Seabird interactions with the deepwater bottom-longline fleet

MIT2013-03 – Characterisation of smaller vessel deepwater bottom-longline operations in relation to risk factors for seabird capture

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CONTENTS

1. INTRODUCTION

In New Zealand waters, bottom longlining is conducted by vessels with diverse characteristics, both physical (e.g., vessel size) and operational (e.g., manual lining versus using autoline systems). Typically, bottom-longline fisheries are considered in two groups: inshore fisheries, involving small vessels deploying hand-baited hooks and targeting a mix of species including snapper (*Pagrus auratus*), bluenose (*Hyperoglyphe antarctica*), and hapuku/bass (*Polyprion oxygeneios*, *P. americanus*), and large deep-water vessels that use auto-line systems, typically operate at considerable distances offshore and target ling (*Genypterus blacodes*) (e.g., Ramm 2010, 2012, Pierre et al. 2013). Nevertheless, an additional component of the bottom-longline fishing fleet comprises middle-sized vessels that often operate in deeper water, and target species such as ling, bluenose, ribaldo (*Mora moro*) and sea perch (*Helicolenus* spp.).

Fishing operations using bottom longlines catch seabirds due to the birds' propensity to forage on baits, fish processing waste, and fish retrieved during hauling. Factors such as slow longline sink rates, the incidental discharge of bait scraps during auto-baiting, and discarding of used baits on hauling exacerbate this bycatch risk. At the same time, there are effective methods available to reduce seabird bycatch risk in bottom-longline fishing operations, including the use of streamer (tori) lines, line weighting, and discharge retention (Bull 2007, Lokkeborg 2011).

Amongst bottom-longline vessels in New Zealand waters, both the highest risk to seabirds and the greatest uncertainty in risk estimation have been linked to vessels less than 34 m in length that target species other than snapper or bluenose (Richard & Abraham 2013c). Within this sector of the bottom-longline fleet, seabirds of particular conservation concern that have been reported caught are Chatham albatross (*Thalassarche eremita*), Salvin's albatross (*T. salvini*), black petrel (*Procellaria parkinsoni*) and flesh-footed shearwater (*Puffinus carneipes*) (Richard & Abraham 2013c).

Vessels less than 34 m in length that target bluenose reflect the next highest risk to seabirds, followed by larger vessels (i.e., greater than 34 m length). Seabirds associated with the risks by these other vessel groups include eight species of albatross, and also black petrel and flesh-footed shearwater (Richard & Abraham 2013c).

Here, we report on the Department of Conservation's (DOC) Conservation Services Programme (CSP) project MIT2013-03. The aim of this project was to characterise bottom-longline fishing activity by middle-sized and large vessels operating in deeper water in relation to seabird captures. Also included in this study was the identification of factors associated with high seabird bycatch risk of these middle-sized vessels.

1.1 Project objectives

- To review observer, fisher, and catch effort data on vessel operations, and findings from previous mitigation projects in deepwater bottom-longline fisheries;

- To identify key risk factors for seabird interactions;
- To characterise the factors relating to seabird captures across bottom-longline vessels over 20 m length;
- To provide recommendations on mitigation practices in this fishery.

2. METHODS

2.1 Data stratification

The activity of bottom-longline fishing vessels was characterised by grouping similar fishing effort into strata based on the reported target species, vessel length, and fishing location. This data grouping included all bottom-longline fishing effort reported in the 13 fishing years from 2000–01 to 2012–13. Recent trends in fishing activity were also identified. The extent of night-setting amongst each focal vessel group was determined by comparing the setting time included in the fisher-reported catch-effort data with the time of sunrise and sunset, which were calculated using the latitude and date of the line-setting (Meeus 1991).

Observer coverage was examined in accordance with the data stratification. The extent of observer coverage was investigated across strata, with a particular emphasis on identifying strata that had little or no observer coverage. Seabird captures reported by observers were examined by fishing year.

Bottom-longline fishing effort is reported here as the number of hooks set, and the number of sets. The number of hooks per set across the fleet varied widely, so that the number of hooks set was a more appropriate descriptor of fishing effort. The number of hooks per set was also used to inform the stratification of effort.

2.2 Sources of information

Fishers report bottom-longline fishing effort to the Ministry for Primary Industries (MPI) on the Catch Effort Landing Return (CELR), the Lining Catch Effort Return (LCER), and the Lining Trip Catch Effort Return (LTCER) forms. These data were available through the MPI warehou database (Ministry of Fisheries 2008). Included in present analysis was all fishing effort recorded on the forms with the primary method reported as bottom longlining. The reporting period included the 13 fishing years from 1 October 2000 to 30 September 2013. Fishing effort data were provided on 12 March 2014.

The observer programme operated by MPI and Department of Conservation deploys fisheries observers to collect data from commercial fishing trips, including information on fishing effort and protected species captures. These data are collated in the Centralised Observer Database (COD) that is managed by National Institute of Water and Atmospheric Research (NIWA) on behalf of MPI (Sanders & Fisher 2010). For this project, COD data were accessed on 14 March 2014.

Fishing effort and observer records were groomed and linked, correcting for errors in date, time, and position fields. (Note: The same fisher-reported data were used for the protected species bycatch website[1].) The grooming rules have been reported previously (Thompson et al. 2013, Abraham & Thompson 2011).

To complement information extracted from the warehou and COD databases, hard-copy files of observer documentation including trip reports were reviewed. This information was accessed for all observed trips since the start of the 2005–06 fishing year during which ten or more birds were caught. Qualitative information in trip reports provided valuable insight into the circumstances of seabird captures, including risk factors that are not well documented in data available in electronic form.

In addition to information extracted from MPI databases, fleet operations and components of the management framework were examined over time. Operational characteristics of vessels >20 m in length and currently operating in the ling fishery were also included, based on information gathered to date from vessel management work undertaken by Deepwater Group Ltd.

While longline fishing methods present inherent risks to seabirds (e.g., through the availability of baited hooks) in New Zealand and internationally, there are effective mitigation methods to reduce these risks. To identify bycatch mitigation methods that may apply to New Zealand bottom-longline fisheries involving vessels >20 m in length, we reviewed existing knowledge of these measures applied elsewhere.

3. RESULTS

3.1 Overall fleet structure

Bottom-longline fishing vessels included in this study ranged in size from less than 10 m to over 50 m length and targeted a number of different species (Figure 1). Considering the target species and vessel length combinations of the 478 bottom longliners that operated in New Zealand fisheries waters in the last 13 fishing years, the median number of hooks set was correlated with vessel length. Vessels >34 m in length set around ten times more hooks than vessels <20 m in length. Vessels at intermediate sizes, i.e., between 20 to 34 m length, showed some differences in fishing effort dependent on the target species; vessels targeting ling generally set a higher number of hooks per day than vessels targeting other species, such as bluenose and hapuku.

From this analysis, we identified three distinct fishery strata:

[1]https://data.dragonfly.co.nz/psc/

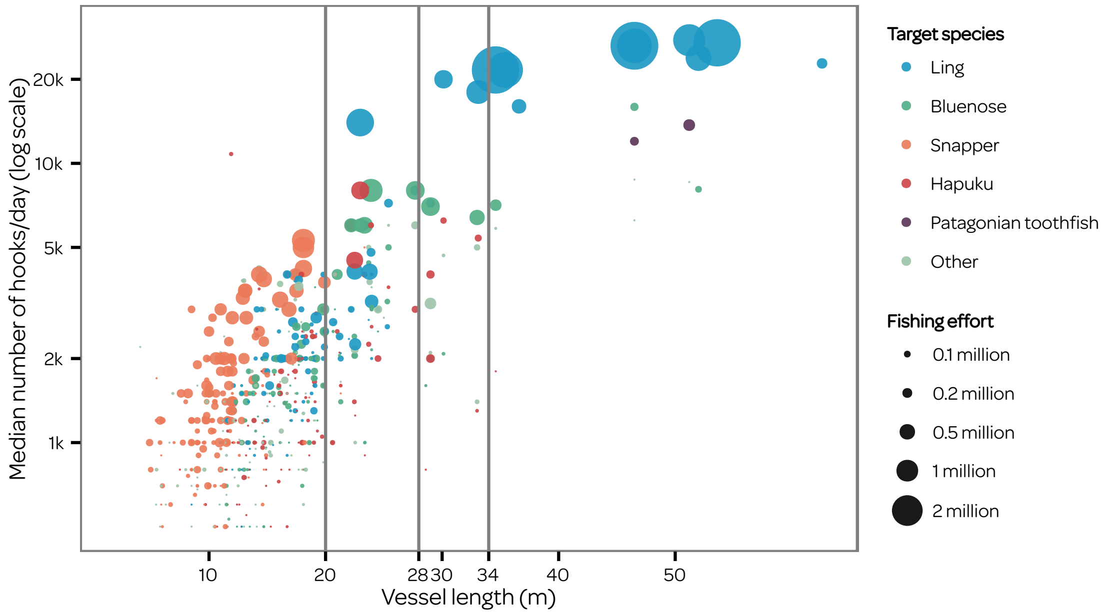

Figure 1: Median number of hooks per day for each vessel and target, by length and target, for bottom longline vessels, in the 13 fishing years between 1 October 2000 and 30 September 2013. The size of dots indicates average annual fishing effort, and target species is indicated by colour. The target species are separately indictaed for the five targets responsible for 98% of all hooks set. Other targets that have set more than 10 000 hooks are school shark, gurnard, ribaldo, tarakihi, blue cod, trumpeter, red snapper, bass groper, kingfish, red scorpion fish, rig, alfonsino, kahawai, trevally, silver warehou, gemfish, spiny dogfish, red cod, sea perch, blue shark, albacore tuna, red perch, scampi.

- small vessels (<20 m length) that mostly targeted snapper, set less than 5000 hooks per day, and less than 500 000 hooks per year;
- large vessels (>34 m length) that targeted ling, set more than 10 000 hooks per day, and over 2 million hooks per year; and,
- medium-sized vessels (20–34 m length) that targeted a range of species including ling, bluenose, hapuku, set less than 10 000 hooks per day, and around 500 000 hooks per year.

In the 13-year data set, there were bottom-longlining vessels that were <20 m in length (Table 1). This part of the fleet was not within the scope of this study, but was included in some of the comparisons. For vessels that were >20 m in length, 19 vessels were operating in the 2012–13 fishing year. Their combined fishing effort was 32 525 000 hooks, representing 100 % of the hooks set in 2012–13.

The medium-sized vessels of 20–34 m length targeted a range of species including ling, hapuku, bluenose, school shark, ribaldo, and "other" target species (Table 2). These vessels fished in similar areas for all targets, mostly along Chatham Rise and around North Island (Figure A-2). Considering the species targeted, vessels in this size grouping frequently switched across target species within months of the different fishing years from 2008–09 to

Table 1: Number of hooks set (in thousands) and number of vessels in each size (length) class for all bottom - longline effort in New Zealand waters between 1 October 2000 and 30 September 2013.

Figure 2: Monthly fishing effort (number of hooks set) by target species for bottom - longline vessels 20 - 30 m in length operating in New Zealand waters between 1 October 2008 and 30 September 2013.

2012–13 (Figure 2). Because there were only few vessels between 28 and 34 m length operating in the bottom-longline fisheries, this size grouping was combined with the 20 to 28 m size grouping in the present study.

Bottom-longline vessels in the larger >34-m size grouping almost exclusively targeted ling. Within this grouping, two vessels accounted for almost all of the fishing effort in the five years since 2008–09 (Figure A-1). These vessels mostly operated along Chatham Rise and around the sub-antarctic islands (Figure A-3).

Considering line-setting times across the different vessel size groupings, bottom-longline vessels >20 m in length initiated the line-setting throughout the day (Figure 3). Amongst vessels >34 m in length, there was no detectable change in setting times before or after the introduction of regulations in March 2008. For medium-sized vessels, a slight shift in set start times was evident, with peaks around dawn. In the most recent fishing year, 2012–13, 41.2% of sets by vessels >20 m in length were set during the night.

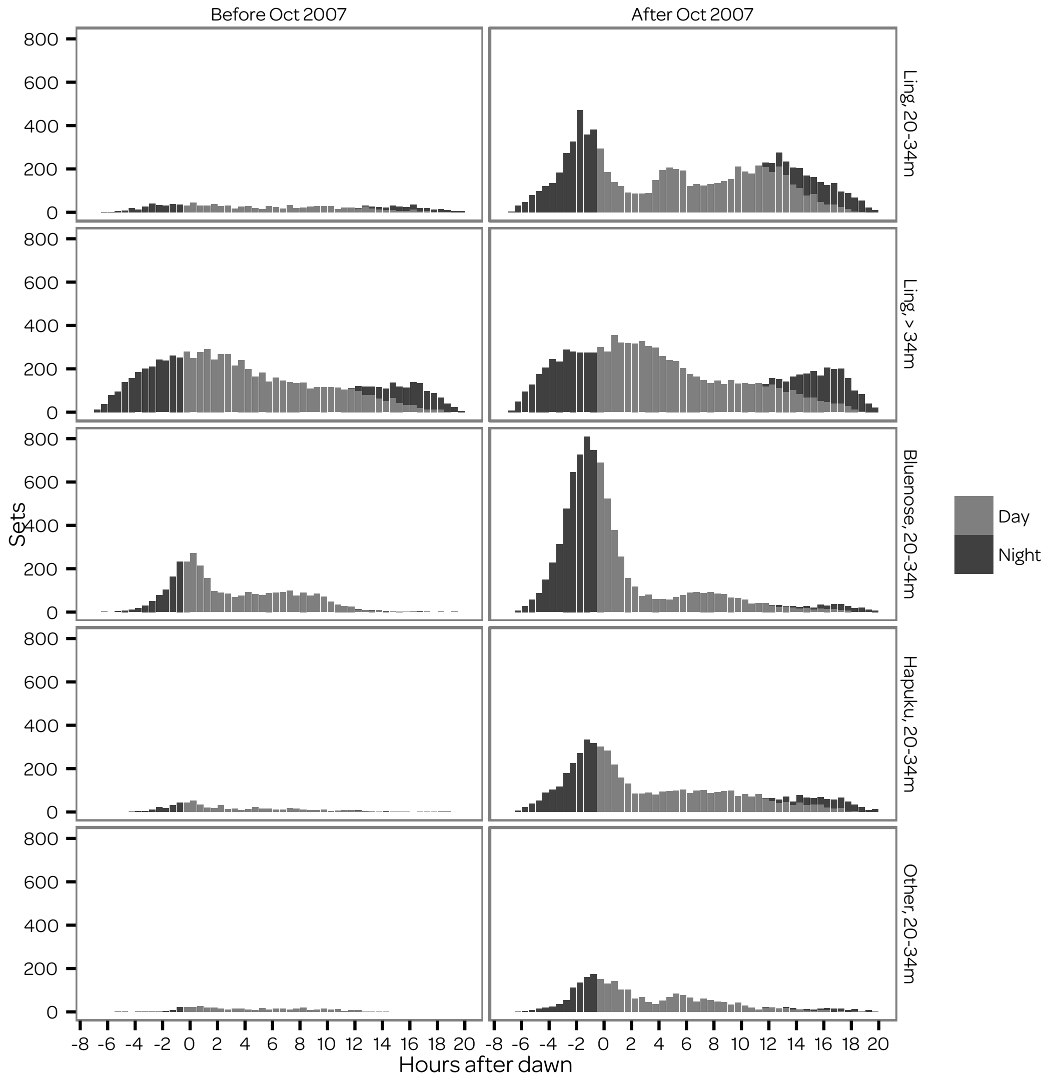

Figure 3: Number of sets by hours after sunrise for all the bottom longline effort from vessels longer than 20 metres, between 1 October 2000 and 30 September 2013. The vertical facets are organised by target species and vessel size class. The horizontal facets present the data before 1 October 2007. The colour indicates if the sets were set more than half an hour before dawn, meaning at night.

Table 2: Number of hooks set (in thousands) and percentage of hooks observed of all fishing effort by bottom-longline vessels 20-30 m in length in New Zealand waters between 1 October 2000 and 30 September 2013. Other target species included: ribaldo, trumpeter, blue cod, bass groper, alfonsino, snapper, tarakihi, sea perch, scampi, rig, albacore tuna, hake, kingfish, kahawai, king tarakihi, rays bream, red cod, gemfish, spiny dogfish, red snapper.

	Target species									
	Ling		Bluenose		Hapuku		School shark		Other	
Fishing year	000s	% obs.	000s	% obs.	000s	% obs.	000s	% obs.	000s	% obs.
2000–01	3 977		478		78		14		11	
2001–02	1 962		102		46		4		13	
2002–03	735	27	287	1	342	8	60		85	
2003–04	1 987	1	882		726		6		57	
2004–05	3 082		2 823		755		146		251	
2005–06	705		3 560		705		155		242	
2006–07	2 530	11	4 439		1 177		144		353	
2007–08	3 765	6	5 598	4	1 379	8	251	3	459	1
2008–09	3 709	14	3 497		1 140	1	489		290	1
2009–10	3 490		4 121		1 435		293		104	
2010–11	4 241	4	3 388	3	1 892	1	530	4	251	
2011–12	4 405	2	2 602		2 034	2	458		530	
2012–13	5 608		683		2 393		751		557	

3.2 Observer coverage

Observer coverage varied dependent on the vessel size grouping. It was was very low across medium-sized vessels, with 3900 hooks observed in the most recent fishing year, 2012–13, representing 0.04% of all hooks set. Across the entire 13-year reporting period, observer coverage did not exceed 5% of the total effort. The highest observer coverage was in 2007–08, when 564250 hooks were observed, representing 4.9% of all hooks set that year (Figure 4).

For large vessels >34 m in length, observer coverage was relatively high, with 40.3% of all hooks observed in the 13-year reporting period (Figure 5). The highest observer coverage in this size grouping was in 2002–03 at 82.9%. In more recent fishing years, observer coverage declined considerably, to a low observer effort of 4.8% in the 2012–13 fishing year. The decline in observer coverage corresponded with a decrease in fishing effort over the same period. Fishing effort in this vessel size grouping decreased from 36 278 908 hooks in 2002–03 to 5 635 005 hooks in 2012–13.

The observed bottom-longline effort has mostly been on large vessels >34 m length. Only 2.0% of observed hooks on medium- and large-sized vessels >20 m in length have been on vessels in the 20–34-m size grouping. Correspondingly, there have been fewer observed captures in the medium-size vessel grouping. There was a total of 1461 seabirds observed caught by bottom longliners in the 13-year data set from vessels >20 m in length, with only 5.3% of these observed captures on vessels 20–34 m in length (see Table A-7 and Table A-8 for detailed information of observed seabird captures in the two vessel size groups).

Figure 4: Total fishing effort (top) and government fisheries observer coverage (bottom) as the number of hooks set by bottom-longline vessels 20–34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013. Data are presented by target fishery (other: ribaldo, trumpeter, blue cod, bass groper, alfonsino, snapper, tarakihi, scampi, sea perch, rig, albacore tuna, hake, kingfish, kahawai, king tarakihi, rays bream, red cod, gemfish, spiny dogfish, red snapper).

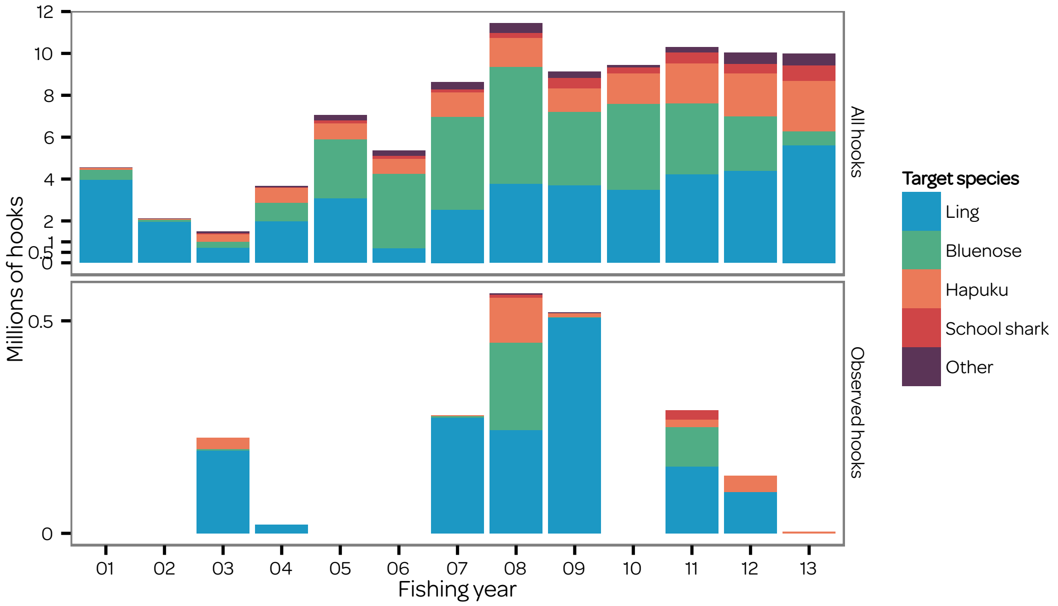

Figure 5: Total fishing effort (top) and government fisheries observer coverage (bottom) as the number of hooks set by bottom-longline vessels >34 m in length. Data include the fishing years between 1 October 2000 and 30 September 2013, and are presented by fisheries management area (FMA).

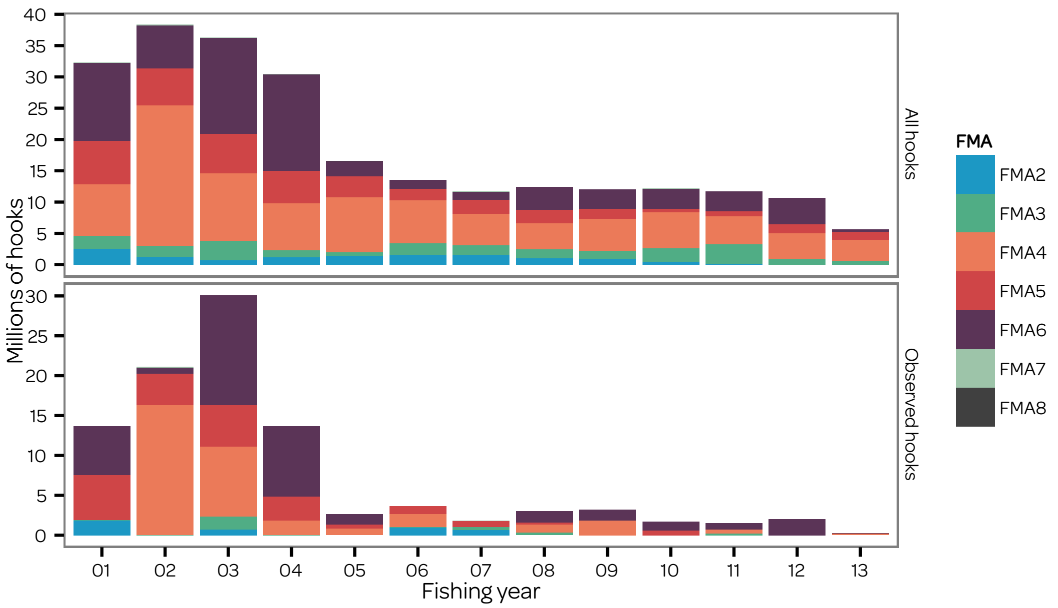

Table 3: Seabird captures reported by fishers on bottom-longline vessels >20 m in length operating in New Zealand waters between 1 October 2008 and 30 September 2013. Captures were recorded on Non-fish/Protected Species Catch Return forms, and included uninjured (U), injured (I), and dead birds (D) for different species and species groups.

	Fishing year														
	2008–09			2009–10			2010–11			2011–12			2012–13		
Species group	U	I	D	U	I	D	U	I	D	U	I	D	U	I	D
White-chinned petrel	6		49	1		46	9	2	79	2		49	1		20
Petrels, prions, and shearwaters			23	1		22			15			7			6
Sooty shearwater	1		21	1		14	1					6			5
Salvin's albatross	1		1	5		5	4		6	2	2	10	1		8
Grey petrel			11	3		1			9			1			2
Westland petrel			3			5		2	7	1	1	4			
Chatham Island albatross			4			6			8			3			1
Cape petrels	1		6	1		2			1			3			
Buller's albatross						5			4				2		3
NZ white-capped albatross															4
Cape petrel			2												
Albatrosses	1		1												
Black petrel			2												
Flesh-footed shearwater			2												
Northern giant petrel		1	1												
Southern Buller's albatross	1														
Penguins		1													
Southern royal albatross		1													
Southern giant petrel						1									
Total	11	3	126	12		107	14	4	129	5	3	83	4		49

3.3 Fisher-reported seabird captures

Since 1 October 2008, fishers have been required to fill in the Non-fish/Protected Species Catch Return (NFPSCR) form when a seabird has been caught during fishing operations. Prior to the introduction of the NFPSCR form, fishers were requrired to use the Non-fish incidental catch form. Fishers report their identification of the captured seabird using a MPI code, and also the status of the bird as uninjured, injured, or dead. Since the introduction of the NFPSCR form, the species most commonly reported caught were white-chinned petrel, sooty shearwater, and Salvin's albatross (Table 3). In the 2012–13 fishing year, a total of 53 bird captures were reported by fisheries, involving 7 bottom-longline vessels. The number of vessels reporting captures has increased from 6 vessels since the first year of the introduction of NFPSCR forms in 2008–09.

3.4 Current operating environment

Regulations for the use of seabird bycatch reduction measures were introduced in New Zealand bottom-longline fisheries in 2008, and updated in 2010 (New Zealand Government 2008, 2010). These measures incorporate elements of global best practice for reducing seabird bycatch in bottom-longline fisheries, modified with the intent of better fitting bottom longliners fishing in New Zealand waters, and following feedback received on gear configurations in use at the time. Regulations provide standards for streamer lines, line-weighting, night-setting, and the discharge of fish waste (New Zealand Government 2010).

The Deepwater Group Ltd (DWG) has represented quota owners holding most ling stocks since 2004–05, and co-manages these stocks with MPI. Initially, management activities focused on larger trawl vessels and on ling caught during fishing operations targeting hoki. Ling caught in quota management areas LIN 3 to 7 using longline and trawl methods entered the assessment process operated by Marine Stewardship Council in 2009, with DWG as the client group.

Since the early 2000s, a code of practice has been available for longliners targeting ling. Initially, the code applied to autoline operations but more recent versions are more inclusive in scope (Deepwater Group Ltd 2013). The current interim code of practice (Deepwater Group Ltd 2013) includes information on seabird interactions in relation to the fishery, bycatch reduction measures, mandatory requirements for bycatch mitigation and reporting.

During the 2013–14 fishing year, Deepwater Group is collecting information about the vessels and fisheries targeting ling, including compiling a list of contact details for vessel operators, and will use this new information to finalise an operational procedures document that will be promulgated prior to the 2014/15 fishing year. Vessel-specific management plans may comprise part of the future package of operational procedures. Information being sought from operators to inform the development of the new operational procedures includes characteristics of gear used, fishing effort, target species, any mitigation measures in place, and seabird capture patterns. In addition to distributing the interim code of practice to vessel operators by email, DWG has initiated crew training sessions and vessel by vessel visits to support information collection. Information compiled by the DWG for LIN 2-7 to date indicates that the current regulations intended to reduce the risk of seabird bycatch present implementation and operational challenges for vessel operators.

3.5 Fleet characterisation

Seventeen vessels are actively using bottom longlines to target ling within the purview of DWG. Therefore, for these vessels, some information is available on operating systems and gear used. The group of vessels is diverse. It includes both freezer vessels and those holding fresh fish, autoline systems and manual baiting operations, two different types of hooks, and three different types of “backbones” (longline mainline) of varying dimensions.

Of these 17 vessels, five vessels are >34 m in length, including three factory vessels that operate autoline systems and fish outside New Zealand’s Exclusive Economic Zone (NZ EEZ). One additional factory vessel >34 m in length targets ling using an autoline system both inside and outside NZ

EEZ. These four vessels deploy integrated weight longlines (IWL) of 11–12-mm diameter backbone. One additional vessel >34 m in length operates an autoline system with a 9-mm diameter tarred backbone. All vessels using autoline systems deploy EZ baiter hooks.

The other 12 bottom-longline vessels included in the vessel group that catches ling quota and is represented by DWG range in size from 20 to 34 m length. One vessel uses an autoline system and deploys 9-mm diameter IWL longline with EZ baiter hooks. Four vessels use autoline systems, tarred rope backbones 7- or 9-mm in diameter, and EZ baiter hooks. Amongst these vessels, one is a freezer vessel and the other three hold fresh fish. The remaining seven vessels hold fresh fish caught by hand-baiting circle hooks deployed on monofilament longline 5–6 mm in diameter.

3.6 Accessibility of data collected by observers

Government fisheries observers deployed in bottom-longline fisheries have been tasked with collecting information of risk factors influencing seabird bycatch for over a decade. The kind of information collected, how it is collected, and its usability and accessibility, however, have been variable. For example, set and haul logs completed by observers capture some information on streamer line specifications, their usage, and on offal discharge. Information on streamer line specifications has also been collected in diagrammatic form and on the dedicated Tori Line Details Form. As only information from the Tori Line Details Form is entered into COD, most of the data collected to date are currently unavailable. Similarly, gear specifications are either not recorded or only recorded in diagrammatic form, and their incorporation in the electronic database has been inconsistent. This variability in the data recording and management precludes any quantitative exploration of mitigation approaches and bycatch patterns.

To increase the value of observer data in the future, it is important that these data are collected in a consistent way and stored in an electronically accessible form. A related project (CSP project INT2013-04) is focused on optimising the collection of protected species data by fisheries observers, and will provide specific recommendations and draft forms to support the consistent recording of gear and operational factors relating to seabird bycatch.

Although the potential for quantitative explorations of observer data is limited, qualitative information recorded by observers in trip reports indicates that significant seabird capture events were linked to factors that are likely to exacerbate bycatch risk. For example, observer comments suggest that when tori lines were used, the construction quality (e.g., the number of streamers) and efficacy (e.g., placement of streamer lines over baited hooks) varied (Department of Conservation and Ministry for Primary Industries, unpublished data). Similarly, while information was not available from all trips, observers reported variability in line-weighting, discharging of used baits into the hauling bay when longlines were retrieved, and bait scraps from auto-baiting machines attracting seabirds at setting (Department of Conservation and Ministry for Primary Industries, unpublished data).

3.7 Review of mitigation measures

Bycatch mitigation measures that significantly reduce the incidence of seabird captures in commercial bottom-longline fisheries include the weighting of longlines to maximise the sink rate of baited hooks close to the stern of the fishing vessel, deploying bird-scaring streamer (or tori) lines to deter birds from attending baited hooks on setting, setting longlines at night, retaining fish waste on-board while longlines are set and hauled, and deploying a "Brickle" curtain or other device to restrict seabird access to the hauling bay (e.g. Bull 2007, Lokkeborg 2011, ACAP 2013a). Recommendations for the reduction of seabird bycatch during fishing operations include the use of effective bycatch reduction in combination (ACAP 2013a).

Although effective measures to reduce seabird bycatch in bottom-longline fisheries are available, standards and specifications recognised as global best practice for bycatch reduction in these fisheries have often been developed on larger industrial vessels rather than smaller artisanal vessels, e.g., streamer lines (BirdLife International and ACAP 2010a) and longline sink rates (BirdLife International and ACAP 2010b). There is a potential need to adapt these standards to suit smaller vessels (ACAP 2013a).

Weighting longlines is a standard part of bottom-longline fishing, regardless of any intent to reduce seabird bycatch risk. As the target fish species occur at depth, longline weighting means that the gear is deployed at depth in the water column, or on the seafloor. Longlines can be weighted externally (e.g., by clipping weights onto the backbone) or internally using lead beads. When external weights are attached to bottom longlines, the best-practice standard for seabird bycatch reduction is line weighting that results in a line sink rate of 0.3 m/s to a depth of 10 m. This sink rate can be achieved by using external weights of 5 kg (or more), placed at intervals of 40 m (or less) along the backbone of longlines (ACAP 2013a).

Internally-weighted, or integrated weight lines are constructed to incorporate lead beads weighing 50 g/m of mainline. Integrated weight line sinks more consistently than externally weighted line because the weight is distributed more evenly along the length of the line. In addition, the use of integrated weight line removes the need for crew to manually attach and remove weights as the longline is set and hauled. The sink rate achieved by integrated weight line, e.g., at least 0.24 m/s to 10 m depth on average (Robertson et al. 2006), has been shown to be effective in reducing seabird bycatch risk (Richard & Abraham 2013b).

There has been considerable research on the use of streamer lines, both in pelagic and bottom-longline fisheries (e.g. Bull 2007, Lokkeborg 2011, ACAP 2013a). In bottom-longline fisheries, this research has resulted in a best-practice specification comprising two streamer lines that are at least 150 m long, deployed from at least 7 m above the sea surface, and constructed in a way that the terminal object creates drag of 100 m aerial extent for each line. Paired (or more) streamers are to be deployed at intervals of less than 5 m along the streamer line backbone, and should reach the sea surface in calm conditions. Design elements that may improve streamer line operation and performance include the use of swivels, a weak link (so that the streamer line can break away in case of tangles), and a boom-and-bridle or other system that allows adjustment of the position of the streamer line to ensure it protects the hooks as they are set (ACAP 2013a). In addition to this best-practice standard, a number of other specifications have been promulgated.

Recent research conducted in pelagic longline fisheries has assessed the efficacy of alternative streamer line designs, including the use of several "light" short streamers compared with a single, long one (Sato et al. 2012). In these longline fisheries, streamer lines need to protect shallow-set hooks for greater distances astern than in bottom-longline fisheries. An evaluation of the performance of the light streamer lines has not been reported from bottom-longline fisheries to date.

Another bycatch reduction practice involves the setting of lines at night. Night-setting is an effective method owing to reduced levels of seabird activity at night. Best practice means that the timing of the night-setting is between the end of nautical twilight and before nautical dawn (e.g., Bull 2007, Lokkeborg 2011, ACAP 2013a).

In bottom-longline fisheries, seabird bycatch risk is also associated with the discharge of bait and processing waste that attracts seabirds to vessels. Bait or bait fragments may be discharged at the set for example, when baits become dislodged from hooks or bait scraps are ejected during auto-baiting processes. At the haul, used baits must be discharged following their removal from hooks.

To reduce seabird bycatch risk, the discharge of any (unattached) bait, discards and processing waste should be avoided during setting and hauling. If waste retention is not possible at these times, it is recommended that fish waste is discharged in areas distant from line setting and hauling locations (ACAP 2013a). Another important factor for waste discharge is the removal of hooks to reduce the likelihood of foraging seabirds getting injured by the hooks or ingesting them (ACAP 2013a).

In addition to the retention of offal and discards, the Brickle curtain is the only other measure recommended as best practice for reducing seabird bycatch at hauling (ACAP 2013a). This device restricts seabird access to the hauling bay when longline hooks are being retrieved. There is no specific construction standard, and the concept of the Brickle curtain can be adapted to any vessel. Key design elements are streamers that hang vertically to block seabirds in the air and on the water from moving into the hauling bay. Streamers can be suspended by a horizontal boom. The efficacy of the Brickle curtain can be increased by incorporating a line of floats on the water, underneath the vertical streamers (ACAP 2013a).

4. DISCUSSION

At the outset of this project, the focal vessel group of interest was defined by a combination of vessel length (20–34 m) and target species (not snapper or bluenose) (Richard & Abraham 2013a). Using fisher-reported catch-effort and information collected by observers confirmed that this characterisation was broadly appropriate. Using a minimum vessel size of 22 m overall length helped to characterise these bottom-longline fisheries, while the number of hooks set (10 000 hooks/day, 500 000 hooks/year) was another useful factor to define this vessel group. Other attributes such as the distinction between factory vessels and fresh fish storage or between autoline and manual systems did not group vessels effectively.

Restricting the target species to ling excluded two bottom-longline vessels (targeting bluenose) from the focal vessel group. Nevertheless, based on existing management structures and the considerable fishing effort of ling target fisheries, focusing on the latter would be effective in addressing much of the seabird bycatch risk posed by the 20–34-m vessel size group.

The extremely low government fisheries observer coverage in the 20–34-m vessel group prevents a better understanding of the seabird bycatch risk posed by this fleet. Overall, less than 5% of the 20–34-m vessel had observer coverage in any one year. In comparison, the annual observer effort on larger vessels, i.e., >34 m in length, been 40.6% of all effort. Furthermore, observer effort in the 20–34-m vessel group has frequently involved the same vessels across a number of trips or years, instead of a broad distribution of observer coverage across a large group of vessels.

Existing observer data are also limited by the inconsistent nature of the data collection, collation, and storage. For example, different information has been collected across trips, with data recorded in different formats such as diagrams, comments, or fields completed on forms. In addition, the electronic storage of collected information varies, including data that have not been stored, and data that were only stored when they were recorded on a subset of observer forms. These limitations affect the accessibility and usability of existing observer data.

The seabird species reported caught by fishers are broadly comparable to the species composition of bycaught birds reported by observers. Almost all seabirds captured during observer deployments on vessels are returned for necropsy or photographed by observers, allowing subsequent confirmation of species identifications. Seabird identifications by fishers cannot be subsequently confirmed in these ways. Nevertheless, information from the fisher reports is highly valuable, especially as observer coverage is low in the fisheries of this vessel size group.

Based on the limitations of observer data, the use of mitigation measures deployed amongst vessels 20–34 m in length is not well understood. Observer data that are available indicate that some vessels are using streamer lines, at least some of the time. The construction and dimensions of these lines used are variable. This variability is expected to affect the efficacy of streamer lines in reducing seabird captures.

Similarly, some vessels are managing fish waste discharge, at least some of the time. Nevertheless, discharge of fish waste into the hauling bay has also been reported, associated with bycatch events. When line-weighting patterns have been documented during deployments, this information has been recorded in diagrams, with reported specifications and perceived efficacy differing significantly amongst vessels. The sink rates of line-weighting regimes have not been investigated quantitatively during observer deployments.

Finally, fisher-reported catch-effort data show that longline sets conducted by the 20–34-m vessel group start throughout the day and also at night. Considering the combination of mitigation measures deployed during these day sets will be important for determining bycatch risk.

Although knowledge of bottom-longline vessels 20–34 m in length is poor, there is sufficient information to characterise the seabird bycatch risks posed by this group at a general level. Key contributors to bycatch risk appear to be the same factors as those for smaller bottom-longline vessels operating in New Zealand waters (Pierre et al. 2013). These contributing factors include the discharge of used baits and fish processing waste when hooks are being hauled, inconsistent use of streamer lines, and use of streamer lines that are of poor construction. Other factors involve day-setting (although other mitigation may be in place at these times), and the use of line-weighting regimes that produce insufficient sink rates to make the hooks unavailable to seabirds while the longlines are protected by streamer lines. In addition, the "EZ baiter" hooks used in autoline systems may be associated with greater seabird bycatch risk than the circle hooks used by hand-baiting operations (Li et al. 2012). Observer have also reported "streams" of bait scraps dropping from auto-baiting machines attracting seabirds to the longline during line setting.

Effective methods exist to reduce seabird captures in bottom longline fisheries (ACAP 2013b). These measures are used to some extent amongst the vessels 20–34 m in length operating in New Zealand waters. Nevertheless, the limited information available precludes an accurate assessment of the extent of mitigation measures used in this vessel size group, and of the consistency of deployments. Similarly, it is not possible to assess the implementation of regulated bycatch reduction measures. Consequently, it is not possible to identify appropriate revisions to mandatory measures that are currently in place.

4.1 Conclusions and recommendations

The nature and extent of seabird captures by bottom-longline vessels 20–34 m in overall length is poorly known. The lack of information includes quantitative data of the risk posed to seabirds by this group of vessels. This lack of knowledge is because:

- there is significant diversity amongst the vessels in the 20–34 m size group, in the gear used and other characteristics of fishing operations;
- observer coverage of this group of vessels has been very low over time;
- where observer coverage has occurred, observer effort tended to involve the same vessels over time;
- since 2000, observer coverage has detected a number of significant seabird bycatch events numbering 10s and 100s of seabirds, in addition to trips during which no birds were caught, which brings high levels of uncertainty into risk estimation exercises;
- the implementation of mandatory bycatch reduction measures regulations are unknown; and,
- whilst enacted, it would appear that mandatory seabird mitigation measures are problematic for some operators to implement on at least some vessels.

When significant bycatch events were recorded by fisheries observers, circumstances increasing the bycatch risk were readily identified. The factors include poorly-constructed and ineffective use of streamer lines, discharge of fish waste into the hauling bay, auto-baiting machines discharging significant amounts of bait fragments at setting, insufficient line-weighting so that lines were exposed to foraging seabirds for prolonged periods and distances astern, and inexperienced skippers and crew who did not know how to manage bycatch risks.

To provide better estimates of the impacts of vessels 20–34 m in length on seabird populations, and to facilitate the development and implementation of appropriate measures to reduce seabird bycatch risk in this vessel group, we make the following recommendations:

- Increased fisheries observer coverage across vessels 20–34 m in length, so that the nature and extent of seabird bycatch in this size group is adequately documented;
- Comprehensive compilation of information on gear types and configurations in use that are relevant to seabird bycatch risk (e.g., line-weighting, use of floats);
- Consistent deployment of well-constructed streamer lines during setting operations;
- “Clean” operation of auto-baiting machines to minimise the drop of bait scraps into the water at setting;
- No discharge of used baits, discards, and fish processing waste into the hauling bay when longlines are retrieved;

- Testing of mitigation measures such as the length of streamer lines and the line-weighting regimes to ensure they are appropriate for reducing seabird bycatch risk;
- Promotion of the use of circle hooks amongst new entrants to the fishery who are not using autoline systems; and,
- Assessment of the efficacy of bycatch reduction measures when day-setting longlines.

In conclusion, this study used available information to characterise the fishing activities and seabird bycatch mitigation measures of bottom-longline vessels 20–34 m in length that operate in New Zealand waters. Although data were limited, they indicated that existing mitigation measures to reduce seabird bycatch risk in bottom-longline fisheries can be applied to vessels in this size grouping. Nevertheless, reducing the risk of seabird bycatch requires the wide adoption of these mitigation measures amongst vessels 20–34 m in length. In addition, improved data collection of fishing characteristics and bycatch reduction efforts is required to gain a greater understanding of this vessel group in relation to seabird captures.

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A. APPENDIX

Table A-1: Number of hooks set (in thousands) by individual bottom-longline fishing vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013 (LFV: large fishing vessel number).

Table A-2: Number of hooks set (in thousands) by target species for bottom-longline fishing vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013.

Figure A-1: Number of hooks set for bottom-longline vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by month. Fishing effort is indicated as the average number of hooks set per year.

Table A-3: Number of hooks set (in thousands) by bottom-longline fishing vessels 20-34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by fisheries management area (FMA).

Table A-4: Number of hooks set (in thousands) by individual bottom-longline vessels 20-34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by fishery management area (FMA).

Figure A-2: Spatial distribution of fishing effort (number of hooks per year) by bottom-longline vessels 20-34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by target fishery.

Table A-5: Number of hooks set (in thousands) by bottom-longline fishing vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by fisheries management area (FMA).

Table A-6: Number of hooks set (in thousands) by individual bottom-longline vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by fishery management area (FMA).

Figure A-3: Spatial distribution of fishing effort (number of hooks per year) by bottom-longline vessels >34 m in length operating in New Zealand waters between 1 October 2000 and 30 September 2013, by target fishery.

Table A-7: Seabird captures reported by government fisheries observers on bottom-longline vessels >34 m in length operating in New Zealand waters between 1 October 2008 and 30 September 2013. The number of captures were reported by species and species groups.

	Fishing year											
Species	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
White-chinned petrel	211	366	128	15	11	13	11	6	1	1	24	1
Grey petrel	187	5	70		1			4	1			
Salvin's albatross	91	12	8	10		1			1		2	
Sooty shearwater	11	16	32	17	3	3	1	5		7		
Cape petrels	3	14	12	1	1	3		1		2		
Common diving petrel		1	22			1						
Chatham Island albatross		5	1			2			1			
Southern Buller's albatross								3				
Northern giant petrel	1	1	2			2						
Grey-faced petrel												
NZ white-capped albatross	1	1				1						
Wandering albatrosses		2				2						
Southern royal albatross		1									1	2
Campbell black-browed albatross												1
Broad-billed prion		1	2									
Storm petrels			3									
Black petrel												
Giant petrels	1		1									
Black-browed albatross	2											
Prions			1				1					
Albatrosses						1						
Southern giant petrel		1										
Northern Buller's albatross		1										
Black-browed albatrosses					1							
Small seabirds												
Crested penguins									1			
Total	508	427	282	43	17	29	13	19	5	10	27	4

Table A-8: Seabird captures reported by government fisheries observers on bottom-longline vessels 20-34 m in length operating in New Zealand waters between 1 October 2008 and 30 September 2013. The number of captures were reported by species and species groups.

	Fishing year											
Species	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
White-chinned petrel			4					4				
Grey petrel							1		2			
Salvin's albatross			3				22					
Sooty shearwater								1				
Cape petrels							1		2			
Common diving petrel												
Chatham Island albatross			1				12					
Southern Buller's albatross			1					3				3
Northern giant petrel												
Grey-faced petrel								6				
NZ white-capped albatross												2
Wandering albatrosses								1				
Southern royal albatross												
Campbell black-browed albatross								3				
Broad-billed prion												
Storm petrels												
Black petrel								3				
Giant petrels												
Black-browed albatross												
Prions												
Albatrosses							1					
Southern giant petrel												
Northern Buller's albatross												
Black-browed albatrosses												
Small seabirds							1					
Crested penguins												
Total			9				38	21	4			5