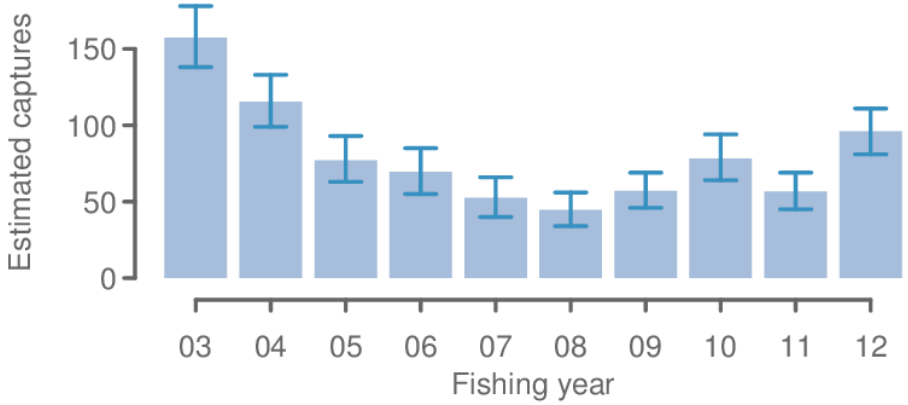


Figure 13: Estimated captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

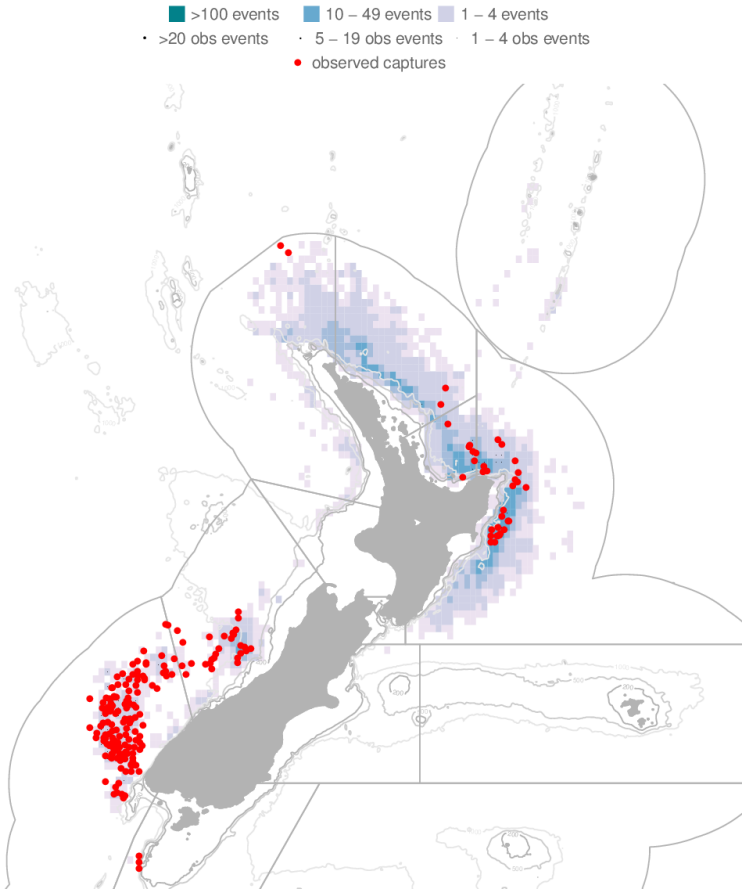


Figure 14: Distribution of fishing effort in the New Zealand surface longline fisheries and observed New Zealand fur seal captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.1% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.3 Incidental fish bycatch

Observer records indicate that a wide range of species are landed by the longline fleets in New Zealand fishery waters. Blue sharks are the most commonly landed species (by number), followed by Ray's bream (Table 13). Southern bluefin tuna and albacore tuna are the only target species that occur in the top five of the frequency of occurrence.

Table 13: Numbers of the most common fish species observed in the New Zealand longline fisheries during 2009–10 by fleet and area. Species are shown in descending order of total abundance (Griggs & Baird 2013).

	Charter	Domestic		Total
Species	South	North	South	number
Blue shark	2 024	4 650	882	7 556
Ray's bream	3 295	326	88	3 709
Southern bluefin tuna	3 244	211	179	3 634
Lancetfish	3	2 139	1	2 143
Albacore tuna	90	1 772	42	1 904
Dealfish	882	0	7	889
Swordfish	3	452	2	457
Moonfish	76	339	6	421
Porbeagle shark	72	328	20	420
Mako shark	11	343	7	361
Big scale pomfret	349	4	0	353
Deepwater dogfish	305	0	0	305
Sunfish	7	283	5	295
Bigeye tuna	0	191	0	191
Escolar	0	129	0	129
Butterfly tuna	15	100	3	118
Pelagic stingray	0	96	0	96
Oilfish	2	75	0	77
Rudderfish	39	20	2	61
Flathead pomfret	56	0	0	56
Dolphinfish	0	47	0	47
School shark	34	0	2	36
Striped marlin	0	24	0	24
Thresher shark	7	17	0	24
Cubehead	13	0	1	14
Kingfish	0	10	0	10
Yellowfin tuna	0	9	0	9
Hake	8	0	0	8
Hapuku bass	1	6	0	7
Pacific bluefin tuna	0	5	0	5
Black barracouta	0	4	0	4
Skipjack tuna	0	4	0	4
Shortbill spearfish	0	4	0	4
Gemfish	0	3	0	3
Bigeye thresher shark	0	2	0	2
Snipe eel	2	0	0	2
Slender tuna	2	0	0	2
Wingfish	2	0	0	2
Bronze whaler shark	0	1	0	1
Hammerhead shark	0	1	0	1
Hoki	0	0	1	1
Louvar	0	1	0	1
Marlin, unspecified	0	1	0	1
Scissortail	0	1	0	1
Broadnose seven gill shark	1	0	0	1
Shark, unspecified	0	1	0	1
Unidentified fish	2	30	8	40
Total	10 545	11 629	1 256	23 430

4.4 Benthic interactions
N/A

4.5 Key environmental and ecosystem information gaps
Cryptic mortality is unknown at present but developing a better understanding of this in future may be useful for reducing uncertainty of the seabird risk assessment and could be a useful input into risk assessments for other species groups.

The survival rates of released target and bycatch species is currently unknown.

Observer coverage in the New Zealand fleet is not spatially and temporally representative of the fishing effort.

5. STOCK ASSESSMENT

There is insufficient information to conduct a stock assessment of moonfish.

CPUE estimates were calculated for each fleet and area stratum in which eight or more sets were observed and at least 2% of the hooks were observed. CPUE estimates were calculated for moonfish for each fleet and area in 2006–07 to 2009–10 and added to the time series for 1988–89 to 2005–06 (Griggs et al 2008) and these are shown in Figure 13 (Griggs & Baird 2013). The CPUE results from the Domestic fleet should be interpreted with caution due to the lower observer coverage of this fleet. CPUE estimates for the Charter fleet can be considered reliable from 1992–93 onwards (Griggs et al 2007). The CPUE trends show high catch rates in the 1990s and there is some indication that these are increasing again in the late 2000s (Figure 15).

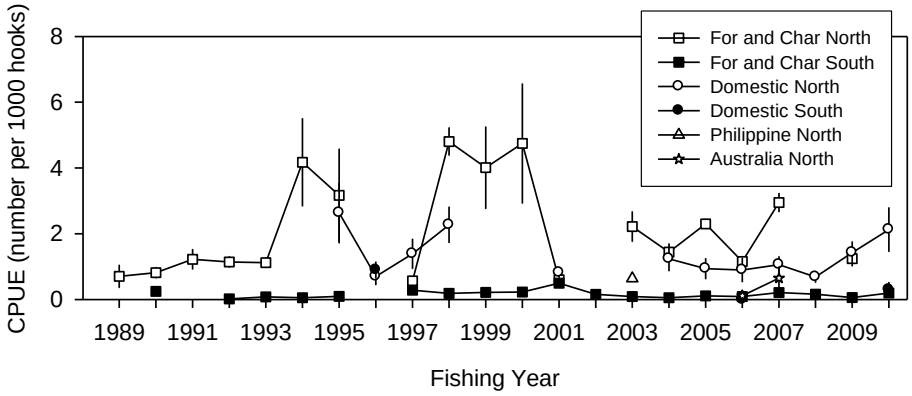


Figure 15: Annual variation in moonfish CPUE by fleet and area. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989 (Griggs & Baird 2013).

5.1 Estimates of fishery parameters and abundance
There are no estimates of relevant fisheries parameters or abundance indices for moonfish.

5.2 Biomass estimates
There are no biomass estimates for moonfish.

5.3 Other yield estimates and stock assessment results
There are no other yield estimates or stock assessment results.

5.4 Other factors

While there is little information on stock status, available data suggests that moonfish are moderately productive and that most (71%) of New Zealand's catches are of mature fish. Provided that juvenile moonfish are not experiencing high fishing mortality elsewhere in their range, it is unlikely that the stock is currently depleted.

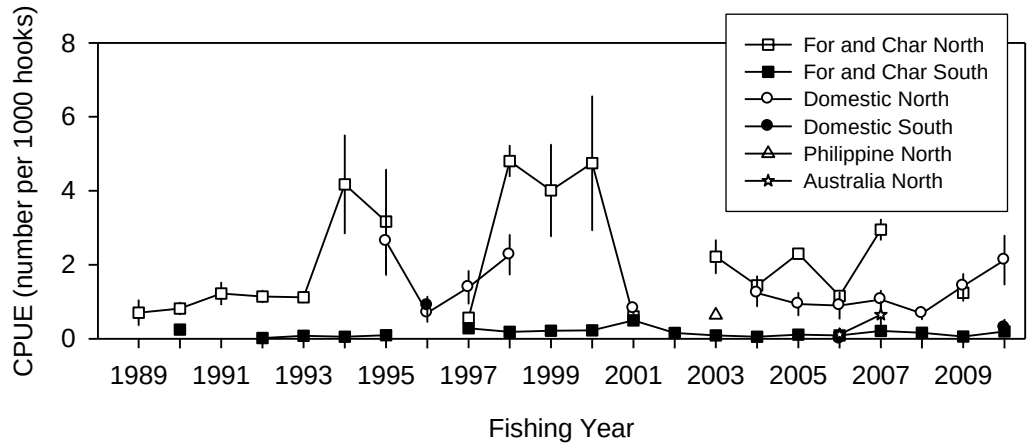
6. STATUS OF THE STOCKS

Stock structure assumptions

MOO 1 is assumed to be part of the wider South Western Pacific Ocean stock but the text below relates only to the New Zealand component of that stock.

Stock Status	
Year of Most Recent Assessment	No assessment
Assessment Runs Presented	-
Reference Points	Target: Not established Soft Limit: Not established by WCPFC; but HSS default of 20% SB_0 assumed Hard Limit: Not established by WCPFC; but HSS default of 10% SB_0 assumed Overfishing threshold: Unknown
Status in relation to Target	Unknown
Status in relation to Limits	Unknown
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



Annual variation in moonfish CPUE by fleet and area. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989 (Griggs & Baird 2013).

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	Unknown
Recent trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	Unknown
Trends in Other Relevant Indicators or Variables	Catches in New Zealand increased from the late 1980s to 2000 but have declined from 351 t in 2000–01 to 43 t in 2007–08, this decline in catch coincides with a decline in longline fishing effort.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 4: Low information evaluation - There are only data on catch and TACC, with no other fishery indicators	
Assessment Method	2 – Medium or Mixed Quality: information has been subjected to peer review and has been found to have some shortcomings	
Assessment Dates	Latest assessment: 2012	Next assessment:
Overall assessment quality rank	N/A	
Main data inputs (rank)	- Commercial reported catch and effort	1 - High quality for the charter fleet but low for all the other fleets
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	
Qualifying Comments		
This fishery is largely a bycatch fishery. There are some issues associated with species identification with a new species recently described as the large-eye moonfish.		

Fishery Interactions
-

7. FOR FURTHER INFORMATION

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