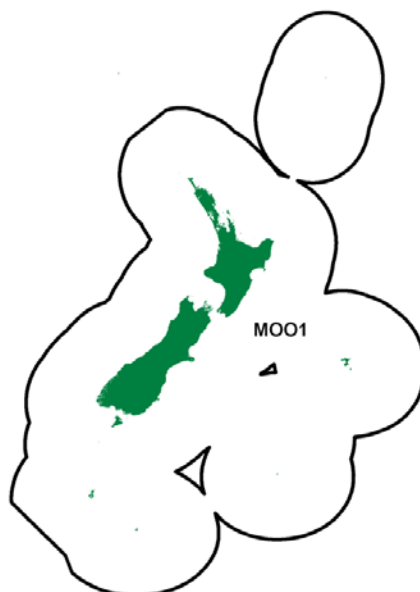


MOONFISH (MOO)*(Lampris guttatus)***1. FISHERY SUMMARY**

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.

MOONFISH (MOO)

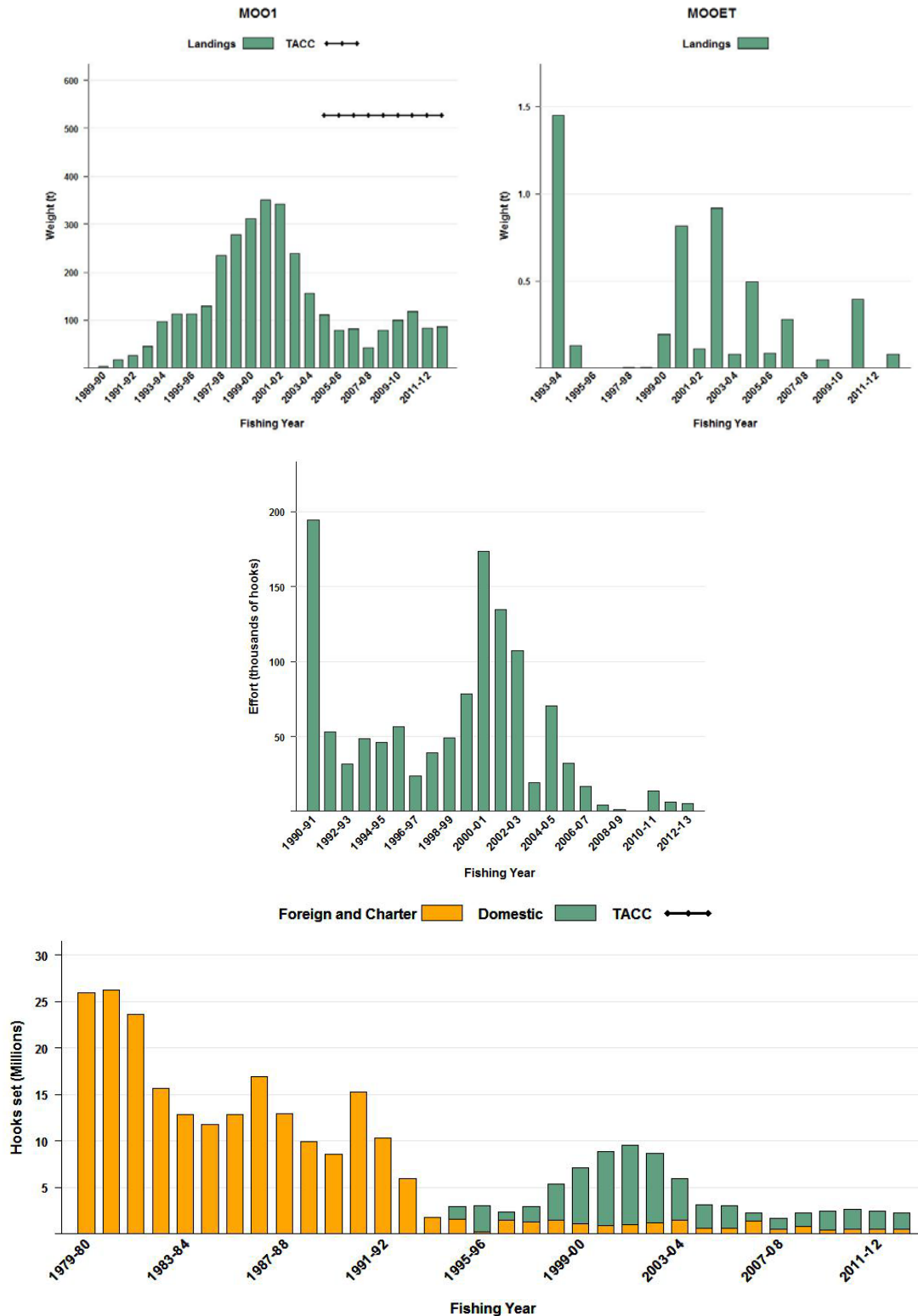


Figure 1: [Top] Moonfish catch from 1989–90 to 2012–13 within New Zealand waters (MOO 1) and 1993–94 to 2012–13 on the high seas (MOO ET). [Middle] Fishing effort (number of hooks set) for all high seas New Zealand flagged surface longline vessels from 1990–91 to 2012–13. [Bottom] Fishing effort (number 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	85

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).

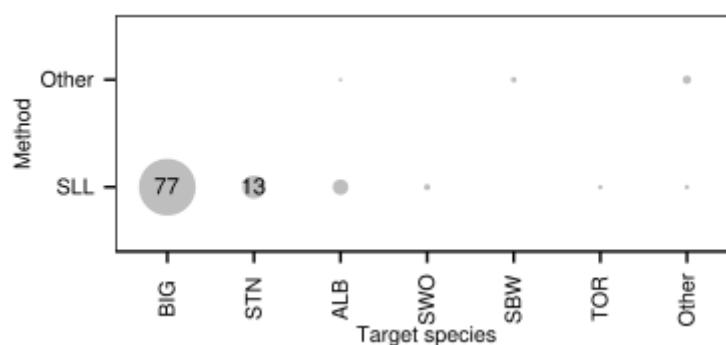


Figure 2: A summary of the proportion of landings of moonfish taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage. SLL = surface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

MOONFISH (MOO)

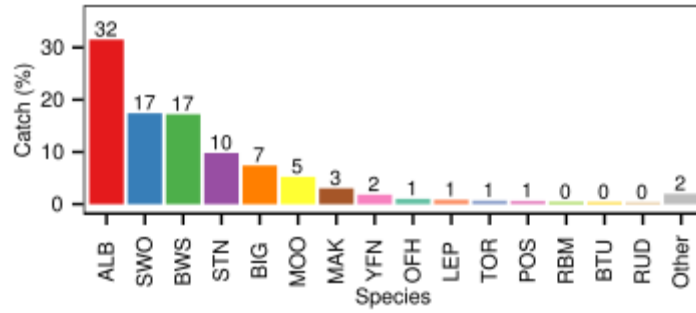


Figure 3: A summary of species composition of the reported surface longline catch. The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).

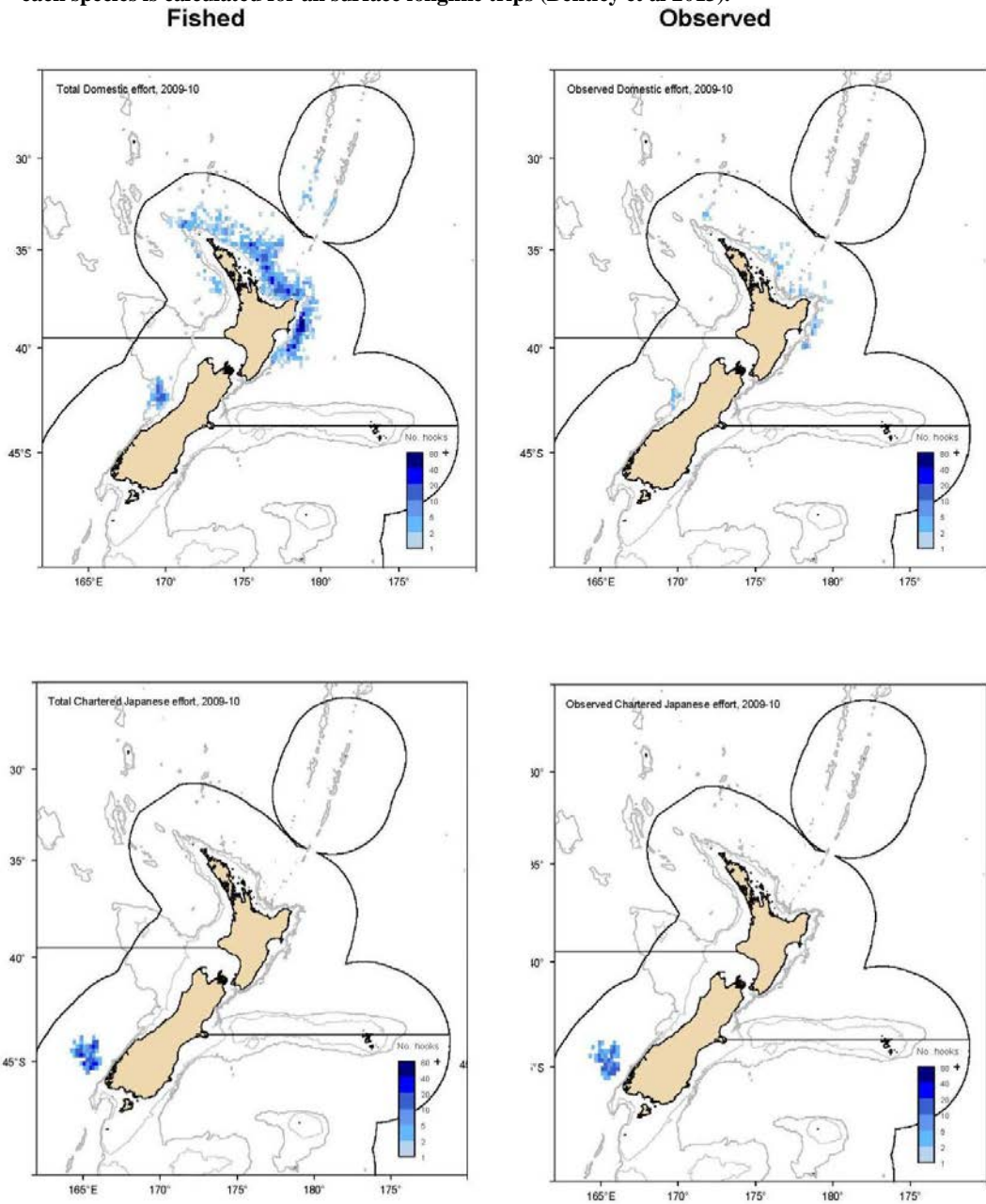


Figure 4: Distribution of fishing positions for domestic (top two panels) and charter (bottom two panels) vessels, for the 2009–10 fishing year, displaying both fishing effort (left) and observed effort (right).

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
	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).

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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 2014 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=2122>) (Ministry for Primary Industries 2013a).

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 2012–13, there were 818 observed captures of birds across other surface longline target fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, pacific bluefin tuna and swordfish). Seabird capture rates since 2003 are presented in Table 5 and Figures 5 and 6. Seabird captures were more frequent off the south west coast of the South Island (Figure 7). Bayesian models of varying complexity dependent on data quality have been used to estimate captures across a range of methods (Richard & Abraham 2014). Observed and estimated seabird captures in albacore longline fisheries are provided in Table 6.

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.

Risk posed by commercial fishing to seabirds has been assessed via a level 2 method which supports much of the NPOA-Seabirds 2013 risk assessment framework (MPI 2013b). The method used in the level 2 risk assessment arose initially from an expert workshop hosted by the Ministry of Fisheries in 2008. The overall framework is described in Sharp et al. (2011) and has been variously applied and improved in multiple iterations (Vaugh et al. 2009, Richard et al. 2011, Richard and Abraham 2013, Richard et al. 2013 and Richard & Abraham in press). The method applies an “exposure-effects” approach where exposure refers to the number of fatalities is calculated from the overlap of seabirds with fishing effort compared with observed captures to estimate the species vulnerability (capture rates per encounter) to each fishery group. This is then

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compared to the population's productivity, based on population estimates and biological characteristics to yield estimates of population-level risk.

The 2014 iteration of the seabird risk assessment (Richard & Abraham in press) assessed other surface longline target fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, pacific bluefin tuna and swordfish) contribution to the total risk posed by New Zealand commercial fishing to seabirds (see Table 7). These target fisheries contribute 0.003 of PBR₁ to the risk to Southern Buller's albatross which was assessed to be at very high risk from New Zealand commercial fishing (Richard & Abraham in press).

Table 5: Number of observed seabird captures in the New Zealand surface longline fisheries, 2002–03 to 2012–13, 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	5	2	27	0	280	39	0	353
NZ white-capped	Very high	0	2	0	3	10	62	36	1	114
Northern Buller's	High	0	0	0	1	0	0	0	0	1
Gibson's	High	4	16	0	17	0	6	3	1	47
Antipodean	High	12	10	1	8	0	0	0	1	32
Northern royal	Medium	0	0	1	0	0	0	0	0	1
Southern royal	Medium	0	1	0	0	0	4	1	0	6
Campbell black-browed	Medium	2	10	2	29	0	3	3	1	50
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	47	8	93	10	355	83	5	657
Other seabirds										
	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
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	20	3	3	38
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	23	9	8	159

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 and preliminary estimates for 2012–13 are based on data version 20140131.

Fishing year	Fishing effort			Observed captures		Estimated captures	
	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 772 188	2 195 152	20.4	115	0.052	2 088	1 613–2 807
2003–2004	7 386 329	1 607 304	21.8	71	0.044	1 395	1 086–1 851
2004–2005	3 679 765	783 812	21.3	41	0.052	617	483–793
2005–2006	3 690 119	705 945	19.1	37	0.052	808	611–1 132
2006–2007	3 739 912	1 040 948	27.8	187	0.18	958	736–1 345
2007–2008	2 246 189	421 900	18.8	37	0.088	524	417–676
2008–2009	3 115 633	937 496	30.1	57	0.061	609	493–766
2009–2010	2 995 264	665 883	22.2	135	0.203	939	749–1 216
2010–2011	3 187 879	674 572	21.2	47	0.07	705	532–964
2011–2012	3 100 277	728 190	23.5	64	0.088	829	617–1 161
2012–2013†	2 862 182	560 333	19.6	27	0.048	783	567–1 144

†Provisional data, model estimates not finalised.

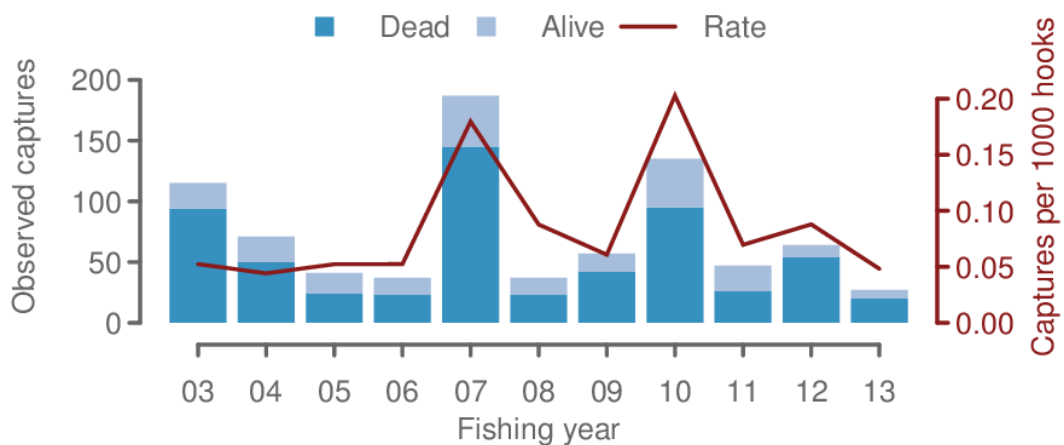


Figure 5: Observed captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

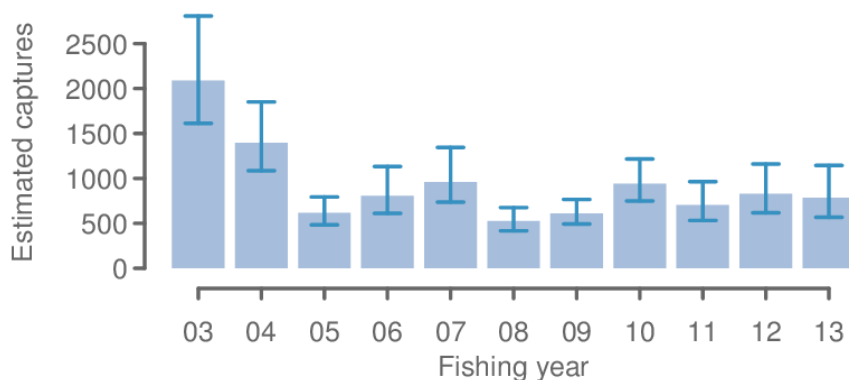


Figure 6: Estimated captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

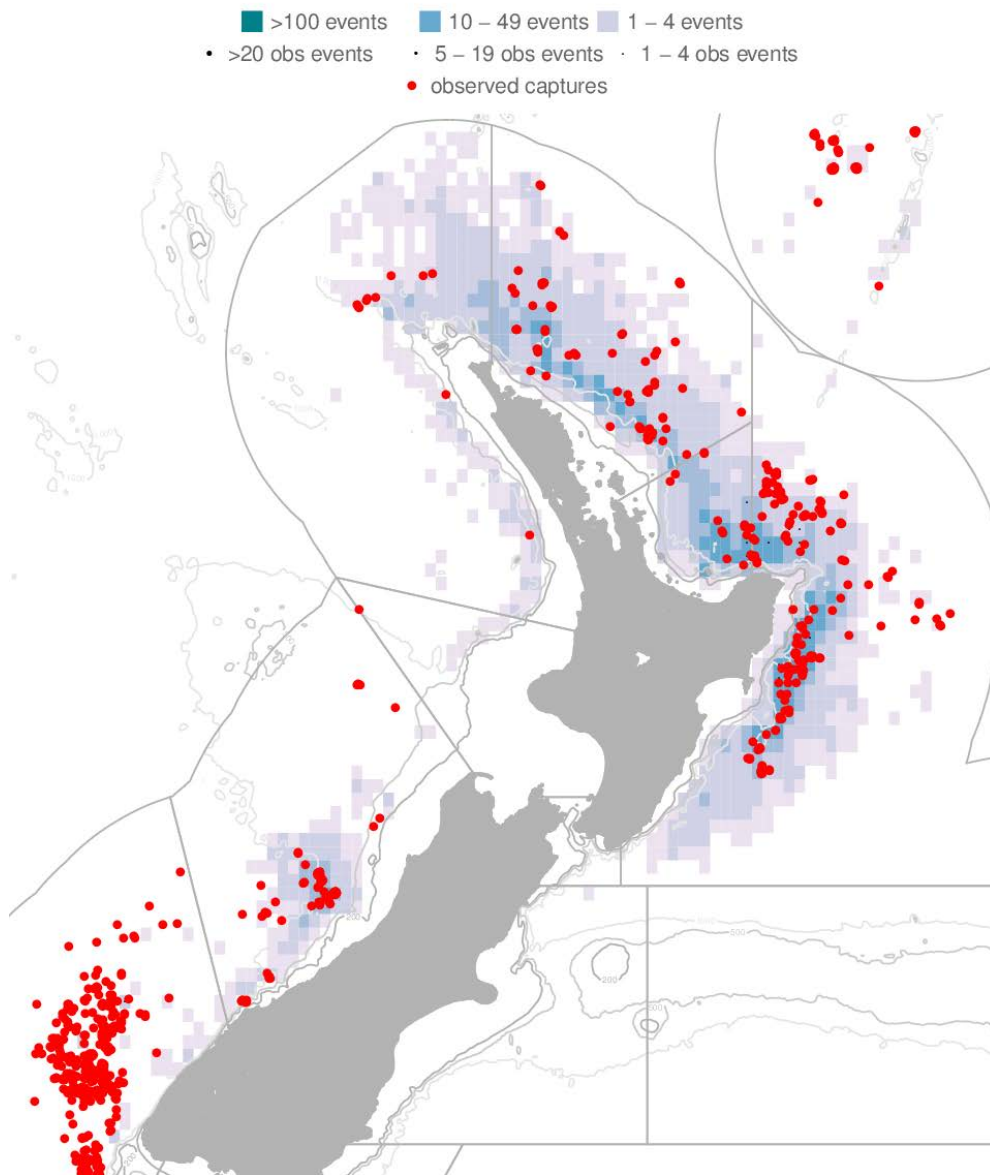


Figure 7: Distribution of fishing effort in the New Zealand surface longline fisheries and observed seabird captures, 2002–03 to 2012–13. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 89.4% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

Table 7: Risk ratio of seabirds predicted by the level two risk assessment for the other species target surface longline fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, pacific bluefin tuna and swordfish) and all fisheries included in the level two risk assessment, 2006–07 to 2012–13, showing seabird species with risk category of very or high, or a medium risk category and risk ratio of at least 1% of the total risk. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Potential Biological Removals, PBR₁ (from Richard and Abraham 2014 where full details of the risk assessment approach can be found). PBR₁ applies a recovery factor of 1.0. Typically a recovery factor of 0.1 to 0.5 is applied (based on the state of the population) to allow for recovery from low population sizes as quickly as possible. This should be considered when interpreting these results. The New Zealand threat classifications are shown (Robertson et al 2013 at <http://www.doc.govt.nz/documents/science-and-technical/nztc4entire.pdf>)

Species name	Risk ratio			Risk category	NZ Threat Classification
	OTH target SLL	Total risk from NZ commercial fishing	% of total risk from NZ commercial fishing		
Black petrel	0.000	15.095	0.00	Very high	Threatened: Nationally Vulnerable
Salvin's albatross	0.000	3.543	0.00	Very high	Threatened: Nationally Critical
Southern albatross Buller's	0.003	2.823	0.10	Very high	At Risk: Naturally Uncommon
Flesh-footed shearwater	0.000	1.557	0.00	Very high	Threatened: Nationally Vulnerable
Gibson's albatross	0.000	1.245	0.00	Very high	Threatened: Nationally Critical
New Zealand white-capped albatross	0.000	1.096	0.01	Very high	At Risk: Declining
Chatham Island albatross	0.000	0.913	0.00	High	At Risk: Naturally Uncommon
Antipodean albatross	0.000	0.888	0.00	High	Threatened: Nationally Critical
Westland petrel	0.000	0.498	0.00	High	At Risk: Naturally Uncommon
Northern albatross Buller's	0.000	0.336	0.13	High	At Risk: Naturally Uncommon
Campbell black-browed albatross	0.000	0.304	0.00	High	At Risk: Naturally Uncommon
Stewart Island shag	0.000	0.301	0.00	High	Threatened: Nationally Vulnerable

4.2.2 Sea turtle bycatch

Between 2002–03 and 2012–13, there were 15 observed captures of sea turtles across all surface longline fisheries (Tables 8 and 9, 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 8: Number of observed sea turtle captures in the New Zealand surface longline fisheries, 2002–03 to 2012–13, 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	2	3
Total	1	6	3	5	15

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Table 9: 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 year	Fishing effort			Observed captures	
	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 772 188	2 195 152	20.4	0	0
2003–2004	7 386 329	1 607 304	21.8	1	0.001
2004–2005	3 679 765	783 812	21.3	2	0.003
2005–2006	3 690 119	705 945	19.1	1	0.001
2006–2007	3 739 912	1 040 948	27.8	2	0.002
2007–2008	2 246 189	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	2	0.002
2009–2010	2 995 264	665 883	22.2	0	0
2010–2011	3 187 879	674 572	21.2	4	0.006
2011–2012	3 100 277	728 190	23.5	0	0
2012–2013	2 862 182	560 333	19.6	2	0.004

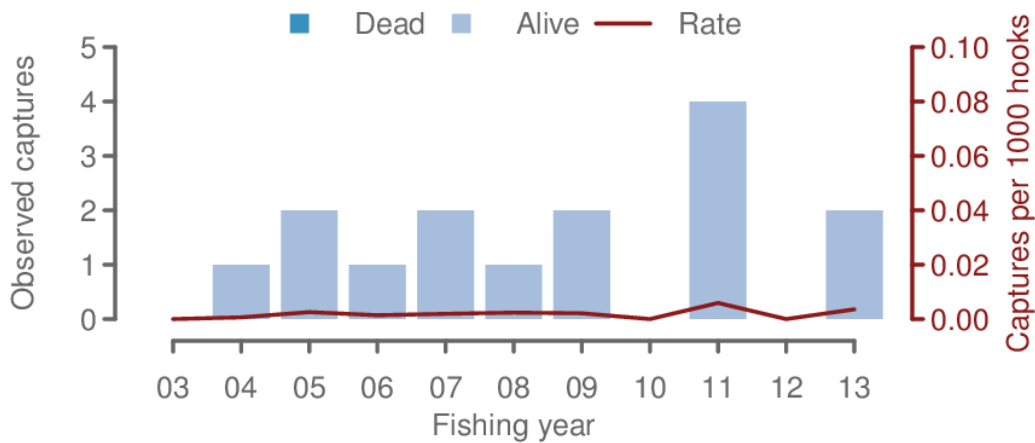


Figure 8: Observed captures of sea turtles in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

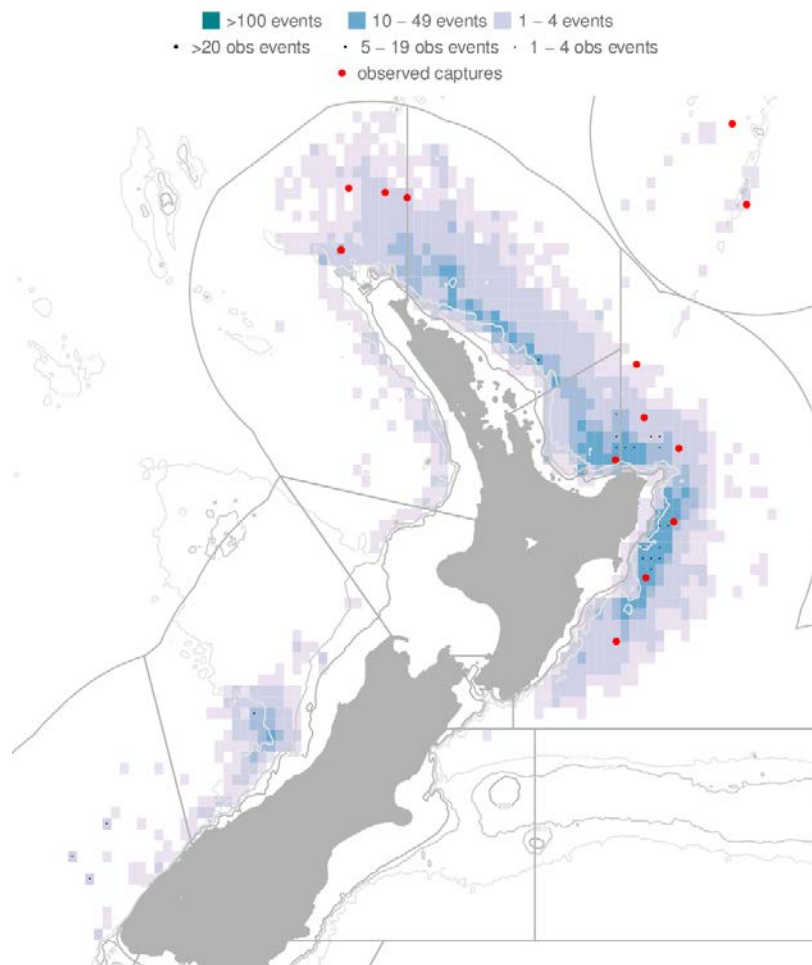


Figure 9: Distribution of fishing effort in the New Zealand surface longline fisheries and observed sea turtle captures, 2002–03 to 2012–13. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 89.4% 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 2012–13, 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 10 and 11, 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).

MOONFISH (MOO)

Table 10: Number of observed cetacean captures in the New Zealand surface longline fisheries, 2002–03 to 2012–13, 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 11: 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 year	Fishing effort			Observed captures	
	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 772 188	2 195 152	20.4	1	0
2003–2004	7 386 329	1 607 304	21.8	4	0.002
2004–2005	3 679 765	783 812	21.3	1	0.001
2005–2006	3 690 119	705 945	19.1	0	0
2006–2007	3 739 912	1 040 948	27.8	0	0
2007–2008	2 246 189	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	0	0
2009–2010	2 995 264	665 883	22.2	0	0
2010–2011	3 187 879	674 572	21.2	0	0
2011–2012	3 100 277	728 190	23.5	0	0
2012–2013	2 862 182	560 333	19.6	0	0

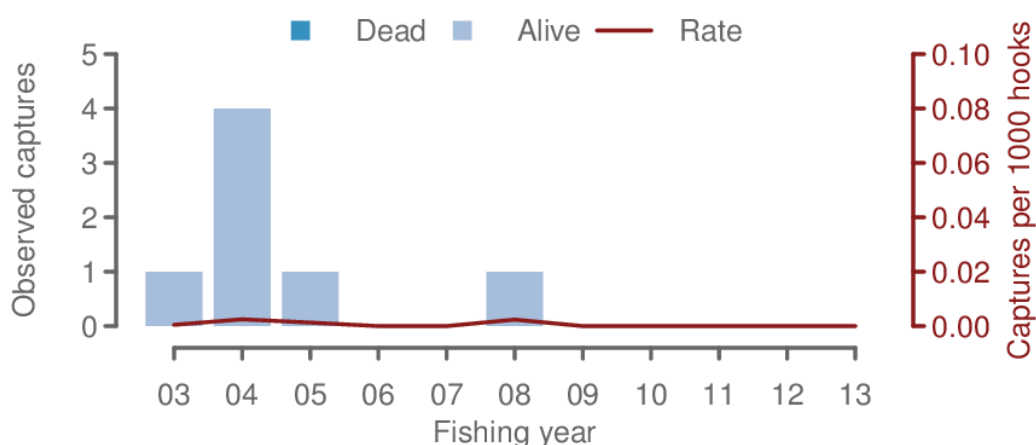


Figure 10: Observed captures of cetaceans in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

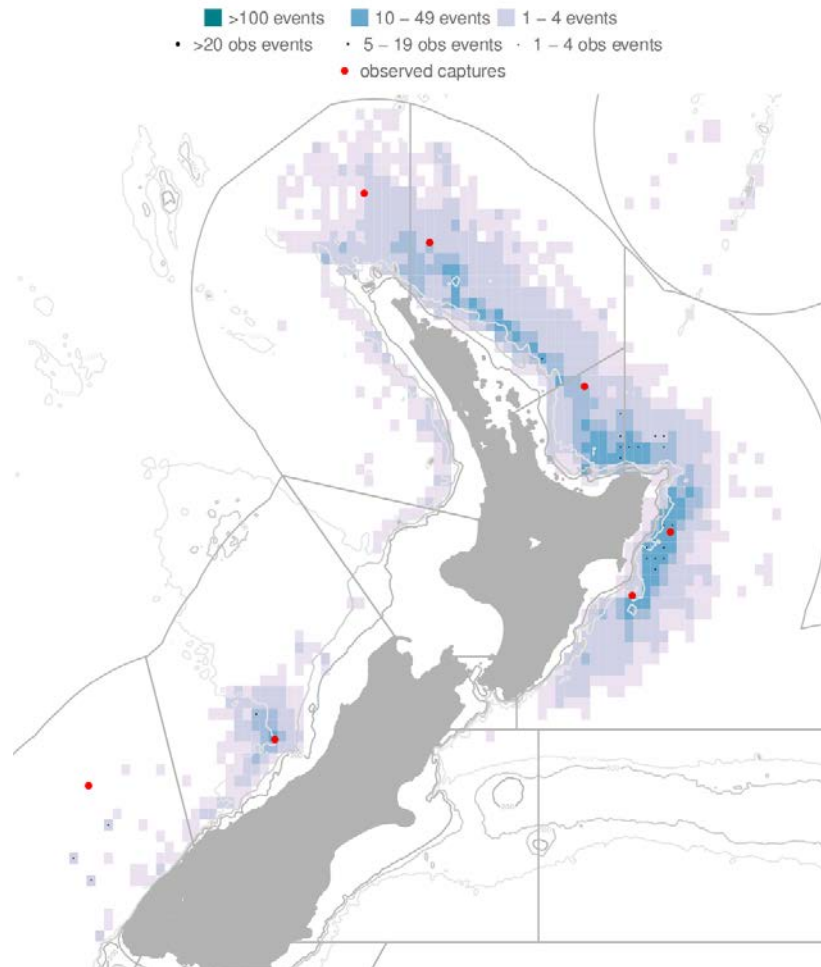


Figure 11: Distribution of fishing effort in the New Zealand surface longline fisheries and observed cetacean captures, 2002–03 to 2012–13. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 89.4% 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 40° 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 slopes steeply to deeper waters relatively close to shore, and thus rookeries and haulouts, around much of the South Island and offshore islands. Captures on longlines occur when the fur seals attempt to feed on the bait and fish catch 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). Capture rates in 2011–12 and 2012–13 were higher than they were in the early 2000s (Figures 12 and 13). While fur seal captures have occurred throughout the

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range of this fishery most New Zealand captures have occurred off the Southwest coast of the South Island (Figure 14). Between 2002–03 and 2012–13, there were 267 observed captures of New Zealand fur seal in surface longline fisheries (Tables 12 and 13).

Table 12: Number of observed New Zealand fur seal captures in the New Zealand surface longline fisheries, 2002–03 to 2012–13, 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 Snare Shelf	West Coast North Island	West Coast South Island	Total
New Zealand fur seal	11	33	179	4	4	2	34	267

Table 13: 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). Data from Thompson et al (2013), retrieved from <http://data.dragonfly.co.nz/psc/>. Estimates from 2002–03 to 2010–11 and preliminary estimates for 2012–13 are based on data version 20140131.

Fishing year	Fishing effort			Observed captures		Estimated captures	
	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 772 188	2 195 152	20.4	56	0.026	299	199–428
2003–2004	7 386 329	1 607 304	21.8	40	0.025	134	90–188
2004–2005	3 679 765	783 812	21.3	20	0.026	66	38–99
2005–2006	3 690 119	705 945	19.1	12	0.017	47	23–79
2006–2007	3 739 912	1 040 948	27.8	10	0.010	32	14–55
2007–2008	2 246 189	421 900	18.8	10	0.024	40	19–68
2008–2009	3 115 633	937 496	30.1	22	0.023	53	29–81
2009–2010	2 995 264	665 883	22.2	19	0.029	77	43–121
2010–2011	3 187 879	674 572	21.2	17	0.025	64	35–101
2011–2012	3 100 277	728 190	23.5	40	0.055	140	92–198
2012–2013†	2 862 182	560 333	19.6	21	0.037	110	65–171

†Provisional data, model estimates not finalised.

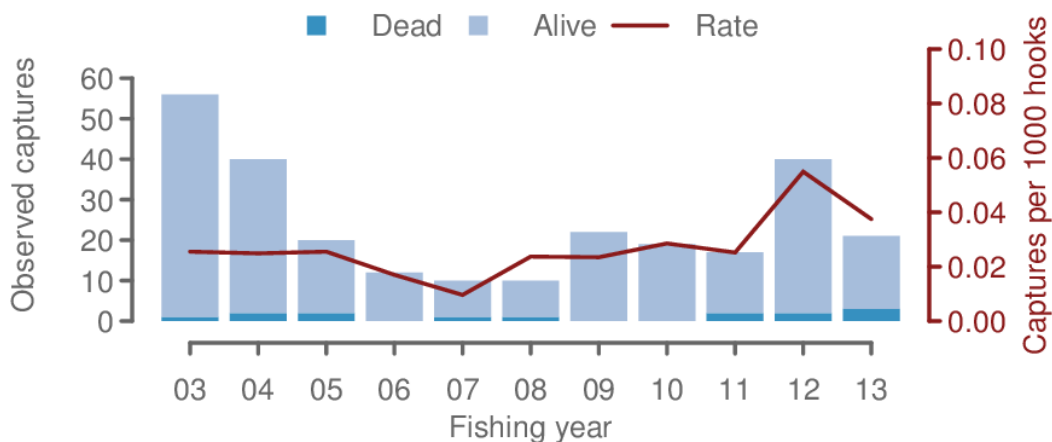


Figure 12: Observed captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

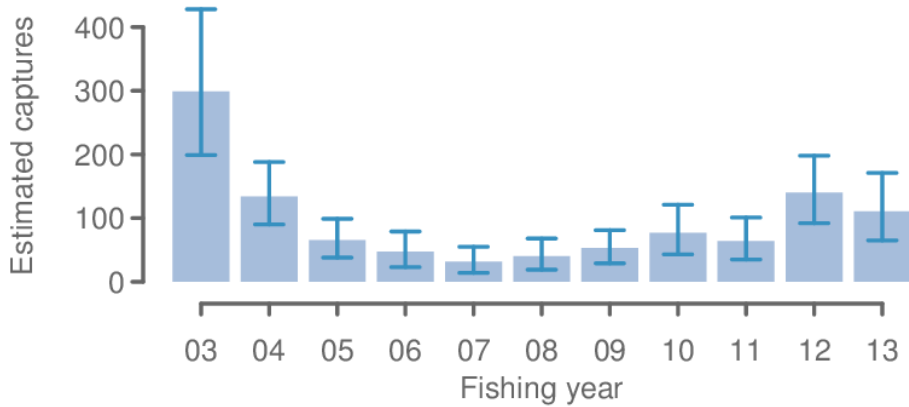


Figure 13: Estimated captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2012–13.

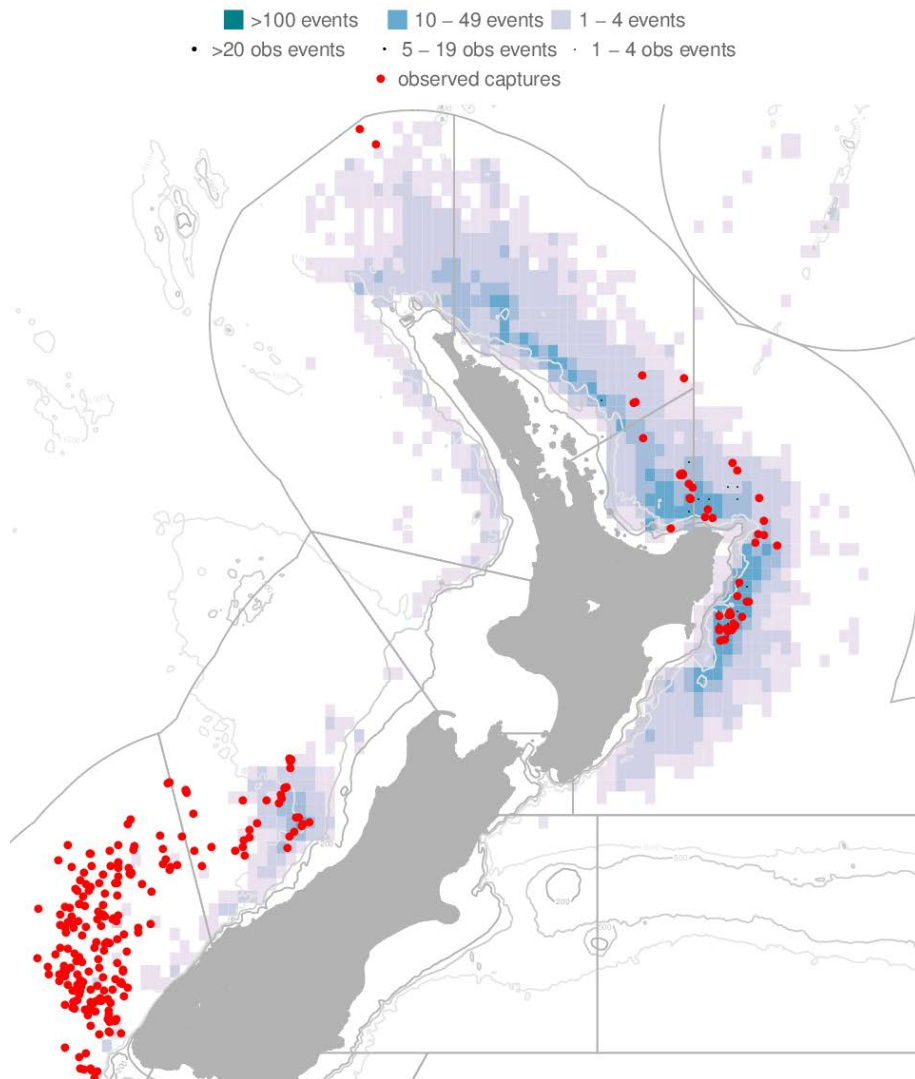


Figure 14: Distribution of fishing effort in the New Zealand surface longline fisheries and observed New Zealand fur seal captures, 2002–03 to 2012–13. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated 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, 89.4% 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 14). Southern bluefin tuna and albacore tuna are the only target species that occur in the top five of the frequency of occurrence.

Table 14: Total estimated catch (numbers of fish) of common bycatch species in the New Zealand longline fishery as estimated from observer data from 2009 to 2013. Also provided is the percentage of these species retained (2013 data only) and the percentage of fish that were alive when discarded, N/A (none discarded).

Species	2010	2011	2012	2013	% retained (2013)	discards % alive (2013)
Blue shark	66113	53432	132925	158736	45.2	97.4
Lancetfish	43425	37305	7866	19172	0.1	37.6
Rays bream	20041	18453	19918	13568	97.4	4.2
Porbeagle shark	4679	9929	7019	9805	34.0	79.8
Mako shark	4490	9770	3902	3981	35.5	84.9
Moonfish	5398	3418	2363	2470	99.0	0.0
Escolar	1539	6602	2181	2088	30.2	76.3
Sunfish	3148	3773	3265	1937	2.7	100.0
Pelagic stingray	1983	4090	712	1199	1.0	97.0
Butterfly tuna	1158	909	713	1030	48.1	11.1
Deepwater dogfish	377	548	647	743	1.2	88.5
Oilfish	886	1747	509	386	26.5	72.2
Rudderfish	326	338	491	362	13.0	80.0
Thresher shark	209	349	246	256	33.3	75.0
Skipjack tuna	91	255	123	240	100.0	N/A
Dealfish	1160	223	372	237	1.7	25.1
Striped marlin	471	175	124	182	0.0	44.4
Big scale pomfret	505	139	108	67	88.2	100.0
School shark	62	49	477	21	100.0	N/A

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).

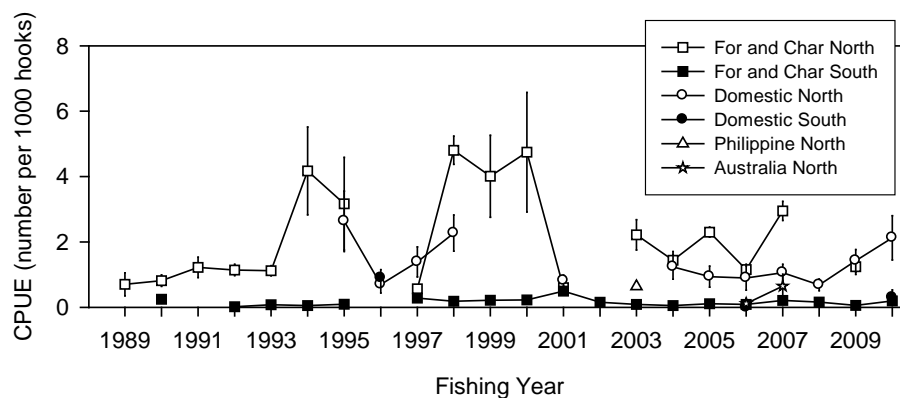


Figure 15: Annual variation in moonfish CPUE by fleet and area. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989 (Griggs & Baird 2013).

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.

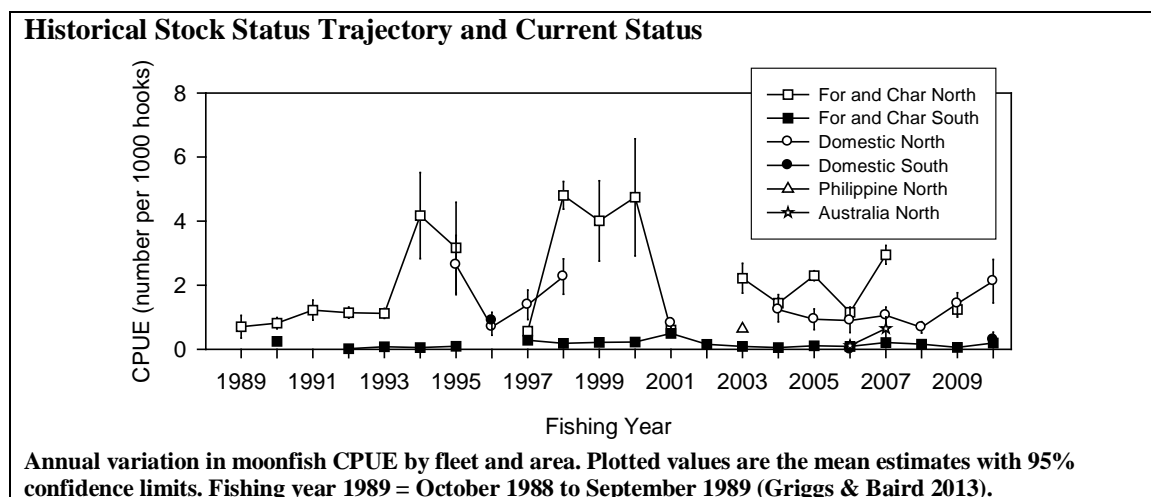
6. STATUS OF THE STOCKS

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

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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
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