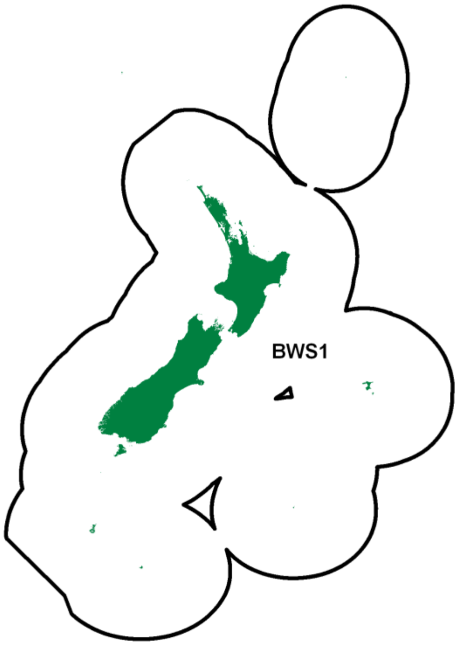
# BLUE SHARK (BWS)

(*Prionace glauca*)




## 1. FISHERY SUMMARY

Blue shark was introduced into the QMS on 1 October 2004 under a single QMA, BWS 1, with allowances, TACC, and TAC in Table 1.

**Table 1: Recreational and Customary non-commercial allowances, other mortalities, TACC and TAC (all in tonnes) for blue shark.**

| Fishstock | Recreational Allowance | Customary non-commercial Allowance | Other mortality | TACC | TAC |
|---|---|---|---|---|---|
| BWS 1 | 20 | 10 | 190 | 1 860 | 2 080 |

Blue shark was added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because blue shark is a highly migratory species and it is not possible to estimate MSY for the part of the stock that is found within New Zealand fisheries waters.

Blue shark was also added to the Sixth Schedule of the 1996 Fisheries Act with the provision that:

> "A commercial fisher may return any blue shark to the waters from which it was taken from if –
> (a) that blue shark is likely to survive on return; and
> (b) the return takes place as soon as practicable after the blue shark is taken."

Management of blue sharks throughout the western and central Pacific Ocean (WCPO) is the responsibility of the Western and Central Pacific Fisheries Commission (WCPFC). Under this regional convention New Zealand is responsible for ensuring that the management measures applied within New Zealand fisheries waters are compatible with those of the Commission.

## 1.1 Commercial fisheries

Most of the blue shark catch in the New Zealand EEZ is caught in the tuna surface longline fishery. Relatively little blue shark is caught by other methods. Data collected by the Ministry for Primary Industries (MPI) Fishery Observer Services from the tuna longline fishery suggest that most of the blue shark catch has been processed (72% of the observed catch), although prior to 1 October 2014 usually only the fins were retained and the rest of the carcass was dumped (over 99% of the processed, observed catch). Greenweight (total weight) was obtained by applying species specific conversion factors to the weight of the fins landed. On 1 October 2014 a ban on shark finning was introduced; after this time any blue sharks for which the fins are retained are required to be landed with the fins attached (artificial attachment such as tying or securing the fins to the trunk is permitted). Figure 1 shows historical landings and fishing effort for BWS 1 and BWS ET.

Landings of blue sharks reported by fishers on CELRs, Catch CLRs, or TLCERs and by processors on LFRRs and MHRs are given in Table 2. Total weights reported by fishers were 551–1167 t per annum during 1997–98 to 2007–08. Processors (LFRRs) reported 525–1415 t per annum during 1997-98 to 2012-13.

In addition to catches within New Zealand fisheries waters, small catches are taken by New Zealand vessels operating on the high seas (Figure 1).

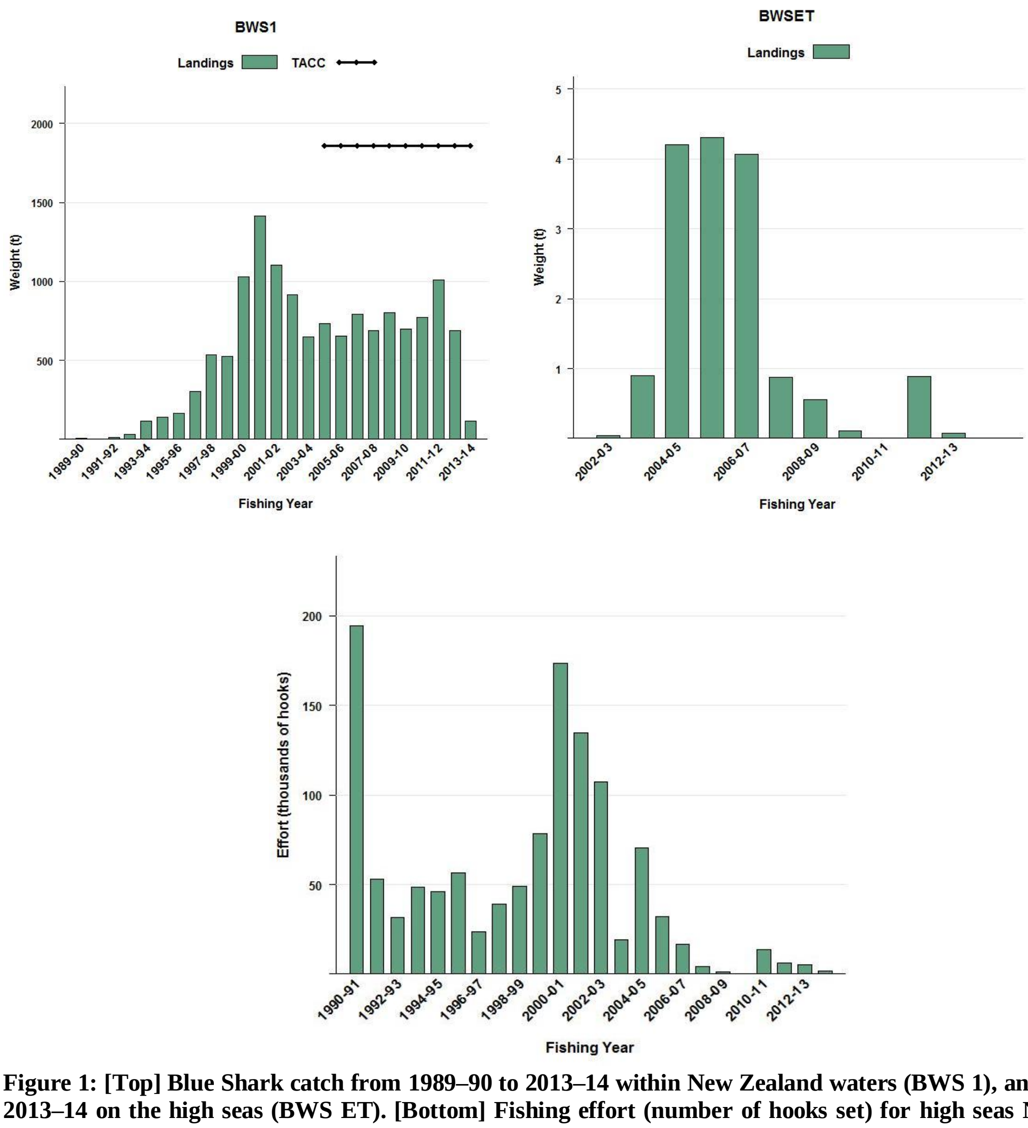



**Figure 1: [Top] Blue Shark catch from 1989–90 to 2013–14 within New Zealand waters (BWS 1), and 2002–03 to 2013–14 on the high seas (BWS ET). [Bottom] Fishing effort (number of hooks set) for high seas New Zealand flagged surface longline vessels, from 1990–91 to 2013–14. [Figure continued on next page].**

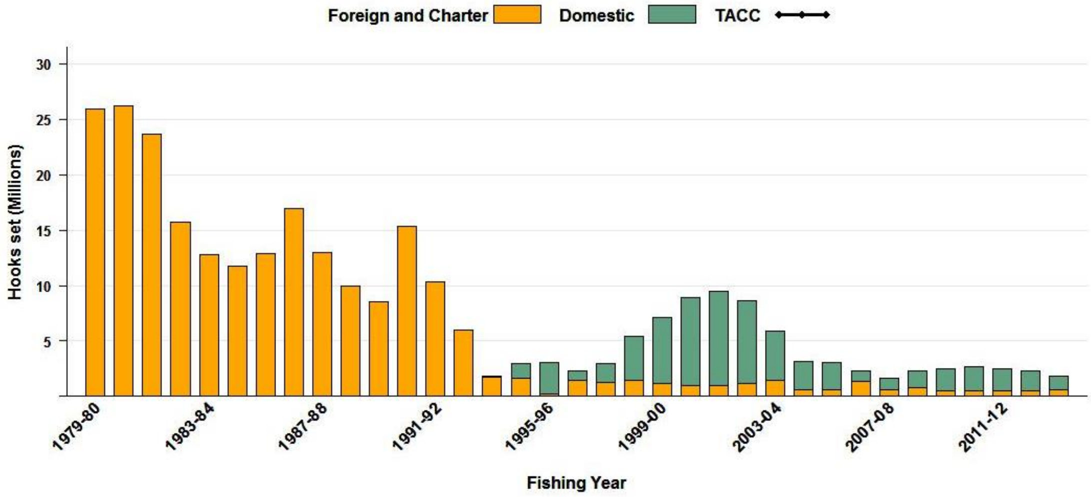



**Figure 1 [Continued]: Fishing effort (number of hooks set) for all domestic and foreign vessels (including effort by foreign vessels chartered by New Zealand fishing companies), from 1979–80 to 2013–14**

The majority of blue sharks (55%) are caught in the bigeye tuna fishery (Figure 2); although there are no directed blue shark fisheries, blue sharks form one of the three top catches by weight across all longline fisheries (17%) (Figure 3). Longline fishing effort is distributed along the east coast of the North Island and the south west coast of the South Island.

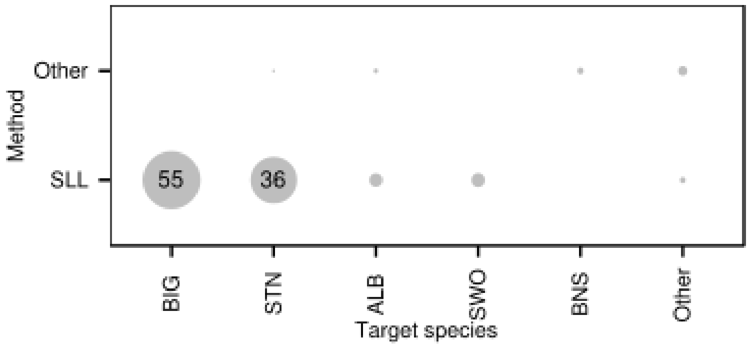



**Figure 2: A summary of the proportion of landings of blue shark taken by each target fishery and fishing method for 2012-13. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage. SLL = surface longline (Bentley et al 2013).**

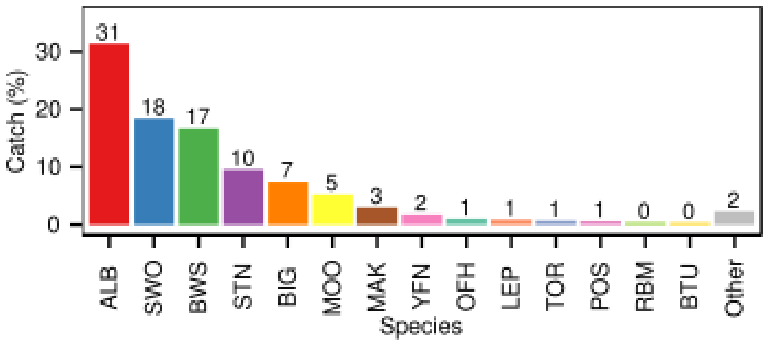



**Figure 3: A summary of species composition of the reported surface longline catch for 2012-13. The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).**

**Table 2: New Zealand estimated commercial landings of blue shark (t) reported by fishers on CELRs, CLRs, or TLCERs and processors (LFRRs or MHRs) by fishing year.**

| Year | Total reported | LFRR/MHR |
|---|---|---|
| 1989–90 | 12 | 5 |
| 1990–91 | 2 | 3 |
| 1991–92 | 18 | 13 |
| 1992–93 | 39 | 33 |
| 1993–94 | 371 | 118 |
| 1994–95 | 254 | 140 |
| 1995–96 | 152 | 166 |
| 1996–97 | 161 | 303 |
| 1997–98 | 551 | 537 |
| 1998–99 | 576 | 525 |
| 1999–00 | 641 | 1 031 |
| 2000–01 | 1 167 | 1 415 |
| 2001–02 | 1 076 | 1 105 |
| 2002–03* | 968 | 914 |
| 2003–04* | 649 | 649 |
| 2004–05* | 734 | 734 |
| 2005–06* | 656 | 656 |
| 2006–07* | 790 | 794 |
| 2007–08* | 681 | 687 |
| 2008–09* | | 804 |
| 2009–10* | | 696 |
| 2010–11* | | 770 |
| 2011–12* | | 1 011 |
| 2012–13* | | 691 |
| 2013–14* | | 117 |

[1] Note that there may be some misreporting of blue shark catches (MPI species code "BWS") as bluenose (*Hyperoglyphe antarctica*; MPI species code "BNS") and vice versa. *MHR rather than LFRR data.

**Table 3: Percentage of blue shark (including discards) that were alive or dead when arriving at the longline vessel and observed during 2006–07 to 2012–13, by fishing year, fleet and region. Small sample sizes (number observed < 20) were omitted Griggs & Baird (2013). [Continued on next page]**

| Year | Fleet | Area | % alive | % dead | Number |
|---|---|---|---|---|---|
| **2006–07** | Australia | North | 95.4 | 4.6 | 131 |
| | Charter | North | 89.8 | 10.2 | 2 155 |
| | | South | 93.4 | 6.6 | 5 025 |
| | Domestic | North | 87.9 | 12.1 | 3 991 |
| | **Total** | | **90.8** | **9.2** | **11 302** |
| **2007–08** | Charter | South | 89.2 | 10.8 | 2 560 |
| | Domestic | North | 88.6 | 11.4 | 5 599 |
| | **Total** | | **88.8** | **11.2** | **8 159** |
| **2008–09** | Charter | North | 94.5 | 5.5 | 1 317 |
| | | South | 95.1 | 4.9 | 4 313 |
| | Domestic | North | 92.0 | 8.0 | 3 935 |
| | | South | 94.9 | 5.1 | 98 |
| | **Total** | | **93.7** | **6.3** | **9 663** |
| **2009–10** | Charter | South | 95.6 | 4.4 | 2 004 |
| | Domestic | North | 85.7 | 14.3 | 2 853 |
| | | South | 94.0 | 6.0 | 882 |
| | **Total** | | **90.5** | **9.5** | **5 739** |
| **2010-11** | Charter | North | 100.0 | 0.0 | 25 |
| | | South | 95.9 | 4.1 | 2 650 |
| | Domestic | North | 92.8 | 7.2 | 3 553 |
| | | South | | | 0 |
| | **Total** | | **94.1** | **5.9** | **6 228** |

**Table 3 [Continued]:**

| Year | Fleet | Area | % alive | % dead | Number |
|---|---|---|---|---|---|
| **2011-12** | Charter | North | 100.0 | 0.0 | 10 |
| | | South | 93.0 | 7.0 | 5 394 |
| | Domestic | North | 93.5 | 6.5 | 5 672 |
| | | South | 93.2 | 6.8 | 1 592 |
| | **Total** | | **93.2** | **6.8** | **12 668** |
| **2012-13** | Charter | North | 96.1 | 3.9 | 256 |
| | | South | 89.3 | 10.7 | 5 087 |
| | Domestic | North | 95.5 | 4.5 | 5 150 |
| | | South | 95.6 | 4.4 | 180 |
| | **Total** | | **92.5** | **7.5** | **10 673** |
| **Total all strata** | | | **91.9** | **8.1** | **64 432** |

Across all fleets in the longline fishery most of the blue sharks were alive (93%) when brought to the side of the vessel during 2010–11 to 2012–13 (Table 3). The foreign charter fleet retained most of the blue sharks (77–89%) mostly for fins, while practices within the domestic fleet were more variable, ranging from 12−53% of their blue shark catch retained, mostly for the fins. The domestic fleet retained some blue shark flesh in 2010–11 and 2011–12, and the percentage of blue sharks discarded by domestic vessels increased over the three year period (Table 4).

**Table 4: Percentage of blue shark that were retained, or discarded or lost, when observed on a longline vessel during 2006–07 to 2012–13, by fishing year and fleet. Small sample sizes (number observed < 20) omitted Griggs & Baird (2013). [Continued on next page]**

| Year | Fleet | Area | % retained or finned | % discarded or lost | Number |
|---|---|---|---|---|---|
| **2006–07** | Australia | | 3.0 | 97.0 | 132 |
| | Charter | | 85.1 | 14.9 | 8 272 |
| | Domestic | | 33.2 | 66.8 | 3 994 |
| | **Total** | | **67.5** | **32.5** | **12 398** |
| **2007–08** | Charter | | 91.8 | 8.2 | 2 638 |
| | Domestic | | 59.5 | 40.5 | 5 650 |
| | **Total** | | **69.8** | **30.2** | **8 288** |
| **2008–09** | Charter | | 87.5 | 12.5 | 5 723 |
| | Domestic | | 54.0 | 46.0 | 4 049 |
| | **Total** | | **73.6** | **26.4** | **9 772** |
| **2009–10** | Charter | | 91.7 | 8.3 | 2 023 |
| | Domestic | | 37.6 | 62.4 | 5 531 |
| | **Total** | | **52.1** | **47.9** | **7 554** |
| **2010-11** | Charter | North | 100.0 | 0.0 | 25 |
| | | South | 88.9 | 11.1 | 2 650 |
| | Domestic | North | 43.0 | 57.0 | 3 736 |
| | | South | | | 0 |
| | **Total** | | **62.2** | **37.8** | **6 411** |

**Table 4 [Continued]:**

| | | | | | |
|---|---|---|---|---|---|
| **2011-12** | Charter | North | 60.0 | 40.0 | 10 |
| | | South | 86.2 | 13.8 | 5 394 |
| | Domestic | North | 44.2 | 55.8 | 6 346 |
| | | South | 88.0 | 12.0 | 1 601 |
| | **Total** | | **66.4** | **33.6** | **13 351** |
| **2012-13** | Charter | North | 72.7 | 27.3 | 256 |
| | | South | 77.0 | 23.0 | 5 088 |
| | Domestic | North | 12.3 | 87.7 | 5 372 |
| | | South | 0.0 | 100.0 | 180 |
| | **Total** | | **43.8** | **56.2** | **10 896** |
| **Total all strata** | | | **62.2** | **37.8** | **68 670** |

Catches of blue sharks aboard tuna longline vessels are concentrated off the west and south-west coasts of the South Island, and the north-east coast of the North Island (Figure 4). Most of the blue shark landings reported by fishers (TLCERs) are concentrated in FMAs 1, 2 and 7.

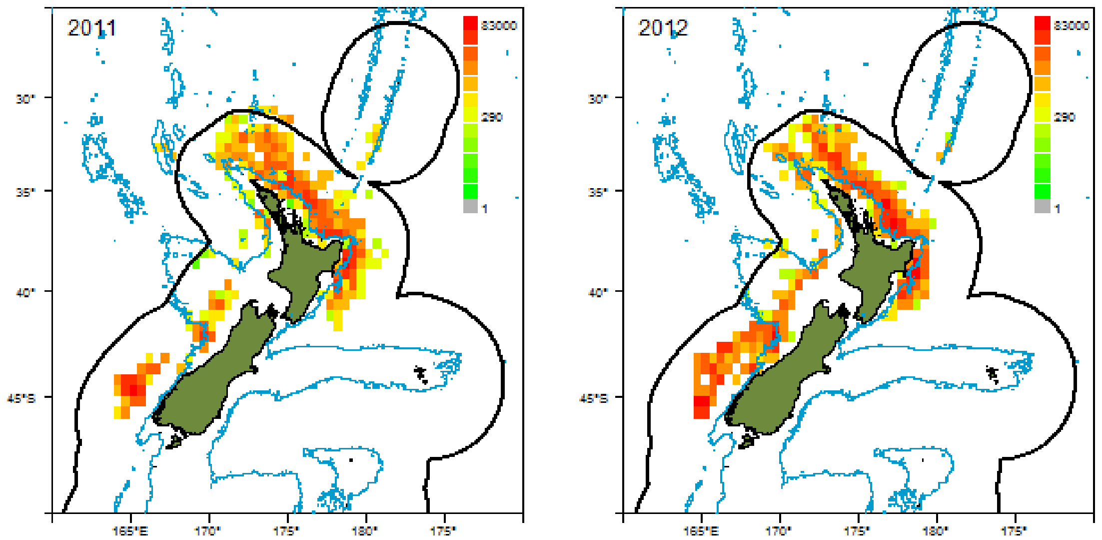



**Figure 4: Blue shark catches (kg) by the surface longline fishery in 0.5 degree rectangles by fishing year. Note the log scale used for the colour palette. Depth contour = 1000 m. Source: TLCER data (Francis et al. 2014) [Continued on next page].**

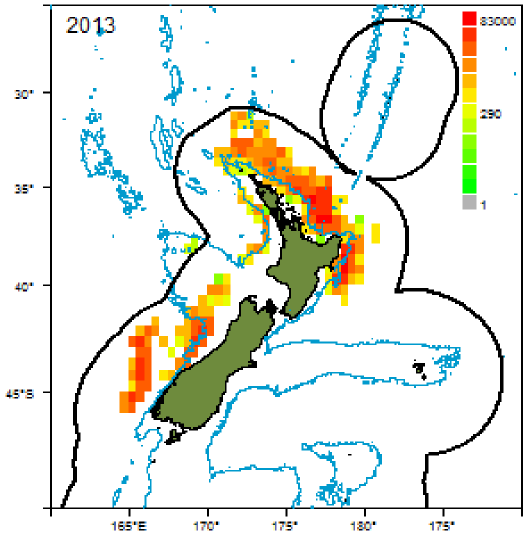



**Figure 4 [Continued]: Blue shark catches (kg) by the surface longline fishery in 0.5 degree rectangles by fishing year. Note the log scale used for the colour palette. Depth contour = 1000 m. Source: TLCER data (Francis et al. 2014).**

### 1.2 Recreational fisheries

Blue sharks are caught in relatively large numbers by recreational fishers in the New Zealand EEZ. Although not as highly regarded as other large, pelagic sharks such as mako in northern New Zealand, blue sharks are the primary target gamefish in southern New Zealand. Several hundred blue sharks were tagged and released each year by recreational fishers off Otago Heads in the late 1990s as part of the New Zealand Gamefish Tagging Programme. About 100 blue sharks have been tagged per year for the last ten years. The total recreational catch is unknown but most are released.

### 1.3 Customary non-commercial fisheries

Prior to European settlement, Maori caught large numbers of cartilaginous fishes, including blue sharks. However, there are no estimates of current Maori customary catch.

### 1.4 Illegal catch

There is no known illegal catch of blue sharks.

### 1.5 Other sources of mortality

About 91% of all observed blue sharks caught in the tuna longline fishery are retrieved alive. About 33% of all observed blue sharks are discarded. The proportion of sharks discarded dead is unknown. Mortality rates of blue sharks tagged and released by the New Zealand Gamefish Tagging Programme are also unknown.

## 2. BIOLOGY

Blue sharks (*Prionace glauca*) are large, highly migratory, pelagic carcharhinids found throughout the world's oceans in all tropical and temperate waters from about 50° N to 50° S. They are slender in build, rarely exceeding 3 m in total length and 200 kg in weight. They feed opportunistically on a range of living and dead prey, including bony fishes, smaller sharks, squid and carrion.

In New Zealand waters, male blue sharks are sexually mature at about 190–195 cm fork length (FL) and females at about 170–190 cm FL. Gestation in female blue sharks lasts between 9–12 months and between 4–135 pups (averaging 26–56) are born alive, probably during the spring. Pups are probably born at about 50 cm FL. The few embryos from New Zealand fisheries waters examined to date consisted of mid-term pups 21–37 cm FL collected in July and a full-term pup 54 cm FL collected in February. Blue sharks 50–70 cm FL are caught year-round in New Zealand fisheries waters but only in small numbers.

Age and growth estimates are available for blue sharks in New Zealand waters. These estimates were derived from counts of opaque growth zones in X-radiographs of sectioned vertebrae with the assumption that one opaque zone is formed per year. This assumption is untested. Female blue sharks appear to approach a lower mean asymptotic maximum length and grow at a faster rate than males. This differs from the age and growth analyses of blue shark from other oceans, where females typically approach a larger mean asymptotic maximum length than males. This is thought to result from the presence of relatively few large (over 250 cm FL), old female blue sharks in the length-at-age dataset analysed.

**Table 5: Estimates of biological parameters.**

| Fishstock | Estimate | | | | | Source |
|---|---|---|---|---|---|---|
| 1. Natural mortality (M) | | | | | | |
| BWS 1 | 0.19–0.21 | | | | | Manning & Francis (2005) |
| 2. Weight = a (length)$^b$ (Weight in kg, length in cm fork length) | | | | | | |
| | $a$ | $b$ | | | | |
| BWS 1 males | $1.578\times10^{-6}$ | 3.282 | | | | Ayers et al (2004) |
| BWS 1 females | $6.368\times10^{-7}$ | 3.485 | | | | |
| 3. Von Bertalanffy model parameter estimates | | | | | | |
| | $k$ | $t_0$ | $L_\infty$ | | | |
| BWS 1 males | 0.0668 | -1.7185 | 390.92 | | | Manning & Francis (2005) |
| BWS 1 females | 0.1106 | -1.2427 | 282.76 | | | |
| 4. Schnute model (case 1) parameter estimates (are provided for comparison with the von Bertalanffy estimates above) | | | | | | |
| | $L_1$ | $L_2$ | $\kappa$ | $\gamma$ | $L_\infty$ | |
| BWS 1 males | 65.21 | 217.48 | 0.1650 | 0.1632 | 297.18 | Manning & Francis (2005) |
| BWS 1 females | 63.50 | 200.60 | 0.2297 | 0.0775 | 235.05 | |

The MPI observer data suggest that large (over 250 cm FL) female blue sharks are missing from the catch, despite reliable personal observations to the contrary from commercial and recreational fishers. There is evidence of size and sex segregation in the distributions of blue sharks in the North Pacific, with large, pregnant females tending to be found nearer the equator than males or smaller females. It is possible that large female blue sharks occur in New Zealand but have not been adequately sampled by observers.

Growth rates estimated for New Zealand blue sharks are broadly comparable with overseas studies. Males and females appear to grow at similar rates until about seven years of age, when their growth appears to diverge. Age-at-maturity is estimated at 8 years for males and 7–9 years for females. The maximum recorded ages of male and female blue sharks in New Zealand waters are 22 and 19 years, respectively. Blue sharks appear to be fully recruited to the commercial longline fishery by the end of their second year. The commercial catch sampled by MPI observers consists of both immature and mature fish.

Estimates of biological parameters for blue sharks in New Zealand waters are given in Table 5.

## 3. STOCKS AND AREAS

The New Zealand Gamefish Tagging Programme has tagged and released 4761 blue sharks between 1979–80 and 2014–15 in the New Zealand EEZ. Most tagged sharks were captured and released off the east coast of the South Island. A total of 88 tagged sharks have been recaptured since the start of the tagging programme. The recapture data show dispersal of tagged sharks away from their release point, although the relationship between time at liberty and dispersal is unclear. While some tagged sharks have been recaptured with little apparent net movement away from their release point, others have been recaptured off from Australia, New Caledonia, Vanuatu, Fiji, Tonga, Cook Islands and French Polynesia (Figure 5). The longest movement recorded from a blue shark released in New Zealand was from a fish recaptured off Chile.

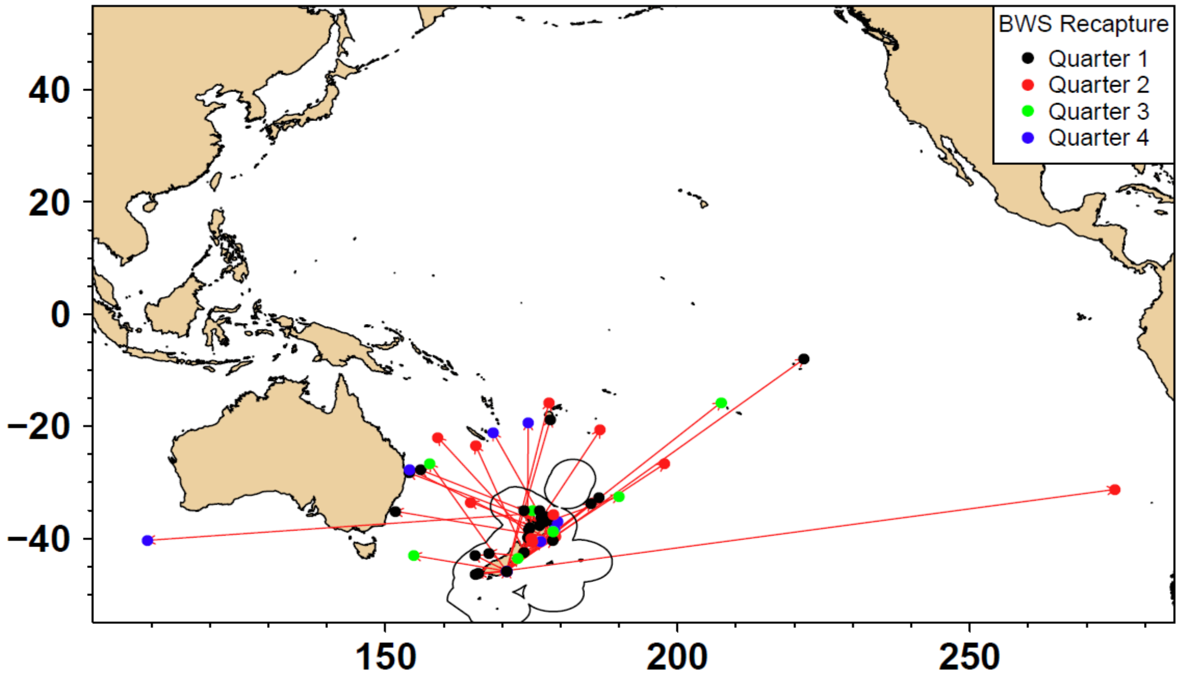



**Figure 5: All release and recapture locations of blue sharks in the gamefish tagging programme, 1982–2012.**

Although the data are relatively sparse, an overview of tagging data from Australia, New Zealand, the Central Pacific and California suggests population exchange exists between not only the eastern and western South Pacific, but also between the South Pacific, south Indian, and even South Atlantic oceans. This suggests that blue sharks in the South Pacific constitute a single biological stock, although whether this is part of a single larger Southern Hemisphere stock is unclear.

No other data are available on blue shark stock structure in the South Pacific.

## 4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was updated for the November 2015 Fishery Assessment Plenary after review by the Aquatic Environment Working Group. This summary is from the perspective of blue shark 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.
(www.mpi.govt.nz/document-vault/5008) (Ministry for Primary Industries (2014).

### 4.1 Role in the ecosystem

Blue shark (*Prionace glauca*) are active pelagic predators of bony fishes and squid. Small blue sharks (less than 1 m) feed predominantly on squid but switch to a diet dominated by fish as they grow (Figure 6) (Griggs et al 2007).

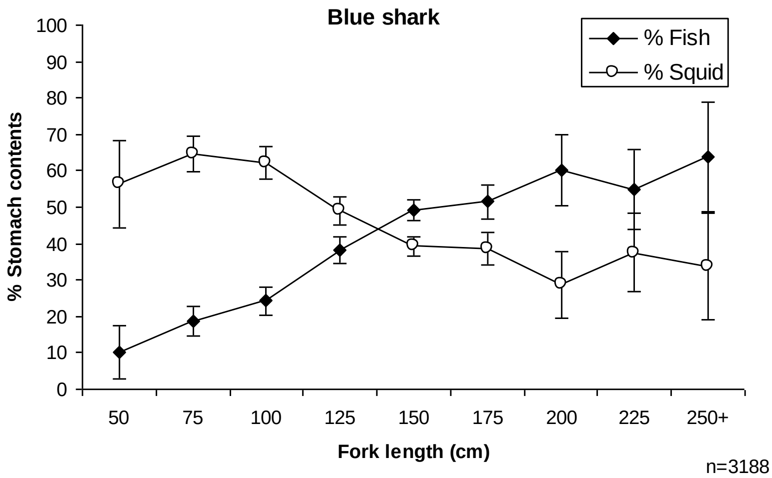



**Figure 6: Change in percentage of fish and squid in stomachs of blue shark as a function of fork length.**

## 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)[1].

### 4.2.1 Seabird bycatch

Between 2002–03 and 2013–14, there were zero 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 Figure 7. Peaks in seabird capture rates occurred in 2006-07 and 2008-09. 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 surface longline fisheries are provided in Table 5.

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 2013). 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 (Waugh 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

[1] As part of its data reconciliation processes, MPI has identified that less than 2% of observed protected species captures between 2002 and 2015 were not recorded in COD. Steps are being taken to update the database and estimates of protected species captures and associated risks. Accordingly, some estimates of protected species captures or risk in this document may have a small negative bias. Neither Maui nor Hector's dolphins are affected. Updated estimates will be reviewed by the Aquatic Environment Working Group in the second quarter of 2016.

estimate the species vulnerability (capture rates per encounter) to each fishery group. This is then 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, and swordfish) contribution to the total risk posed by New Zealand commercial fishing to seabirds (see Table 6). These target fisheries contribute 0.003 of $PBR_1$ 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: 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) are available via [http://www.fish.govt.nz/en-nz/Environmental/Seabirds/](http://www.fish.govt.nz/en-nz/Environmental/Seabirds/). Estimates from 2002–03 to 2013–14 are based on data version 2015003.**

| Fishing year | | | Fishing effort | Observed captures | | Estimated captures | |
|---|---|---|---|---|---|---|---|
| | All hooks | Observed hooks | % observed | Number | Rate | Mean | 95% c.i. |
| 2002–2003 | 173 410 | 0 | 0 | 0 | - | 34 | 11–76 |
| 2003–2004 | 220 787 | 13 000 | 5.9 | 0 | 0 | 37 | 12–83 |
| 2004–2005 | 100 290 | 800 | 0.8 | 0 | 0 | 87 | 32–198 |
| 2005–2006 | 40 320 | 0 | 0 | 0 | - | 11 | 2–30 |
| 2006–2007 | 45 795 | 0 | 0 | 0 | - | 12 | 2–30 |
| 2007–2008 | 47 755 | 0 | 0 | 0 | - | 12 | 2–32 |
| 2008–2009 | 16 178 | 0 | 0 | 0 | - | 5 | 0–17 |
| 2009–2010 | 26 800 | 0 | 0 | 0 | - | 8 | 1–22 |
| 2010–2011 | 20 100 | 0 | 0 | 0 | - | 5 | 0–16 |
| 2011–2012 | 18 900 | 0 | 0 | 0 | - | 3 | 0–11 |
| 2012–2013 | 43 160 | 0 | 0 | 0 | - | 10 | 2–28 |
| 2013–2014 | 19 700 | 820 | 4.2 | 0 | 0 | 4 | 0–14 |

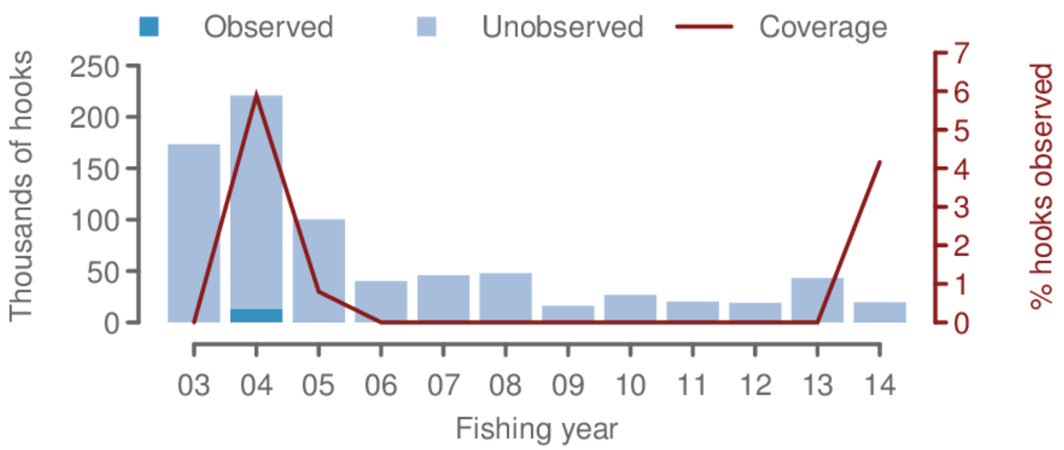



**Figure 7 Observed captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

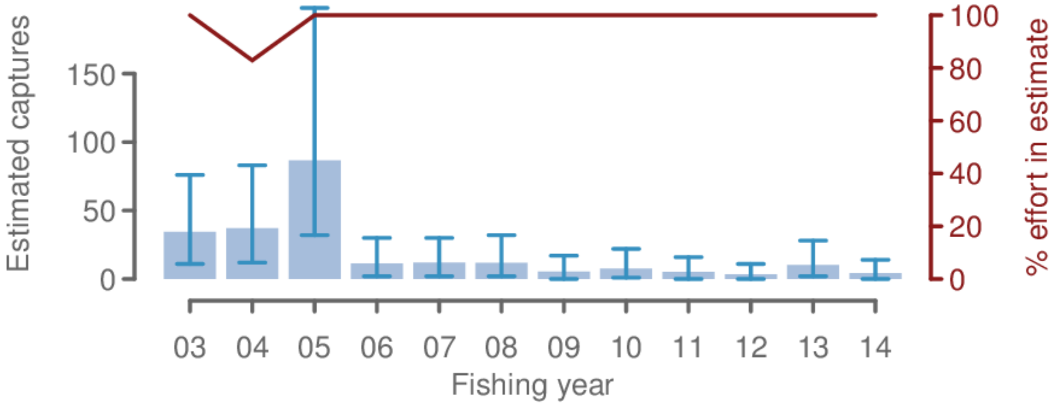



**Figure 7 Estimated captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

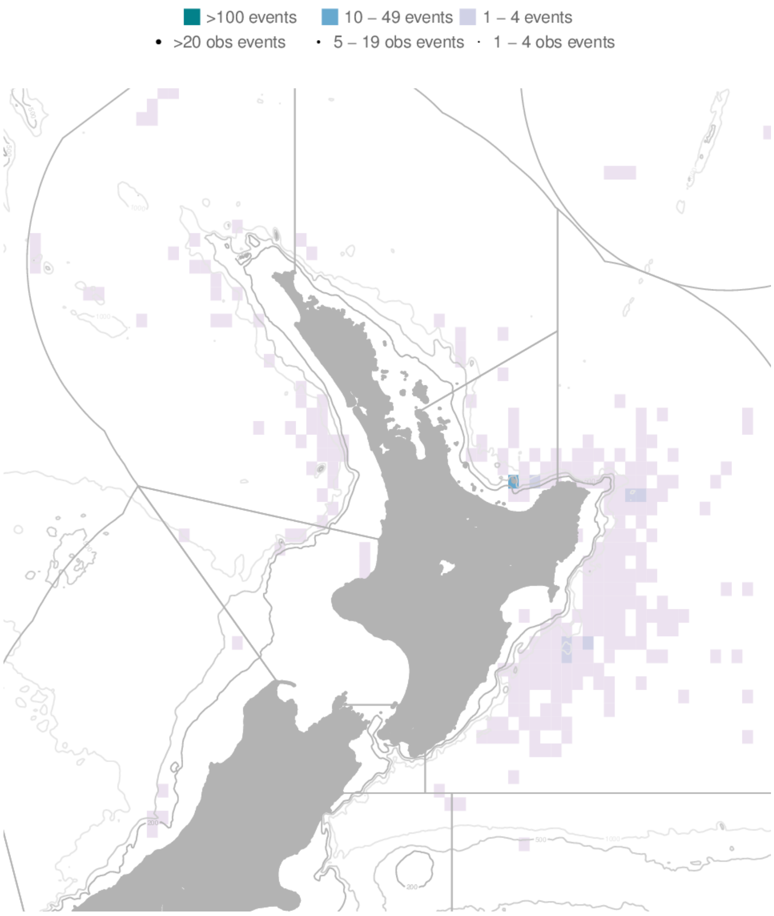



**Figure 8 Distribution of fishing effort in the New Zealand surface longline fisheries and observed seabird captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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.**

**Table 6: 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 high 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, $PBR_1$ (from Richard and Abraham 2014 where full details of the risk assessment approach can be found). $PBR_1$ 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/nztcs4entire.pdf)**

| | Risk ratio | | | | |
|---|---|---|---|---|---|
| Species name | OTH target SLL | Total risk from NZ commercial fishing | % of total risk from NZ commercial fishing | Risk category | NZ Threat Classification |
| 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 Buller's albatross | 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 Buller's albatross | 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 2013–14, there were 15 observed captures of sea turtles across all surface longline fisheries (Tables 7 and 8, Figure 9). 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 10).

**Table 7: Number of observed sea turtle captures in the New Zealand surface longline fisheries, 2002–03 to 2013–14, 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 |

**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 year | | Fishing effort | | Observed captures | |
|---|---|---|---|---|---|
| | All hooks | Observed hooks | % observed | Number | Rate |
| 2002–2003 | 10 770 488 | 2 195 152 | 20.4 | 0 | 0 |
| 2003–2004 | 7 386 484 | 1 607 304 | 21.8 | 1 | 0.001 |
| 2004–2005 | 3 679 765 | 783 812 | 21.3 | 2 | 0.003 |
| 2005–2006 | 3 690 869 | 705 945 | 19.1 | 1 | 0.001 |
| 2006–2007 | 3 739 912 | 1 040 948 | 27.8 | 2 | 0.002 |
| 2007–2008 | 2 246 139 | 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 | 3 188 179 | 674 572 | 21.2 | 4 | 0.006 |
| 2011–2012 | 3 100 177 | 728 190 | 23.5 | 0 | 0 |
| 2012–2013 | 2 876 932 | 560 333 | 19.5 | 2 | 0.004 |
| 2013–2014 | 2 546 764 | 773 527 | 30.4 | 0 | 0 |

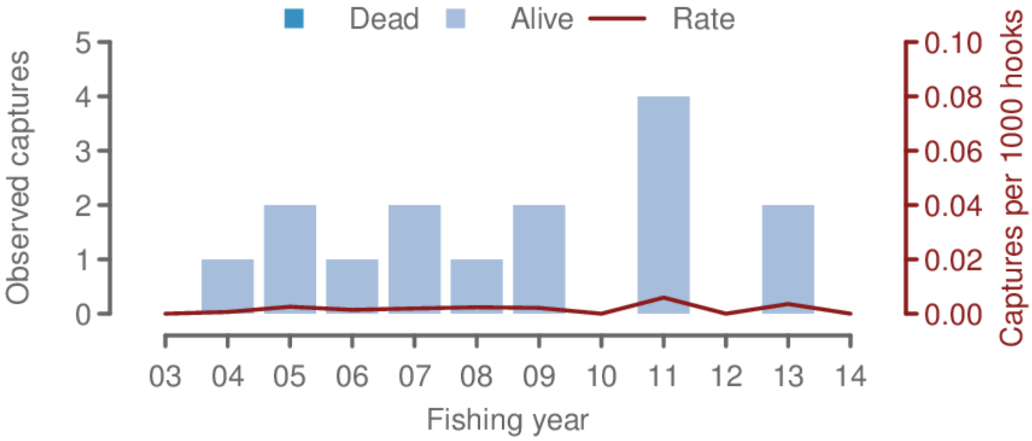



**Figure 9 Observed captures of sea turtles in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

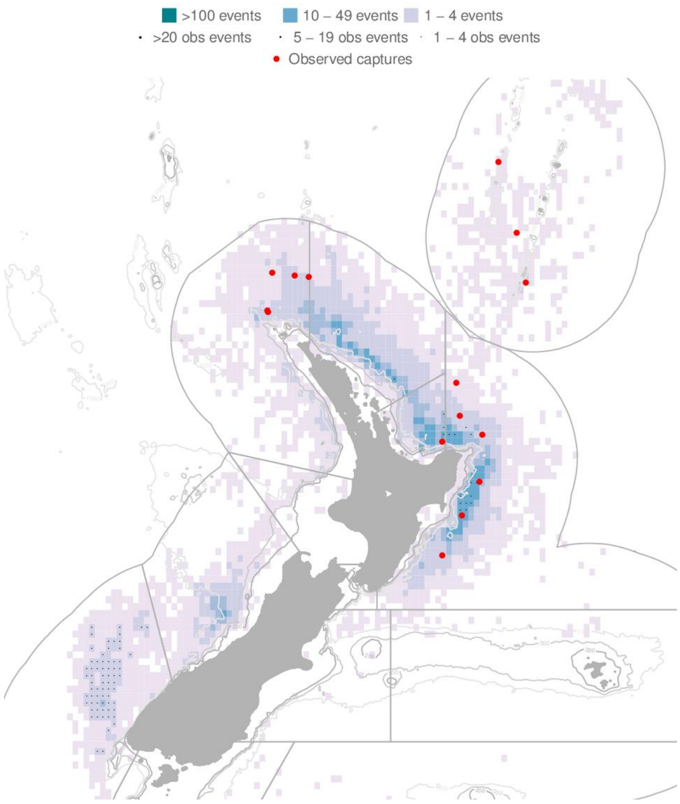



**Figure 10 Distribution of fishing effort in the New Zealand surface longline fisheries and observed sea turtle captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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 2013–14, 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 11) (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 12)

**Table 9: Number of observed cetacean captures in the New Zealand surface longline fisheries, 2002–03 to 2013–14, 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 year | Fishing effort | | | Observed captures | |
|---|---|---|---|---|---|
| | All hooks | Observed hooks | % observed | Number | Rate |
| 2002–2003 | 10 770 488 | 2 195 152 | 20.4 | 1 | 0 |
| 2003–2004 | 7 386 484 | 1 607 304 | 21.8 | 4 | 0.002 |
| 2004–2005 | 3 679 765 | 783 812 | 21.3 | 1 | 0.001 |
| 2005–2006 | 3 690 869 | 705 945 | 19.1 | 0 | 0 |
| 2006–2007 | 3 739 912 | 1 040 948 | 27.8 | 0 | 0 |
| 2007–2008 | 2 246 139 | 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 | 3 188 179 | 674 572 | 21.2 | 0 | 0 |
| 2011–2012 | 3 100 177 | 728 190 | 23.5 | 0 | 0 |
| 2012–2013 | 2 876 932 | 560 333 | 19.5 | 0 | 0 |
| 2013–2014 | 2 546 764 | 773 527 | 30.4 | 0 | 0 |

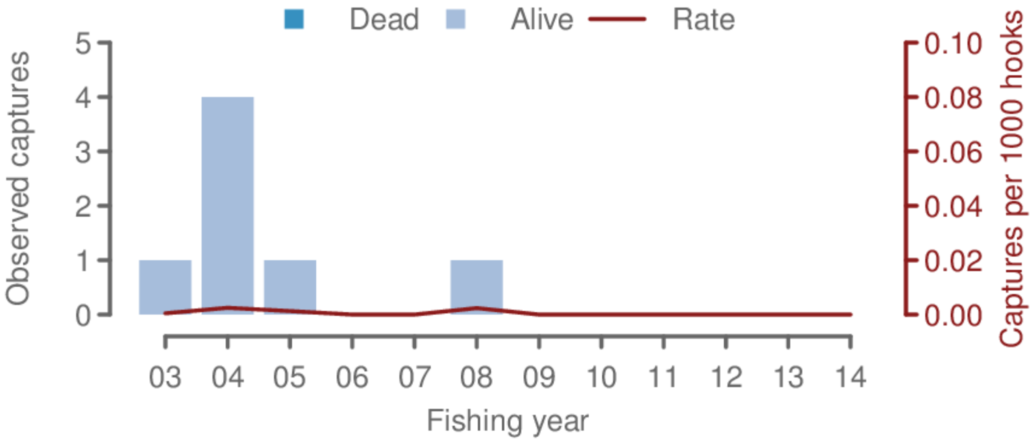



**Figure 11: Observed captures of cetaceans in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

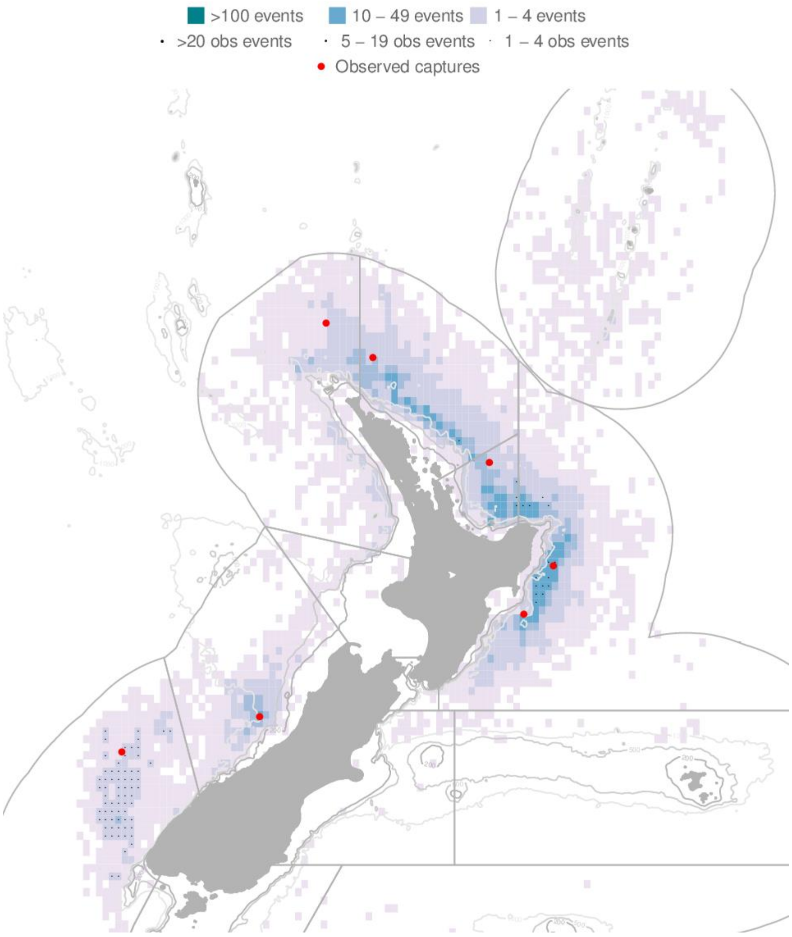



**Figure 12 Distribution of fishing effort in the New Zealand surface longline fisheries and observed cetacean captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 84.9% 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 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 2013-14 were higher than they were in the early 2000s (Figures 14 and 15). 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 15). Between

2002–03 and 2013–14, there were 323 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 2013–14, 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 | 16 | 33 | 228 | 4 | 4 | 2 | 36 | 323 |

**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). Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. Estimates from 2002–03 to 2012–13 and preliminary estimates for 2013–14 are based on data version 2015003.**

| 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 | 7 386 484 | 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 | 3 690 869 | 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 | 2 246 139 | 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 | 3 188 179 | 674 572 | 21.2 | 17 | 0.025 | 64 | 35–101 |
| 2011–2012 | 3 100 177 | 728 190 | 23.5 | 40 | 0.055 | 140 | 92–198 |
| 2012–2013 | 2 876 932 | 560 333 | 19.5 | 21 | 0.037 | 110 | 65–171 |
| 2013-2014 | 2 546 764 | 773 527 | 30.4 | 56 | 0.072 | 103 | 88-121 |

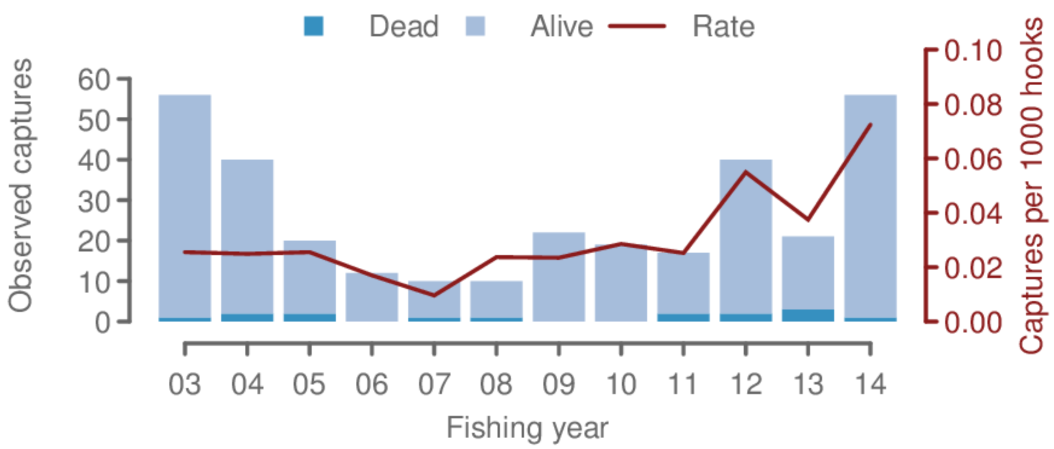



**Figure 13: Observed captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

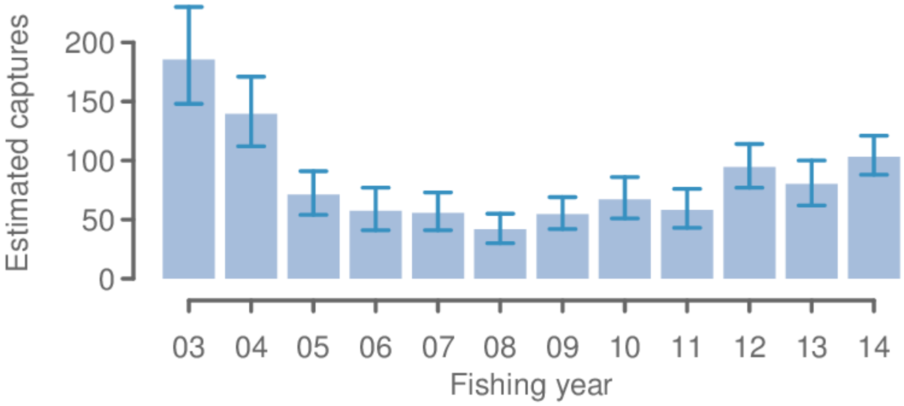



**Figure 14 Estimated captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2013–14.**

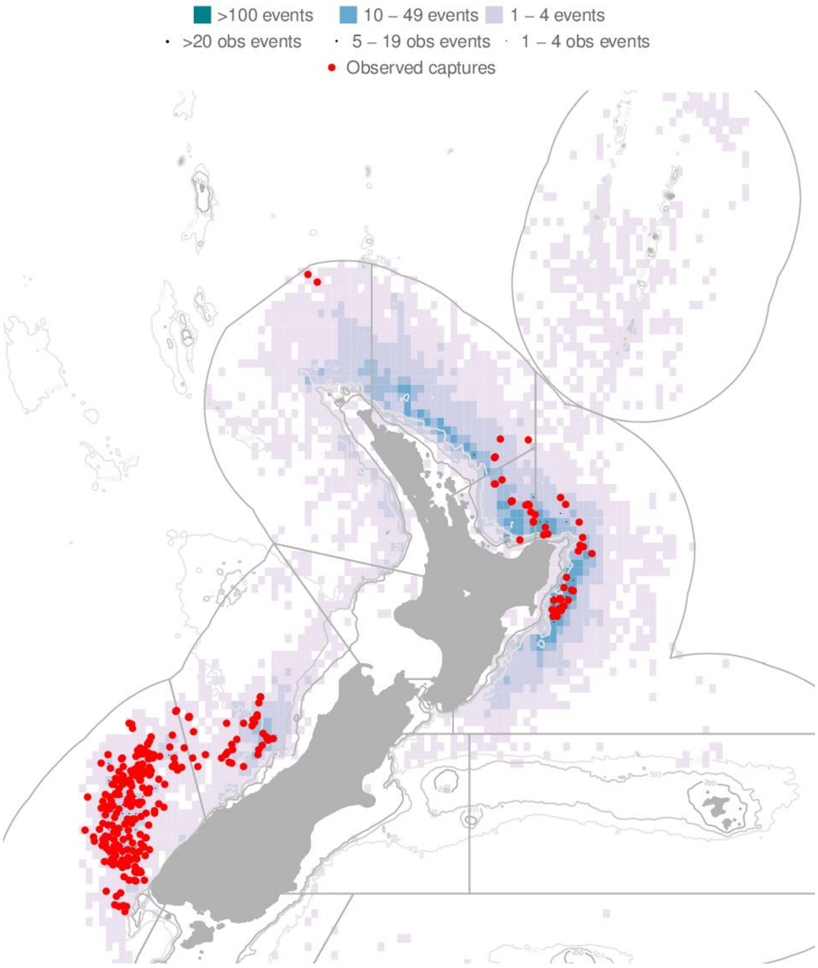



**Figure 15: Distribution of fishing effort in the New Zealand surface longline fisheries and observed New Zealand fur seal captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated 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 Lancetfish (Table13).

**Table 13: Total estimated catch (numbers of fish) of common bycatch species in the New Zealand longline fishery as estimated from observer data from 2010 to 2014. Also provided is the percentage of these species retained (2014 data only) and the percentage of fish that were alive when discarded, N/A (none discarded).**

| Species | 2011 | 2012 | 2013 | 2014 | % retained (2014) | discards % alive (2014) |
|---|---|---|---|---|---|---|
| Blue shark | 53 432 | 132 925 | 158 736 | 80 118 | 16.2 | 89.2 |
| Lancetfish | 37 305 | 7 866 | 19 172 | 21 002 | 0.3 | 24.4 |
| Porbeagle shark | 9 929 | 7 019 | 9 805 | 5 061 | 30.6 | 70.7 |
| Rays bream | 18 453 | 19 918 | 13 568 | 4 591 | 96.1 | 7.4 |
| Mako shark | 9 770 | 3 902 | 3 981 | 4 506 | 30.3 | 68.8 |
| Sunfish | 3 773 | 3 265 | 1 937 | 1 981 | 2.4 | 80.0 |
| Moonfish | 3 418 | 2 363 | 2 470 | 1 655 | 96.6 | 87.5 |
| Dealfish | 223 | 372 | 237 | 910 | 0.4 | 24.9 |
| Butterfly tuna | 909 | 713 | 1 030 | 699 | 77.3 | 3.4 |
| Pelagic stingray | 4 090 | 712 | 1 199 | 684 | 0.0 | 93.5 |
| Escolar | 6 602 | 2 181 | 2 088 | 656 | 88.6 | 0.0 |
| Deepwater dogfish | 548 | 647 | 743 | 600 | 1.2 | 80.9 |
| Oilfish | 1 747 | 509 | 386 | 518 | 82.1 | 40.0 |
| Rudderfish | 338 | 491 | 362 | 327 | 10.7 | 83.3 |
| Thresher shark | 349 | 246 | 256 | 261 | 28.6 | 80.0 |
| Big scale pomfret | 139 | 108 | 67 | 164 | 74.5 | 75.0 |
| Striped marlin | 175 | 124 | 182 | 151 | 0.0 | 94.3 |
| School shark | 49 | 477 | 21 | 119 | 72.0 | 78.6 |
| Skipjack tuna | 255 | 123 | 240 | 90 | 80.0 | 0.0 |

### 4.4 Benthic interactions

N/A

### 4.5 Key environmental and ecosystem information gaps

Cryptic mortality is unknown at present.

Observer coverage in the New Zealand fleet has historically not been spatially or temporally representative of the fishing effort. However in 2013 the observer effort was re-structured to rectify this by planning observer deployment to correspond with recent spatial and temporal trends in fishing effort.

## 5. STOCK ASSESSMENT

With the establishment of the WCPFC in 2004, future stock assessments of the western and central Pacific Ocean stock of blue shark will be reviewed by the WCPFC.

Quantitative stock assessments of blue sharks outside the New Zealand EEZ have been mostly limited to standardised CPUE analyses, although quantitative assessment models have been developed using conventional age-structured and MULTIFAN-CL methods. An indicator analysis of blue sharks in New Zealand waters was conducted in 2014.

Results of these indicator analyses (Figures 17 and 18) suggest that blue shark populations in the New Zealand EEZ have not been declining under recent fishing pressure, and may have been increasing since 2005 (Table 14, Francis et al. 2014). These changes are presumably in response to a decline in SLL fishing effort since 2003 (Griggs & Baird 2013), and a decline in annual landings since a peak in 2001 for blue sharks. Observer data from 1995 suggest that blue sharks may have undergone a down-then-up trajectory. The quality of observer data and model fits means these interpretations are uncertain. The stock status of blue sharks may be recovering. Conclusive determination of stock status will require a regional (i.e. South Pacific) stock assessment.

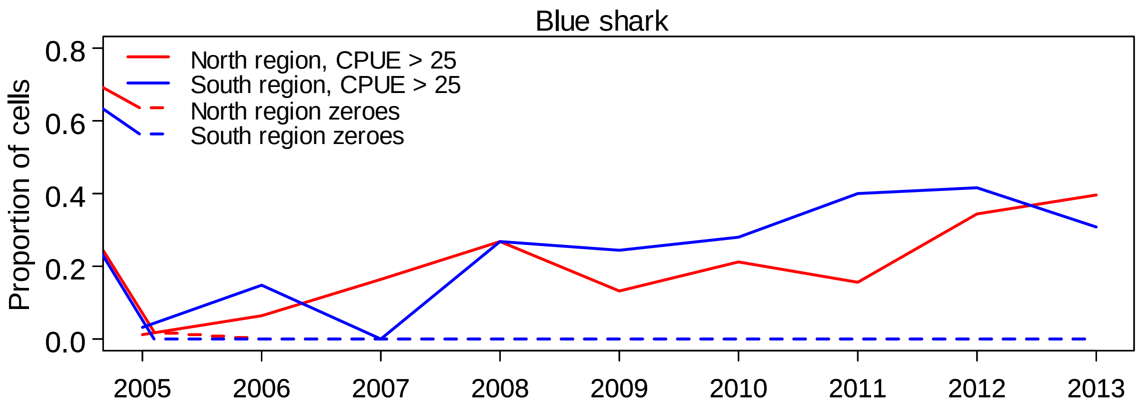



**Figure 16. Blue shark distribution indicators. Proportions of 0.5 degree rectangles having CPUE greater than 25 per 1000 hooks, and proportions of rectangles having zero catches, for North and South regions by fishing year, based on estimated catches (processed and discarded combined) reported on TLCERs. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7.**

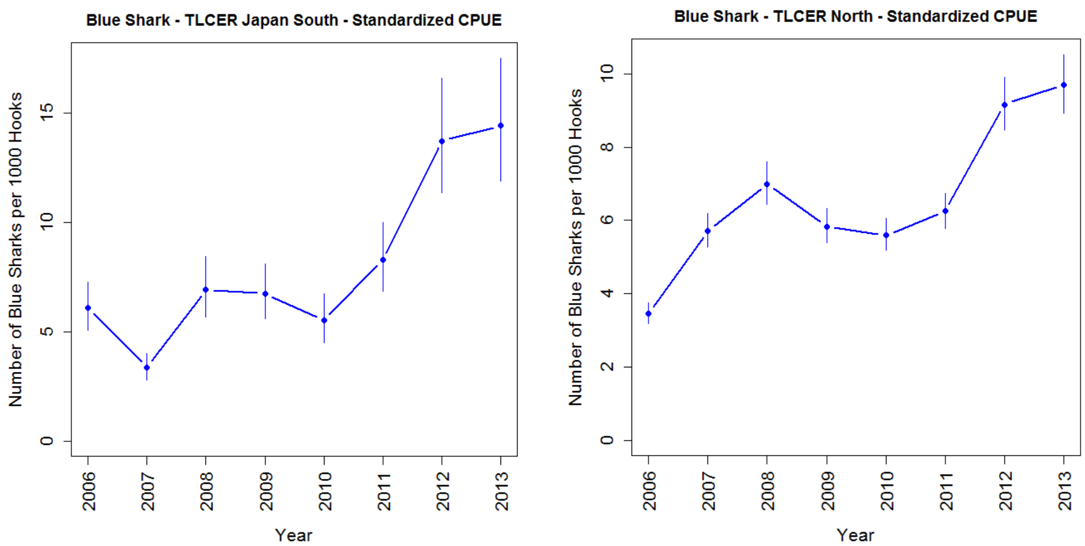



**Figure 17: Standardised CPUE indices for commercial TLCER (Japan South and North) and observer datasets (all New Zealand) [Continued on next page].**

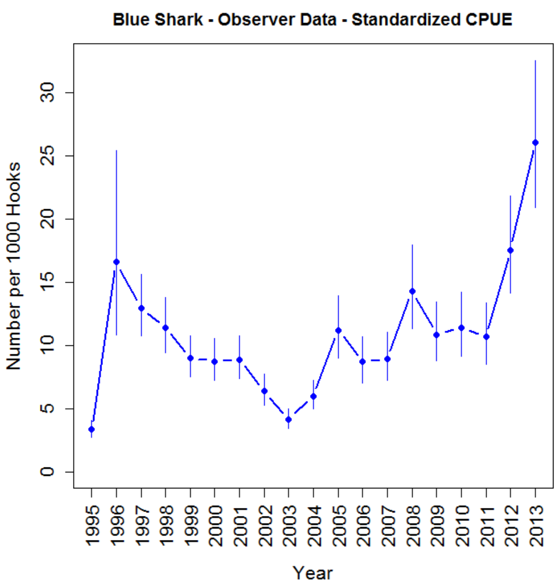



**Figure 17 [Continued]: Standardised CPUE indices for commercial TLCER (Japan South and North) and observer datasets (all New Zealand).**

**Table 14: Summary of trends identified in abundance indicators since the 2005 fishing year based on both TLCER and observer data sets. The CPUE-Obs indicator was calculated for both North and South regions combined. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7. For the CPUE-TLCER indicator in South region, only the Japan dataset indicator is shown (the TLCER Domestic South dataset was small and probably unrepresentative). Green cells show indicators that suggest positive trends in stock size. Note that a downward trend in 'proportion-zeroes' is considered a positive stock trend. NA = indicator not applicable because of small sample size. Source: Francis et al. (2014).**

| | | North region | | | South region | | |
|---|---|---|---|---|---|---|---|
| Indicator class | Indicator | Blue | Porbeagle | Mako | Blue | Porbeagle | Mako |
| Distribution | High-CPUE | Up | Up | Up | Up | Up | NA |
| Distribution | Proportion-zeroes | Nil | Down | Down | Nil | Nil | Down |
| Catch composition | GM index total catch - TLCER | Up (all species) | | | Up (all species) | | |
| Catch composition | GM index total catch - Obs | Up (all species) | | | Nil (all species) | | |
| Catch composition | GM index HMS shark catch - TLCER | Up (all species) | | | Up (all species) | | |
| Catch composition | GM index HMS shark catch - Obs | Up (all species) | | | Nil (all species) | | |
| Standardised CPUE | CPUE - TLCER | Up | Nil | Up | Up | Nil | Nil |
| Standardised CPUE | CPUE - Obs | Up | Nil | Nil | Up | Nil | Nil |
| Sex ratio | Proportion males | Nil | Nil | Nil | Nil | Nil | NA |
| Size composition | Median length - Males | Nil | Nil | Nil | Nil | Nil | NA |
| Size composition | Median length - Females | Nil | Nil | Nil | Nil | Nil | NA |

Blue sharks are the most heavily fished of the three large pelagic shark species (blue, mako, and porbeagle sharks) commonly caught in the tuna longline fishery. Compared to mako and porbeagle sharks, however, blue sharks are relatively fecund, fast growing, and widely distributed.

Observed length frequency distributions of blue sharks by area and sex are shown in Figure 18 for fish measured in 1993-2012. Length frequency distributions of blue sharks showed differences in size composition between North and South areas (Figure 18). There were more female blue sharks caught than males, with a higher proportion of females in the South than the North. Based on the length-frequency distributions and approximate mean lengths at maturity of 192.5 cm fork length for males and 180 cm for females (Francis & Duffy 2005), most blue sharks were immature (91.1% of males and 92.9% of females, overall). Greater proportions of mature male blue sharks were found in the North (12.1% mature in the North and 1.1% in the south), while more similar proportions of mature females were found in the North and South (4.5% and 8.4% respectively).

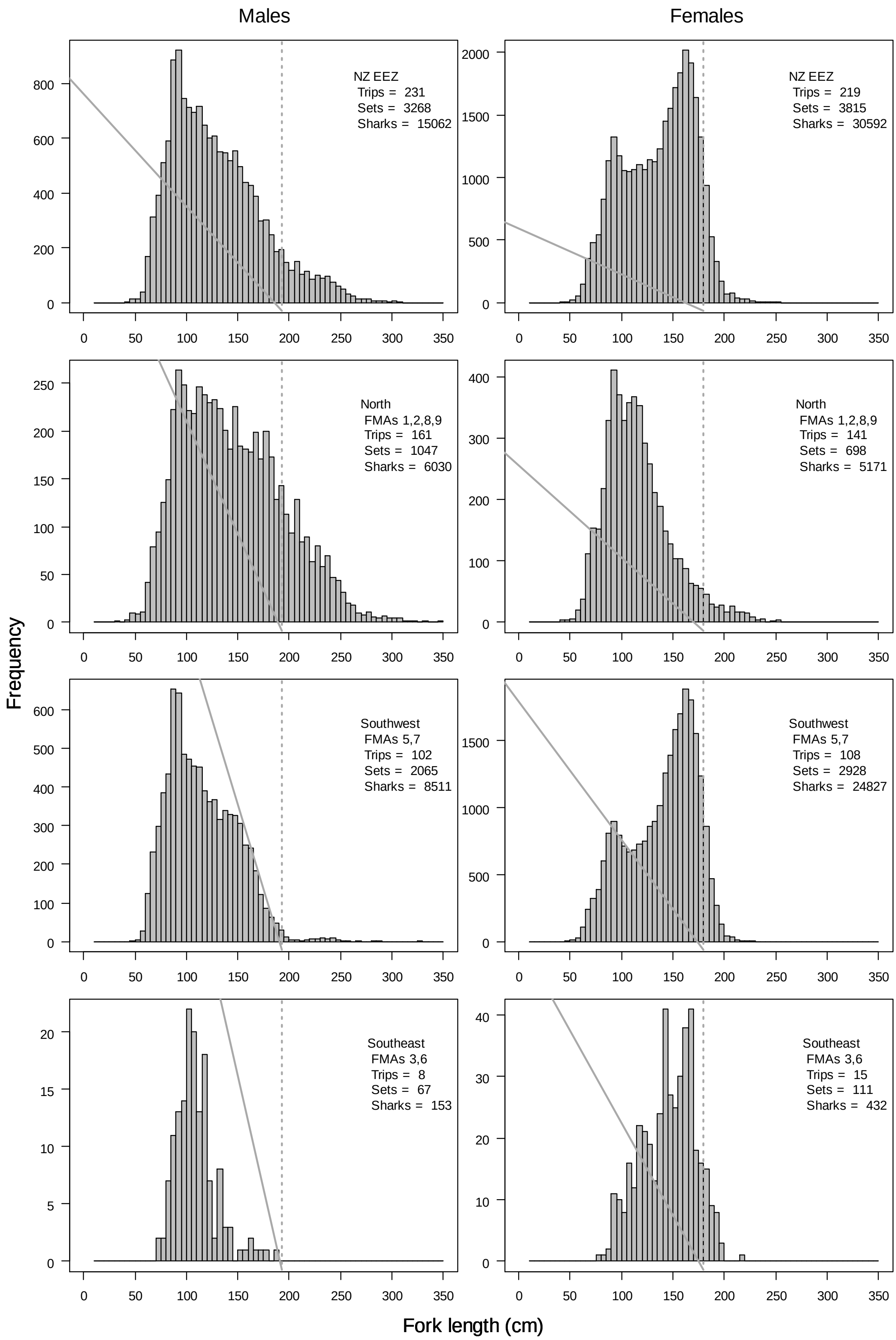



**Figure 18: Length-frequency distributions of male and female blue sharks measured by observers aboard surface longline vessels between 1993 and 2012 for the New Zealand EEZ, and North, Southwest and Southeast regions. The dashed vertical lines indicate the median length at maturity. Source: Francis (2013).**

A data informed qualitative risk assessment was completed on all chondrichthyans (sharks, skates, rays and chimaeras) at the New Zealand scale in 2014 (Ford et al. 2015). Blue sharks had a risk score of 12 and were ranked lowest risk of the eleven QMS chondrichthyan species. Data were described as ‘exist and sound’ for the purposes of the assessment and consensus over this risk score was achieved by the expert panel.

## 6. STATUS OF THE STOCK

**Stock structure assumptions**

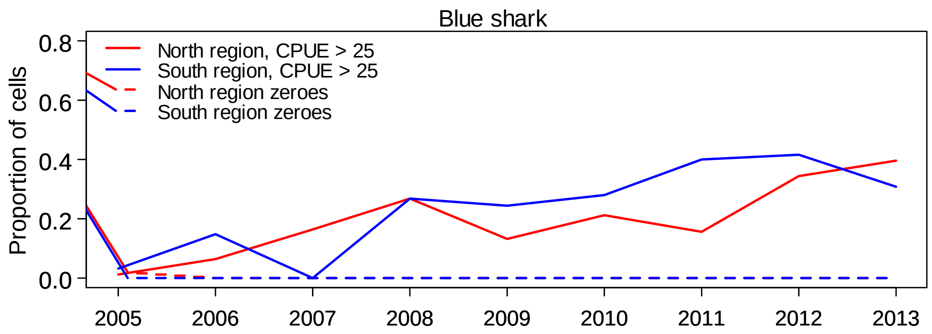
BWS 1 is assumed to be part of the wider South Western Pacific Ocean stock. However, there is no stock assessment for this wider stock. The results below are from indicator analyses of the New Zealand component of that stock only.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2014 |
| Assessment Runs Presented | Indicator analyses only for NZ EEZ |
| Reference Points | Target: Not established<br>Soft Limit: Not established but HSS default of 20% $SB_0$ assumed<br>Hard Limit: Not established but HSS default of 10% $SB_0$ assumed<br>Overfishing threshold: $F_{MSY}$ |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Unknown |
| Status in relation to Overfishing | Unknown |

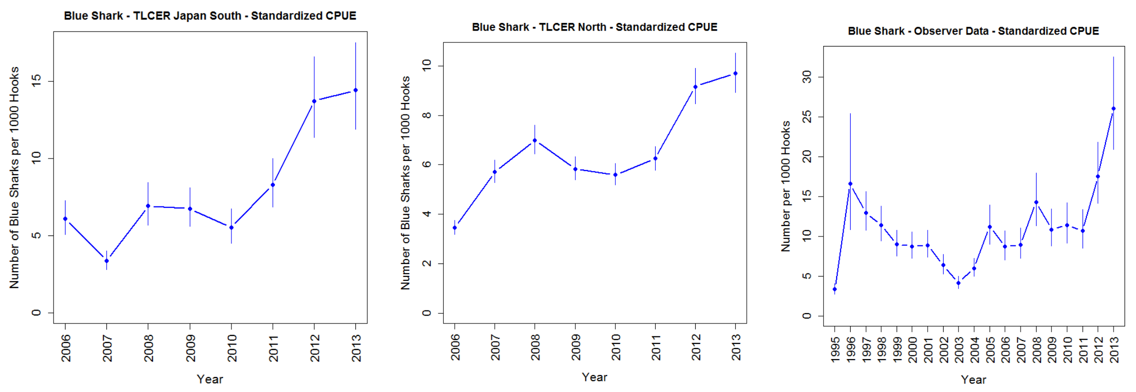
**Historical Stock Status Trajectory and Current Status**

**Summary of trends identified in abundance indicators since the 2005 fishing year based on both TLCER and observer data sets. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7.**

| | | North region | | | South region | | |
|---|---|---|---|---|---|---|---|
| Indicator class | Indicator | Blue | Porbeagle | Mako | Blue | Porbeagle | Mako |
| Distribution | High-CPUE | Up | Up | Up | Up | Up | NA |
| Distribution | Proportion-zeroes | Nil | Down | Down | Nil | Nil | Down |
| Catch composition | GM index total catch - TLCER | Up (all species) | | | Up (all species) | | |
| Catch composition | GM index total catch - Obs | Up (all species) | | | Nil (all species) | | |
| Catch composition | GM index HMS shark catch - TLCER | Up (all species) | | | Up (all species) | | |
| Catch composition | GM index HMS shark catch - Obs | Up (all species) | | | Nil (all species) | | |
| Standardised CPUE | CPUE - TLCER | Up | Nil | Up | Up | Nil | Nil |
| Standardised CPUE | CPUE - Obs | Up | Nil | Nil | Up | Nil | Nil |
| Sex ratio | Proportion males | Nil | Nil | Nil | Nil | Nil | NA |
| Size composition | Median length - Males | Nil | Nil | Nil | Nil | Nil | NA |
| Size composition | Median length - Females | Nil | Nil | Nil | Nil | Nil | NA |




**Blue shark distribution indicators. Proportions of 0.5 degree rectangles having CPUE greater than 25 per 1000 hooks, and proportions of rectangles having zero catches, for North and South regions by fishing year, based on estimated catches (processed and discarded combined) reported on TLCERs. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7.**




**Standardised CPUE indices for commercial TLCER (Japan South and North) and observer datasets (all New Zealand).**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | Appears to be increasing |
| Recent Trend in Fishing Intensity or Proxy | Appears to be decreasing |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicator or Variables | Catches in New Zealand increased from the early 1990s to a peak in the early 2000s but declined slightly in the mid 2000s and have remained relatively stable since that time. |

| **Projections and Prognosis** | | |
|---|---|---|
| Stock Projections or Prognosis | The stock is likely to increase if effort remains at current levels | |
| Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits | Soft Limit: Unknown<br>Hard Limit: Unknown | |
| Probability of Current Catch or TACC causing Overfishing to continue or to commence | Unknown | |
| **Assessment Methodology and Evaluation** | | |
| Assessment Type | Level 2 – Partial Quantitative Stock Assessment: Standardised CPUE indices and other fishery indicators | |
| Assessment Method | Indicator analyses | |
| Assessment Dates | Latest assessment: 2014 | Next assessment: Unknown |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | -Distribution<br>-Species composition<br>-Size and sex ratio<br>-Catch per unit effort | 1 – High quality |
| Data not used (rank) | N/A | |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | Historical catch recording may not be accurate. | |

| **Qualifying Comments** |
|---|
| . |

| Fishery Interactions |
| --- |
| Interactions with protected species are known to occur in the longline fisheries of the South Pacific, particularly south of 25°S. Seabird bycatch mitigation measures are required in the New Zealand and Australian EEZs and through the WCPFC Conservation and Management Measure CMM2007-04. Sea turtles are also incidentally captured in longline gear; the WCPFC is attempting to reduce sea turtle interactions through Conservation and Management Measure CMM2008-03. |

## 7. FOR FURTHER INFORMATION


Abraham, E R; Thompson, F N (2009) Capture of protected species in New Zealand trawl and longline fisheries, 1998–99 to 2006–07. *New Zealand Aquatic Environment and Biodiversity Report No. 32*.

Abraham, E R; Thompson, F N (2011) Summary of the capture of seabirds, marine mammals, and turtles in New Zealand commercial fisheries, 1998–99 to 2008–09. Final Research Report prepared for Ministry of Fisheries project PRO2007/01. (Unpublished report held by the Ministry for Primary Industries, Wellington.) 170 p.

Abraham, E R; Thompson, F N; Oliver, M D (2010) Summary of the capture of seabirds, marine mammals, and turtles in New Zealand commercial fisheries, 1998–99 to 2007–08. *New Zealand Aquatic Environment and Biodiversity Report No. 45*. 148 p.

Ayers, D; Francis, M P; Griggs, L H; Baird, S J (2004) Fish bycatch in New Zealand tuna longline fisheries, 2000–01 and 2001–02. *New Zealand Fisheries Assessment Report 2004/46*. 47 p.

Baird, S J (2008) Incidental capture of New Zealand fur seals (*Arctocephalus forsteri*) in longline fisheries in New Zealand waters, 1994–95 to 2005–06. *New Zealand Aquatic Environment and Biodiversity Report No. 20.* 21 p.

Bentley, N; Langley, A D; Middleton, D A J; Lallemand, P (2013). Fisheries of New Zealand, 1989/90-2011/12. Retrieved from http://fonz.tridentsystems.co.nz. Accessed 8 October 2013.

CMM2008-03 (2008) Conservation and Management measure for sea turtles, for the Western and Central Pacific Ocean. CMM2008-03 of the Western and Central Pacific Fisheries Commission.

Ford, R; Galland, A; Clark, M; Crozier, P; Duffy, C A; Dunn, M; Francis, M; Wells, R (2015) Qualitative (Level 1) Risk Assessment of the impact of commercial fishing on New Zealand Chondrichthyans. *New Zealand Aquatic Environment and Biodiversity Report. No. 157***.** 111 p.

Francis, M P (2013) Commercial catch composition of highly migratory elasmobranchs. *New Zealand Fisheries Assessment Report* 2013/68. 79 p.

Francis, M P; Clarke, S C; Griggs, L H; Hoyle, S D (2014) Indicator based analysis of the status of New Zealand blue, mako and porbeagle sharks. *New Zealand Fisheries Assessment Report* 115 p.

Francis, M P; Duffy, C (2005) Length at maturity in three pelagic sharks (*Lamna nasus*, *Isurus oxyrinchus*, and *Prionace glauca*) from New Zealand. *Fishery Bulletin 103*: 489–500.

Griggs, L H; Baird, S J (2013). Fish bycatch in New Zealand tuna longline fisheries 2006–07 to 2009–10. *New Zealand Fisheries Assessment Report 2013/13*. 71 p.

Griggs, L H; Baird, S J; Francis, M P (2007) Fish bycatch in New Zealand tuna longline fisheries 2002–03 to 2004–05. *New Zealand Fisheries Assessment Report 2007/18*. 58 p.

Holdsworth, J; Saul, P (2005) New Zealand billfish and gamefish tagging, 2003–04. *New Zealand Fisheries Assessment Report 2005/36*. 30 p.

Holdsworth, J; Saul, P (2011) New Zealand billfish and gamefish tagging, 2009–10. *New Zealand Fisheries Assessment Report 2011/23*. 26 p.

Kleiber, P; Takeuchi, Y; Nakano, H (2001) Calculation of plausible maximum sustainable yield (MSY) for blue sharks (*Prionace glauca*) in the North Pacific. Southwest Fisheries Science Centre Administrative Report H-01-02, National Marine Fisheries Service, Honolulu, USA. 10 p.

Manning, M J; Francis, M P (2005) Age and growth of blue shark (*Prionace glauca*) from the New Zealand Exclusive Economic Zone. *New Zealand Fisheries Assessment Report 2005/26*. 52 p.

Mattlin, R H (1987) New Zealand fur seal, *Arctocephalus forsteri*, within the New Zealand region. In Croxall, J P; Gentry, R L Status, biology, and ecology of fur seals: Proceedings of an international symposium and workshop, Cambridge, England, 23–27 April 1984. *NOAA Technical Report NMFS-51.*

Ministry for Primary Industries (2014). Aquatic Environment and Biodiversity Annual Review 2014. Compiled by the Fisheries Management Science Team, Ministry for Primary Industries, Wellington, New Zealand. 560 p.

Ministry for Primary Industries (2013). Nathional Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand Fisheries. Ministry for Primary Industries, Wellington, New Zealand. 59 p.

New Zealand Waitangi Tribunal (1992) The Ngai Tahu sea fisheries report, 1992 (Wai 27). Waitangi Tribunal Report 27. 409 p. (Unpublished report held in NIWA library, Wellington.)

Perrin, W F; Wursig, B; Thewissen, J G M (Eds) (2008) *Encyclopedia of marine mammals*. Second Edition. Academic Press, San Diego.

Richard, Y; Abraham, E R (2013) Application of Potential Biological Removal methods to seabird populations. *New Zealand Aquatic Environment and Biodiversity Report No. 108*. 30 p.

Richard Y; Abraham, E R (2014a) Estimated capture of seabirds in New Zealand trawl and longline fisheries, 2002–03 to 2011–12. Draft New Zealand Aquatic Environment and Biodiversity Report held by Ministry for Primary Industries, Wellington.

Richard Y; Abraham, E R (2014b) Assessment of the risk of commercial fisheries to New Zealand seabird, 2006–07 to 2012–13. Draft New Zealand Aquatic Environment and Biodiversity Report held by Ministry for Primary Industries, Wellington.

Richard, Y, Abraham, E R; Filippi, D (2011) Assessment of the risk to seabird populations from New Zealand commercial fisheries. Final Research Report for projects IPA2009/19 and IPA2009/20. (Unpublished report held by the Ministry for Primary Industries, Wellington.) 137 p.

Richard, Y; Abraham, E R; Filippi, D (2013) Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2010–11. *New Zealand Aquatic Environment and Biodiversity Report No. 109*. 58 + 70p.

Robertson, H A; Dowding, J E; Elliot, G P; Hitchmough, R A; Miskelly, C M; O'Donnell, C F J; Powlesland, R G; Sagar, P M; Scofield, R P; Taylor, G A (2013) Conservation status of New Zealand Birds, 2012. *New Zealand Threat Classification Series 4*. 22 p.

Rowe, S J (2009) Conservation Services Programme observer report: 1 July 2004 to 30 June 2007. *DOC Marine Conservation Services Series 1*. 93 p.
Sharp, B; Waugh, S; Walker, N A (2011) A risk assessment framework for incidental seabird mortality associated with New Zealand fishing in the New Zealand EEZ., Unpublished report held by the Ministry of Fisheries, Wellington., 39 p.
Skomal, G B; Natanson, L J (2003) Age and growth of the blue shark (*Prionace glauca*) in the North Atlantic Ocean. *Fishery Bulletin 101*: 627–639.
Stevens, J D (1975) Vertebral rings as a means of age determination in the blue shark (*Prionace glauca* L.). *Journal of the Marine Biological Association of the United Kingdom 55*: 657–665.
Thompson, F N; Abraham, E R (2010) Estimation of fur seal (*Arctocephalus forsteri*) bycatch in New Zealand trawl fisheries, 2002–03 to 2008–09. *New Zealand Aquatic Environment and Biodiversity Report No. 61*. 37 p.
Thompson, F N; Berkenbusch, K; Abraham, E R (2013) Marine mammal bycatch in New Zealand trawl fisheries, 1995–96 to 2010–11. *New Zealand Aquatic Environment and Biodiversity Report No. 105*. 73 p.
Waugh, S; Fillipi, D; Abraham, E (2009) Ecological Risk Assessment for Seabirds in New Zealand fisheries, Final Research Report for Ministry of Fisheries project PRO2008-01. 58 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)
West, G; Stevens, J D; Basson, M (2004) Assessment of blue shark population status in the western South Pacific. Research report prepared for the Australian Fisheries Management Authority for project R01/1157. 139 p. (Unpublished report available from NIWA library, Wellington.)