PISCES RESEARCH

Assessing management of fish waste discharge in the scampi fishery

Final report for MIT2019-04 prepared by Pisces Research Ltd for the Department of Conservation, Conservation Services Programme

Authors:
David A. J. Middleton
Edward R. Abraham

To be cited as:

Middleton, D. A. J. and Abraham, E. R. (2020). Assessing management of fish waste discharge in the scampi fishery. Final report for MIT2019-04 prepared by Pisces Research Ltd for the Department of Conservation, Conservation Services Programme. 36 p.

CONTENTS

EXECUTIVE SUMMARY

Batch discharge of fish waste is used as a seabird bycatch mitigation tool in fisheries, including the New Zealand scampi trawl fisheries. Fish waste is accumulated aboard the vessel, and then discharged as rapidly as possible. Batching aims to reduce seabirds feeding around fishing vessels, thereby reducing the risk of fatal seabird interactions with fishing gear.

Following experimental studies in New Zealand and overseas, batching is considered a best-practice mitigation strategy in guidelines from the Agreement on the Conservation of Albatrosses and Petrels (ACAP). For this strategy, ACAP recommends a minimum interval of two hours between batches. The Deepwater Group's Operational Guidelines for New Zealand scampi fisheries specify a shorter minimum interval of 30 minutes between batches, but have a particular focus on avoiding discharges around setting or hauling of the net. Most seabird captures in scampi fisheries are net captures.

Conservation Services Programme project MIT2019-04 was established to review existing observer data with the aim of determining if an 'optimum' batch discharge interval could be identified.

Scampi fishing occurs in five key regional fisheries in New Zealand, using target bottom trawling. Like other crustacean trawl fisheries around the world, bycatch in the scampi fishery is high. Statutory data from the Ministry for Primary Industries' electronic reporting regime, introduced gradually from 2018, allows a characterisation of the retained and discarded catch by the different regional scampi fisheries; the SCI 3 fishery on the western Chatham Rise has the highest rates of bycatch fish discards and the greatest proportion of catch retained in processed form.

Numbers of seabirds observed around scampi fishing vessels do not show consistent differences between regions, although the composition of the seabird assemblage does vary regionally. Seabird captures have, however, varied with the highest estimates in the Chatham Rise and subantarctic scampi fisheries.

Detailed observational protocols on seabird attendance at vessels were developed for particular experimental work and required a dedicated observer. Routine data collection by fisheries observers currently only provides qualitative, trip-level information on vessel batching practices and is primarily focused on assessing vessels' adherence to their Vessel Management Plans. The limited resolution of data on batching precludes a detailed investigation into the effects of variation in batch interval and batch discharge times on either seabird attendance or seabird captures.

If fisheries managers require a more detailed understanding of how variation in batching parameters affects seabird attendance around scampi vessels, we suggest that an experimental approach would be more efficient than increasing the detail of observational data collection. Experimentation allows the covariates of interest to be modified while other covariates are held constant. In contrast, analyses of observational data have to address between-vessel variation in addition to temporal and spatial variation, and may detect little variation in batching practice.

In future, simple image-based data collection technologies could be developed to provide information on both batching practice and seabird attendance in place of intensive data collection by observers.

1. INTRODUCTION

The discharge of fish waste (both whole fish discards and processing waste) from fishing vessels creates a potential food source that can attract large numbers of seabirds. Seabird presence around fishing vessels can lead to interactions with fishing gear (including captures) that may result in seabird injuries and mortalities. These fishery-related mortalities are considered a key global threat to seabird populations (Croxall et al. 2012), and a suite of bycatch mitigation measures have been developed in response.

Batch discharge of fish waste is used as a mitigation strategy for seabird captures in New Zealand deepwater trawl fisheries, including scampi (*Metanephrops challengeri*) fisheries (Deepwater Group 2018). Batching involves the accumulation of fish waste aboard the vessel. The batch is then discharged as rapidly as possible in a 'batch discharge event', with the expectation that intervals between these events are sufficiently long, and that discharges are scheduled to avoid parts of the fishing operation that present the highest risk to seabirds.

The aim of batching strategies is to limit the time that vessel activities are attractive to seabirds as a source of food. Reducing continuous seabird attendance at the vessels would reduce the resulting risk of interactions with fishing gear. If vessels are continuously discharging fish waste, then seabirds will follow the vessel, and are at risk of interacting with trawl warps (the cables used to tow the net) during fishing, or the trawl net itself during shooting and hauling. Although seabirds are attracted to the vessel during batch discharge events, there is a general expectation that birds would remain with the resulting food patch instead of following the vessel when discharge ceases.

Throughout this report, the term 'fish waste' refers to both unwanted fish bycatch, which is typically discarded whole, and 'offal' which is the waste that results from processing fish at sea. Batch discharge of fish waste is one of a range of measures that vessels can employ as a mitigation strategy for seabird captures. Other strategies for managing fish waste include (Agreement on the Conservation of Albatrosses and Petrels 2019):

Retention of waste where no discharge of fish waste occurs during fishing trips (full retention) or at least during fishing activity;

Mealing waste where fish waste is converted into fish meal and discharge is restricted to liquid discharge; and

Mincing waste where the fish waste is reduced to smaller-sized particles before discharge.

In addition to managing fish waste, vessel mitigation strategies typically also include the deployment of physical mitigation devices, such as streamer lines, to limit seabird access to high-risk areas such as trawl warps.

A series of experimental studies carried out between 2006 and 2010 investigated the management of trawler waste streams to mitigate seabird captures (Abraham et al. 2009,

Pierre et al. 2010, Pierre et al. 2012a, Pierre et al. 2012b); batching of fish waste discharge generally emerged as a more suitable overall strategy for reducing risk to seabirds than mincing waste. Reducing seabird interactions with trawl warps was a key focus of this previous research.

Pierre et al. (2013) noted that net captures were the prevalent cause of seabird interactions with the scampi fishery. Although the contents of trawl nets represent an attractive food source to seabirds, their study suggested that improving batch discharge regimes would likely reduce vessel attendance by seabirds and so reduce the risk of net captures. These improvements included ensuring that discharge is held onboard during shooting and hauling.

Management of fish waste to reduce the general attractiveness of fishing vessels to seabirds is considered one of the best-practice measures to reduce seabird bycatch in trawl fisheries (Agreement on the Conservation of Albatrosses and Petrels 2019). Storing of fish waste for two hours or longer before 'strategically discharging it in batches' is recommended in situations where fish meal production or full retention of fish waste is impractical. Nevertheless, a recent review of information from fisheries observers on discharge management in small-vessel (<28 m length) trawl and longline fisheries in New Zealand recommended further testing of the effectiveness of batch discharging for bycatch reduction (Rexer-Huber & Parker 2019), including assessing the influence of holding duration, discharge duration and discharge timing. As a result, the Conservation Services Programme developed the current project MIT2019-04, with the aim of investigating variation in batching intervals and determining if an 'optimum' batch discharge interval could be identified in terms of reducing both seabird activity around fishing vessels and seabird interactions with fishing gear.

Project MIT2019-04 was specified as an analysis of existing observer data on batching practices in the scampi fishery. Nevertheless, discussions with Department of Conservation (DOC) and Ministry for Primary Industries (MPI) staff subsequently established that fisheries observers only provide general observations on fish waste management procedures by scampi vessels. In particular, there is no systematic collection of quantitative information on vessel batching regimes, nor is there ongoing collection of detailed information on seabird attendance at vessels. The seabird observation protocols used in previous studies, such as outlined by Pierre et al. (2010), were detailed observational protocols, designed for specific experimental studies and requiring a dedicated observer. As such, these protocols have not been adopted for routine data collection by fisheries observers in New Zealand.

This report summarises relevant available data from scampi fisheries, focused on seabird captures and discharge batching. It also assesses whether there is evidence of specific details of batch discharge regimes that minimise the risk to seabirds of interactions with fishing gear. Specifically, the present study focused on:

- considering the context for the use of batching as a tool for mitigating seabird captures;
- characterising New Zealand's scampi fisheries and fleet using MPI statutory data

from 2009 to 2019;

- investigating the discards of the scampi fleet using available data following the introduction of MPI electronic reporting (ER);
- describing the operational regime, based around individual Vessel Management Plans (VMPs), that aims to ensure vessels are implementing best-practice waste management procedures, and detail the information collected by observers that assists in assessing compliance with VMP expectations;
- investigating patterns in estimated seabird captures by scampi vessels and seabird attendance at scampi vessels, based on data collected by fisheries observers; and
- discussing options for further data collection to obtain additional information on the implementation and impacts of discharge batching.

1.1 Context

Le Bot et al. (2018) note that seabirds have been feeding on fishery waste around the world ever since humans started harvesting marine organisms. In some parts of the world, the energy requirements of large numbers of seabirds are potentially supported by fisheries discards (Sherley et al. 2019). Nevertheless, foraging around fishing vessels exposes seabirds to a risk of injury or mortality as a result of interactions with fishing gear.

Seabird mortality in global trawl fisheries was identified more recently than in longline fisheries, and mitigation initially focused on devices that aimed to limit seabird access to trawl warps (Sullivan et al. 2006a). Although seabird capture mitigation devices provided an immediate solution to reduce warp interactions, the management of fish waste discharge is required to address one of the main causes of seabird interactions with fishing gear (Sullivan et al. 2006b).

In addition to experimental studies in New Zealand (Abraham et al. 2009, Pierre et al. 2010, Pierre et al. 2012a, Pierre et al. 2012b), batch discharging of fish waste has also been studied in Falkland Islands fisheries (Kuepfer et al. 2016, Kuepfer & Pompert 2017). Studies from both these regions contributed to advice of the Advisory Committee of the Agreement on the Conservation of Albatrosses and Petrels (ACAP) that batching of waste is a proven and recommended mitigation method for both pelagic and demersal trawl fisheries where fish meal production and retention of fish waste are impracticable (Agreement on the Conservation of Albatrosses and Petrels 2019).

1.2 Risks to seabirds from scampi fisheries

The updated assessment of risks to seabirds from New Zealand commercial fisheries included estimation of the proportion of seabird captures in nets or on warps (Richard & Abraham 2020, table A-2). Mean estimated proportions of net captures in scampi fisheries varied from 0.73 (95% credible interval: 0.61–0.84) for the group of mollymawks

(*Thalassarche* and *Phoebetria* species) and giant petrel (*Macronectes halli*) to 1.00 (95% credible interval: 1.00–1.00) for diving seabirds (penguins, shags, boobies, gannets).

Fisheries New Zealand (2020c, part of the Ministry for Primary Industries) considers that, although observer coverage of the scampi trawl fishery is relatively low (varying from 3% of tows in 2015–16 to 16% in 2018–19), the coverage is reasonably representative of effort and, as a result, current estimates of seabird interactions in the scampi fishery are reasonably accurate.

Specific interactions between seabirds and scampi fisheries that are highlighted in the supporting material for the National Plan of Action - Seabirds 2020 (NPOA; Fisheries New Zealand 2020c) are:

- Salvin's albatross (*Thalassarche salvini*) and white-capped albatross (*Thalassarche cauta steadi*), primarily on the Chatham Rise and in the subantarctic region, with the scampi fishery contributing 12% of the risk score for Salvin's albatross and 3% of the risk to white-capped albatross (Richard & Abraham 2020);
- flesh-footed shearwater (*Puffinus carneipes*) in the Bay of Plenty (6% of risk); and
- white-chinned petrel (*Procellaria aequinoctialis*) in the subantarctic region.

1.3 Mitigating risks from scampi fisheries

Mitigation standards to reduce incidental captures of seabirds in scampi trawl fisheries (Department of Conservation and Fisheries New Zealand 2019) aim to:

1. manage the discharge of fish waste from vessels to not attract seabirds to risk areas;
2. minimise the risk to seabirds from trawl warps;
3. minimise seabird attraction towards, and access to, trawl nets, and minimise the risk of harmful interactions to seabirds that do access nets; and
4. minimise the risk of deck landings or impacts against vessels.

Management of fish waste is primarily addressed under the first standard: the DOC/MPI mitigation standard 1.1 (Department of Conservation and Fisheries New Zealand 2019) requires that fish waste is not discharged from the vessel immediately before or during shooting or hauling; standard 1.2 requires the batch discharge of fish waste occurs whilst the net is being towed.

Some aspects of the mitigation standards for scampi trawl fisheries are implemented through statutory measures, specifically the Seabird Scaring Devices Circular 2010, which specifies the seabird scaring devices that are to be used by trawl vessels >28 m length. However, the mitigation standards relating to fish waste management are primarily implemented by non-regulatory management measures as set out in the

Deepwater Group's (DWG) Scampi Fisheries Operational Procedures (the 'Operational Procedures'; Deepwater Group 2018).

2. THE SCAMPI FISHERY

Scampi (SCI) was introduced to the Quota Management System (QMS) on 1 October 2004. Statutory catch and effort data from the fishing years 2010 to 2019 were included in this study to characterise the New Zealand scampi fishery. Throughout this report, the fishing year is labelled by the second calendar year; for example, 2019 indicates the fishing year from 1 October 2018 to 30 September 2019.

Scampi is managed as eleven fish stocks (Figure 1), but catch history data demonstrate that the target scampi fishery is currently limited to five of these stocks (SCI 1, SCI 2, SCI 3, SCI 4A and SCI 6A) (Fisheries New Zealand 2020b).

2.1 Fishery data

Within these five scampi stocks, 99.6 % of the scampi catch is taken by scampi-targeted bottom trawling.

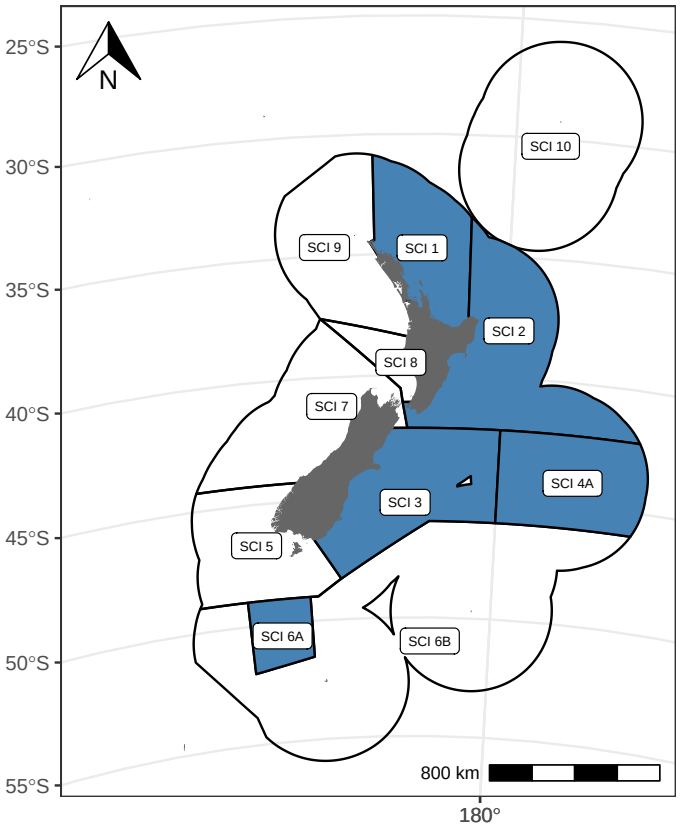

Figure 1: Quota management areas of New Zealand scampi fisheries, with key fishing areas (SCI 1, SCI 2, SCI 3, SCI 4A, SCI 6A) highlighted in blue.

All scampi-target trawl effort since 1 October 2009 has been reported on 'high-resolution' statutory returns that provide at least one latitude and longitude position per tow (Figure 2).

With the recent migration to the ER regime (the effort denoted by 'ERS - Trawl' in Figure 2), vessels must report all disposal of unwanted catch. This includes returns of fish below the minimum legal size (sub-MLS fish), which were not recorded in the previous reporting regime using paper forms.

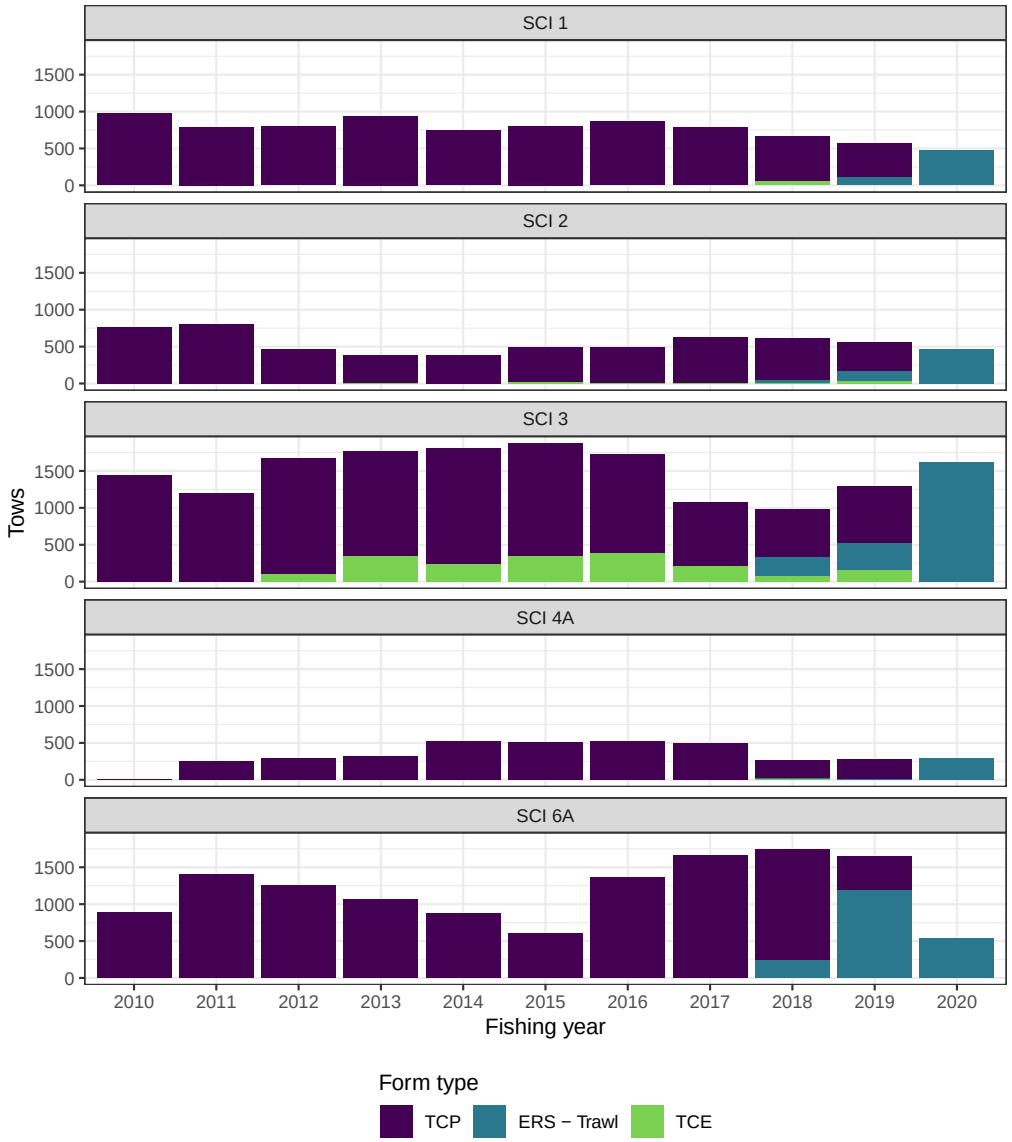

Figure 2: Time series of fishing effort and reporting forms used on trips landing scampi from the quota management areas with scampi target fisheries. The abbreviations TCP and TCE denote the Trawl Catch, Effort and Processing Return and the Trawl Catch and Effort Return, respectively; ERS - Trawl denotes the electronic reporting (ER) regime. Data from the incomplete 2020 fishing year was included here to demonstrate the transition to the ER regime.

2.2 Fishery overview

Over the period from 2010 to 2019, the scampi-target fisheries occurred in localised areas within each quota management area (Figure 3). Fishing occurred year-round in SCI 1 and SCI 3, but some seasonality was evident in the other fisheries (Figure 4).

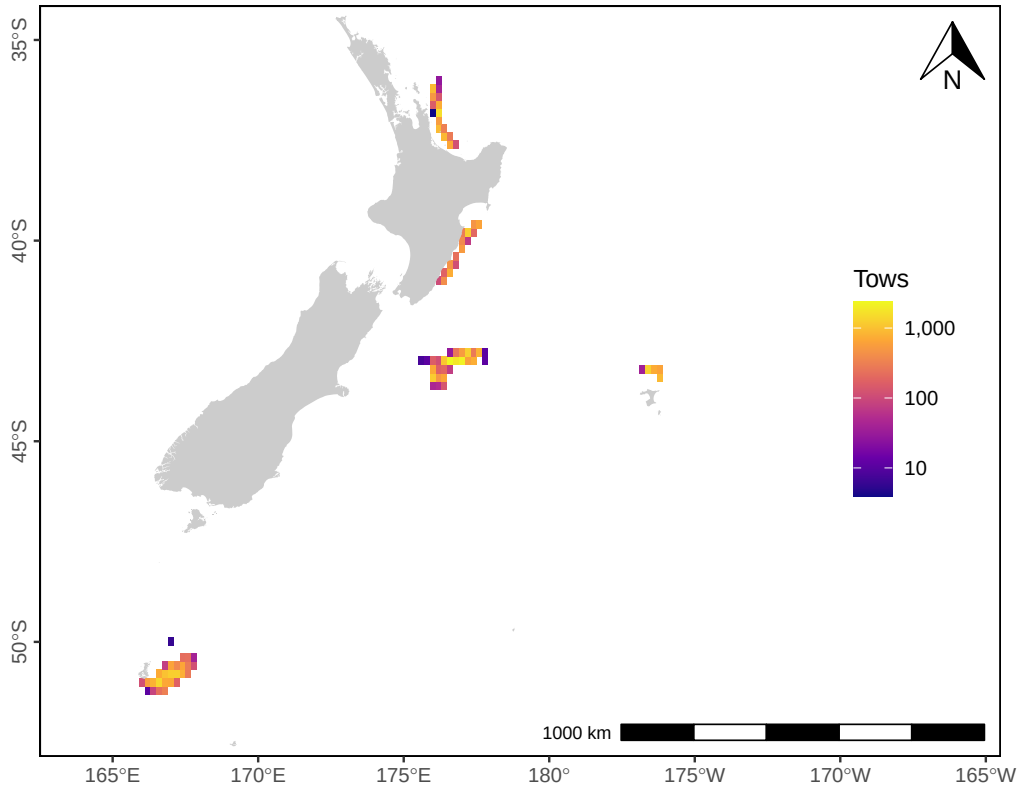

Figure 3: Total scampi-target bottom-trawl effort in the five key scampi fisheries (SCI 1, SCI 2, SCI 3, SCI 4A, SCI 6A) from 1 October 2009 to 30 September 2019.

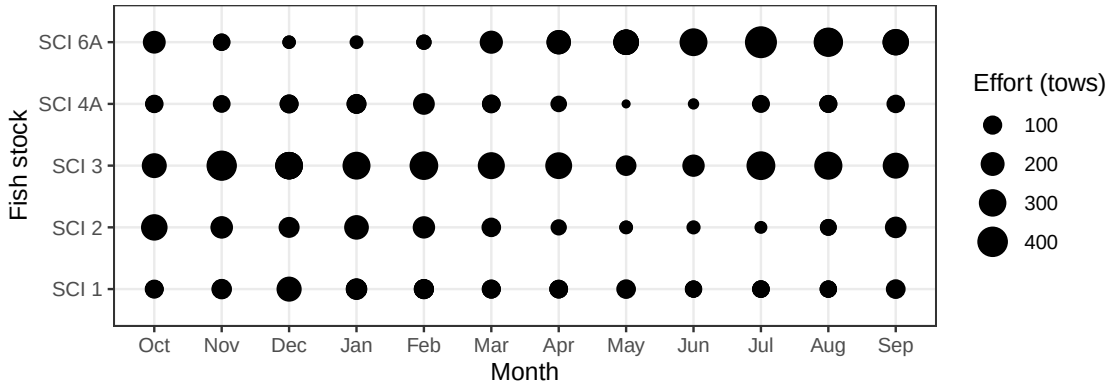

Figure 4: Total scampi-target bottom-trawl effort by month in the five key scampi fisheries from 1 October 2009 to 30 September 2019.

2.3 The scampi fleet

In the period since 1 October 2009, fourteen vessels have been part of the scampi fleet (excluding one vessel that only carried out two scampi-target trawls in this period). Three vessels left the fleet in this period (Figure 5). Only three scampi vessels fishing during this period had registered lengths exceeding 28 m (Figure 6).

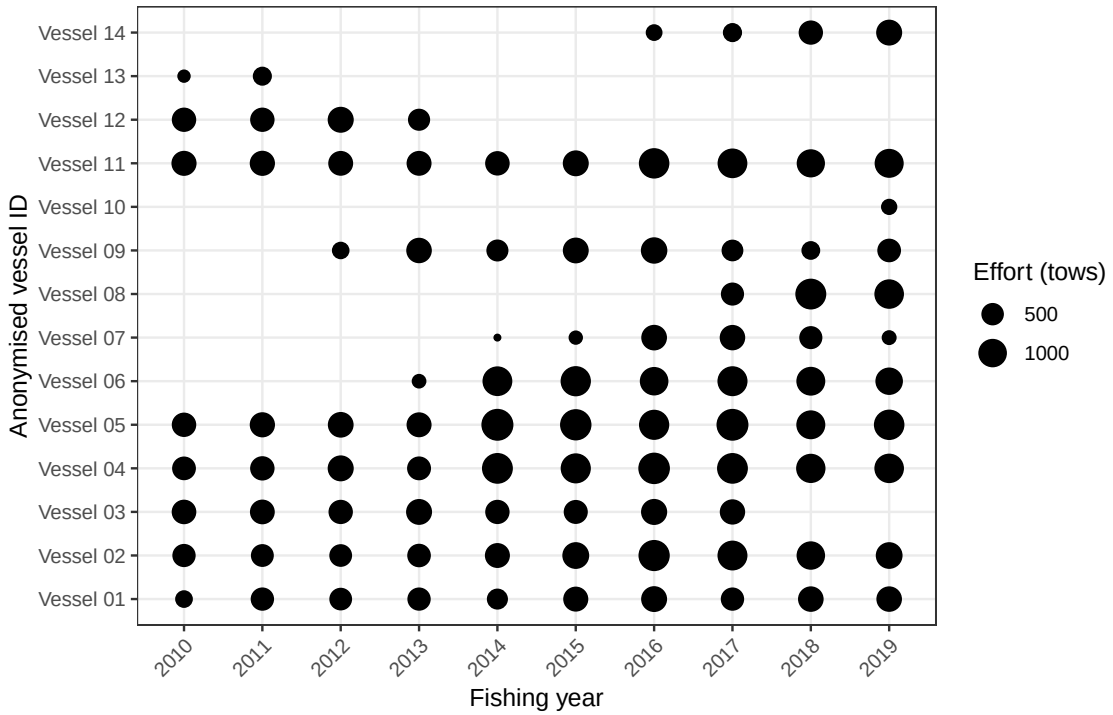

Figure 5: Total scampi-target bottom trawl effort by individual vessels (anonymised vessel identifications) aggregated across the five key scampi fisheries (SCI 1, SCI 2, SCI 3, SCI 4A, SCI 6A) from 1 October 2009 to 30 September 2019.

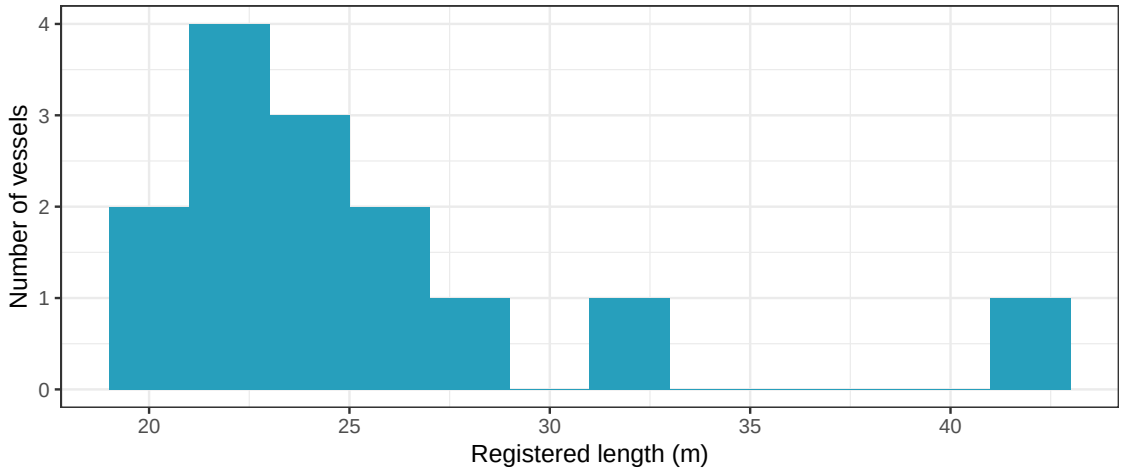

Figure 6: Registered lengths of vessels in the scampi trawl fleet from 1 October 2009 to 30 September 2019.

Three to five vessels have participated in the SCI 1 fishery in the past decade. In the other quota management areas, the number of vessels has gradually increased, with the largest increase in the SCI 4A fishery (Figure 7). This fishery had a single vessel operating in the 2010 fishing year, increasing to a maximum of eight vessels in 2018.

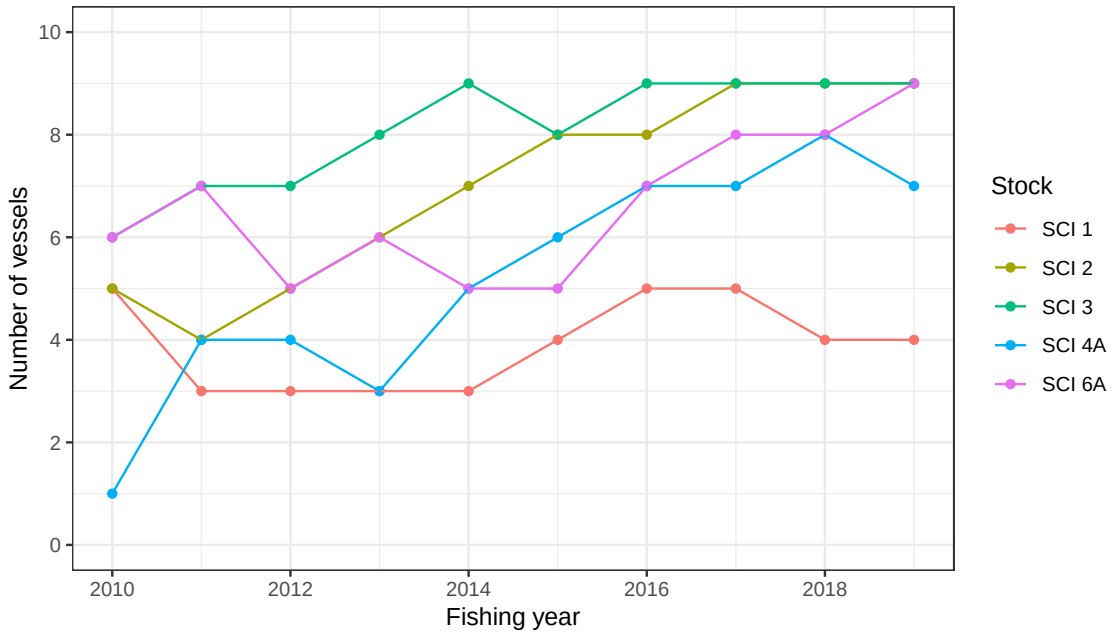

Figure 7: Vessel numbers in the five key scampi fisheries from 1 October 2009 to 30 September 2019.

2.4 Discarding in scampi fisheries

While tropical shrimp trawl fisheries have been identified as having the highest discard rates amongst the world's marine fisheries (Kelleher 2005), an analyses of fisheries observer data from 2003 to 2016 indicated that scampi comprised 19% (by green weight) of the catch of scampi target trawling in New Zealand (Anderson & Edwards 2018). In comparison, 79% of the catch of the squid-target trawl fishery was estimated to be arrow squid (*Nototodarus gouldi, N. sloanii*).

Key non-scampi catches in scampi target trawls included the non-QMS species javelinfish (*Lepidorhynchus denticulatus*; 18%) and other rattails (*Macrouridae*; 12%), and the QMS species sea perch (*Helicolenus* spp.; 10%), hoki (*Macruronus novaezelandiae*; 5%), ling (*Genypterus blacodes*; 4%), and ghost shark (*Hydrolagus* spp.; 3%). Observers recorded that 95% of javelinfish and 91% of rattails were discarded (Anderson & Edwards 2018).

With the introduction of the ER regime, fishers are currently required to complete a disposal report for all fish returned to the sea. Landing reports for retained catch indicate whether catch is landed whole ('green') or in a processed state. As a result, the ER data are considered to provide complete information on fish waste discarding by vessels targeting scampi.

Because the ER regime has not been in place for all scampi trawl effort for a complete fishing year (Figure 2), the potential of these data was examined here by considering the available ER data (i.e., from 2018 to 2020). Data were restricted to trips that landed a single scampi stock to evaluate regional differences. Because ER data have only been available for a short period of time, these results should be considered preliminary.

There were regional differences in the fate of catch from scampi trips (Figure 8). In SCI 1 and SCI 4A, over 50% of the catch (by weight) was retained in an unprocessed form. Discards were slightly lower in SCI 1 than SCI 4A (approx. 24% vs. 28% of catch), but more of the retained catch was processed in SCI 1 (approx. 22% vs. 14% of catch). Discards were greatest in SCI 6A, with over 50% of the catch weight discarded. Similar quantities of catch were retained unprocessed in SCI 6A and SCI 3, but a higher proportion of the catch was processed at sea in SCI 3.

Tows in SCI 1 provided high yields of scampi with the lowest average discards, whereas tows in SCI 3 had both the greatest quantities of discards and of processed catch (Figure 9). The greatest average catch of scampi per tow was from SCI 4A (over 400 kg), associated with intermediate quantities of discards (around 260 kg) and processing (approx. 14% of catch). Fishing patterns were similar across the scampi stocks, although the average number of tows and fishing duration per vessel-day was lower in SCI 4A (Table 1).

These patterns reflected a reasonably current indication of catch, discarding, and fishing patterns across the scampi stocks; changes are expected to occur over time in response to variation in the abundance of scampi and associated bycatch stocks. Nevertheless, the information is informative in terms of the regional variation in quantities of material that must be managed via the batch-discharge regime, the available non-fishing time for safe discharge, and the number of setting and hauling periods when discharge must be avoided.

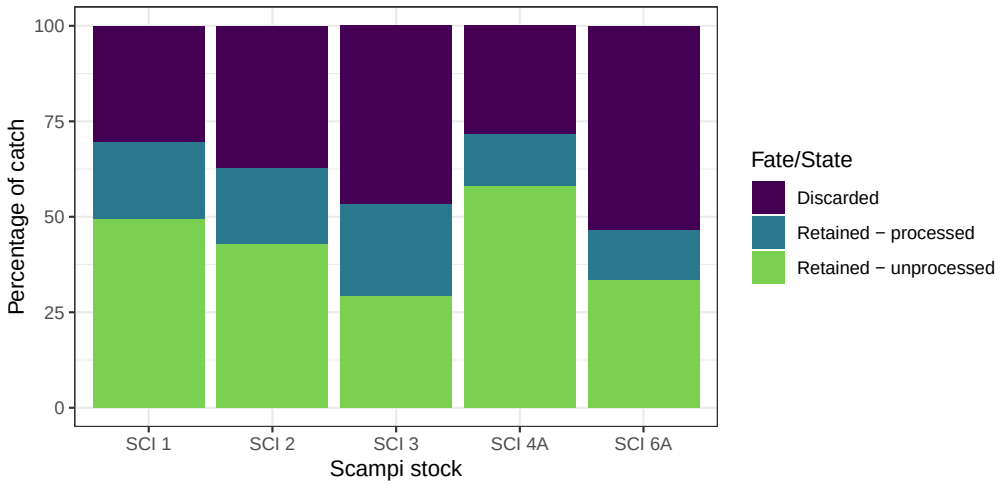

Figure 8: Percentage of catch (by weight) retained unprocessed, retained but processed at sea, and discarded, for trips reporting using the Electronic Reporting (ER) regime and landing to a single scampi stock. The ER regime was introduced from the 2018 fishing year but was not used by all scampi vessels until 2020.

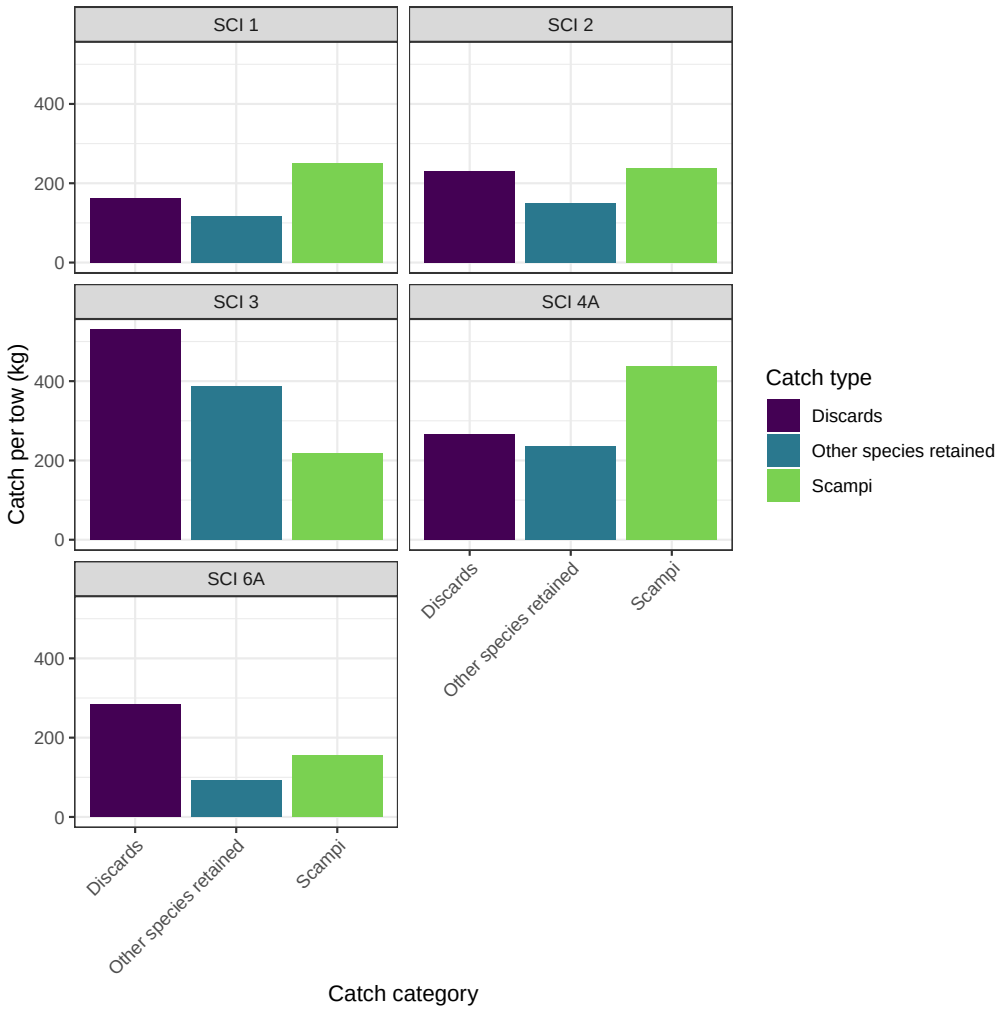

Figure 9: Overall catch per tow of scampi and other retained catch and discards, for trips reporting using the Electronic Reporting (ER) regime and landing to a single scampi stock. The ER regime was introduced from the 2018 fishing year but was not used by all scampi vessels until 2020

Table 1: Average daily tows and fishing duration per vessel, for trips reporting under the Electronic Reporting (ER) regime and landing to a single scampi stock. The ER regime was introduced from the 2018 fishing year but was not used by all scampi vessels until 2020.

Scampi stock	Tows per day	Fishing duration (hrs)
SCI 1	2.6	18.3
SCI 2	2.5	18.0
SCI 3	2.4	16.9
SCI 4A	2.0	13.7
SCI 6A	2.6	18.1

2.5 Reported seabird captures

Fisher-reporting of seabird captures indicated that the number of annual captures was generally less 50 birds in all areas; the key exception was SCI 6A in 2011, when the number of annual captures exceeded 100 birds (Figure 10). For the recent period under the ER regime, reported seabird capture rates were lowest in the northern scampi fisheries (SCI 1 and SCI 2), and highest in the subantarctic region (SCI 6A; Table 2).

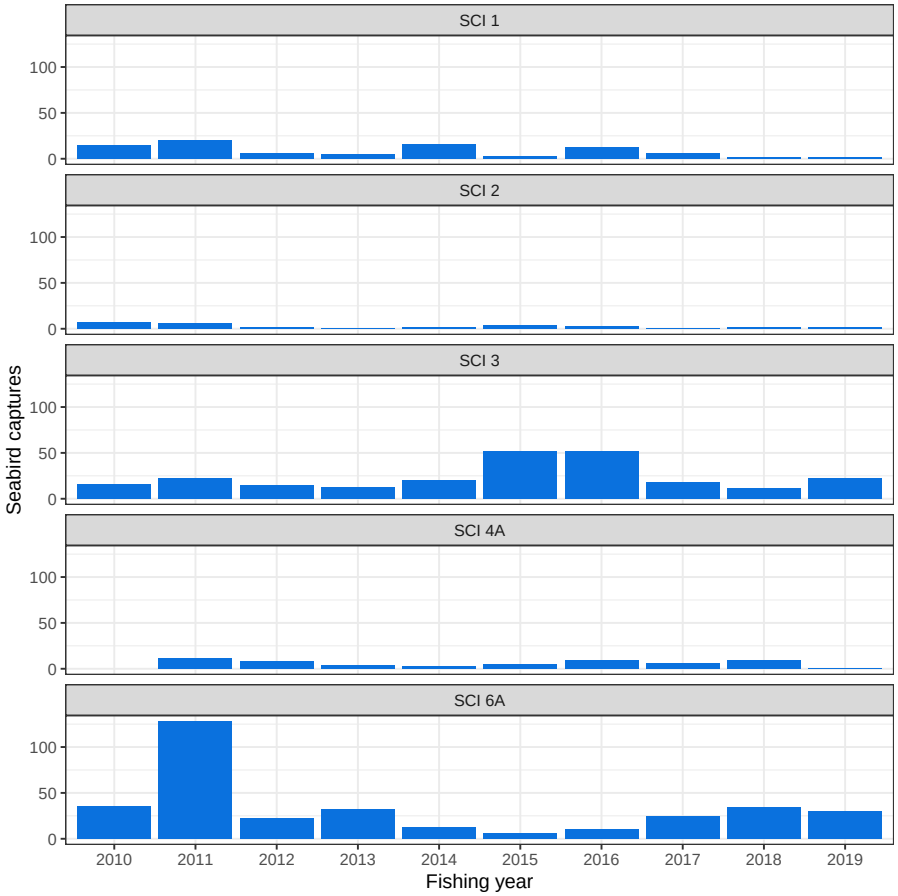

Figure 10: Number of seabird captures in scampi-target bottom trawls reported via MPI statutory catch and effort data between 1 October 2009 and 30 September 2019.

Table 2: Average number of seabird captures per 100 tows in scampi fisheries, for trips reported using the electronic reporting (ER) regime and landing to a single scampi stock. The ER regime was introduced from the 2018 fishing year, but was only extended to all scampi vessels in the 2020 fishing year.

Scampi stock	Captures per 100 tows
SCI 1	0.00
SCI 2	0.18
SCI 3	1.13
SCI 4A	1.04
SCI 6A	1.82

3. SCAMPI VESSEL MANAGEMENT PLANS

Vessel-specific procedures for the management of discards and processing waste to minimise risks to seabirds are specified in scampi VMPs, required as part of the Operational Procedures of the DWG[1].

The DWG represents participants in New Zealand's main deepwater commercial fisheries, working in conjunction with MPI. Its Operational Procedures detail best practices for commercial fishing activity, particularly for managing interactions with marine protected species. These procedures have recently been reviewed and codified as 'Mitigation standards' (Department of Conservation and Fisheries New Zealand 2019).

Operational requirements for scampi vessels are summarised in guidelines by the DWG ('Ten commandments'), which include a well-managed fish waste control system (Appendix A). The control system needs to ensure that no continuous, uncontrolled or *ad hoc* discharge occurs when towing. Another requirement is that all fish waste, discards and offal are being held during shooting and hauling. The more detailed Operational Procedures specify that vessels using batching should have a dedicated storage, holding or batching bin, tank or conveyor with the capacity to hold all offal, fish waste and discards (Deepwater Group 2018). These procedures require vessels to hold fish waste for a minimum of 30 minutes, and batch discharge in less than five minutes when towing (and specifically not discharge during shooting or hauling).

A key component of the Operational Procedures is the requirement that each vessel has an individual VMP that details vessel-specific procedures and processes to reduce risks to protected species, especially seabirds and marine mammals. The VMPs were originally introduced for deepwater vessels by the DWG in 2008, and Sanford Ltd agreed to adopt these procedures for their scampi vessels (John Cleal, pers. comm.). The initial VMPs for the scampi fleet were based on a shared template that detailed generic procedures that also applied to large-size fresher vessels (i.e., vessels that primarily pack fish whole rather than processing at sea).

A new scampi VMP template was introduced in 2014, and extended to the entire scampi fleet. As a result of a large number of observed seabird captures in the 2011 fishing year (Figure 11), there was a particular focus on the mitigation of net captures in the centre trawl of vessels using triple-rig (three net) trawls. This work included the development of a net-restrictor (Pierre et al. 2013). The 2014 updates also included the production of individual vessel risk management plans. Scampi VMPs were then updated in 2018, with the separation of the fleet-wide Operational Procedures from the individual vessel-specific plans (John Cleal, pers. comm.).

All scampi vessel operators gave permission to the DWG to share their scampi VMPs with Pisces Research for the purpose of this project. These VMPs detail the vessel-specific equipment and systems in place for managing fish waste to meet the requirements of the Operational Procedures. The VMPs do not generally include information to infer whether vessels would routinely exceed the minimum standards for batching intervals and discharge time.

[1] https://deepwatergroup.org/newsresources/op-manual/ (Deepwater Group 2018)

Holding-tank capacities used in fish waste batching were stated for two vessels (350 kg and 500 kg). Otherwise the current scampi VMPs only indicated the use of batching to prevent discharge of waste when shooting and hauling, and to prevent continuous discharge when towing.

3.1 Observer review of vessel procedures

On observed trips, fisheries observers currently collect two types of information on the implementation of the VMPs and fish waste management practices, as follows.

A review form for observers was introduced in 2011 to assess each vessel's adherence to its VMP (Department of Conservation and Fisheries New Zealand 2019). The review form is used in annual reporting against the targets set under the National Deepwater Fisheries Plan (Fisheries New Zealand 2020a). This information is qualitative (i.e., it consists of 'yes' or 'no' answers to a series of questions; see Appendix B); however, it is the most consistent and reliable information available on vessel practices on a trip-by-trip basis.

In addition to carrying out structured data collection, observers also gather *ad hoc* information on vessel practices. Information on a vessel's fish waste management strategy is typically obtained during discussions between MPI staff and the observer during the observer's post-voyage debrief (Daniel Kerrigan, pers. comm.). If a debrief is not possible, then the fish waste management strategy used during the trip is reconstructed from the observer's trip report or comments on the VMP audit form.

MPI managers share this information with operational staff in the DWG who manage the implementation of, and conformance with, VMPs across the deepwater fleet. Summary information on the fish waste management strategies utilised on board scampi vessels during all observer trips between 1 October 2017 and May 2020 was provided by MPI (reproduced in Appendix C). In most cases, the observer comments indicate that vessels are following their VMPs. Nevertheless, the commentary highlights some occasions where vessels have failed to implement batch discharge processes, although there is no associated information about the reasons for this failure. There is also evidence of active management to correct onboard procedures to meet the requirements of the VMP (i.e., skippers monitoring and correcting crew practices) and of vessels implementing additional measures to reduce the risk to seabirds when waste is discharged.

3.2 Vessel Management Plan review form data

MPI provided copies of 45 VMP review forms from scampi trips carried out on 16 vessels between 2011 and 2020. The information from the first page of the form (Appendix B) was keyed. There were three versions of the form: version three was used during the 2010 fishing year, with only one version-three forms being keyed; version four was used from 2010–11, with 31 version-four forms being keyed; an updated version (here referred to as version five) was used from 2018–19, with 13 version-five forms being keyed.

Information from the forms that was related to potential seabird bycatch was standardised between the forms, focusing on information available from each version of the form. Of the trips that had the VMP field completed, 95.2% trips were reported as having a VMP; on the trips that carried VMPs, the crew were reported as being familiar with its content on 97.5% of trips.

The observers recorded whether the vessel held fish processing waste during shooting and hauling, with the waste being held during 85.7% of trips. As reported by the observers, 66.7% of the vessels had systems in place (such as grating) to prevent fish waste from being discharged during processing. The recording of this feature appeared inconsistent, however, with some vessels being reported as having and not having systems in place during different trips.

Other management measures to reduce the attraction of seabirds to the vessel during fishing include the net being cleaned of fish (so called 'stickers') before being re-shot: this measure was carried out for 51.1% of trips. The Mitigation Standards (Department of Conservation and Fisheries New Zealand 2019) only require the removal of as many stickers 'as practicable', recognising that removal of all stickers could require the net to be on the surface for extended periods of time; the latter aspect could lead to increased seabird bycatch. Observers also recorded when the time period of the net being on the surface was minimised, which occurred during 90.9% of trips. This assessment is a qualitative judgement by observers, and does not include recording data on the time that the net was on the surface. Gear failure can lead to the net being on the surface of the water for longer than normal, and was reported as occurring on 15.6% of trips.

One of the solutions proposed for reducing seabird bycatch in scampi trawl fisheries is a net restrictor (Pierre et al. 2013). The net restrictor prevents an increase in the opening height of the centre net when the net is being hauled, thus making it more difficult for diving seabirds to enter the net. The use of a net restrictor was included on version five of the VMP review forms; however, this information was only available for five trips. The net restrictor was recorded as being used on two trips. The guidelines by the DWG only specifically advise net restrictors as a strategy for triple-rig trawlers (see Appendix A).

Version five of the VMP review form also introduced two new items that are specifically relevant to the assessment of batch discharge: items 10 and 11 require the observer to assess whether the discharge of fish waste was managed as per the VMP, and to confirm whether any periods of continuous fish waste discharge occurred during towing. This information was available for 13 trips between 2018 and 2020. Vessels were assessed as managing waste in accordance with their VMP on 100% of these trips, but continuous waste discharge was nevertheless recorded on one trip. This discrepancy may represent a recording error, as no explanation was included.

The VMP forms were sometimes not fully completed by the observers. Not considering fields that were only introduced on the recent version of the form, other fields of potential relevance to seabird bycatch were only completely recorded for 77.8% of trips. This percentage includes form where the VMP review question was answered as 'unknown' or 'not applicable'. The latter option was only available on VMP review

form version five, and so missing information may be confounded in older forms.

4. SEABIRD CAPTURE ESTIMATES AND ABUNDANCE AROUND VESSELS

Fleet-scale estimates of seabird captures in scampi fisheries have been made by fitting generalised linear models to the capture data collected by observers (Abraham & Richard 2018). During the 2018 fishing year, an estimated 130 (95% credible interval: 99 to 165) birds were caught in scampi trawl fisheries, with 12.5% of scampi trawl fishing being observed (Abraham & Richard 2018). Estimated captures of seabirds were highest in the Chatham Rise (most of SCI 3, SCI 4) and Auckland Islands (SCI 6A) areas, at around 50 birds per annum, with lower numbers of captures in the Bay of Plenty (SCI 1) and East Coast North Island (SCI 2) areas (Figure 11).

The estimated captures reflect changes in fishing effort and in the underlying estimated capture rate. No clear trends in the captures were apparent. There was a marked peak in captures (a mean of 141 birds) during the 2011 fishing year in the Auckland Islands (SCI 6A) area (Figure 11); it was due to a high number of observed captures (86; Abraham & Richard 2018) in that fishery during that year.

In interpreting these plots however, it is important to note that the scampi fishery includes vessels that are <28 m long, and vessels that are >28 m. In the estimation, estimates of captures by trawl vessels <28 m is made using a model that has no annual variation (due to the generally low observer coverage in small-vessel trawl fisheries). For this component of the fishery, the estimated seabird capture rates do not vary annually.

Although not fully comparable in terms of area or time period, the seabird capture estimates based on observer data for the 2018 fishing year (Table 3) confirm the impression from the fisher reporting (Table 2) that capture rates are higher on the Chatham Rise and in the subantarctic region.

Table 3: Average seabird captures per tow in the scampi fishery in the 2018 fishing year, for the standard estimation areas (Abraham & Richard 2018).

Area	Captures per 100 tows
Auckland Islands	3.05
Bay of Plenty	2.27
Chatham Rise	3.80
East Coast North Island	2.06

Observers also recorded counts of seabirds around fishing vessels, generally during the first fishing event of the day, and sometimes more frequently depending on their other duties (for a detailed description of the data collection and processing see Richard et al. 2020). An initial analysis of these data demonstrated that they are informative about seabird distributions, supplementing maps based on expert knowledge and data from seabird tracking (Richard et al. 2011). This dataset has recently been updated to include

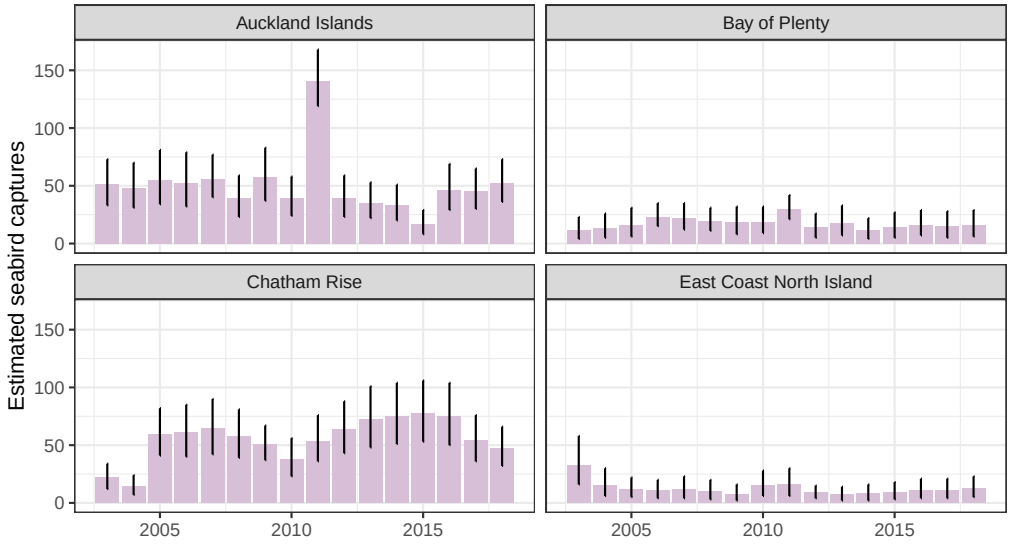

Figure 11: Estimated capture of seabirds during scampi fishing, by the areas used in protected species capture (PSC) reporting. The bars indicate the mean annual estimated captures, with the lines showing the 95% credible intervals. Fishing within scampi quota management areas is associated with the areas as follows: Auckland Islands (SCI 6A), Bay of Plenty (SCI 1), Chatham Rise (SCI 3, SCI 4) and East Coast North Island (SCI 2)

data up to November 2018 (Richard et al. 2020); it consists of 6563 observations periods when counts were made of seabirds around trawl vessels targeting scampi.

On average, around 150 to 250 seabirds were attending scampi trawl vessels during the haul. In most of the QMAs, the most frequently recorded seabirds were in the genus *Thalassarche* (mollymawk). In the Bay of Plenty fishery (SCI 1), *Puffinus* (sooty shearwater and flesh-footed shearwater) was the most frequently recorded genus.

Of the 45 trips in the seabird count dataset, 26 trips are represented in the VMP review data. Nevertheless, some of the trips included in the count data but missing from the VMP data were recent (i.e., after 2011), so it is likely that VMPs were in place on those vessels. The dataset is not well balanced in terms of important covariates such as area and year (Figure 14). While there were trips in SCI 6A in 2011 and 2012 on vessels with and without VMPs in place, and the trips with VMPs had lower median seabird attendance, there is limited opportunity to explore other important covariates (e.g., vessel effects) with these data.

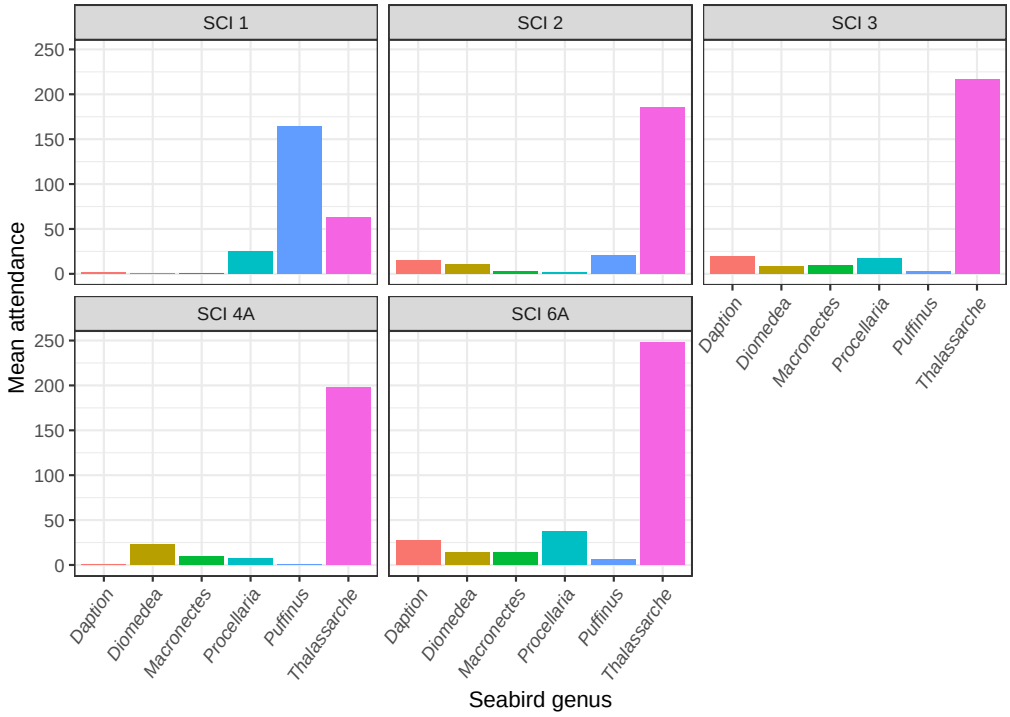

Figure 12: Mean attendance of seabirds at scampi fishing vessels during the haul, by genus and quota management area. The genera are *Daption*: Cape petrel; *Diomedea*: great albatross; *Macronectes*: giant petrel; *Procellaria*: e.g., black petrel, white-chinned petrel; *Puffinus*: e.g., sooty shearwater, flesh-footed shearwater; *Thalassarche*: mollymawk. Genera with a mean attendance of <1 bird are not shown.

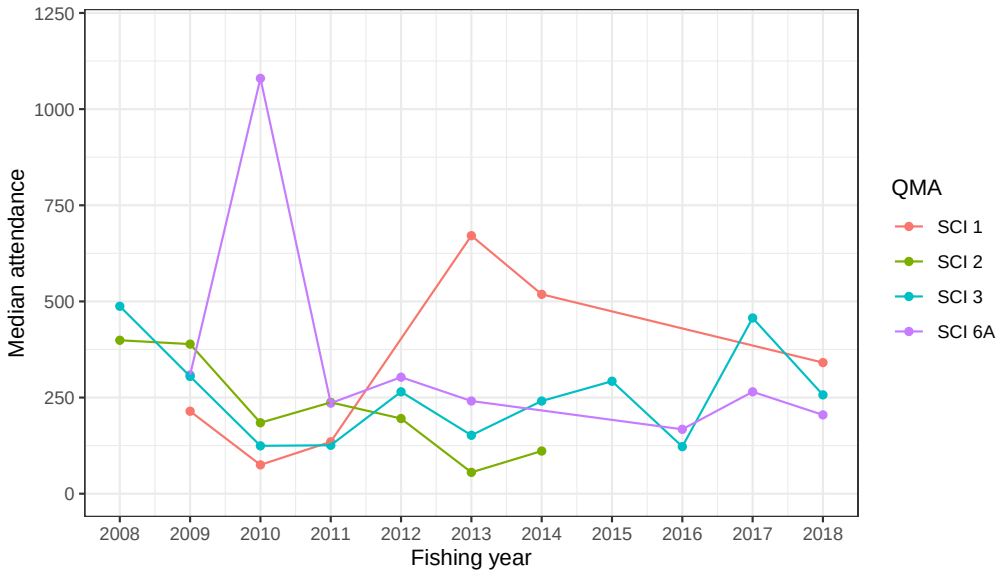

Figure 13: Median attendance of seabirds at scampi fishing vessels, by year and quota management area.

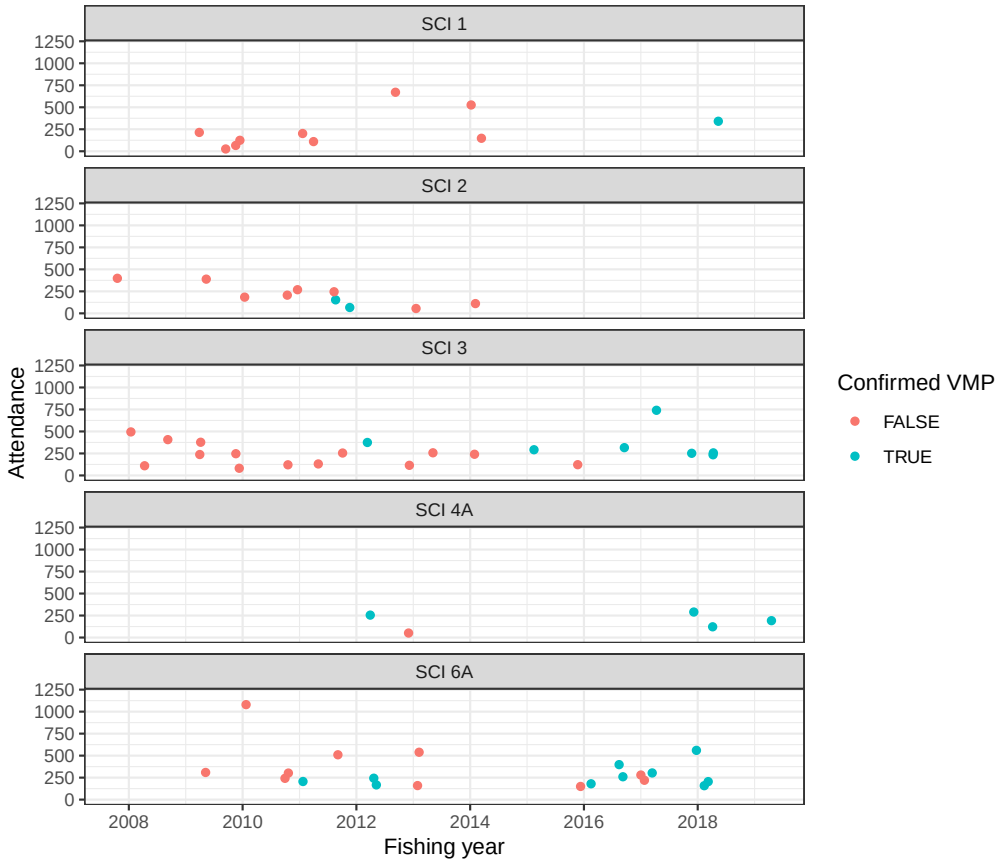

Figure 14: Median attendance of seabirds at scampi fishing vessels, by trip, year and vessel management plan (VMP) status.

5. DISCUSSION

Batch discharge is considered a proven and recommended method for managing discards and fish processing waste in pelagic and demersal trawl fisheries where fish meal production and retention of offal and discards are impracticable (Agreement on the Conservation of Albatrosses and Petrels 2019). ACAP recommends that, where feasible, waste should be retained for at least two hours between batches, and preferably four hours or longer.

Batching of fish waste is the key approach adopted in scampi VMPs to prevent the continuous discharge of fish waste while towing. Operational procedures require a minimum retention period of 30 minutes (Deepwater Group 2018). Experimental research in New Zealand previously established that holding periods of at least four hours were required to reduce seabird attendance at fishing vessels, but noted that shorter retention periods may still be effective (Pierre et al. 2010, Pierre et al. 2012b). Specifically, Pierre et al. (2012b) concluded:

> Second to holding waste for discharge when fishing gear is out of the water, discharging waste rapidly in maximally large batches, as infrequently as possible, is the recommended practice for reduction of seabird interactions with trawl warps.
>
> (a) Holding waste for 30 minutes can reduce the abundance of small species of seabirds attending vessels. However, holding periods of up to 8 h may be required.
>
> (b) Holding waste for 2 h can reduce the abundance of large seabird species at vessels. However, holding periods of 4 h may be required.
>
> (c) Eight-hour holding periods are preferable to 4-h holding periods, to further reduce seabird abundance at vessels.

Nevertheless, the same study also noted that timing of batch events relative to net setting and hauling is important (Pierre et al. 2010). Longer holding times can also impact on the practicality of discharging the batch as rapidly as possible. The discharge of a batch results in birds rapidly transferring from the air around the vessel to the water to feed. Avoiding discharge of waste batches prior to hauling may, therefore, assist in mitigating seabird net captures, which is of particular relevance in scampi trawl fisheries (Pierre et al. 2013).

A recent review of discharge management of small (<28 m length) vessels in New Zealand noted that it was not possible to assess the effect of trawl batching on seabird bycatch rates, because relevant data were too limited (Rexer-Huber & Parker 2019). Limitations included a high proportion of trips with unknown information about batching, and lack of information when batching occurred. The review recommended further research into batching by small trawlers.

The present project (MIT2019-04) aimed to use existing observer data to investigate variation in batching intervals in the scampi fishery; it also aimed to determine if an

'optimum' batch discharge interval could be identified that reduces both seabird activity around fishing vessels and their interactions with fishing gear. The review of data in the present project made it apparent that observers had not been tasked to collect quantitative information on batching activity. The detailed observation protocols used for the studies between 2006 and 2010 were onerous, requiring a dedicated observer to collect seabird abundance data at 5-minute intervals for a period around the batch discharge events (Abraham et al. 2009, Pierre et al. 2010, Pierre et al. 2012a, Pierre et al. 2012b). It is unlikely that this type of data collection could be readily incorporated into the routine duties of fisheries observers in scampi fisheries, where a range of data collection tasks are carried out on behalf of MPI and DOC.

Although there is no data collection protocol for quantitative information on batching, qualitative information is available. The free-form comments in observer reports, collated by MPI and communicated to the DWG, provide general information on whether a vessel is successfully implementing its VMP, and if any specific difficulties have arisen (Appendix C). During this project, we identified the use of the standardised VMP review forms (Appendix B). These data are not currently entered into the Centralised Observer Database (COD), but are valuable because they provide a standardised approach for observers to report on a vessel's adherence to its VMP, albeit in a qualitative sense and at a trip-level resolution.

This information is valuable to fisheries managers in assessing whether vessels are successfully implementing their VMPs and minimising risks to seabirds; however, there is spatial and temporal confounding that limits the potential of this information for investigating the factors that may explain variation in seabird attendance at vessels. In general, we suggest that further investigations into the effect of batch discharge time on seabird attendance at vessels require an experimental approach, where time between discharge is varied while holding other covariates constant. Observer comments indicate that some vessels in the scampi fleet are capable of holding processing waste for an entire tow (Appendix C); these vessels could provide suitable platforms for comparing these long holding intervals with the minimum (30 minute) intervals required by the current Operational Procedures.

There is currently limited information on the extent to which scampi vessels are routinely discharging at the minimum required interval, or typically achieving considerably longer intervals. Characterising batching behaviour would be a first step towards gaining information, before embarking on further experimental trials. Although data on batching practices could be collected by observers, it may also be possible to collect this information from the fleet by requesting logs be kept of discharge times and volumes. Consultation with vessel operators would be required to determine whether a simple paper log could be kept, or if some form of electronic recording would be appropriate. For example, on vessels with specific holding tanks, a photograph of the tank prior to each discharge would provide discharge times (from the photo timestamps) and allow an estimate of fish waste volume to be made.

Richard et al. (2020) demonstrated the value of existing observer seabird count data, and also some of their limitations. Although the observer counts provide a broadscale

dataset, they do not provide counts at the fine temporal scale used in previous experimental studies. Pierre et al. (2010) noted that, when batch discharges occurred, the numbers of birds on the water increased faster than could be resolved within the 5-minute observation interval. In future, any detailed studies of the response of seabirds to batching should consider the potential to quantify attendance from video records instead of counts by onboard observers.

All New Zealand commercial fisheries have recently transitioned to the ER regime introduced under the Fisheries (Reporting) Regulations 2017. Although there are currently no ER data for a complete fishing year for any of the scampi fisheries, ER data provide comprehensive information on fish disposals. This information highlights the value of ER data for identifying where the discarding of unwanted bycatch and fish processing waste is most prevalent. The current preliminary analysis highlighted that the SCI 3 fishery had the greatest per tow quantities of discards, and this fishery also had the greatest proportion of processed catch.

6. SUMMARY OF RECOMMENDATIONS

1. For a more detailed understanding of the effect of batching parameters (i.e., time between discharges, discharge duration etc.) on seabird attendance at vessels, an experimental approach should be pursued.

2. To better characterise batching practices, vessel operators should be consulted about keeping logs of discharge times and volumes.

3. Development of simple, image-based data collection technologies should be considered to provide information on both batching practice and seabird attendance in place of intensive data collection by observers.

7. ACKNOWLEDGEMENTS

This work was funded by the Department of Conservation's Conservation Services Programme project MIT2019-04, with funds cost-recovered from quota owners in all eleven scampi fish stocks. Dr Karen Middlemiss (DOC marine science adviser) managed the project for CSP. Scampi vessel operators gave the Deepwater Group permission to share the Scampi Vessel Management Plans (VMPs) referred to in this report, which was facilitated by Richard Wells and John Cleal. MPI gave permission to use extracts from their databases, supplied summaries of observer reports from scampi vessels, and provided copies of VMP review forms from observed trips. MPI replogs 11790 and 13105 were used to provide the statutory catch and effort data used in this report. Daniel Kerrigan and William Gibson (both MPI) clarified the data collection undertaken by MPI observers placed on scampi vessels. Dr Katrin Berkenbusch assisted with final editing.

8. REFERENCES

Abraham, E. R.; Pierre, J. P.; Middleton, D. A. J.; Cleal, J.; Walker, N. A., & Waugh, S. M. (2009). Effectiveness of fish waste management strategies in reducing seabird attendance at a trawl vessel. *Fisheries Research*, *95*(2-3), 210–219. doi:10.1016/j.fishres.2008.08.014

Abraham, E. R. & Richard, Y. (2018). Estimated capture of seabirds in New Zealand trawl and longline fisheries, 2002–03 to 2014–15. *New Zealand Fisheries Assessment Report No. 197*, *2018/197*. 97 p. Retrieved from https://www.mpi.govt.nz/dmsdocument/27588/

Agreement on the Conservation of Albatrosses and Petrels (2019). *ACAP Review and Best Practice Advice for Reducing the Impact of Pelagic and Demersal Trawl Fisheries on Seabirds*. Reviewed at the Eleventh Meeting of the Advisory Committee Florianópolis, Brazil 13–17 May 2019. Retrieved from https://acap.aq/bycatch-mitigation/mitigation-advice/3531-acap-2019-review-and-best-practice-advice-for-reducing-the-impact-of-pelagic-and-demersal-trawl-fisheries-on-seabirds/file

Anderson, O. F. & Edwards, C. T. T. (2018). Fish and invertebrate bycatch and discards in New Zealand arrow squid and scampi trawl fisheries from 2002-–03 until 2015-–16. *New Zealand Aquatic Environment and Biodiversity Report No. 199*. 135 p.

Croxall, J. P.; Butchart, S. H. M.; Lascelles, B.; Stattersfield, A. J.; Sullivan, B.; Symes, A., & Taylor, P. (2012). Seabird conservation status, threats and priority actions: A global assessment. *Bird Conservation International*, *22*, 1–34.

Deepwater Group (2018). *Scampi fisheries. Operational procedures for mitigating risk of seabird and marine mammal captures*. Retrieved from https://deepwatergroup.org/wp-content/uploads/2018/11/DWG-Scampi-Fisheries-OP-V3-1.pdf

Department of Conservation and Fisheries New Zealand (2019). *Mitigation Standards to Reduce the Incidental Captures of Seabirds in New Zealand Commercial Fisheries. Scampi trawl*. Retrieved from https://www.mpi.govt.nz/dmsdocument/38015-mitigation-standards-scampi-trawl-vessels-less-than-28-metres-in-length

Fisheries New Zealand (2020a). *Annual Review Report for Deepwater Fisheries*. Fisheries New Zealand Discussion Paper No: 2020/01. Prepared by the Deepwater Team, Fisheries Management, Fisheries New Zealand. Retrieved from https://www.mpi.govt.nz/dmsdocument/39770/direct

Fisheries New Zealand (2020b). *Fisheries Assessment Plenary, May 2020: stock assessments and stock status*. Compiled by the Fisheries Science and Information Group, Fisheries New Zealand, Wellington, New Zealand. 1 746 p.

Fisheries New Zealand (2020c). *National Plan of Action – Seabirds 2020. Supporting document*. Retrieved from https://www.mpi.govt.nz/dmsdocument/40658-national-plan-of-action-seabirds-2020-supporting-document

Kelleher, K. (2005). Discards in the world's marine fisheries: An update. *FAO Fisheries Technical Paper*, *470*. 131 p.

Kuepfer, A.; Gras, M., & Pompert, J. (2016). *Discard management as a seabird by-catch mitigation tool: The effect of batch-discarding on seabird interactions in the Falkland Islands trawl fishery*. ACAP Seabird Bycatch Working Group Information Paper SBWG7 Inf 25. Retrieved from https://acap.aq/working-groups/seabird-bycatch-

working-group/seabird-bycatch-wg-meeting-7/sbwg7-information-papers/2746-sbwg7-inf-25-discard-management-as-a-seabird-by-catch-mitigation-tool-the-effect-of-batch-discarding-on-seabird-interactions-in-the-falkland-islands-trawl-fishery/file

Kuepfer, A. & Pompert, J. (2017). *Discard management as a seabird bycatch mitigation tool: Results from further batch-discard trials in the Falkland Islands trawl fishery*. ACAP Seabird Bycatch Working Group Information Paper SBWG8 Inf 16. Retrieved from https://acap.aq/working-groups/seabird-bycatch-working-group/seabird-bycatch-wg-meeting-8/sbwg8-information-papers/2921-sbwg8-inf-16-discard-management-as-a-seabird-bycatch-mitigation-tool-results-from-further-batch-discard-trials/file

Le Bot, T.; Lescroël, A., & Grémillet, D. (2018). A toolkit to study seabird–fishery interactions. *ICES Journal of Marine Science*, *75*, 1513–1525. doi:10.1093/icesjms/fsy038

Pierre, J. P.; Abraham, E. R.; Cleal, J., & Middleton, D. A. J. (2012a). Reducing effects of trawl fishing on seabirds by limiting foraging opportunities provided by fishery waste. *Emu*, *112*(3), 244–254. doi:10.1071/MU12002

Pierre, J. P.; Abraham, E. R.; Middleton, D. A. J.; Cleal, J.; Bird, R.; Walker, N. A., & Waugh, S. M. (2010). Reducing interactions between seabirds and trawl fisheries: Responses to foraging patches provided by fish waste batches. *Biological Conservation*, *143*, 2779–2788. doi:10.1016/j.biocon.2010.07.026

Pierre, J. P.; Abraham, E. R.; Richard, Y.; Cleal, J., & Middleton, D. A. J. (2012b). Controlling trawler waste discharge to reduce seabird mortality. *Fisheries Research*, *131–133*, 30–38. doi:10.1016/j.fishres.2012.07.005

Pierre, J. P.; Cleal, J.; Thompson, F. N., & Abraham, E. R. (2013). *Seabird bycatch reduction in scampi trawl fisheries*. Final research report for Department of Conservation project MIT2011-02 (Unpublished report held by Department of Conservation, Wellington). Retrieved from http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/mit-2011-02-scampi-trawl-mitigation.pdf

Rexer-Huber, K. & Parker, G. C. (2019). *Characterising discharge management in small-vessel trawl and longline fisheries*. Final research report for Department of Conservation project MIT2017-02 (Unpublished report held by Department of Conservation, Wellington). Retrieved from https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/mit2017-02-final.pdf

Richard, Y. & Abraham, E. R. (2020). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2016–17. *New Zealand Aquatic Environment and Biodiversity Report 237*. 61 p. Retrieved from https://www.mpi.govt.nz/dmsdocument/39407/direct

Richard, Y.; Abraham, E. R., & Berkenbusch, K. (2020). *Counts of seabirds around commercial fishing vessels within New Zealand waters, 2007–-08 to 2018–-19*. (Unpublished draft report held by the Department of Conservation, Wellington.) Retrieved from https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/draft-reports/observer-sightings-data-draft-report.pdf

Richard, Y.; Abraham, E. R., & Filippi, D. (2011). *Counts of seabirds around commercial fishing vessels within New Zealand waters*. (Unpublished report held by the Department of Conservation, Wellington.) Retrieved from http://data.dragonfly.co.nz/seabird-counts/static/pdf/seabirds-around-fishing-vessels.pdf

Sherley, R. B.; Ladd-Jones, H.; Garthe, S.; Stevenson, O., & Votier, S. C. (2019). Scavenger communities and fisheries waste: North Sea discards support 3 million seabirds, 2 million fewer than in 1990. *Fish and Fisheries*, *21*, 132–145. doi:10.1111/faf.12422

Sullivan, B. J.; Brickle, P.; Reid, T. A.; Bone, D. G., & Middleton, D. A. J. (2006a). Mitigation of seabird mortality on factory trawlers: Trials of three devices to reduce warp cable strikes. *Polar Biology*, *29*, 745–753.

Sullivan, B. J.; Reid, T. A., & Bugoni, L. (2006b). Seabird mortality on factory trawlers in the Falkland Islands and beyond. *Biological Conservation*, *131*, 495–504.

APPENDIX A Deepwater Group guidelines for scampi fisheries

TEN COMMANDMENTS

FOR SCAMPI VESSELS

1. Ensure your vessel has the current Scampi Fisheries Operational Procedures (OPs) on board.

2. Ensure crew understand and follow the OPs and your Vessel Management Plan (VMP).

3. Have a well-managed fish waste control system that ensures no continuous or ad-hoc discharge occurs when towing.

4. Ensure all fish waste, discards and offal are held during shooting and hauling.

5. Always deploy fit-for-purpose seabird mitigation devices as risk dictates.

6. For triple rig trawlers, if there's a risk of multiple captures or the DWG Trigger Point has been reached for net captures, fit net restrictors. If captures continue, remove centre net until risk reduces.

7. Minimise the time that gear is on or near the surface; shoot and haul the trawls as quickly as practicable.

8. Mark any dead marine mammals with a cable tie or twine and take two photos of all seals captured in SCI 6A before returning to the sea.

9. Advise DWG (same day) when seabird captures reach Trigger Point. Email DWG Trigger Point Report to . Assess event and implement further risk reduction measures. Trigger points are:
   - Within any 24-hour period, 5 dead small (e.g. petrel/shearwater) or 3 dead big (albatross/mollymawk); or
   - Within any 7-day period, 10 birds dead or released alive (all species).

10. As legally required, record all protected species captures in your ERS or on the Non-fish / Protected Species Catch Return.

APPENDIX B Observer Vessel Management Plan review forms

Observers carry out qualitative reviews of vessel staff knowledge of, and adherence to, the VMP on a trip-by-trip basis. These reviews are structured using a series of 'yes' or 'no' questions, as illustrated below. The forms have a second page that allows the observer to provide comments on the nature of any deviations from the VMP requirements.

The form has been revised a number of times; all but one of the 45 examples provided here were either on the original 2011 form (Version 4-Jun 2011) or the revised form with Fisheries New Zealand branding introduced in 2018 (but without a version number).

Vessel Management Plan/Marine Mammal Operating Procedure Observer reviews (Version 4 - Jun 2011)

Ministry for Primary Industries
Manatū Ahu Matua

1. Write the trip number ☐☐☐☐ start date of trip ☐☐/☐☐/☐☐

and vessel name ☐

2. If any of items 1-10 are "U" or "N" then a comment is required in section 5:		Y/N/U
Item 1.	Did the vessel have a copy of the Marine Mammal Operating Procedure?	
Item 2.	Was a Vessel Management Plan onboard and was it specific to this vessel?	
Item 3.	Were key crew members familiar with the contents of the above documents?	
Item 4.	Did the crew clear the net of "stickers" before shooting?	
Item 5.	Did the vessel attempt to minimise the amount of time the net spent on the surface?	
Item 6.	Did the vessel refrain from discarding plastic or netting?	
Item 7.	Did the vessel use mechanisms or procedures that reduced accidental discharge of floor offal and fish to the sea (e.g. grates)?	
Item 8.	Did the vessel steam away from large congregations of marine mammals?	
Item 9.	Did the vessel refrain from setting gear when dolphins were nearby?	
Item 10.	Was there a designated crew member looking for marine mammal captures?	

3. Items 11-13 use "Y" to indicate which options were present:

Item 11.	The seabird scaring devices available during this trip were:	None	Tori Line	Bird Baffler	Warp Scarer	Other
		☐	☐	☐	☐	☐
Item 12.	The most regularly used seabird scaring device was:	None	Tori Line	Bird Baffler	Warp Scarer	Other
		☐	☐	☐	☐	☐
Item 13.	The main offal management strategy employed during this trip was:	Meal	Held	Batch	Mince	Other
		☐	☐	☐	☐	☐

4. If any of items 14-20 are "Y" or "U" then a comment is required in section 5:		Y/N/U
Item 14.	When targeting JMA, was there evidence to suggest that the net was shot or retrieved between 2:30am and 4:30am (Only applies north of 40 deg 30 mins S)	
Item 15.	Was offal or fish discharged during net shooting or net retrieval periods?	
Item 16.	Was an additional seabird mitigation device(s) deployed during this trip?	
Item 17.	During turns, were the doors ever fully submerged with a headline depth of less than 50m?	
Item 18.	Were any marine mammal or seabird 'trigger' points activated during this trip?	
Item 19.	Were there equipment failures that increased seabird/marine mammal capture risk?	
Item 20.	Were there any other notable seabird or marine mammal related events during this trip?	

Deepwater Trawl VMP & MMOP
Fisheries New Zealand observer review form

Fisheries New Zealand
Tini a Tangaroa

Trip Number	Vessel Name	FMAs fished	Trip start date	Trip end date
			/ /	/ /

Target species		Observer name		Tows observed	

Record Yes (Y), No (N), Unknown (U) or Not Applicable (N/A) in the box provided. If you answer N or U to any questions, or Y for items 3, 4 or 19, then please make detailed comments on the reverse.

Item 1. Were copies of the DWG vessel specific *Vessel Management Plan (VMP)* and *Marine Mammal Operating Procedures (MMOP)* carried on board and made available upon request?

Item 2. Were the senior crew familiar with and have access to the above documents?

Item 3. Were any seabird, marine mammal or protected shark 'trigger-points' activated during the trip?
(if Y record details of the triggers and the action taken by the vessel)

Item 4. Did a gear or equipment failure event occur that increased the risk of seabird or marine mammal captures? *(if Y detail the event and the action taken by the vessel)*

Item 5. Were there any changes in crew behaviour, fishing activity, mitigation devices or gear used following 'trigger-point' events or during high risk periods?

Seabird/Marine Mammal Mitigation Devices

Item 6. Record what mitigation devices were carried by the vessel and when they were utilised

	Carried on board	Deployed all tows	Deployed some tows	Not deployed
Bird Baffler				
Tori line				
SLED				
Other *(describe on reverse)*				

Item 7. Was an additional seabird mitigation device deployed when required by the VMP?

Item 8. Was a Dolphin Dissuasive Device deployed on every JMA7 night tow (JMA7 only)?

Item 9. Were net restrictors fitted into the centre net of a triple-rig configuration when required? **(SCI only)**
(i.e. once a 'trigger point' was reached)

Fish Waste Management:

Item 10. Was the discharge of fish waste from the vessel managed as per the VMP?

Item 11. Were there any periods of continuous fish waste discharge during the tow *(apart from minced offal)*

Item 12. Was all fish waste (including offal and whole fish) held on board during shooting and hauling?

Item 13. Was the net cleared, as practicable, of all stickers prior to shooting?

Item 14. Was a grating or trap system used to prevent fish or offal accidentally lost to the factory floor or deck from being discharged overboard via scuppers or sump-pumps *(whilst still allowing the free egress of water)*

General Procedures:

Item 15. Were all plastics and netting retained on board?

Item 16. Was shooting fishing gear near congregations of marine mammals avoided?

Item 17. Was the amount of time the net spent on the surface minimised as much as practicable?

Item 18. Were any turns conducted with the doors fully submerged and a headline depth of less than 50 m?

Item 19. Were all seabird, marine mammal or protected shark captures reported by the vessel?

Item 20. Were all seabirds, marine mammals or protected sharks released alive handled with due care?

Item 21. Was gear shot between 02:30 and 04:30 (NZST) when targeting JMA North of 40.30^0 S? **(JMA7 only)**

APPENDIX C Summaries of observed scampi vessel management strategies of fish waste

This appendix contains summaries of observer information on scampi vessel fish waste management procedures for 2017–18 to 2019–20. These summaries were by Ministry for Primary Industries fisheries management staff, following observer debrief meetings; they were shared with Deepwater Group operational staff, who provide feedback and support to vessels.

In most cases, the observer comments indicated that vessels are following their Vessel Management Plans (VMPs). Highlighting (added for this report) illustrates cases where there is evidence of:

- vessels failing to implement batch discharge processes [yellow highlight];
- active management to correct onboard procedures to meet the requirements of the VMP [blue highlight]; and
- vessels implementing additional measures to reduce the risk to seabirds when waste is discharged [green highlight].

Vessel	Fishing year	Fish waste management strategy
g	2019/20	Unwanted fish accumulated in a hopper during sorting and were then batch discharged through the scuppers whilst towing. Processing offal (LIN/STA heads etc.) were discharged in ad-hoc fashion whilst towing; crew would initially throw over starboard side but skipper spoke to crew and instructed them to discharge waste over the stern. Crew would remove stickers as practicable
h	2019/20	Batch discharged. Fish waste would accumulate in batching tank during sorting and be discharged when crew thought a sufficient amount had accumulated. No grating on scuppers however crew would take to ensure fish did not fall to the deck with only small quantities (estimated at a couple of kgs per sort) discharged through the scuppers. Crew did not remove stickers as this would increase the amount of time the net spent on the surface.
b	2019/20	Fish waste batch discharged outside shooting hauling.
j	2019/20	Fish waste generally held on board during shooting/hauling. On occasion, discharge occurred during shooting. When sorting, fish waste would be continuously discharged. If the catch was small, the two nets would be on board when sorting occurred but with larger catches, one net would remain in the water while the other was sorted on deck. All practicable stickers removed prior to shooting.
d	2018/19	Batch discharged. Turn conducted just before discharging to keep the fish waste away from the warp.
f	2018/19	Batch discharged. Stickers removed when practicable.
e	2018/19	Fish waste would be stored in a discharge hopper during sorting and batch discharged when full. Between three and four discharge events per haul. On one occasion the hopper overfilled resulting in small amounts of fish waste being discharged overboard. Skipper spoke to crew and reminded them to empty hopper when full. On one occasion during hauling the crew were observed to be washing down the deck resulting in small amounts of fish waste being discharged through the grates. Skipper spoke to the crew and told them not to do this during hauling.
k	2018/19	Batch discharged.
c	2018/19	All batch discharged on starboard side via a discharge chute
a	2018/19	All discards and offal was held in a purpose made holding bin which was large enough to hold all of a tows discards/offal. This resulted in only one batch to be discarded for each tow which was emptied during the hours of darkness when possible. No discards were made during any shooting or

		hauling operations. Each codend was suspended from the gantry during the tows turnaround enabling the crew to shake and pull stickers out of the codend. Offal was batch discarded throughout the trip and stickers were removed from the codend before shooting.
i	2018/19	All fish waste from each tow retained and batch discharged. One discharge event per tow.
j	2018/19	Continuous discharge of whole fish during sorting (up to 15-20 minutes for the biggest catches). During this time the remaining cod ends would be under the surface or on deck (un-tipped). Either two or three periods of fish discharge each haul (depending on the number of codends). All processing offal (from bycatch) was discharged whilst net was on board.
a	2018/19	All fish waste batch discharged. No discharge during shooting/hauling.
h	2018/19	All fish waste batch discarded. Whole fish discarded first then offal. For first half of trip batch discarding began as soon as the doors left the surface (and before warp scarer deployed), after a seabird warp capture all fish waste retained until brakes came on and warp scarer deployed
d	2018/19	All fish waste batch discarded on port side. No discharge occurred whilst the winches were on. After a seabird warp capture, the vessel would make a turn to starboard when discharging.
b	2017/18	Offal and whole fish discards batch discarded whilst towing. No discarding during shooting and hauling
f	2017/18	Batched. Offal held on chute prior to discarding. Approx. 3 'batches' per tow.
i	2017/18	Offal was discarded from the vessel. Discards happened when doors were below the surface. When discarding, the vessel would turn to port while the discard occurred through the starboard side discard chute, so as to reduce the chance of bird captures.
c	2017/18	Vessel refrained from discarding whole fish and offal during shootings and hauls
g	2017/18	Whole fish batch discarded by storing on discard chute until sorting was finished and then discarding (discarding took less than 5 minutes). Small amount of processing (e.g. max of 5 ling per tow and occasional tailed scampi) with processing offal discarded on an ad-hoc basis. No discarding of offal/whole fish during shooting/hauling.

k	2017/18	Offal and whole fish discharge was held in a large hopper at the end of the sorting conveyor until shooting was complete.
a	2017/18	Whole fish and offal were batch discharged overboard from a large hopper bin on the port side of the vessel but not during hauling and shooting operations. Before emptying the hopper bin the captain turned the vessel slightly so that the port trawl warp lay in close to the side of the vessel, which kept it well out of the offal stream and avoided the risk of birds striking it.
k	2017/18	Discarding of whole fish and offal was completed in batches. Discarding never occurred during shooting or hauling operations and the crew ensured the winches had stopped before commencing in batch discarding.
a	2017/18	Fish and offal were held in a batch tank and discarded after birds were showing less interest in the vessel. This was generally a few hours after processing was completed.
h	2017/18	The vessel used a batch dumping system for most of the discarded species and was used for all tows during the sorting process. All of the large discards were thrown over the side when the vessel was steaming or after the doors were shot away.