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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Cover Notes

To be cited as:

Pierre, J.P., Thompson, F.N., and Cleal, J. (2014). Seabird interactions with the deepwater bottom-longline fleet, 36 pages. MIT2013-03 – Characterisation of smaller vessel deepwater bottom-longline operations in relation to risk factors for seabird capture.

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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-longlining catch seabirds due to the birds' propensity to forage on baits, fish processing waste and fish retrieved at the haul. 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 lines, line weighting, and discharge retention (Bull 2007, Lokkeborg 2011).

Amongst bottom-longline vessels, 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 do not target snapper or bluenose (Richard & Abraham 2013b). 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 (*Pro-*

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cellaria parkinsoni) and flesh-footed shearwater (*Puffinus carneipes*) (Richard & Abraham 2013b). 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 2013b).

Here, we report on 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 range of bottom-longline vessels over 20 m length with respect to factors relating to seabird captures
- 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 together into strata based on the reported target

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species, vessel length, and fishing location. All bottom longline fishing effort reported in the 13 fishing years from 2000–01 to 2012–13 was included. Recent trends in fishing activity were identified. To ascertain the extent of night-setting amongst the focal vessel group, the number of hours after sunrise that each line was set was determined. This was undertaken by using the latitude and date to calculate the time of sunrise. Then, sunrise and the set time from the fisher-reported catch-effort data was compared.

Observer coverage was considered with respect to the above stratification. The extent of observer coverage was investigated across strata and in particular, strata that have not been observed are highlighted. Seabird captures reported by observers were examined by fishing year.

Bottom longline fishing effort is reported here in terms of numbers of hooks set, and the number of sets. The number of hooks per set across the fleet varied widely, and consequently the number of hooks was an appropriate descriptor of fishing effort. The number of hooks per set is also used, to inform the stratification of effort.

2.2 Information sources

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. This data is made available through the Warehou database (Ministry of Fisheries 2008). All fishing effort from these forms with the primary method reported as bottom longline for the 13 fishing years from 1 October 2000 to 30 September 2013 was included in the analysis presented here. Data was provided as at 12 March 2014.

The observer programme operated by the MPI and the Department of Conservation deploys fisheries observers to collect data from commercial fish-

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ing trips, including information on fishing effort and protected species captures. The data is collected in the Centralised Observer Database (COD) that is managed by NIWA on behalf of MPI (Sanders & Fisher 2010). In this project, COD data was accessed as at 14 March 2014.

Fishing effort and observer records were groomed and linked, correcting for errors in date, time, and position fields. Fisher-reported data is the same as that 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 occurring since the start of the 2005–06 fishing year, during which 10 or more birds were caught. Qualitative information in trip reports provided useful insight into circumstances around seabird captures, including where risk factors not well captured 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 are also included, based on information gathered to date from vessel management work undertaken by the Deepwater Group Ltd.

While the longline method presents inherent risks to seabirds (e.g., through the availability of baited hooks), in New Zealand and internationally, effective methods have been identified to reduce these risks. To identify bycatch reduction methods that may apply to New Zealand bottom longline fisheries in which vessels > 20 m in length are active, the knowledge-base de-

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

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scribing methods to reduce seabird bycatch in bottom longline fisheries was reviewed. These methods are considered, alongside the factors considered (given existing information) to increase bycatch risks amongst vessels > 20 m in length.

3. RESULTS

3.1 Overall fleet structure

Bottom longline fishing vessels range from less than 10 metres to over 50 metres. Figure 1 compares the target species and vessel length combinations of the 478 bottom longliners that have operated in New Zealand fisheries waters in the last 13 fishing years. The median number of hooks is correlated with the vessel length, with vessels > 34 m setting around 10 times more hooks than vessels < 20 m. For the vessels 20 – 34 m in length, a separation can be seen in the number of hooks set per day between ling targets versus the other targets, mainly bluenose and hapuku.

From this analysis we identified three distinct fishery strata:

- small vessels that mostly target snapper, set less than 5 000 hooks per day, and less than 500 000 hooks per year.
- large vessels targeting ling, setting more than 10 000 hooks per day, and over 2 million hooks per year, and,
- medium sized vessels targeting a range of species including ling, bluenose, hapuku, setting less than 10 000 hooks per day, and around 500 000 per year.

In the 13-year dataset, there are 112 vessels < 20 m in length that are using bottom longlines (Table 1). This part of the fleet is not in the scope of this study but has been included in some figures for comparison. For the ves-

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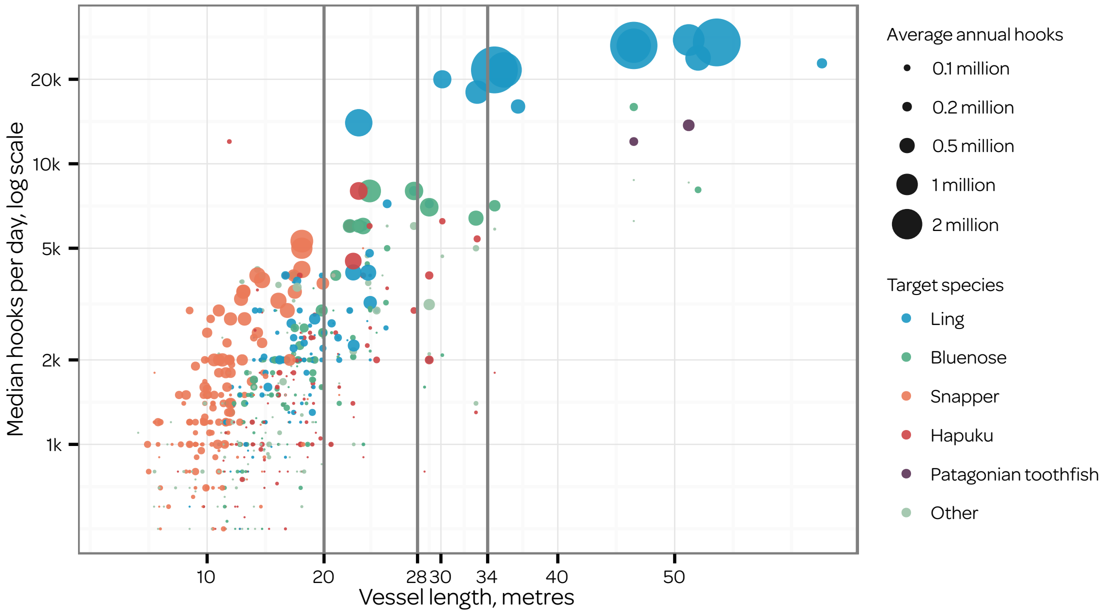

Figure 1: Median number of hooks per day for each vessel and target, by length and target, for bottom longline vessels, in the 13 fishing years between 1 October 2000 and 30 September 2013. The size of dots indicates average annual fishing effort, and target species is indicated by colour. The target 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, sea perch, blue shark, red cod, scampi, albacore tuna, red perch.

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Table 1: Number of hooks (in thousands) and number of vessels in each vessel size class, by fishing year, for all bottom longline effort occurring between 1 October 2000 and 30 September 2013.

Table 2: Number of hooks (in thousands) set, and percentage of hooks set on observed trips, by target species, for vessels between 20 and 34 metres, by fishing year. Includes all bottom longline effort between 1 October 2000 and 30 September 2013. The first four target species are detailed, with other species included: 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.

	Target species									
	Ling		Bluenose		Hapuku		School shark		Other	
	000s	% obs.	000s	% obs.	000s	% obs.	000s	% obs.	000s	% obs.
2000–01	3 977		478		78		14		15	
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	3 389	3	1 891	1	537	4	250	
2011–12	4 405	2	2 602		2 034	2	458		530	
2012–13	5 608		683		2 393		751		557	

sels > 20 m in length, 19 were operating in the 2012–13 fishing year, and set 15 628 000 hooks - 48 % of the hooks set in that year.

The middle-sized vessels of 20–34 m in length target a range of species including ling, hapuku, bluenose, school shark, ribaldo, and others (Table 2). Moreover, the vessels frequently switch between targets within a month, as shown in Figure 2. While these vessels target a range of species, they fish in similar areas for all targets (mostly along the Chatham Rise and around the North Island, Figure A-2). Because there are only a few vessels between 28 and 34 metres operating in the bottom longline fisheries, these are grouped together with the 20 to 28 metres class.

The larger vessels > 34 m in length almost exclusively target ling. Morever, two vessels account for almost all the fishing effort in the five years since 2008–09 (Figure A-1). These vessels mostly operate along the Chatham Rise and around the sub-Antarctic islands (Figure A-3).

Line-setting was initiated throughout the day amongst bottom longline ves-

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Figure 2: Number of hooks set by vessels between 20 and 34 metres, by month, for vessels operating between 1 October 2008 and 30 September 2013. The size of dots indicates number of hooks and colour indicates target species.

sels > 20 m in length (Figure 3). There is no detectable change in setting times prior and subsequent to the introduction of regulations in March 2008 amongst vessels > 34 m in length. However, for the middle-sized vessels, a slight shift in set-start times is evident, with strong peaks around the dawn. In 2012–13, 41.2% of sets by vessels > 20 m were set during the night.

3.2 Observer coverage

Observer coverage has been very low across middle-sized vessels, with 3900 hooks observed in the most recent 2012–13 fishing year, which is only 0.04% of all hooks set in that year. Observer coverage has never been over 5% of hooks, peaking in 2007–08 at 564250 hooks, or 4.9% of all hooks set in that year. (Figure 4).

For the large vessels > 34 m, observer coverage has been high. Observer coverage over the whole 13 year period is 40.6%, with a peak in 2002–03 of 82.9%. In recent years observer coverage has dropped considerably, to a low of 4.8% in 2012–13. Observer coverage follows a similar pattern to the fishing effort, which has also reduced considerably over the period from 36 278 908 hooks in 2002–03 to 5 635 005 hooks in 2012–13. Observer coverage for the large vessels has been presented in Figure 5 stratified by FMA because almost all the effort is targeting ling, fished in a wide range of areas.

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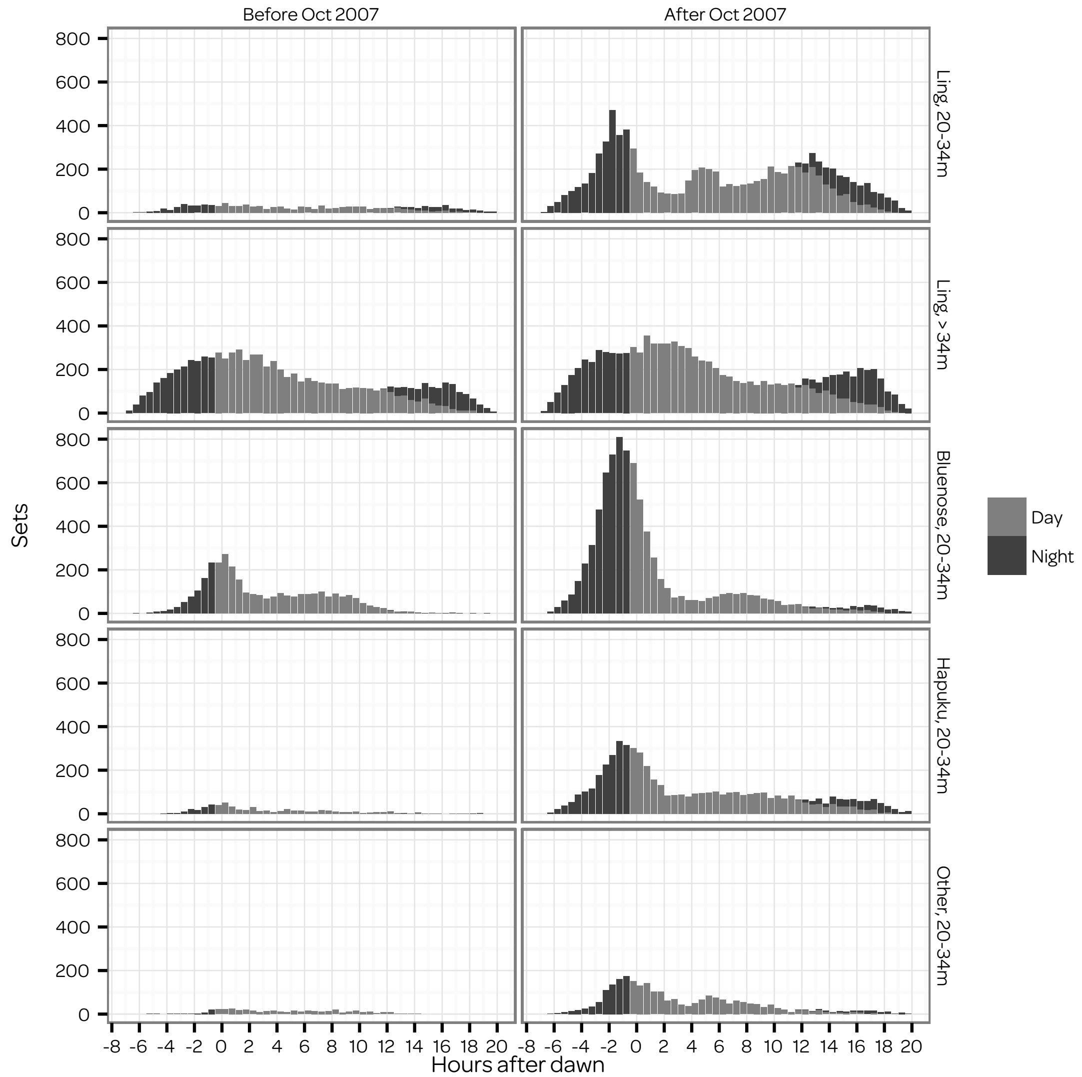

Figure 3: Number of sets by hours after sunrise for all the bottom longline effort from vessels longer than 20 metres, between 1 October 2000 and 30 September 2013. The vertical facets are organised by target species and vessel size class. The horizontal facets present the data before 1 October 2007.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

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Figure 4: All effort and observed effort, measured in hooks, for vessels 20–34 m in length, between 1 October 2000 and 30 Septmber 2013. Colour indicates the target species.

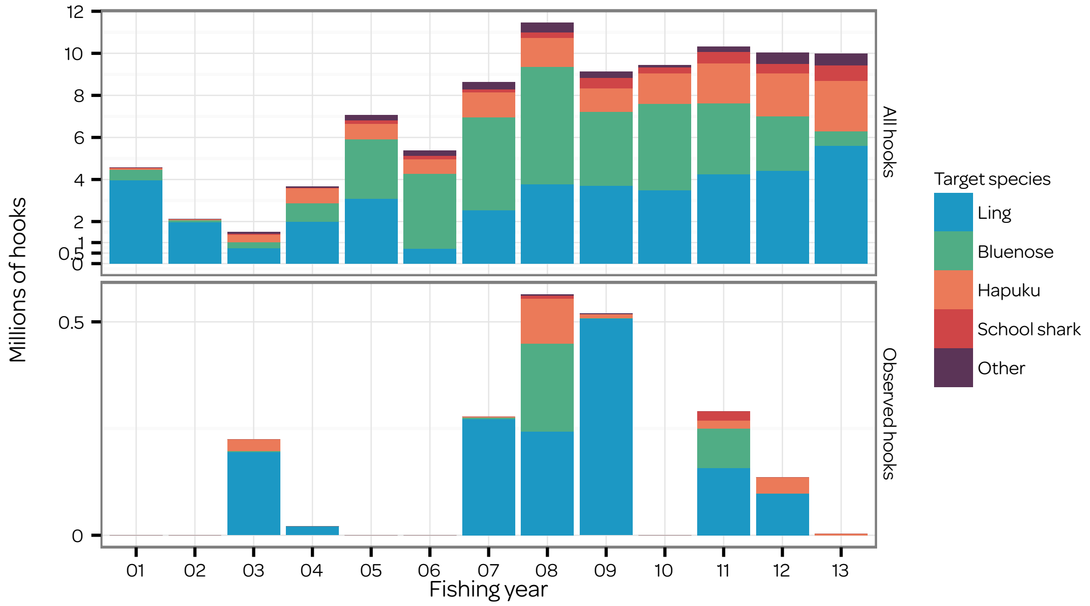
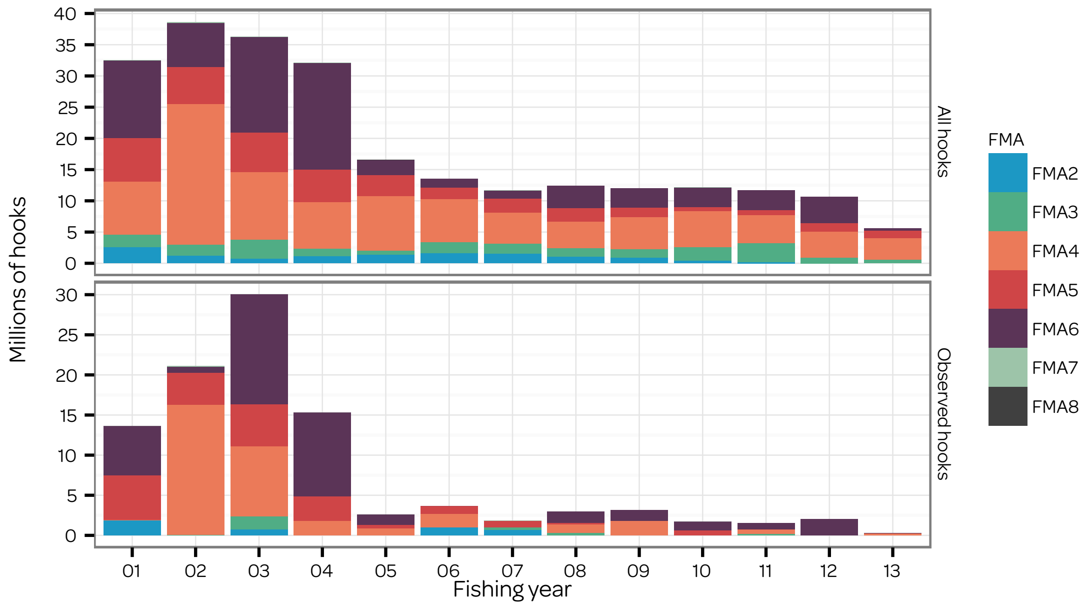


Figure 5: All fisher-reported fishing effort and observed fishing effort, measured in hooks, for vessels > 34 m in length, between 1 October 2000 and 30 Septmber 2013. Colour indicates the fisheries management area (FMA).



The observed bottom longline effort has mostly been on the large vessels > 34 m. In fact only 2.0% of observed hooks from vessels > 20 m in length have been from vessels < 34 m in length. Correspondingly, there have been fewer observed captures. There was a total of 1461 seabirds observed caught by bottom longliners in the 13 year data set from vessels > 20 m, while only 5.3% were reported from vessels < 34 m. In Table A-7 and Table A-8 the number of observed captures is listed by species and fishing year. The tables have the same structure, with the species ordered by total number of captures.

3.3 Fisher-reported seabird captures

Since 1 October 2008 fishers have been required to fill in the Nonfish / Protected Species Catch Return (NFPSCR) whenever a seabird is caught. Fishers report their identification of the seabird captured using an MPI code, as well as the status of the bird which can be uninjured, injured, or dead. In Table 3 the number of each species is reported by fishing year and capture status. The species most commonly reported caught are white-chinned petrels, sooty shearwaters, and Salvin's albatross. A total of 53 birds were reported in 2012–13, reported by 7 vessels. The number of vessels reporting captures has increased from 6 in the first year, 2008–09.

3.4 Current operating environment

Regulations for the use of seabird bycatch reduction measures were introduced to 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

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Table 3: Sea bird captures reported on the Non-fish / Protected Species Catch Return by bottom longline fishing from vessels longer than 20 metres. The total number of uninjured birds (U), injured birds (I), and dead birds (D), for each fishing year and species.

	Fishing year														
	2008–09			2009–10			2010–11			2011–12			2012–13		
	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									
All	11	3	126	12		107	14	4	129	5	3	83	4		49

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. Originally, management activities focused on larger trawl vessels and ling caught during fishing targeting hoki. Ling caught in Quota Management Areas LIN 3 - 7 using the 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

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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 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 Ex-

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clusive Economic Zone (NZ EEZ). One additional factory vessel > 34 m in size targets ling using an autoline system both inside and outside the 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 group catching ling quota represented by DWG are from 20 - 34 m in 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 and deploying those 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 relating to risk factors influencing seabird bycatch for more than a decade. However, what is collected, how it is collected, and the usability and accessibility of information collected are variable. For example, set and haul logs completed by observers capture some information on streamer line specifications, usage and offal discharge. Information on streamer line specifications has also been collected in diagrammatic form and on the dedicated Tori Line Details Form. However, only the Tori Line Details Form is entered into COD, making only a fraction of the information collected to date unavailable. Similarly, gear specifications have also not been recorded, recorded in diagrammatic form only, and stored electronically in a database inconsistently. This variability in the data

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recorded and stored precludes thorough quantitative exploration of bycatch patterns in relation to mitigation approaches.

Collecting data consistently and ensuring this is stored in an electronically accessible form will increase the value of future observer coverage. CSP project INT2013-04, which involves optimising the collection of protected species data by fisheries observers, is expected to produce specific recommendations and draft forms to support consistent recording of gear and operational factors relating to seabird bycatch.

While the potential for quantitative explorations of observer data is limited, qualitative information recorded by observers in trip reports links significant seabird capture events to factors likely to exacerbate the risk of these captures. For example, observer comments suggest that when tori lines were used, 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). Similarly, while information was not available from all trips, observers report variable line-weighting, used baits being discharged 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).

3.7 Mitigation review

Bycatch mitigation measures that significantly reduce the incidence of seabird captures in commercial bottom longline fisheries include weighting longlines such that the sink rate of baited hooks is maximised close to the stern of the fishing vessel, deploying bird-scaring (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

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curtain or other device to restrict seabird access to the hauling bay (e.g. Bull 2007, Lokkeborg 2011, ACAP 2013a). The use of effective bycatch reduction measures in combination during fishing operations is recommended (ACAP 2013a). While 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). The potential need to adapt these standards to suit smaller vessels is recognised (ACAP 2013a).

Weighting longlines is a standard part of bottom longline fishing, regardless of any intent to reduce seabird bycatch risk. Target fish species occur at depth, and so to catch them, gear must sit deeper in the water column or on the seabed. Longlines can be weighted externally (e.g., by clipping weights on to the backbone) or internally using lead beads. Where external weights are attached to bottom longlines, the best-practice standard for seabird bycatch reduction is that lines should sink at a speed of 0.3 m/s to a depth of 10 m. This sink rate is reported to be achieved 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 in a more uniform fashion along the length of the line. In addition, the use of integrated weight line removes the need for crew to attach and remove weights manually as the longline is set and hauled. The sink rate achieved by integrated weighted line (e.g., ≥ 0.24 to 10 m depth, on average, (Robertson et al. 2006)) is effective in reducing seabird bycatch risk.

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A substantial body of work is available on streamer lines, both from pelagic and bottom longline fisheries (e.g. Bull 2007, Lokkeborg 2011, ACAP 2013a). In bottom longline fisheries, work has culminated in a best-practice specification comprising two streamer lines at least 150 m long, deployed from at least 7 m above the sea surface, constructed such that the terminal object creates drag delivering 100 m in 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 the position of the streamer line to be adjusted to ensure it protects the hooks as they set (ACAP 2013a). However, in addition to this best-practice standard, many other specifications have been promulgated. Recent work conducted in pelagic longline fisheries (where streamer lines must protect shallow-set hooks for greater distances astern than in bottom longline fisheries), has assessed the efficacy of alternative designs of streamer lines. As yet, an evaluation of the performance of these "light streamer" lines (Sato et al. 2012) has not been reported from bottom longline fisheries.

Night-setting is an effective method by which to reduce seabird bycatch due to reduced levels of seabird activity. Best-practice night-setting is characterised as occurring between the end of nautical twilight and before nautical dawn (e.g. Bull 2007, Lokkeborg 2011, ACAP 2013a).

In bottom longline fisheries, the discharge of bait and processing waste 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, old baits may be discharged following their removal from hooks. The discharge of any (unattached) bait, discards and processing waste should be avoided at all times

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during setting and hauling, to reduce seabird bycatch risk. If retaining fish waste during setting and hauling is not possible, discharging at locations away from the setting or hauling areas is recommended (ACAP 2013a). In addition, the removal of hooks from discards is important to reduce the likelihood of these hooks injuring or being ingested by foraging seabirds (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. Efficacy can be increased by incorporating a line of floats on the water under the vertical streamers (ACAP 2013a).

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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 observer-collected information confirmed that this characterisation was broadly appropriate. Using a lower bound of 22 m overall length improved the characterisation and considering the number of hooks set (10 000 hooks/day, 500 000 hooks/year) was a third factor that usefully contributed to defining this vessel group. Other vessel attributes (e.g., whether vessels were factory vessels or stored fresh fish and operated autoline or manual systems) did not group vessels effectively. Restricting the target species to ling excluded two vessels (targeting bluenose) from the focal vessel group. However, in terms of interacting with management structures in place, a focus on ling-target fishing would be effective in addressing much of the seabird bycatch risk represented amongst the 20–34 m vessel group.

The extremely limited level of coverage of the 20–34 m vessel group by government fisheries observers leads to a restricted understanding of the bycatch risk this fleet presents to seabirds. Where vessels have been covered by observers, this coverage has often occurred on the same vessels across a number of trips or years, rather than being distributed across a broader group of vessels. Overall, less than 5% of the 20 - 34 m fleet has ever been covered in any one year (in contrast, for example, with an annual average of 40.6% coverage for vessels > 34 m in length). Further, the nature of information collected during past observer deployments precludes analysis across observed vessels. For example, different information has been collected during different trips and in different formats (e.g., diagrams, comments, or fields completed on forms). In addition, information collected has been stored electronically to different extents (e.g., not at all or only when recorded on a subset of observer forms), limiting its accessibility and usability.

Seabird species reported caught by fishers are broadly comparable to the species composition of bycaught birds reported by observers. Seabirds captured during observer deployments on vessels are almost all returned for necropsy or photographed, allowing confirmation of their identity onshore. Fisher identifications of seabirds caught are not confirmed in these ways. Regardless, in fisheries with such low levels of observer coverage, the value of these fisher reports is especially high.

Given the constraints applying to observer data, the use of mitigation measures deployed amongst vessels 20–34 m in length is not well understood.

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However, observer information is sufficient to demonstrate that some vessels are using streamer lines, at least some of the time. The construction and dimensions of these lines are variable, which 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. However, occurrences of fish waste being discharged into the hauling bay have also been reported, and associated with bycatch events. When line-weighting patterns have been documented during deployments, this has been achieved diagrammatically and reported specifications and perceived efficacy differ significantly amongst vessels. The sink rates of line-weighting regimes have not been investigated quantitatively during observer deployments. Finally, fisher-reported catch-effort data shows that longline sets conducted by the 20–34 m group of vessels start throughout the day as well as occurring at night. Considering the package of mitigation measures deployed during these day sets will be important for determining bycatch risk.

While the knowledge base describing bottom longline vessels 20–34 m in length is poor, sufficient information exists to characterise the bycatch risks this group presents to seabirds at a broad level. Key contributors to bycatch risk appear to be the same as for smaller vessel bottom longline fisheries operating in New Zealand waters (Pierre et al. 2013), that is, the discharge of used baits and fish processing waste where hooks are being hauled, inconsistent use of streamer lines and use of streamer lines that are of poor construction, occurrence of day-setting (noting that other mitigation may be in place at these times), and use of line-weighting regimes insufficient to ensure hooks are out of seabird reach while longlines are protected by streamer lines. In addition, the EZ baiter hooks used by autoline systems may be associated with greater seabird bycatch risk than the circle hooks used by hand-baiting operations (Li et al. 2012), and observers have reported the streams of bait scraps dropping from auto-baiting machines as attracting

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seabirds towards the longline on setting.

Effective methods exist to reduce seabird captures in bottom longline fisheries (ACAP 2013b) and these are being utilised to some extent amongst vessels 20 - 34 m operating in New Zealand waters. However, the limited information available precludes an assessment of the extent to which mitigation measures are deployed amongst this vessel group, and the consistency of deployment. Similarly, an assessment of the extent to which regulated bycatch reduction measures are implemented is not possible. Consequently, any appropriate revisions to mandatory measures cannot currently be effectively identified.

4.1 Conclusions and Recommendations

The nature and extent of seabird captures amongst bottom longline vessels 20–34 m in overall length is poorly known. In addition, the risk that this group of vessels represents to seabirds is not well understood at a quantitative level. This is because:

- there is significant diversity amongst the group of vessels 20–34 m in length, in gear used and style of fishing operations
- observer coverage of this group of vessels has been very low over time
- where observer coverage has occurred, this has tended to be on 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
- levels of implementation of mandatory bycatch reduction measures regulations are unknown, and,

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- while they are legally in place, legally-required bycatch reduction measures appear problematic for operators to implement on at least some vessels.

However, where significant bycatch events have been detected by fisheries observers, circumstances contributing to elevated bycatch risk have been readily identified. These include poorly-constructed and ineffectively-used streamer lines, discharge of fish waste into the hauling bay, auto-baiting machines discharging significant streams of bait fragments at setting, insufficient line-weighting such 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.

The following recommendations are made to increase the accuracy with which the impacts of vessels 20–34 m in length on seabird populations can be estimated, and to facilitate the development and implementation of appropriate measures for reducing seabird bycatch risk amongst this vessel group:

- coverage by fisheries observers must be increased across vessels 20–34 m length, such that the nature and extent of seabird bycatch amongst this group of vessels is effectively documented
- comprehensive information must be compiled on gear types and configurations in use, as these relate to seabird bycatch risk (e.g., line-weighting, use of floats)
- well-constructed streamer lines should be consistently deployed during setting operations,
- auto-baiting machines must operate "cleanly", to minimise the flow of bait scraps into the water at setting

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- used baits, discards, and fish processing waste must not be discharged into the hauling bay when longlines are retrieved
- line-weighting regimes should be tested to ensure sink rates achieved are appropriate to seabird bycatch risk, and other mitigation measures in place (e.g., the length of streamer lines)
- the use of circle hooks should be promoted amongst new entrants to the fishery not using autoline systems, and,
- where day-setting is occurring, the efficacy of other bycatch reduction measures should be confirmed, e.g., by assessing longline sink rates.

In short, the combination of knowledge available on fishing activities undertaken by bottom longline vessels 20–34 m in length, and mitigation measures relevant to bottom longline fisheries, is sufficient to provide for the reduction of seabird bycatch risks but needs to be supported with improved information collection across amongst this vessel group.

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A. APPENDIX

Table A-1: Number of hooks (in thousands) set by vessels longer than 34 metres by fishing year. Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

Table A-2: Number of hooks (in thousands) set by target species, for vessels longer than 34 metres, by fishing year. Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

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Figure A-1: Number of hooks set by vessels over 34 metres, by month. The size of dots indicates number of hooks and colour indicates target species.

Table A-3: Number of hooks (in thousands) set by vessels longer than 34 metres by fishing year and fisheries management area (FMA). Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

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Table A-4: Number of hooks (in thousands) set by FMA and vessel, for vessels more than 20 and less than 34 metres. Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

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Figure A-2: Geographic distribution of bottom longline effort by vessels between 20 and 34 metres over the 13 year period from 1 October 2000 to 30 September 2013. Effort is measured in hooks per year.

Table A-5: Number of hooks (in thousands) set by vessels longer than 34 metres by fishing year and fisheries management area (FMA). Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

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Table A-6: Number of hooks (in thousands) set by FMA and vessel, for vessels longer than 34 metres. Includes all bottom longline effort between 1 October 2000 and 30 September 2013.

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Figure A-3: Geographic distribution of bottom longline effort by vessels over 34 metres over the 13 year period from 1 October 2000 to 30 September 2013. Effort is measured in hooks per year.

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Table A-7: Seabirds observed caught by government fisheries observers, on vessels longer than 34 metres long.

	Fishing year											
	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			
All	508	427	282	43	17	29	13	19	5	10	27	4

Table A-8: Seabirds observed caught by ministry observers, on vessels between 20 and 34 metres long.

	Fishing year											
	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												
All			9				38	21	4			5

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