Protected species interactions with the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1

DOC MARINE CONSERVATION SERVICES SERIES 7

Department of Conservation
Te Papa Atawhai

This page has been intentionally left blank

Protected species interactions with the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1

Conservation Services Programme

DOC MARINE CONSERVATION SERVICES SERIES 7

Published by
Publishing Team
Department of Conservation
PO Box 10420, The Terrace
Wellington 6143, New Zealand

DOC Marine Conservation Services Series is a published record of scientific research and other work conducted to guide fisheries management in New Zealand, with respect to the conservation of marine protected species. This series includes both work undertaken through the Conservation Services Programme, which is funded in part by levies on the commercial fishing industry, and Crown-funded work. For more information about DOC's work undertaken in this area, including the Conservation Services Programme, see www.doc.govt.nz/mcs.

Titles are listed in our catalogue on the website, refer www.doc.govt.nz under *Publications*, then *Science & technical*.

ISSN 1179-3147 (web PDF)
ISBN 978-0-478-14850-3 (web PDF)

This report was prepared for publication by the Publishing Team; editing and layout by Lynette Clelland. Publication was approved by the General Manager, Research and Development Group, Department of Conservation, Wellington, New Zealand.

In the interest of forest conservation, we support paperless electronic publishing.

CONTENTS

Abstract 5

1. Background 6

2. Details of the fishery, observer coverage and the extent of protected species interactions in FMA 1 7

3. Factors related to seabird interactions 10

4. Seabird mitigation measures observed 17

5. Conclusions 18

6. Recommendations 18

7. References 19

Appendix 1

Fishing effort by month in the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1 over the period 2001–07 20

Appendix 2

Fishing effort by statistical area in the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1 over the period 2001–07 21

Appendix 3

Details of protected seabird species observed caught as bycatch in the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1 in 2001–07 22

Appendix 4

Box-and-whisker plots of tori line specifications observed on fishing vessels operating in the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1 in 2001–07 23

Protected species interactions with the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1

Conservation Services Programme

Department of Conservation, PO Box 10420, Wellington 6143, New Zealand.
Email: csp@doc.govt.nz

A B S T R A C T

In order to understand the interactions between marine protected species and the demersal longline snapper (*Pagrus auratus*) fishery in New Zealand's Fisheries Management Area 1 (FMA 1), government observers have been placed on vessels fishing the area since 2001. This study considered the period 2001–07, during which 584 longlines, totalling 715 000 hooks, were observed. A maximum observer coverage of about 2% of all hooks set in this fishery was achieved in 2004 and 2005. During the 2001–07 period, observers recorded 37 protected seabirds incidentally killed by the fishing operations; 12 live bird captures on fishing gear; one green turtle live capture on the fishing gear; and a further ten live bird interactions associated with fishing events. Mortalities included species of high conservation concern. Although the limited extent of data recorded meant that it was not possible to fully analyse all relevant factors relating to protected species bycatch in this fishery, simple analysis of the data highlighted that the use of proven mitigation techniques such as tori lines and setting lines at night (not close to full moon) reduced the seabird bycatch rate. A relatively large proportion of the seabird mortalities observed were in the early years of the study period, when tori line use was not common. We make recommendations for future monitoring of this fishery and use of mitigation techniques.

Keywords: protected species, demersal longline, snapper, *Pagrus auratus*, commercial fishing, bycatch, incidental mortality, seabird, mitigation, tori line

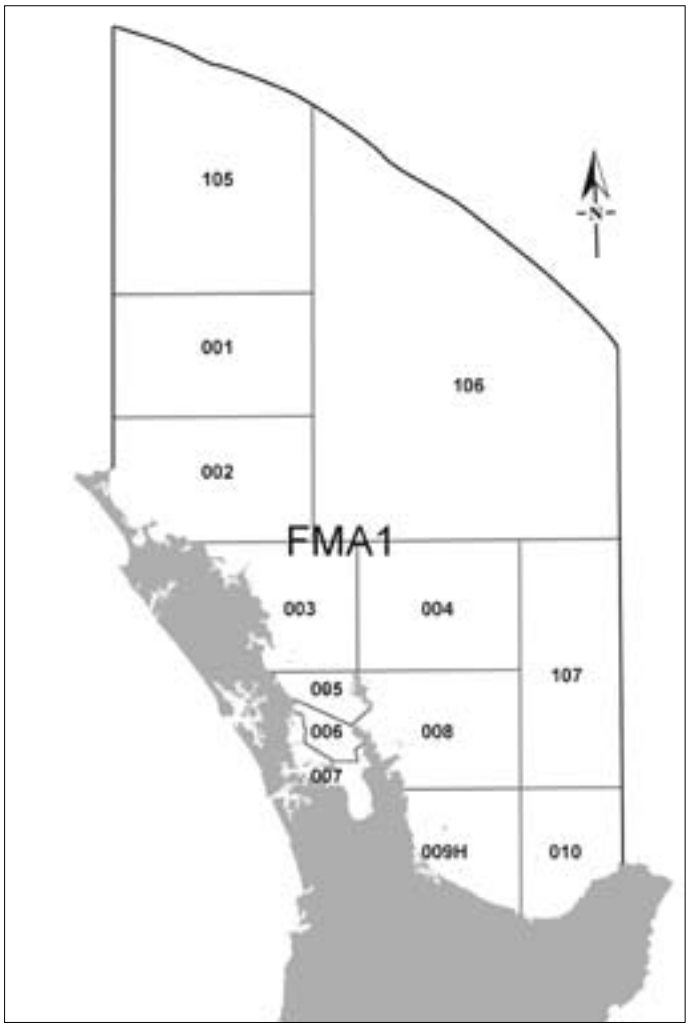
Conservation Services Programme 2010: Protected species interactions with the snapper (*Pagrus auratus*) demersal longline fishery in FMA 1. *DOC Marine Conservation Services Series 6*. Department of Conservation, Wellington. 23 p.

1. Background

Seabirds and other marine protected species are often long-lived with relatively slow reproductive rates. This means that their populations can be seriously affected by adverse impacts resulting from anthropogenic activities, such as birds being caught as bycatch in fisheries (Tasker et al. 2000). The Department of Conservation (DOC) has a statutory duty to protect certain marine species. The Conservation Services Programme (CSP) aims to understand the nature and extent of adverse effects from commercial fishing activities on protected species in New Zealand fisheries waters, and to develop effective methods to mitigate these adverse effects.[1]

In order to understand the interactions occurring between protected species and the demersal longline snapper fishery in Fisheries Management Area 1 (FMA 1), government observers were placed on vessels in this fishery as part of the CSP Observer Programme. FMA 1 covers an area including the Bay of Plenty, Hauraki Gulf and the eastern coast of Northland (Fig. 1). The ultimate aim of collecting this information is to provide a means to measure any adverse affects this fishery is having on protected species and to aid the development of ways to mitigate these effects.

Figure 1. Map of FMA 1 and statistical areas.



In this report, we consider the fishery to be all commercial fishing events targeting snapper using the demersal longline fishing method in FMA 1. Government observer coverage in this fishery commenced in 2001, with most coverage achieved in 2004–05. This report covers the period 2001 to 2007 inclusive.

Making detailed information available on the interaction between protected species and fishing activities is an important step towards finding solutions to any problems the fishery may be causing. The aims of this report were to:

- Summarise available data on the interactions between protected species and the snapper demersal longline fishery in FMA 1.
- Identify information gaps.
- Make recommendations for actions required to mitigate protected species bycatch in this fishery.

[1] See www.doc.govt.nz/mcs for more details.

2. Details of the fishery, observer coverage and the extent of protected species interactions in FMA 1

In 2001–07, the demersal longline fishing effort targeting snapper in FMA 1 amounted to 86 million hooks set. The annual effort decreased from almost 15.5 million hooks in 2001 to just under 10 million in 2007 (Fig. 2). During this period, the set and haul of 584 longlines, totalling 715 thousand hooks, were observed by government observers as part of the CSP Observer Programme. The highest level of observer coverage, at around 2% of all hooks set in the fishery, was achieved in 2004 and 2005 (Fig. 2). In general, the entire set and haul of the longline was observed when an observer was present. Most vessels set one or two longlines per day, but sometimes up to five were set. Fishing effort was generally quite consistent throughout the year, with a slight decrease in effort during the winter months (June to September) (Fig. 3). Observer coverage was predominantly during the summer months, with the highest levels of coverage during December and January (Fig. 3). Fishing effort was centred on inshore areas, particularly the Hauraki Gulf and coastal areas to the north (Fig. 4). Appendices 1 and 2 provide a full summary of fishing effort by month and by statistical area for each year 2001–07.

During the 584 observed sets, a total of 37 birds were reported incidentally killed by the fishing operations, there were 12 live bird captures on fishing gear, one green turtle live capture on the fishing gear, and a further 10 live bird interactions with the fishing vessel (mainly deck landings) associated with fishing events (Table 1). Observers also noted a number live bird interactions at other times (e.g. deck landings when the vessel was at anchor), but these are not further reported here.

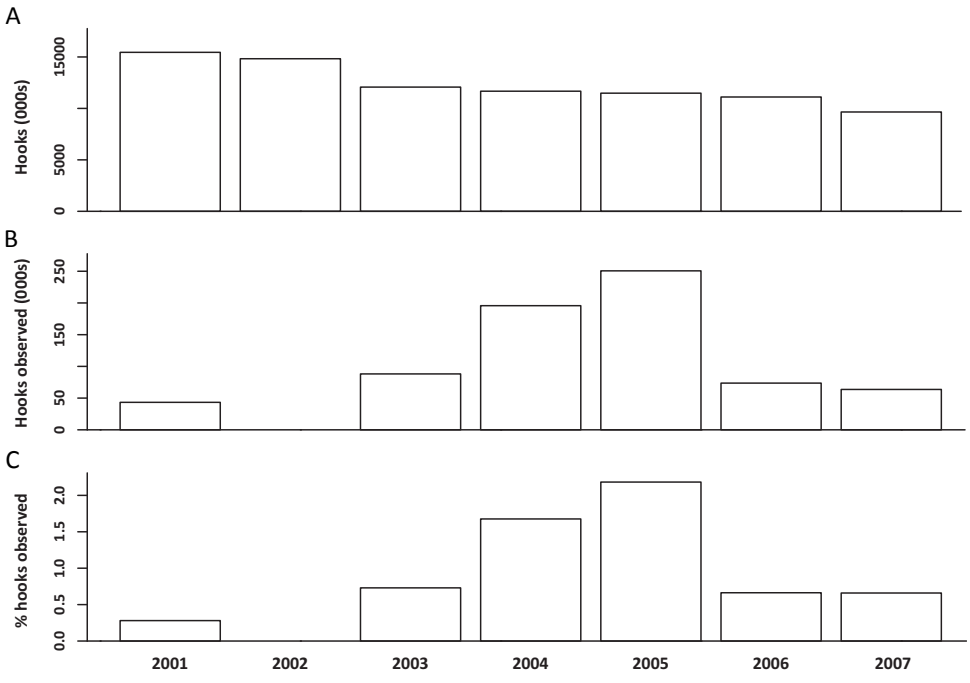


Figure 2. A. Total fishing effort, B. Observer effort, C. Observer coverage in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) by calendar year for the period 2001–07.

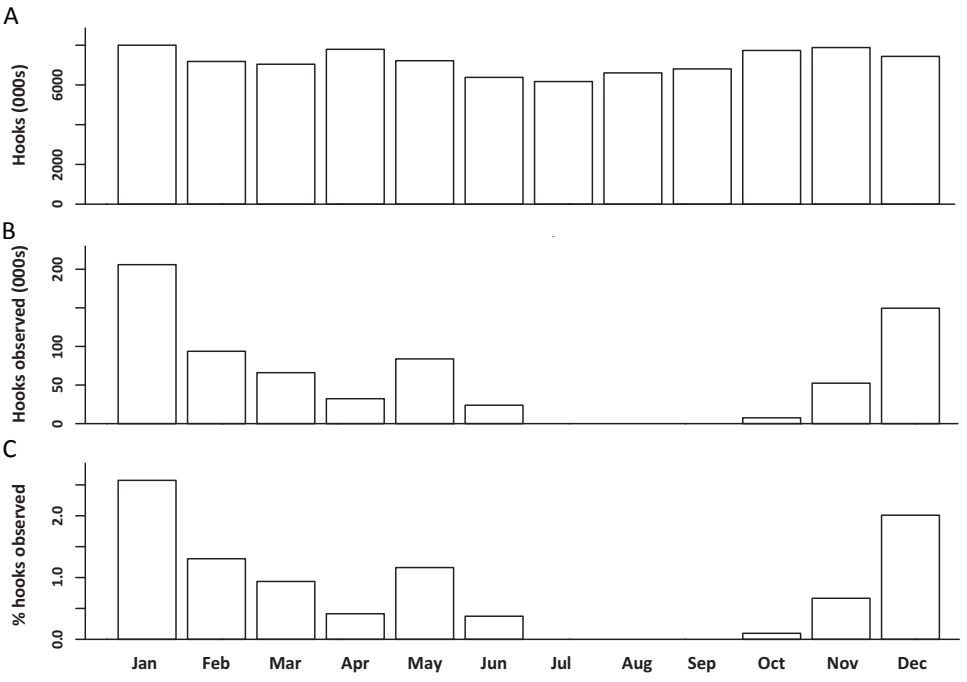


Figure 3. A. Total fishing effort, B. Observer effort, C. Observer coverage, by month in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07.

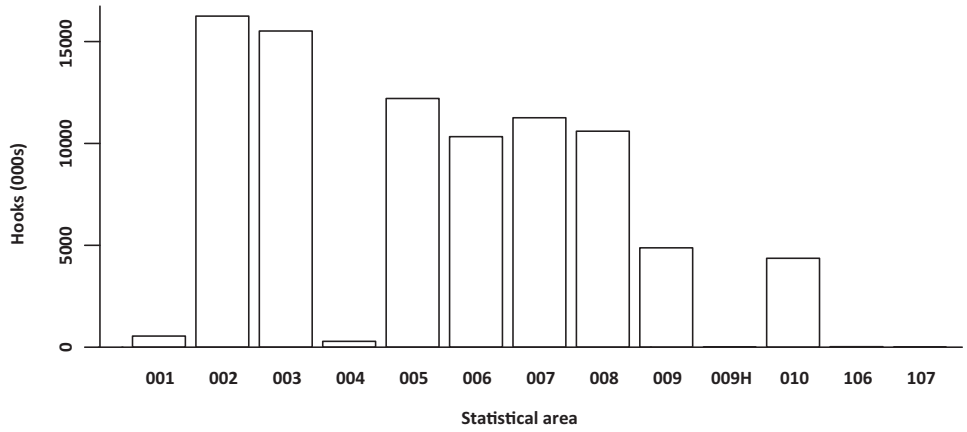


Figure 4. Total fishing effort by statistical area in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. See Fig. 1 for statistical areas.

TABLE 1. PROTECTED SPECIES INTERACTIONS RECORDED DURING OBSERVED FISHING EVENTS IN FISHING MANAGEMENT AREA 1 (FMA 1). SEE APPENDIX 3 FOR MORE INFORMATION ABOUT THESE SPECIES.

SPECIES	INCIDENTALLY KILLED	LIVE INTERACTION: FISHING GEAR*	LIVE INTERACTION: OTHER†
Flesh-footed shearwater	17	8	
Grey-faced petrel	11		
Black petrel	4	1	
Buller's shearwater	2		4
Fluttering shearwater	2		
Pied shag	1		
Australasian gannet		2	
Red-billed gull		1	
Green turtle (*Chelonia mydas*)		1	
Unidentified petrels†			6
Total	37	13	10

* Species identification not confirmed.

† Photographs show at least some of these were Cook's petrels (*Pterodroma cookii*) or Pycroft's petrels (*P. pycrofti*).

The protected species most commonly recorded caught as bycatch in this fishery—the flesh-footed shearwater—breeds at a number of sites around the North Island and Cook Strait, including within FMA 1. The extent and status of many colonies remain uncertain. A Ministry of Fisheries project is currently underway to determine the population size and trend for this species on the Hen and Chicken Islands, the major breeding site. The next most commonly-caught species—the grey-faced petrel—breeds only on islands and headlands of northern New Zealand, and the two major colonies of this species are both within FMA 1. Of particular conservation concern is the third most commonly caught species—the black petrel—which breeds only on Great Barrier Island (Aotea Island) and Hauturu/Little Barrier Island in the Hauraki Gulf, with only a few thousand breeding birds in total. A CSP research project is currently investigating the at-sea distribution of black petrels, their overlap with commercial fishing effort, and population trend (Bell et al. 2009). A summary of the threat status, abundance and distribution of each seabird species caught as bycatch during this study is given in Appendix 3. The green turtle capture represents the first documented capture of this species in New Zealand fisheries. Globally, turtle species are under a high threat of extinction from many causes, including fisheries bycatch. While turtles do not breed in New Zealand, the extent to which green and other turtle species use New Zealand waters during their long and complex migrations remains unknown.

Fishing-related variables monitored over the years 2001–07 are summarised in Fig. 5. Twenty-six of the 37 birds incidentally killed during the period were killed in 2001 (Fig. 5D), during the first year of observer coverage in this fishery, on two out of three observed fishing trips. This gives rise to a much higher seabird mortality rate for 2001 (Fig. 5F) than in the other years observed in 2001–07. There were no live seabird interactions in 2001 (Fig. 5C), with most live interactions recorded in 2004 and 2005, when there was greatest observer coverage (Fig. 5A). Because of the predominance of seabirds in the protected species interactions recorded in FMA 1, the factors that may be related to seabird mortality or interaction with fishing gear in this fishery are explored further in section 3.

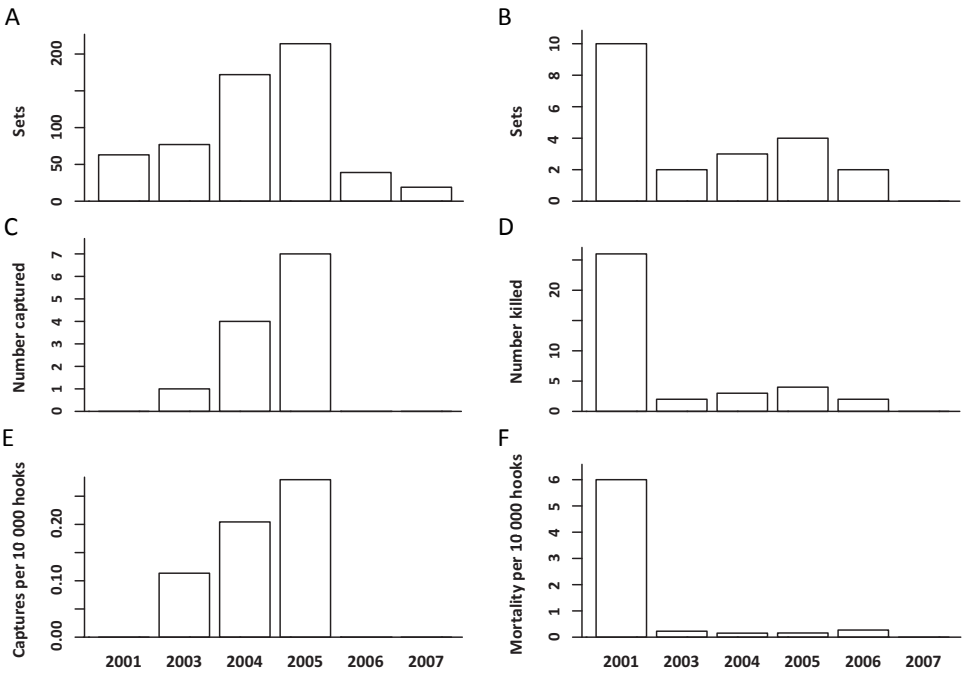


Figure 5. A. Observer coverage, B. Sets with birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, by year in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) during 2001–07.

The green turtle was captured in January off northern Northland, on a relatively large set (approx. 2000 hooks) baited with barracouta which was soaked overnight, close to new moon, in very shallow water (less than 20 m deep). Because of our very limited knowledge about the distribution of turtles and their interaction with longline fishing operations in New Zealand, the relevance of these fishing variables to capture likelihood is unknown.

The ten live bird interactions not involving fishing gear that were recorded involved two events on one observed fishing trip where birds crashed onto the deck at night, possibly attracted and/or dazzled by deck lighting. All birds were released alive. These records are not included in the analysis in section 3.

3. Factors related to seabird interactions

This section examines the influence of a number of fishing variables recorded by government observers in FMA 1, to see if they can help us understand when and why seabirds were caught during the fishing operations. For most variables, a standard panel of charts is presented, that shows the overall pattern of fishing effort observed (A), the number of sets that resulted in seabird mortalities (B), the numbers of live seabird captures (C) and dead seabird captures (D), and the live capture rate (E) and the bird mortality rate (F) per 10 000 hooks set. However, caution is needed when interpreting these charts, as sample sizes are quite low; for example, a few large seabird capture events (as were recorded in 2001) can heavily influence the observed pattern, and may hide important underlying factors. For this reason we have not conducted statistical modelling on the data.

Figure 6 shows fishing-related variables by month for the period 2001–06. As discussed previously, most fishing observed was over the summer period, and this pattern is reflected in the live seabird captures, with all captures recorded during summer months (Fig. 6C). While there is a similar underlying pattern for seabirds incidentally killed, a strong peak in mortality is observed in April and May (Fig. 6D). These are the months when vessels were observed in 2001, and this peak is a reflection of this. All of the seabird species recorded bycaught in this study breed within FMA 1. The risk of fisheries bycatch in waters close to breeding colonies is likely to be highest during the breeding period, when birds must regularly return to the nest. Flesh-footed shearwaters and black petrels are both summer breeders, with many individuals migrating outside of New Zealand waters during winter. In contrast, grey-faced petrels are winter breeders (see Appendix 3).

Using a tori line has been proven to be one of the key mitigation techniques to reduce the incidental capture of seabirds in fisheries (Bull 2007). The line acts as a physical barrier, denying birds access to baited hooks as they are set from the boat. A good tori line covers the longline from the boat to a distance at which baited hooks have sunk to a depth where birds can no longer dive on them (Brothers 1995). The speed at which baited hooks sink is determined to a large

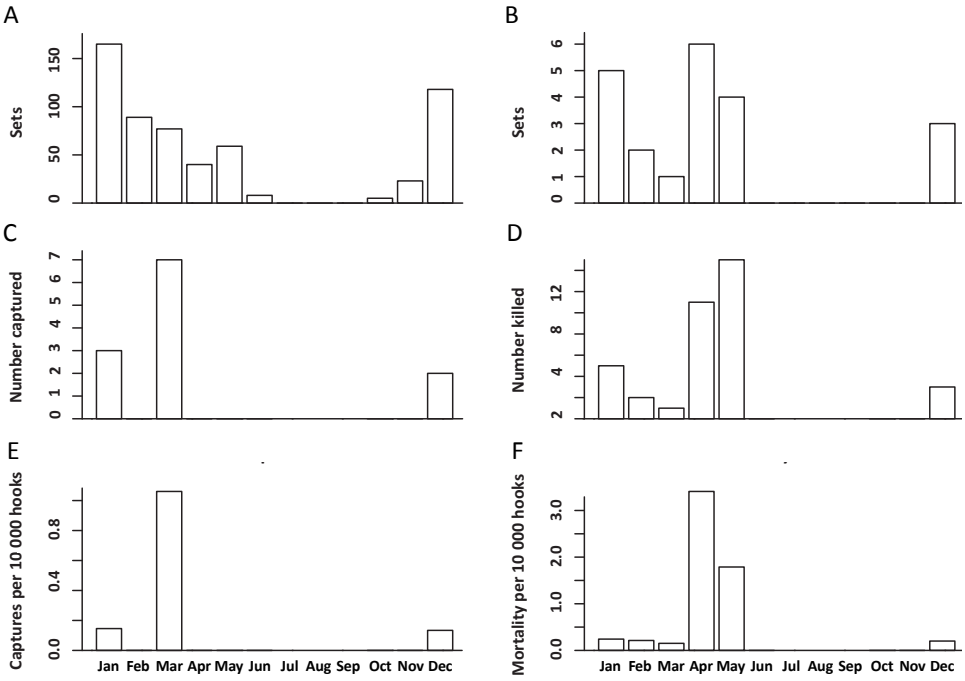


Figure 6. A. Observer coverage, B. Sets with birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, by month in the snapper (*Pagrus auratus*) demersal longline fishery Fishing Management Area 1 (FMA 1) for the period 2001–07.

extent by the weighting regime used. Using weights to increase the sink rate of hooks is an important seabird bycatch mitigation technique. However, if a line drifts or floats after setting, baited hooks may become available to seabirds and pose a hazard not mitigated by tori line use. During this study, tori lines were used for about 40% of sets, with records of use missing for a few sets (2%). Only 3 of the 37 birds killed during this study were landed dead from sets using a tori line (Fig. 7). Tori lines were rarely used during the fishing events observed in 2001 (Fig. 8), and it seems likely this is a key factor for explaining the very high levels of seabird mortality observed in that year, compared with later years when tori lines were used much more frequently.

More live bird captures occurred when tori lines were used, compared with when they were not used. An important difference in likely timing and method of bird interaction between birds killed and those captured live is that live-captured birds are much more likely to have become caught on the fishing gear during hauling, or in the later stages of soaking if the line is at or close to the surface. Tori lines are particularly effective at mitigating bird interactions with hooks when lines are set, but are usually not used at hauling. Other mitigation techniques may be required to reduce the incidental live capture of seabirds on hauling. See section 4 (and Appendix 4) for a summary of observed tori line specifications.

Seabirds are attracted to longline vessels during setting primarily because of the bait on the hooks. Birds are attracted to many types of fishing vessel by discarded catch or offal (Weimerskirch et al. 2000). However, in longline fishing, discharge mainly occurs during hauling, so seabirds are attracted during setting, primarily because of the bait on the hooks (also, if baits are discarded on hauling, this can attract seabirds, increasing the likelihood of live captures). The pattern of seabird mortality and captures by primary bait type used on each set clearly shows that most live captures were on sets that used squid bait, and there was a high live capture rate with octopus bait, but this is based on a small number of sets using octopus (Fig. 9). Most seabird mortalities were from sets using pilchard bait. Pilchard was the main bait type used during the sets observed in 2001, when tori

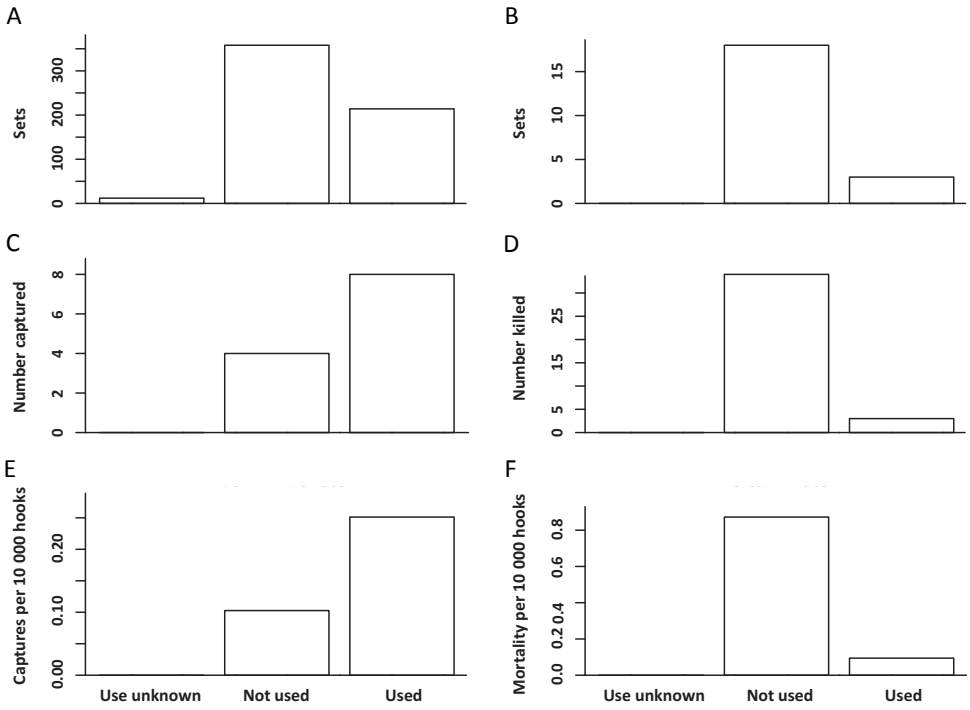


Figure 7. Tori line use related to A. Observer coverage, B. Sets with birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07.

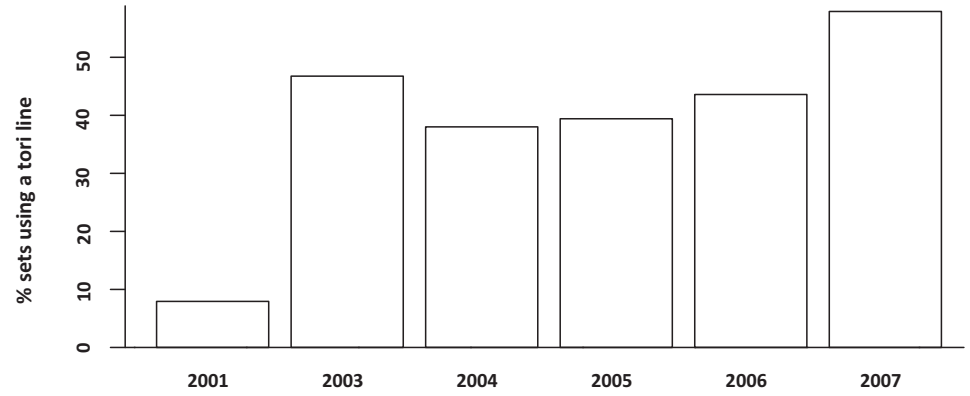


Figure 8. Tori line usage on all observed sets in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) over the period 2001–07.

line use was low. As already discussed, tori lines are an effective mitigation tool, so it is likely that the lack of a tori line would be more important in influencing the higher seabird mortality rate observed in 2001 than the type of bait used. The high mortality rate on sets using kahawai is based on a single bird mortality and may represent a chance event.

Seabirds use sight and smell to find and take food (Brooke 2004). Feeding behaviour can be influenced by the diurnal and lunar cycles, so the time of day that longlines are set and hauled is important. Setting longlines at night is an established and proven mitigation technique to reduce the incidental capture of some seabird species (Klaer & Polacheck 1998). The longlines observed in this study were set at a variety of times of day, although mainly during the morning or day, and were hauled almost entirely during the morning or day (Fig. 10). The seabird mortality rate was highest when lines were set during the day, and live the capture rate was highest when lines hauled during the day (Fig. 10). Only three birds were killed when lines were set at night, and two of these were during full moon (see below). Even when observations from 2001 are removed (to avoid the dominance of these few events on underlying patterns), the highest mortality rate remains for sets made during the day, but night sets appear to

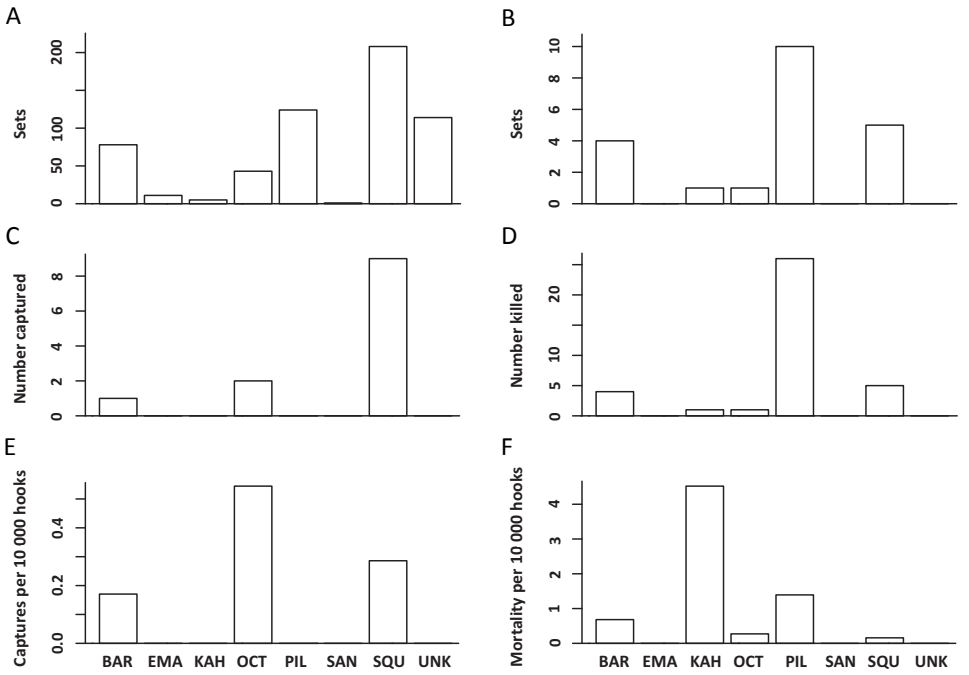


Figure 9. Primary type of bait used related to A. Observer coverage, B. Sets with birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. BAR = barracouta; EMA = blue mackerel; KAH = kahawai; OCT = octopus; PIL = pilchard; SAN = sanmar; SQU = squid; UNK = unknown.

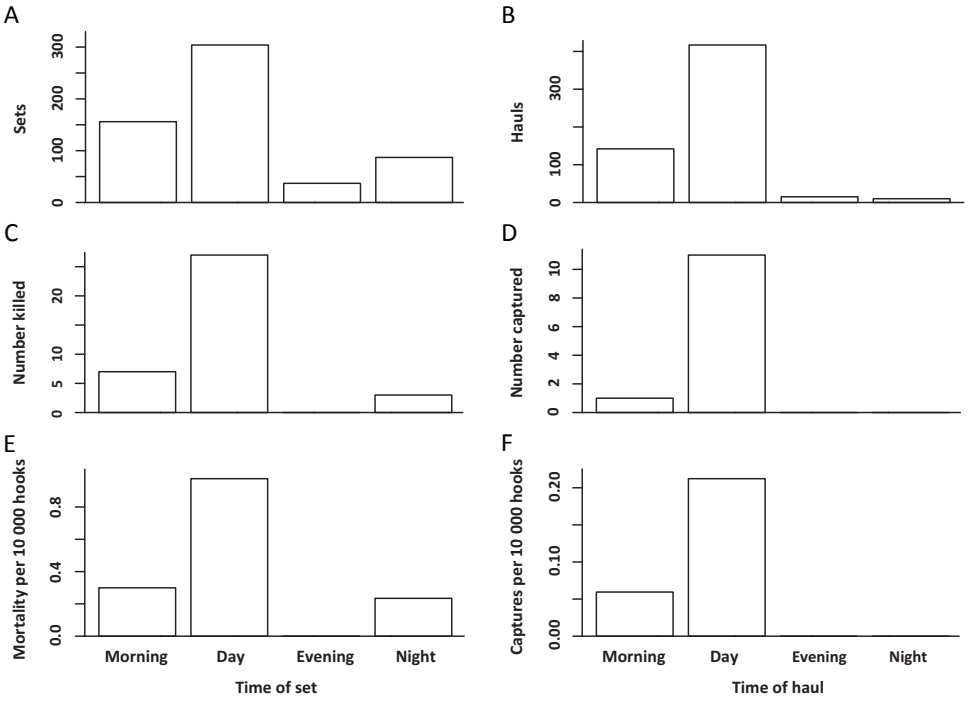


Figure 10. Time of day at start of set and haul related to A. Observer coverage, B. Sets with birds killed, C. Birds killed, D. Live capture rate, E. Mortality rate, F. Live capture rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. Morning = 0.5 h before to 2 h after sunrise; evening = 2 h before to 0.5 h after sunset.

have a mortality rate almost as high (Fig. 11). Bright moonlight at night can allow seabirds to forage as they would during daylight, and reduce the effectiveness of night setting as a seabird mitigation technique (Klaer & Polacheck 1998). When night sets are considered separately (Fig. 12), two of the three mortalities from lines set at night were during the full moon phase, despite only a small number of night sets being observed close to full moon.

There is a noticeable difference between the fishing depth of sets that resulted in bird mortalities and those that resulted in live bird captures (Fig. 13). Most sets observed where fishing depth is available were set in water 20–60 m deep, ranging up to about 140 m deep. Most live captures were from sets in less than

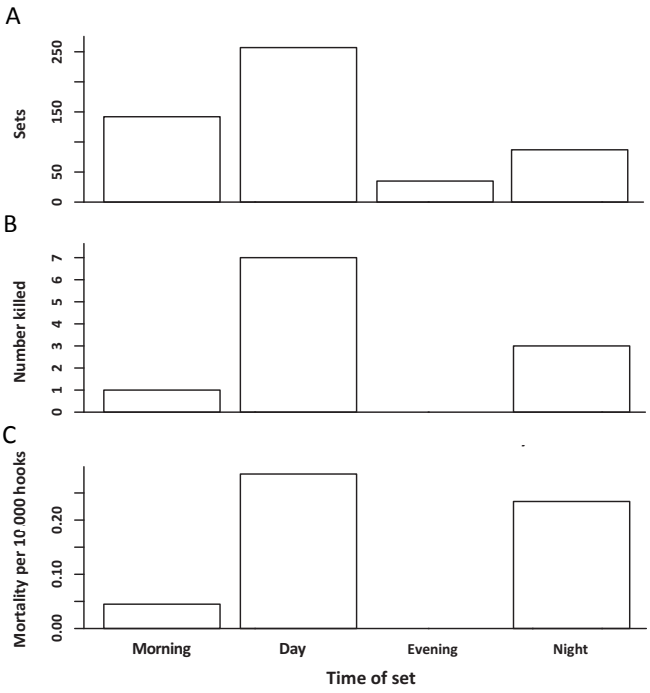


Figure 11. Time of day at start of set related to A. Observer coverage, B. Birds killed, C. Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2003–07. Morning = 0.5 h before to 2 h after sunrise; evening = 2 h before to 0.5 h after sunset.

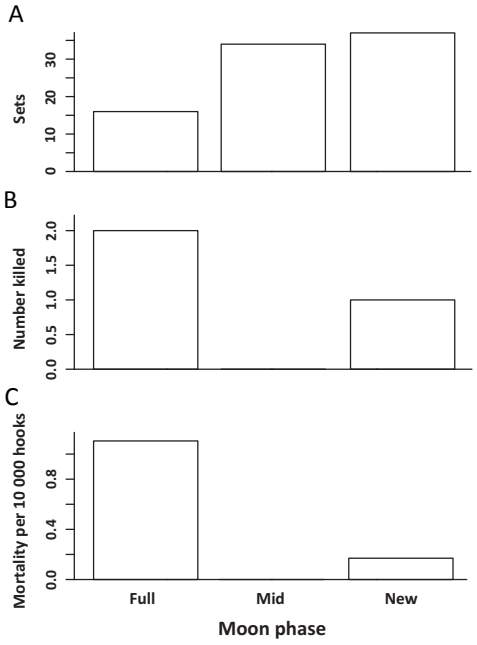


Figure 12. Moon phase, related to A. Observer effort, B. Birds killed, C. mortality rates for night sets only, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. Moon phases are three equal periods centred on the full moon, new moon or two mid-phase points.

40 m of water, with no live captures recorded from sets deeper than 60 m. In contrast, sets resulting in bird mortalities ranged over almost the entire range of fishing depths, with no mortalities from sets in less than 20 m of water. The particularly high mortality rate for depths of 100–120 m is associated with a large number of mortalities on one set in that depth range. When lines are set in less than 60 m of water, baited hooks are potentially within reach of some of the deepest-diving birds (Brooke 2004) at all times; and during hauling, lifted lines move back to the surface and become available to a greater variety of seabirds.

The weather conditions (especially wind) during fishing operations can influence the foraging behaviour of seabirds, and the availability of baited hooks (e.g. rough weather may cause hooks to sink more slowly or reduce the effectiveness of tori lines). In this study, however, wind conditions (as measured on the Beaufort scale) had little influence on the seabird interactions recorded (Fig. 14).

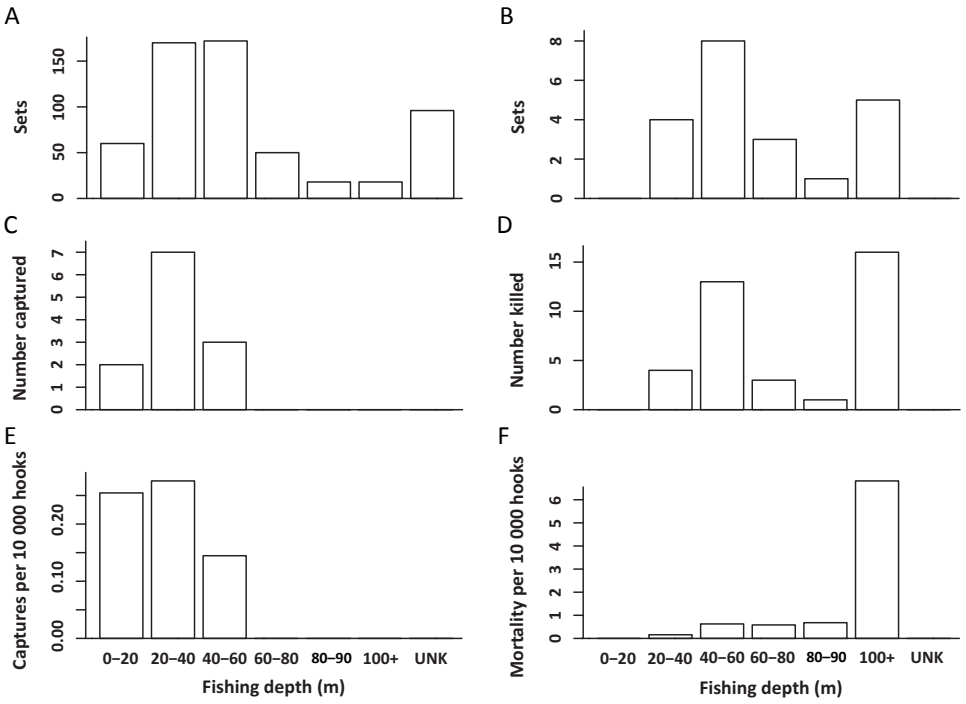


Figure 13. Fishing depth (m) related to A. Observer coverage, B. Birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. UNK = fishing depth unknown.

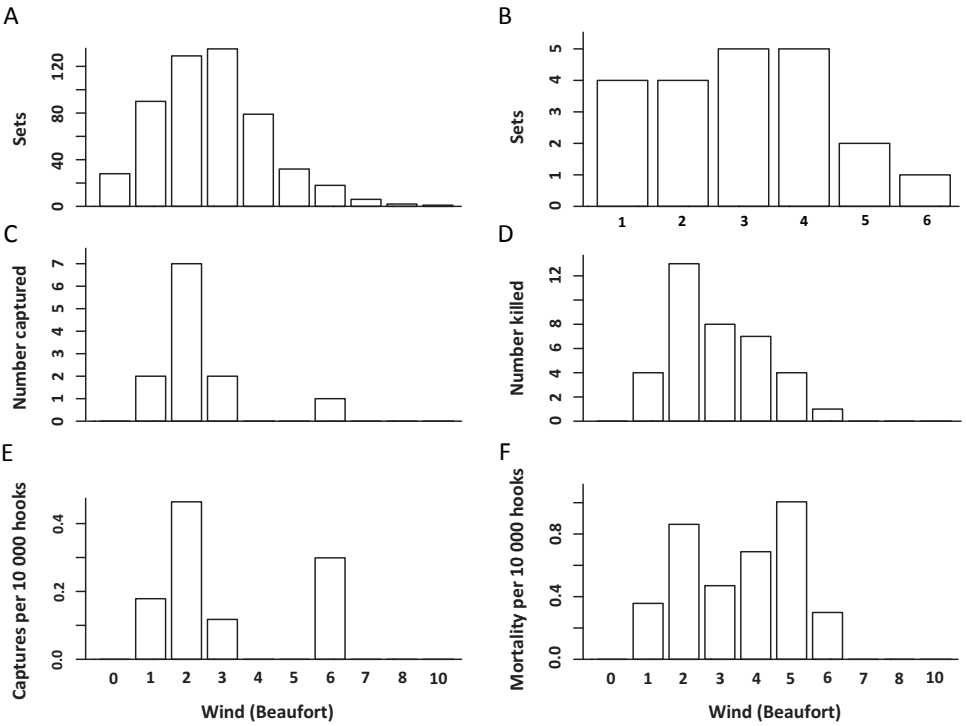


Figure 14. Wind intensity (Beaufort scale) related to A—Observer coverage, B—Sets with birds killed, C—Live bird captures, D—Birds killed, E—Live capture rate, F—Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1), for the period 2001–07.

Note: Wind intensity was treated as categories, rather than a numeric scale. Therefore Beaufort 9 does not show as there were no observations.

So far we have considered a range of environmental and mitigation variables in an effort to understand the incidents of seabird captures observed. Different fishing vessels have different fishing practices and some vessels may have more incidental catch of protected species than others. Because different vessels fish in different areas at different times, it becomes very hard to establish whether it is just vessel-specific factors, or a combination of vessel-specific factors and the environmental factors experienced by that vessel that cause differences in protected species bycatch rates. Additionally, fishing practices are likely to have

changed during the period of this study. A CSP fisheries advisory officer worked with fishers in this fishery during 2003–05 to reduce seabird bycatch by sharing knowledge on interactions and mitigation techniques, and encouraging greater uptake of mitigation measures (further details can be found in the project report available on the DOC web site[2]). In this study, 43 fishing vessels in the snapper demersal longline fishery were observed. The levels of observer coverage and live capture and mortality rates varied considerably between vessels (Fig. 15). Vessels 3 and 6 were the two vessels that had large seabird mortality events observed in 2001. Both these vessels were observed again in later years, with only a single seabird observed bycaught. Apart from these two vessels, only one vessel recorded more than one seabird mortality (two mortalities). The live bird interactions events occurred on only a few vessels.

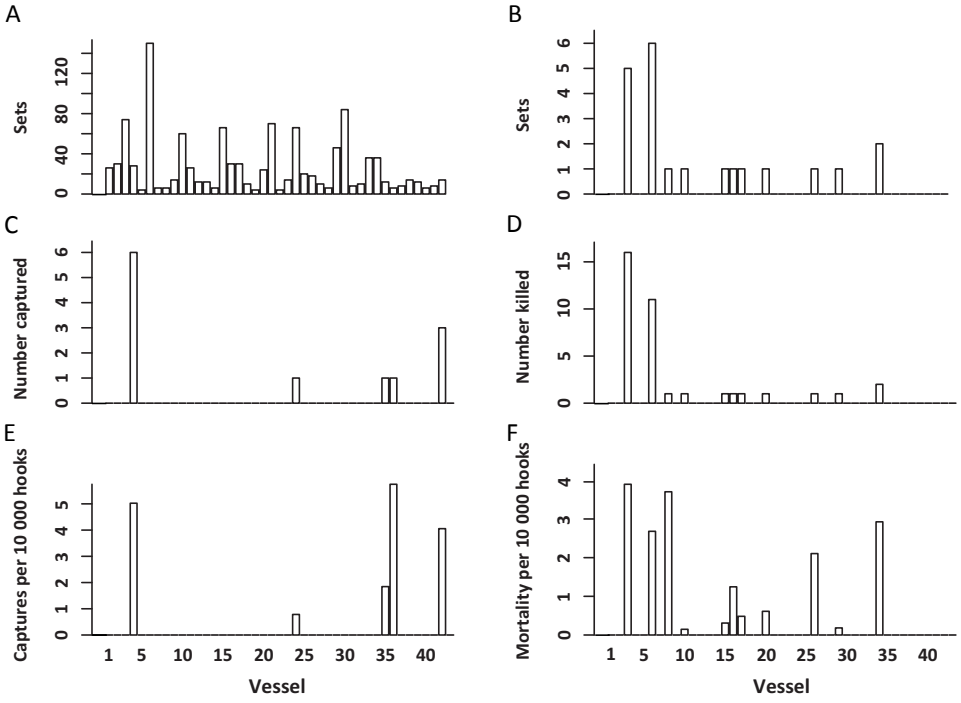


Figure 15. Fishing vessel related to A. Observer coverage, B. Sets with birds killed, C. Live bird captures, D. Birds killed, E. Live capture rate, F. Mortality rate, in the snapper (*Pagrus auratus*) demersal longline fishery in Fishing Management Area 1 (FMA 1) for the period 2001–07. Note: vessel names have been changed to numbers to maintain confidentiality.

[2] www.doc.govt.nz/publications/conservation/marine-and-coastal/marine-conservation-services/csp-reports/archive/2003-2004/northern-snapper-longline-fishery-advisory-officer-report-1-april-2003-to-31-march-2005/

4. Seabird mitigation measures observed

During this study, a number of practices that act to mitigate the incidental capture of seabirds were observed. As described in section 3, the use of tori lines and setting lines on dark nights both appeared effective in reducing seabird capture rates in this fishery. Data was collected on the type of tori lines used during observed fishing trips, including the length, aerial extent, height of attachment and number of branch streamers. In summary, Most tori lines used during the fishing events observed in this study did not have any branch streamers (although some had up to 15), were generally attached to boats at a height of about 4 m, and had an average length of 85 m, Most lines achieved an aerial extent of 20–40 m. A graphical summary of the tori lines used on trips reported in this study is presented in Appendix 4.

Line weighting is another practice that has been proven to reduce seabird capture rates in longline fisheries. This practice involves adding weights to lines to make the lines (and hooks) sink more quickly, thus reducing the period during which hooks are available to seabirds (Bull 2007). Line weighting is a common practice in demersal longline fishing. The fishing methods observed during this study can be roughly divided into two types: longlines hard on the seabed and floating longlines. Longlines hard on the seabed are typically weighted at intervals of 12–25 hooks, with one or more mid-line floats (sometime associated with additional heavier weights). The most commonly used weights weighed 700 g, although weights up to 5 kg, and as little as 250 g were used by some vessels. The average distance between weights varied from 7 to 125 hooks. Some vessels that normally used a weight every 25 hooks would increase this to one every 12 hooks if the risk of seabird capture was thought to be high for that set. Floating longlines typically have less weighting applied to the lines, and have a small float associated with each weight in order to float the mainline above the seabed. In the fishing sets observed during this study, both line-setting methods were often used by the same vessel, with floating longlines being used when the seabed surface was rough. Data on line set up and weighting was collected by observers on a trip-by-trip basis, not set-by-set, so it is not possible to relate the weighting regime or line set-up to seabird captures. However, it was noted by the observer on at least one trip that the floating line set-up on that vessel could pose a higher seabird capture risk by increasing the availability of hooks to birds because of slower sinking of hooks and shallower setting depths.

Another mitigation practice recorded by observers during this study was the fishers choosing to fish in areas where it was thought large numbers of seabirds would not occur, or to steam away from areas with large numbers of seabirds before setting gear.

5. Conclusions

Having government observers on boats in the snapper demersal longline fishery in FMA 1 has provided a useful insight into the interaction between protected species and this fishery. It has established that protected species interactions do occur, and the incidental mortality of species of high conservation concern has been recorded.

Although the data in this study are very limited, there appear to be some patterns in the occurrence of seabird bycatch. Analysis of the data indicates that using proven mitigation techniques such as tori lines or setting lines at night (apart from close to full moon) can be very important in reducing the levels of seabird mortality. Another widely recognised mitigation method is line weighting. Weighting can act to sink baited hooks faster, reducing the period during which they are available to seabirds.

Further observations of this fishery, more widespread and consistent use of proven mitigation techniques, and adoption of additional mitigation techniques are required to further reduce the negative effects of fishing on protected species in the FMA 1 fishery.

6. Recommendations

The analysis of data collected from the FMA 1 fishery has demonstrated that the extent of protected species interactions with snapper longline fishing operations in FMA 1 may be considerable, and has highlighted the need for further information. Placing government observers on fishing vessels is currently the only reliable method for collecting robust data on protected species interactions with commercial fishing in New Zealand waters, although alternative approaches are being actively investigated by DOC. In order to estimate the extent of interactions, and to be able to use statistical modelling techniques to investigate the underlying factors related to protected species interactions in this fishery, further information is required. To enable the successful mitigation of adverse effects on protected species by this fishery we recommend that:

- Effective monitoring of protected species bycatch and characteristics of fishing operations be continued to ensure that new or ongoing issues are readily identified
- Observers collect a full range of data on environmental factors that may influence protected species interactions with this fishery
- Effective mitigation measures are developed and implemented (where these are not already in place)

7. References

Bell, E.A.; Sim, J.L.; Scofield, P. 2009: Population parameters and distribution of the black petrel (*Procellaria parkinsoni*), 2005/06. *DOC Research & Development Series 307*. Department of Conservation, Wellington. 47 p.

Brooke, M. 2004: Albatross and petrels across the world. Oxford University Press, Oxford. 499 p.

Brothers, N. 1995: Principles of birdline construction and use to reduce bait loss and bird deaths during longline setting. CCAMLR, Hobart. 19 p.

Bull, L.S. 2007: Reducing seabird bycatch in longline, trawl and gillnet fisheries. *Fish and Fisheries 8*: 31–56.

Klaer, N.; Polacheck, T. 1998: The influence of environmental factors and mitigation measures on by-catch rates of seabirds by Japanese longline fishing vessels in the Australian region. *Emu 98*: 305–316.

Miskelly, C.M.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Powlesland, R.G.; Robertson, H.A.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2008: Conservation status of New Zealand birds, 2008. *Notornis 55*: 117–135.

Tasker, M.L.; Camphuysen, C.J.; Cooper, J.; Garthe, S.; Montevecchi, W.A.; Blaber, S.J.M. 2000: The impacts of fishing on marine birds. *ICES Journal of Marine Science: Journal du Conseil 57*: 531.

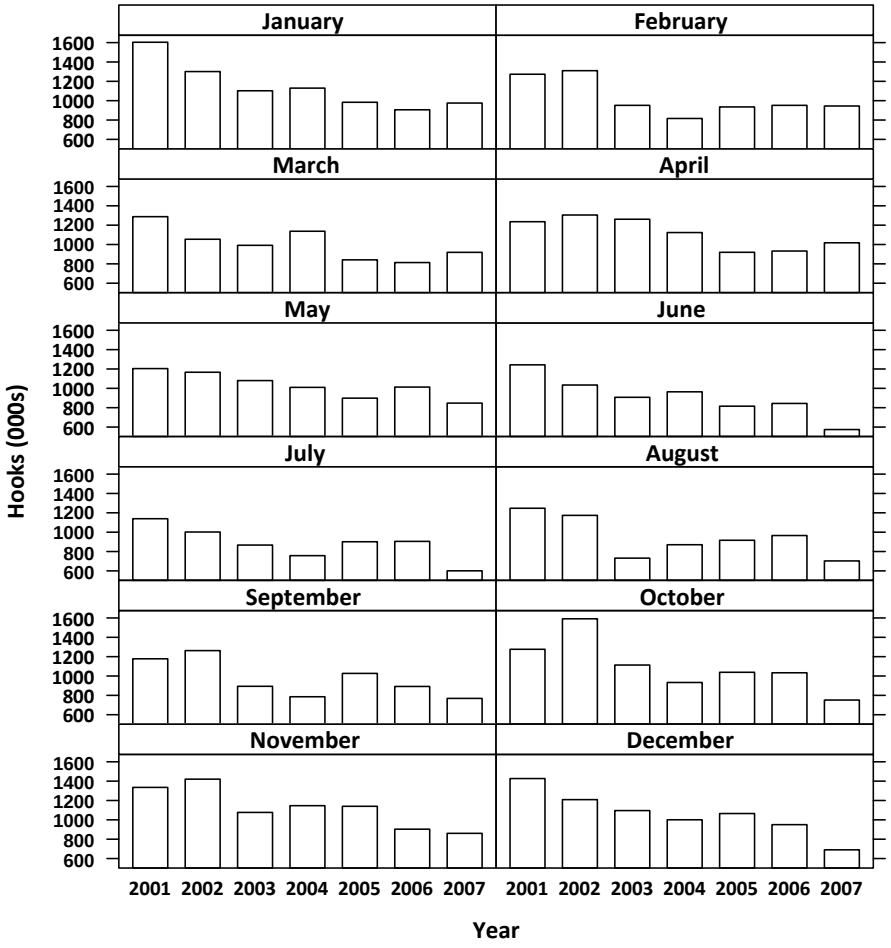
Taylor, G.A. 2000a: Action plan for seabird conservation in New Zealand. Part A: Threatened seabirds. Department of Conservation, Wellington. Pp. 1–234.

Taylor, G.A. 2000b: Action plan for seabird conservation in New Zealand. Part B: Non-threatened seabirds. Department of Conservation, Wellington. Pp. 236–435.

Weimerskirch, H.; Capdeville, D.; Duhamel, G. 2000: Factors affecting the number and mortality of seabirds attending trawlers and long-liners in the Kerguelen area. *Polar Biology 23*: 236–249.

Appendix 1

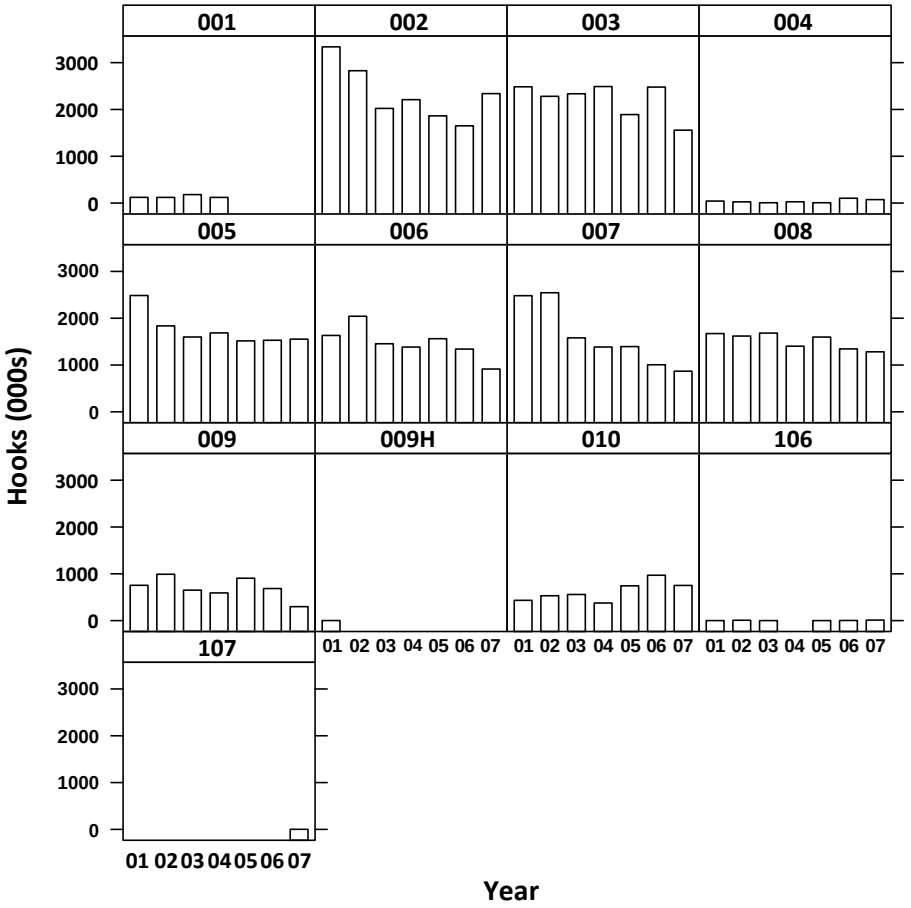
FISHING EFFORT BY MONTH IN THE SNAPPER (*Pagrus auratus*) DEMERSAL LONGLINE FISHERY IN FMA 1 OVER THE PERIOD 2001–07



Appendix 2

FISHING EFFORT BY STATISTICAL AREA IN THE SNAPPER (*Pagrus auratus*) DEMERSAL LONGLINE FISHERY IN FMA 1 OVER THE PERIOD 2001–07

See Fig.1 for location of statistical areas.



Appendix 3

DETAILS OF PROTECTED SEABIRD SPECIES OBSERVED CAUGHT AS BYCATCH IN THE SNAPPER (*Pagrus auratus*) DEMERSAL LONGLINE FISHERY IN FMA 1 IN 2001–07

SPECIES	NZ THREAT STATUS*	NZ ABUNDANCE†	NZ DISTRIBUTION†
Flesh-footed shearwater (*Puffinus carneipes*)	Declining (At Risk)	8000–10 000 pairs‡	Breeds during summer on islands around the North Island and Cook Strait, mainly Hen and Chickens Islands, Northland and in Bay of Plenty. Also breeds in Australia and Indian Ocean. Most birds absent from NZ in winter.
Grey-faced petrel (*Pterodroma macroptera gouldi*)	Not Threatened	200 000–300 000 pairs	Endemic (sometimes considered a subspecies). Breeds during winter on islands off the northern North Island, mainly in Bay of Plenty and off Coromandel.
Black petrel (*Procellaria parkinsoni*) Birds	Nationally Vulnerable (Threatened)	3000–4000 birds	Endemic. Breeds during summer only on Great Barrier Island (Aotea Island) and Hauturu/Little Barrier Island. migrate to the eastern tropical Pacific outside the breeding season.
Buller's shearwater (*Puffinus bulleri*)	Naturally Uncommon (At Risk)	Uncertain, perhaps 2.5 million birds	Endemic. Breeds during summer only at the Poor Knights Islands. Birds migrate to the north Pacific in winter.
Fluttering shearwater (*Puffinus gavia*)	Relict (At Risk)	Unknown, probably >100 000 birds	Endemic. Breeds in summer on numerous islands around the North Island and Cook Strait. Many birds remain in NZ waters during winter.
Pied shag (*Phalacrocorax varius varius*)	Nationally Vulnerable (Threatened)	5000–10 000 pairs	Endemic subspecies. Breeds mainly in coastal areas around mainland NZ. Birds remain inshore year round.
Australasian gannet (*Morus serrator*)	Not Threatened	46 000 pairs	Breeds in summer in colonies around the North and South Islands. Small numbers also breed in Australia. Birds disperse over the continental shelf, with juveniles migrating to Australia.
Red-billed gull (*Larus novaehollandiae scopulinus*)	Nationally Vulnerable (Threatened)	Uncertain, perhaps 40 000–100 000 pairs	Endemic (sometimes considered a subspecies). Breeds widely about the coasts and islands of NZ. Birds disperse over coastal and continental seas, as well as over land.

* New Zealand Threat Classification System 2008 (Miskelly et al. 2008).

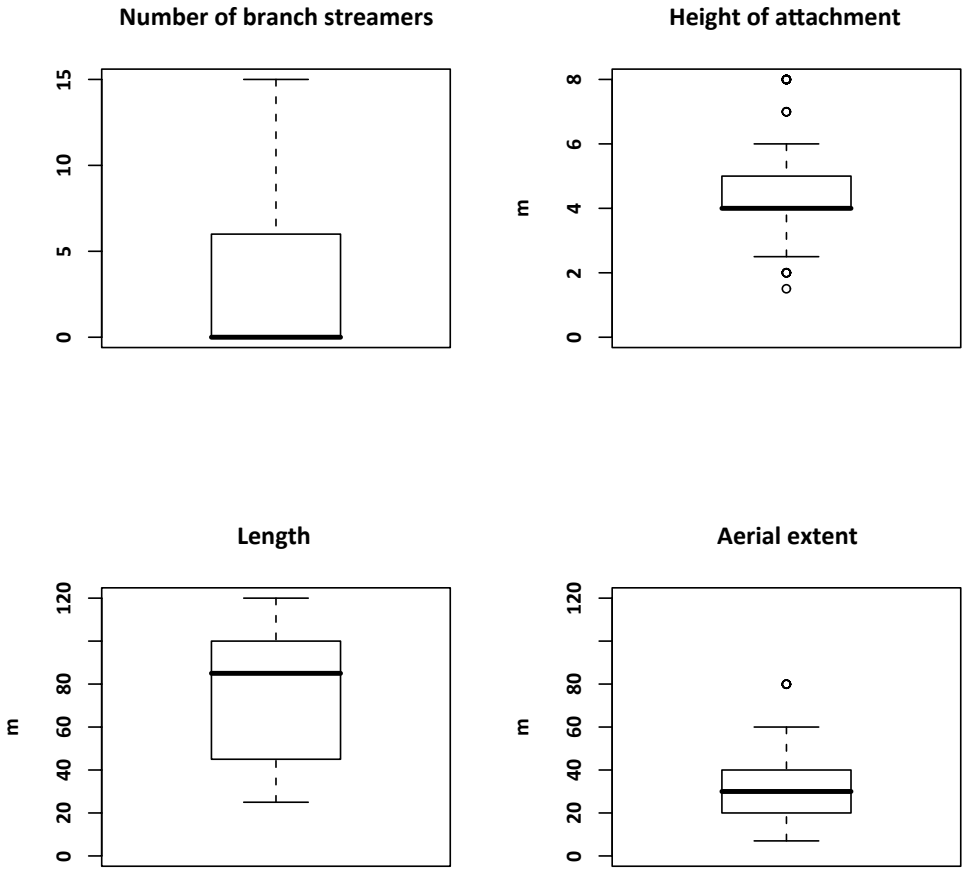
† For further details see Taylor (2000a, b).

‡ Most recent information, B. Baker, pers. comm.

Appendix 4

BOX-AND-WHISKER PLOTS OF TORI LINE SPECIFICATIONS OBSERVED ON FISHING VESSELS OPERATING IN THE SNAPPER (*Pagrus auratus*) DEMERSAL LONGLINE FISHERY IN FMA 1 IN 2001–07

Information on tori lines summarised here was collected from 42 observed trips on 25 different vessels over the monitoring period.



DOC Marine Conservation Services Series

DOC Marine Conservation Services Series *is a published record of scientific research and other work conducted to guide fisheries management in New Zealand, with respect to the conservation of marine protected species. This series includes both work undertaken through the Conservation Services Programme, which is funded in part by levies on the commercial fishing industry, and Crown-funded work. For more information about DOC's work undertaken in this area, including the Conservation Services Programme, see www.doc.govt.nz/mcs.*

Individual copies are printed, and are also available from the departmental website in pdf form. Titles are listed in our catalogue on the website, refer www.doc.govt.nz under Publications*, then* Science & technical.

New Zealand Government