Optimisation of protocols employed by New Zealand government fisheries observers for protected species data collection

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Authors:
Johanna P. Pierre
Finlay N. Thompson
Richard Mansfield

DRAGONFLY Data Science

PO Box 27535, Wellington 6141
New Zealand
dragonfly.co.nz

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CONTENTS

EXECUTIVE SUMMARY

The deployment of independent fisheries observers is widely recognised as a key component of best practice fisheries management. In New Zealand, observers have been a critical component of the commercial fisheries management regime since the 1990s. The data collection approaches and protocols used by observers in New Zealand fisheries have generally become more detailed over time, as well as covering a greater number and diversity of protected species groups and fishing gears.

Here, we review the strategic framework that generates information needs that may be addressed by fisheries observers and evaluate current observer data collection protocols in that context. The review covers international and national agreements, legislation, policies, management plans, and international approaches to observer data collection, as well as manuals, briefing notes, protocols, and forms used by observers in New Zealand fisheries.

Broadly, the strategic documents reviewed focused on the achievement of sustainability in environmental management and/or the conservation of biological diversity. Information needs that creates for New Zealand in relation to commercial fisheries encompass the characteristics of the fishing operations, the nature and extent of protected species captures, the status of captured animals, the operational and environmental factors that may contribute to captures, and, measures in place to avoid or reduce captures.

Protocols and forms currently used by observers to collect data from New Zealand fisheries partially address these information needs. Scope for improvements includes ensuring clarity and consistency in observer instructions, the addition of new fields or amendments to current fields on current data collection forms, the creation of new forms to capture additional information, and, the discontinuation of forms, fields, and metrics that are redundant or no longer useful. Priority areas in which to improve information collection relate to longline gear and protected species bycatch mitigation, purse seine gear and protected species interactions, mitigation of seabird strikes on trawl warps, cryptic mortality of protected species interacting with commercial fisheries, and coral bycatch. However, the most significant current impediment to meeting information needs is the paucity of observer coverage achieved in some fisheries, especially smaller-vessel fisheries operating in inshore areas. Ultimately, this results in a piecemeal understanding of protected species interactions with New Zealand commercial fisheries and compromises New Zealand's ability to deliver on domestic and international obligations. Regular review of the data collection approaches observers implement, combined with ensuring effective coverage of New Zealand commercial fisheries, will maximise the current and future benefits gained from observer deployments.

1. INTRODUCTION

The deployment of independent fisheries observers is widely recognised as a key component of best practice fisheries management (FAO 1995, 2009). Observers on fishing vessels are able to collect data across all aspects of at-sea operations, including quantification and sampling of the target and non-target landed catch, characteristics of gear deployed, collection and verification of information relating to compliance with legal requirements, and broader interactions between fishing operations and the marine environment (Barnes et al. 2005, Sabourenkov & Appleyard 2005, Porter 2010). Observer data can be fundamental to assessments of target species' stocks, identification of the effects of fishing on non-target species and the marine environment, and maintenance of the integrity of fisheries management regimes (Ministry for Primary Industries 2012, 2013a, Richard & Abraham 2013).

In New Zealand, observers have been a critical component of the commercial fisheries management regime since the 1990s. The Fisheries Act (1996) provided for the establishment of an observer programme for the purpose of "collecting reliable and accurate information for fisheries research, fisheries management, and fisheries enforcement". Amongst other duties, the scope of observer services includes the collection of information on fisheries resources, fishing (catch and effort information, vessel operations, processing and disposal etc.), and the effects of fishing on the aquatic environment. Marine protected species are encompassed by the Fisheries Act 1996 as part of the broader context of fisheries management and through "Conservation Services" which are the responsibility of the Department of Conservation (DOC). Given this joint responsibility, the specifications for observer services relating to marine protected species are developed by the Ministry for Primary Industries (MPI) and DOC. Documenting the nature and extent of the interactions between commercial fishing operations and marine protected species has been an increasingly important component of observer duties since the early 2000s, with some data available from 1990 (Conservation Services Programme 2004, Ministry of Fisheries 2010, Conservation Services Programme 2013a). Coincident with the increasingly large volume of data collected, the number of protected marine species identified through the Wildlife Act 1953 has increased. Species classified as legally protected in New Zealand are listed in Appendix 1.

The data collection approaches and protocols used by observers at sea in New Zealand fisheries, and internationally, have evolved over time. In New Zealand, data collection has generally become more detailed as well as covering a greater number and diversity of protected species groups and fishing gears. Consequently, knowledge of protected species interactions with fishing gears has increased significantly since the initiation of observer data collection. While still aiming to meet the strategic objectives of MPI and DOC, the development or review, and implementation, of data collection protocols for observer use have been incremental and often reactive, driven by legislative, policy, management, and scientific developments. To date,

data collection approaches relevant to the interactions between commercial fisheries and marine protected species have not been comprehensively reviewed. Similarly, approaches used in New Zealand fisheries have not been comprehensively evaluated against international standards for observer data collection on these species.

This report documents Conservation Services Programme project INT2013-04 (Conservation Services Programme 2013a), which has the overall objective of reviewing the data collected by fisheries observers in relation to understanding interactions with protected species, and refining efficient protocols for future data collection. The specific objectives are:

- to examine the information historically collected by observers on factors relevant to protected species interactions, and,
- to provide recommendations on refinement or development of data collection protocols to allow for more informative and efficient data collection.

2. METHODS

Information needs relating to marine protected species were identified through a review of international instruments, legislation, policy and other strategic government documents. In identifying information needs, the overall objective of the instrument, its scope in relation to New Zealand marine protected species, and any particular purposes relevant to these species were considered. Specific compliance requirements were not considered, unless these also related to the risk of protected species captures (e.g., where the utilisation of a mitigation measure or bycatch reduction strategy was required by law). Information needs that could be addressed in part or wholly by fisheries observers at sea were articulated in 10 international instruments relating to the management of biodiversity or fisheries, four legislative Acts, four government policy documents, 20 management strategies, and two risk assessments that focused on interactions between seabirds and New Zealand commercial fisheries (Table 1).

Following the identification of information needs relating to marine protected species, three approaches were taken to investigate the methods used by fisheries observers to meet these needs. First, international approaches to observer data collection were reviewed. This review encompassed observer manuals, protocols, and forms used by national observer programmes to collect information on marine species similar to those protected in New Zealand (e.g., National Oceanic and Atmospheric Administration (USA), Falklands Islands Fisheries Department, Government of South Georgia and the South Sandwich Islands) and by multilateral organisations involved in environmental and fisheries management (e.g., Southwest Indian Ocean Fisheries Project, Commission for the Conservation of Antarctic Marine Living Resources, and Regional Fisheries Management Organisations).

Second, the Ministry for Primary Industries' Observer Manual (Ministry for Primary Industries 2013d), briefing notes (Ministry for Primary Industries, unpublished), and data forms used by observers during deployments in New Zealand commercial fisheries were examined. These were sourced from MPI directly, as well as from the documentation for the Centralised Observer Database (COD) (Sanders & Fisher 2010). To explore information that may not be effectively recorded on forms currently in use, comments observers had written on forms recording information relating to protected species bycatch were extracted from COD from 1997 onwards. Where these comments included consistent threads, the value of amending forms was considered.

Third, selected technical reports on marine protected species that utilised data collected by observers in New Zealand fisheries were considered. Such reports often draw on many years of observer data, and were the main way in which past data collection practices were considered. Given the extent of data usage, these reports are able to highlight issues with the usability of observer data collected and offer recommendations to improve the scope of data collection and methods used. Recommendations relating to observer data collection practices were compiled from reports using observer data and evaluated alongside current observer taskings.

Finally, to evaluate technology-based tools for monitoring protected species interactions, the availability and utilisation of electronic data entry and video monitoring approaches were reviewed. Where possible given the available information, these tools were compared to the more traditional approach of human observers using paper forms.

When opportunities to improve data collection were identified, these have been addressed by recommending amendments to current observer protocols and forms and through the development of new forms. In addition, proposed improvements to the observer manual (Ministry for Primary Industries 2013d) and briefing notes (Ministry for Primary Industries, unpublished) are highlighted.

Draft forms developed by MPI are included in this report. These forms draft forms are included to provide context and will undergo refinement based on further input, including field testing. MPI has also provided the following commentary (K. George, pers.comm.). "The Observer form design process is run out of the Fisheries Directorate at MPI. The process, in brief, is to establish a form design project team, redesign forms, test the prototype forms, revise, and amend until stated efficiency improvements are achieved. This will ensure that all forms used by observers to collect data are well designed with current information needs, data quality and observer work load in mind. New forms will be designed with a logical data flow sequence, require minimal additional calculations, and be trialled by observers prior to implementation. There are a number of individual steps in the form design process, that collectively, will ensure these requirements are met, resulting in an increase in data collection efficiency, as well as improving data accuracy."

3. RESULTS

3.1 Review of strategic documents

The documents reviewed spanned a diversity of objectives, ranging from the very generic to the highly specific. For example, amongst international agreements (Table 1), the Convention on Biological Diversity 1992 focuses on the "conservation of biological diversity and the sustainable use of its components", and calls for the avoidance or minimisation of adverse impacts and monitoring of human effects on components of biological diversity, especially those in need of conservation. Data collected by observers at sea is clearly useful to address these issues, but the need for, and role of, such data are not explicitly identified. In contrast, and amongst other requirements, the United Nations Fish Stocks Agreement 1995 calls for the assessment of the impacts of fishing on species co-occurring with target stocks, and the collection of detailed, accurate and verifiable data on fishing activities including non-target species catch. A detailed annex to the agreement describes data collection requirements and standards. Amongst the more specific of the international instruments reviewed, the Agreement on the Conservation of Albatrosses and Petrels 2004 requires measures to be taken to reduce or eliminate the fishing-related mortality of 30 albatross and petrel species. Data collection is an integral part of this, and the use of at-sea observers is explicitly identified as a key method for collecting reliable data, which is to be verifiable where possible, allowing the assessment of albatross and petrel interactions with fisheries.

Amongst the four pieces of New Zealand legislation reviewed (Table 1), the Fisheries Act 1996 provides for the maintenance of biological diversity in the marine environment and the maintenance of associated or dependent species above levels ensuring their long-term viability. If a population management plan (PMP) has been approved, the Minister of Fisheries is responsible for ensuring that its maximum allowable fishing-related mortality level is not exceeded. The Minister can also implement additional measures s/he considers necessary to avoid, remedy or mitigate adverse effects of fishing on protected species. Finally, the Fisheries Act 1996 defines Conservation Services, which are delivered through the Conservation Services Programme (Conservation Services Programme 2013b). Conservation Services include outputs produced in relation to the adverse effects of commercial fishing on protected species, including research relating to these effects and their mitigation, and PMPs. In providing for a programme of at-sea observer services on vessels, the Fisheries Act 1996 created a resource for collecting data to support other aspects of the management regime provided for in the Act, including those relating to biodiversity and the adverse effects of commercial fishing on protected species.

The Wildlife Act 1953 and the Marine Mammals Protection Act 1978 identify marine protected species and several tools for their management, including PMPs, conservation management strategies (CMSs) and the Conservation General Policy (Table 1). The General Policy and CMSs are also highlighted

in the Conservation Act 1987. PMPs include a number of components that can be informed in part through at-sea data collection on marine protected species, for example, an assessment of known fisheries interactions with the species. The objectives and scope of CMSs vary. Where marine protected species are considered explicitly, current CMSs tend to focus on the distribution and abundance of marine mammals at sea. The Conservation General Policy 2007 takes a broader approach, specifying similarly to the Fisheries Act 1996, that marine protected species should be managed for long-term viability. In addition, the Conservation General Policy 2007 seeks the recovery of these species throughout their natural range, and states that absolute protection will be considered for threatened marine species for which this protection is not already in place. Clearly, these requirements establish a need for information and datasets to which observers at sea can contribute.

In addition to the Conservation General Policy 2007 and CMSs, three government policy documents were reviewed. These were the Conservation Services Programme's Strategic Statement 2013 and two National Plans of Action (NPOA) for seabirds and sharks (Ministry for Primary Industries 2013b, 2013c). These policy documents all articulate a series of objectives that highlight specific data and information needs, some of which can only be effectively met by data collection at sea. For example, the Conservation Services Programme Strategic Statement specifies five objectives which all require at-sea data collection in order to be partially or wholly met. These relate to the utilisation of effective bycatch mitigation strategies, the description and understanding of direct and indirect effects of commercial fishing on marine protected species, and the availability of adequate information to facilitate detailed risk assessments and/or fisheries management (Conservation Services Programme 2013b).

The NPOA - Seabirds 2013 (Ministry for Primary Industries 2013b) includes the objective that where seabird taxa are currently classified as at a very high or high risk (Richard & Abraham 2013), these taxa must move to a lower risk category by 2018. Effectively evaluating performance against this objective requires robust estimates of seabird captures which must be developed using data collected at sea. In addition, the robustness of the risk assessment would be improved with additional information, e.g., on seabird distributions. Another objective articulated in the NPOA-Seabirds 2013 is that by 2018, all New Zealand commercial fishing vessels can be shown to be implementing current best practice mitigation measures. Evaluating performance against this objective must also require data collection at sea, albeit a different type of information to that required to quantitatively estimate capture rates.

The NPOA-Sharks 2013 (Ministry for Primary Industries 2013c) includes as an objective that the mortality of all sharks from fishing is at or below a level that allows for the maintenance at, or recovery to, a favourable stock and/or conservation status (giving priority to protected species and high risk species, Objective 1.4). Other elements of the draft NPOA-Sharks 2013 to which at-sea data collection can contribute include the identification of

Table 1: Strategic documents that define government information needs on marine protected species.

International agreements and guidelines

Agenda 21 1992
Convention on Biological Diversity 1992
Convention on the Conservation of Migratory Species of Wild Animals 1979
United Nations Convention on the Law of the Sea 1982
United Nations Fish Stocks Agreement 1995
United Nations Food and Agriculture Organization Code of Conduct for Responsible Fisheries 1995
Agreement on the Conservation of Albatrosses and Petrels 2004
United Nations Food and Agriculture Organization Technical Guidelines for Responsible Fisheries: Best practices to reduce incidental catch of seabirds in capture fisheries 2009
Western and Central Pacific Fisheries Convention 2004
Convention for the Conservation of Southern Bluefin Tuna 1994

Acts of Parliament

Fisheries Act 1996
Conservation Act 1987
Marine Mammals Protection Act 1978
Wildlife Act 1953

Policy documents

National Plan of Action - Seabirds 2013
National Plan of Action - Sharks 2013
Conservation Services Programme Strategic Statement 2013
Conservation General Policy 2007

Management Strategies and Plans

Conservation Management Strategies (12 draft and finalised strategies, 1994 – 2013)
Hector's Dolphin Threat Management Plan 2007
Maui's Dolphin Threat Management Plan 2013
New Zealand Sea Lion Species Management Plan: 2009 – 2014
Department of Conservation Marine Mammal Action Plan for 2005 – 2010
Published Department of Conservation Threatened Species Recovery Plans:
Albatrosses in the Chatham Islands 2001 – 2011
Chatham Island shag and Pitt Island shag 2001 – 2011
Hoiho 2000 – 2025

Risk assessments

Richard & Abraham (2013)
Rowe (2013)

critical shark habitats (Objective 1.5), the development of a risk assessment framework to identify the nature and extent of risks to shark populations (Objective 1.1), and explorations of cryptic mortality post-capture (part of Objective 6.2) (Ministry for Primary Industries 2013c).

The management plans reviewed focused on a group of marine protected species (e.g., threatened seabirds), species (e.g., the yellow-eyed penguin *Megadyptes antipodes*), or subspecies (e.g., Maui's dolphin, *Cephalorynchus hectori maui*) (Table 1). As such, management recommendations are presented which generate specific information needs (e.g., the nature and extent of captures of Chatham Island *Leucocarbo onslowi* and Pitt Island *Stictocarbo featherstoni* shag in cray pots and setnets). While developed at the species or subspecies level however, information needs can be grouped into broad categories that apply across marine protected species, such as, understanding the direct and indirect impacts of commercial fishing.

In summary, reviewing strategic documents relating to biodiversity and fisheries management highlighted a series of information needs relating to the interactions of marine protected species with New Zealand commercial fisheries. Broadly, these relate to the:

- characteristics of the fishing operation,
- nature and extent of protected species captures,
- status of captured animals,
- operational and environmental factors that may contribute to captures, and,
- measures in place to avoid or reduce captures.

Additional specific information needs highlighted in the review related to subsets of marine protected species groups. For example, cryptic mortality was identified as being of particular interest for seabirds and sharks (Conservation Services Programme 2013a, Ministry for Primary Industries 2013c, 2013b) but by implication, this has relevance across all protected species if the full extent of fishing impacts is to be understood and managed for. Diet as an information need was highlighted in relation to marine protected species for which there is interest in the indirect effects of commercial fishing (Conservation Services Programme 2013b).

3.2 Review of international observer programmes

Review of the objectives, manuals, protocols and forms used by observer programmes internationally confirmed that data collected could also be grouped into the five broad categories above, which reflect the information needs relevant to New Zealand marine protected species. Not all observer programmes reviewed sought to collect all categories of data, and the objectives of observer programmes influenced the data collected. (We do not consider objectives specific to international observer programmes

here). Further, observer programmes typically maintained a set of core data collection requirements that spanned a number of years, and these were augmented by additional protocols that addressed particular objectives over shorter periods, e.g., one year or fishing season (**S. Northridge and K. Ross**, **pers. comm.**, Mormede 2008).

All programmes reviewed involved the collection of at least some information describing the fishing operation. This could include crew information (e.g., the experience of the skipper and senior crew), specifications of the vessel (e.g., vessel length, engine power, gross tonnage, freezer storage capacity), target species, when and where the gear was set and hauled, and the amount of gear deployed (Groeneveld & Heinecken 2010, Western and Central Pacific Fisheries Commission 2013). The detailed characteristics of fish catch *per se* are not directly relevant to protected species interactions and so are not considered further. However, given catch is central to the economics (including the sustainability) of fisheries, this information can become important for managers exploring the potential consequences of measures intended to reduce or mitigate protected species interactions, such as gear changes or spatial management.

Amongst the marine species legally protected in New Zealand, seabirds, marine mammals, and turtles were best covered by international observer programmes. In observer programmes requiring data collection on these species, tasking typically involved, at a minimum, recording the number or weight of animals landed, by species, and an assessment of whether they were dead or alive (Indian Ocean Tuna Commission 2010a, 2010b). In more comprehensive programmes, observer tasking included recording the geographic position at which the capture (and release of a live animal) occurred, location of the captured animal in the fishing gear, where animals were hooked on the body (for longline fisheries), assessing the sex, age, and reproductive condition of bycaught animals and taking tissue or other biological samples to support research onshore (National Oceanic and Atmospheric Administration 2012a, 2013, Alaska Fisheries Science Center 2014). More comprehensive approaches to the life status of captured animals included a description of the bycaught animal's injuries, the animal's consciousness or vitality, a post-release prognosis, and whether fishing gear remained on or inside the animal (Dietrich et al. 2010, National Oceanic and Atmospheric Administration 2013). Amongst other non-target marine species however, observer programme requirements were variable. For example, some programme specifications included the documentation of all non-target catch landed (Commission for the Conservation of Southern Bluefin Tuna 2001) while others had particular species-based requirements (e.g., recording the number of released oceanic whitetip shark *Carcharhinus longimanus*, and their life status (Western and Central Pacific Fisheries Commission 2012)).

For coldwater corals, few data collection protocols were available from fisheries observer programmes internationally. The best known programmes focused on the detection of vulnerable marine ecosystems (VMEs), rather than the incidental capture of corals *p*er se (CCAMLR 2011, South Pacific

Regional Fisheries Management Organisation 2014b, 2014a). The approach taken by the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR) focuses on the detection of VMEs using specific indicator species. Observers record the number landed and weight of these species, e.g., black corals (Order: Antipatharia), stony corals (Order: Scleractinia) (CCAMLR 2013a). The South Pacific Regional Fisheries Management Organisation (SPRFMO) guidelines provide for the reporting of VME taxa observed, together with their relative and absolute densities or numbers of organisms (South Pacific Regional Fisheries Management Organisation 2014b, 2014a). In fisheries off the northeastern US, observers are tasked with photographing all coral (and sea pen) specimens, returning all stony corals to shore, and also returning soft corals when possible. Three codes are used to document these landings, for Scleractinia, Pennatulacea, and Alcyonacea (Lewandowski 2013).

Amongst the programmes reviewed, there was one case in which data collection on cryptic mortality was described for marine mammals. This involved observers recording animals that dropped out of setnets during hauling and so would not have otherwise been recorded amongst landed captures (S. Northridge, pers. comm.). Two programmes collected data related to cryptic mortality of seabirds (CCAMLR 2011, Falkland Islands Fisheries Department 2011). In the Falkland Islands, seabird strikes on trawl warps were assessed in detail. The perceived outcome of warp contacts may give some insight into possible levels of cryptic mortality as well as the efficacy of mitigation strategies (Falkland Islands Fisheries Department 2011). CCAMLR observers on trawl vessels also record warp strikes (CCAMLR 2013b). In addition, when conducting longline observations, CCAMLR observers are requested to investigate the outcome of incidences of seabirds becoming hooked at setting, to determine whether they were retrieved on hauling (CCAMLR 2011). For elasmobranchs, observers at sea have been involved in short-term studies investigating survival after capture in commercial fisheries (Braccini et al. 2012).

Protected species that ultimately interact with fishing gear are a subset of those occurring in the marine environment. Some observer programmes included at-sea monitoring of certain species occurrences, whether or not these species were interacting directly with fishing gear. Monitoring was either opportunistic or structured. Opportunistic monitoring involved no particular effort being made to observe the species of interest but recording when these animals were detected. Amongst the programmes reviewed, opportunistic sightings of marine mammals and sea turtles were documented (Groeneveld & Heinecken 2010, National Oceanic and Atmospheric Administration 2013, 2014). In some cases, opportunistic sightings of particular species of interest were also sought, for example, the short-tailed albatross (*Phoebastria albatrus*) in Hawaiian fisheries (National Oceanic and Atmospheric Administration 2013). As a minimum, fields completed as part of opportunistic monitoring included the species seen (or identification to the lowest taxonomic level possible), date (latitude and longitude) and location of the observation. Additional fields included the time, sea state, sea surface temperature where animals occurred, number of

animals, number of adults and calves or juveniles (for marine mammals), behaviour of animals seen, distance from the vessel, and whether animals were tagged or banded. Photographs were also requested for opportunistic sightings to facilitate accurate identifications (Groeneveld & Heinecken 2010, National Oceanic and Atmospheric Administration 2012a, 2012b).

In contrast, structured monitoring involved conducting counts that were standardised to some degree. Standardised counts were most commonly described for seabirds and marine mammals. Standardisation approaches included specifying the times of day and stages of the fishing cycle at which to conduct counts, as well as focal areas around the vessel or gear (Groeneveld & Heinecken 2010, CCAMLR 2011, National Oceanic and Atmospheric Administration 2012a, 2013). In addition to those completed for opportunistic sightings, data fields for the standardised monitoring of seabirds, marine mammals, and turtles typically included environmental conditions including weather, sighting conditions in which observations were made, the possible cause of any interactions observed with fishing gear, the status of the animal at the end of the monitoring (e.g., hooked or not hooked if the animal was seen around longline gear), features used to identify the animal and confidence in the identification made, and an indication of the range in abundances observed (e.g., minimum, maximum and best estimates of abundance) (Groeneveld & Heinecken 2010, CCAMLR 2011, National Oceanic and Atmospheric Administration 2012a, 2010, 2013). While many of the fields populated during targeted monitoring were common between observer programmes reviewed, the distances or areas in which animals were observed differed in all cases.

In two programmes reviewed, observations were structured such that monitoring when the gear was in the water was linked to documenting additional characteristics of interactions between protected species and fishing gear once an interaction occurred (National Oceanic and Atmospheric Administration 2010, 2013). Specifically, observers in Hawaiian and American Samoa longline fisheries conducted monitoring structured in terms of "sightings" and "behaviours" (in which marine mammals, seabirds, or sea turtles were seen but did not interact with the fishing gear) and "contacts" (in which the animal makes contact with a part of the fishing gear). Seabird contacts during a longline set or haul triggered a "catch scan", which involved the observer sweeping 360 degrees around the vessel and recording the identity and abundances of all birds present within a 137 m (150 yard)-radius (National Oceanic and Atmospheric Administration 2010, 2013). The intent of this catch scan is to record a snapshot of the context in which the bird contacted the fishing gear.

All international observer programmes reviewed collected operational (e.g., gear specifications) and environmental (e.g., weather or sea conditions) information that may relate to protected species interactions with fishing gear and bycatch. The detail of this data collection varied between programmes (Indian Ocean Tuna Commission 2010a, 2010b, CCAMLR 2011, Western and Central Pacific Fisheries Commission 2013). For longline fisheries, risks to protected species include entanglement in the mainline

or backbone and the snoods, and being hooked. Therefore, relevant gear dimensions include longline length, weighting regimes, snood length, and hook size and type. Relevant operational variables include setting speed, bait state (frozen or thawed, live or dead), and fish waste discharge regimes (e.g., offal discharge, unhooked baits discharged from an autobaiter). For longline fisheries, "best practice" recommendations for observer data collection have been promulgated, including these fields (Dietrich et al. 2007, Wolfaardt 2011). In trawl and other net fisheries, best practice gear descriptors have not been identified and the relationships between gear components and bycatch risk are less established. However, some observer programmes collect very detailed information about the configuration of trawl gear (Northeast Fisheries Science Center 2013). For purse seine and setnet fisheries, gear descriptors relevant to protected species interactions include the size and length of the net and (stretched) mesh size (Indian Ocean Tuna Commission 2010a, Western and Central Pacific Fisheries Commission 2013). Operational variables relevant to bycatch risk in net fisheries may include fishing depth, discharge of processing waste, time of day that gear is set and hauled, and for trawling, the length of time the trawl net is at the surface, tow speed, and tow duration (Bull 2007, Bull 2009, Francis & Sutton 2012, Pierre et al. 2012a).

The use of bycatch reduction measures is an integral component of many fishing operations. The deployment of these measures is recorded by some observer programmes (CCAMLR 2011, Falkland Islands Fisheries Department 2011), and best practice approaches to observer documentation of bycatch reduction measures have been developed for longline fisheries (Wolfaardt 2011). Best practice for recording line-weighting includes documenting the mass of added weight and location of weights relative to hooks (Wolfaardt 2011). For streamer lines, best practice recording includes the number of lines used, aerial coverage achieved, length of the line(s), attachment height, number of streamers, and distance between streamers (Wolfaardt 2011). Observers reporting deviations from the area streamer lines are intended to cover provides an indication of the efficacy of the lines in trawl fisheries (Falkland Islands Fisheries Department 2011) and could also be applied in longline fisheries. The use of measures intended to reduce seabird captures in trawl nets – net binding and net weighting (Roe 2005, Sullivan et al. 2009) – are reported by CCAMLR fisheries observers. In a northern hemisphere setnet fishery, pinger deployment and viability have been recorded by observers monitoring net shooting and hauling (S. Northridge, pers. comm.).

The extent to which environmental variables were recorded, where these may relate to the incidence of protected species interactions with fishing operations, varied across the programmes reviewed. For example, weather conditions (wind force and direction, sea height and direction, swell height and direction) were recorded at the start and sometimes the end of setting and hauling operations (Indian Ocean Tuna Commission 2010a, National Oceanic and Atmospheric Administration 2013), and when seabird interactions occurred (Alaska Fisheries Science Center 2014). Environmental conditions recorded during seabird warp strike

observations in Falklands trawl fisheries included wind direction, sea state, wave direction, cloud cover and moon phase ((Falkland Islands Fisheries Department 2011). Documenting moon phase and cloud cover is relevant due to the heightened risk of seabird bycatch on clear moonlit nights (Dietrich et al. 2007, CCAMLR 2011), as reported from longline fisheries (Bull 2007). Numerous authors have speculated or confirmed that other weather variables (e.g., wind speed and direction) influence seabird interactions with fishing gear (Sullivan et al. 2006, Middleton & Abraham 2007, Melvin et al. 2011).

In addition to the quantitative and qualitative information recorded in the areas described above, observers were often tasked with taking digital photos and videos in the international programmes reviewed. The detail or specificity on photo angles and composition were variable in observer instructions issued (Groeneveld & Heinecken 2010, National Oceanic and Atmospheric Administration 2010, Northeast Fisheries Science Center 2013). In one programme, observers are tasked with renaming images at sea using a prescribed set of codes to reflect the subject area of the image (e.g. incidental take, gear, compliance issues) (Northeast Fisheries Science Center 2013). Naming conventions are in place within each subject category. For example, photos of animals incidentally captured are labelled using a string including year, trip number, target species, specimen identification, haul number, image number in the sequence taken. This approach effectively links images to other components of recorded data and the events observed, as well as facilitating access to images by end users once trips are complete.

In the programmes reviewed, data collection was most commonly structured on paper forms. However, some programmes also enabled observers to use electronic recording formats that followed the structure of forms (CCAMLR 2011). In addition to form by form data records, most observer programmes tasked observers with collating a summary of the trip in some form of "Trip Report" (Indian Ocean Tuna Commission 2010b, CCAMLR 2011). The scope of trip reports and amount of detail required in them varied. Information observers were requested to incorporate in trip reports included fishing location, vessel and crew information, target species and catch information, fishing effort, and type, number, and outcome status of selected non-target species bycaught (Groeneveld & Heinecken 2010, Indian Ocean Tuna Commission 2010b, CCAMLR 2011).

In contrast to electronic data recording by observers, full electronic monitoring of fisheries involves the use of cameras to record images in the absence of a human observer. The use of electronic monitoring requires careful consideration of monitoring objectives before cameras are deployed and may require changes in catch handling and other operational practices to ensure efficacy (McElderry et al. 2010, Ruiz et al. 2013). The prevalence of pilot studies to evaluate electronic monitoring has increased in the last decade and a variety of fishing methods has been examined, including gillnetting, purse seining, and surface and bottom longlining (Pria et al. 2008, McElderry et al. 2010, Evans & Molony 2011, Ruiz et al. 2013). Protected species monitoring objectives have been explored

in some studies (Ames et al. 2005, McElderry et al. 2010). Over time, electronic monitoring has been mainstreamed internationally as a standard component of fisheries monitoring in some trap, trawl, seine, gillnet and longline fisheries (McElderry et al. 2011, Zollett et al. 2011).

3.3 Review of data collection by observers in New Zealand fisheries

For New Zealand fisheries, the MPI Observer Manual (Ministry for Primary Industries 2013d) and briefing notes (Ministry for Primary Industries, unpublished) convey to observers which forms should be filled out based on the fishery they are observing and the data collection activity undertaken. In terms of optimising instructional material given to observers, clarity could be increased in the first instance by updating the Observer Manual so that instructions given in relation to marine protected species are consistent. An up-to-date list of protected species is provided to observers in the Observer Manual. However subsequently, taskings relating to particular groups of protected species are inconsistently identified (e.g., species to be included on the Non-fish Bycatch Form). Similarly, removing defunct form names from briefing notes would improve their clarity (e.g., Longline Catch Effort Logbook).

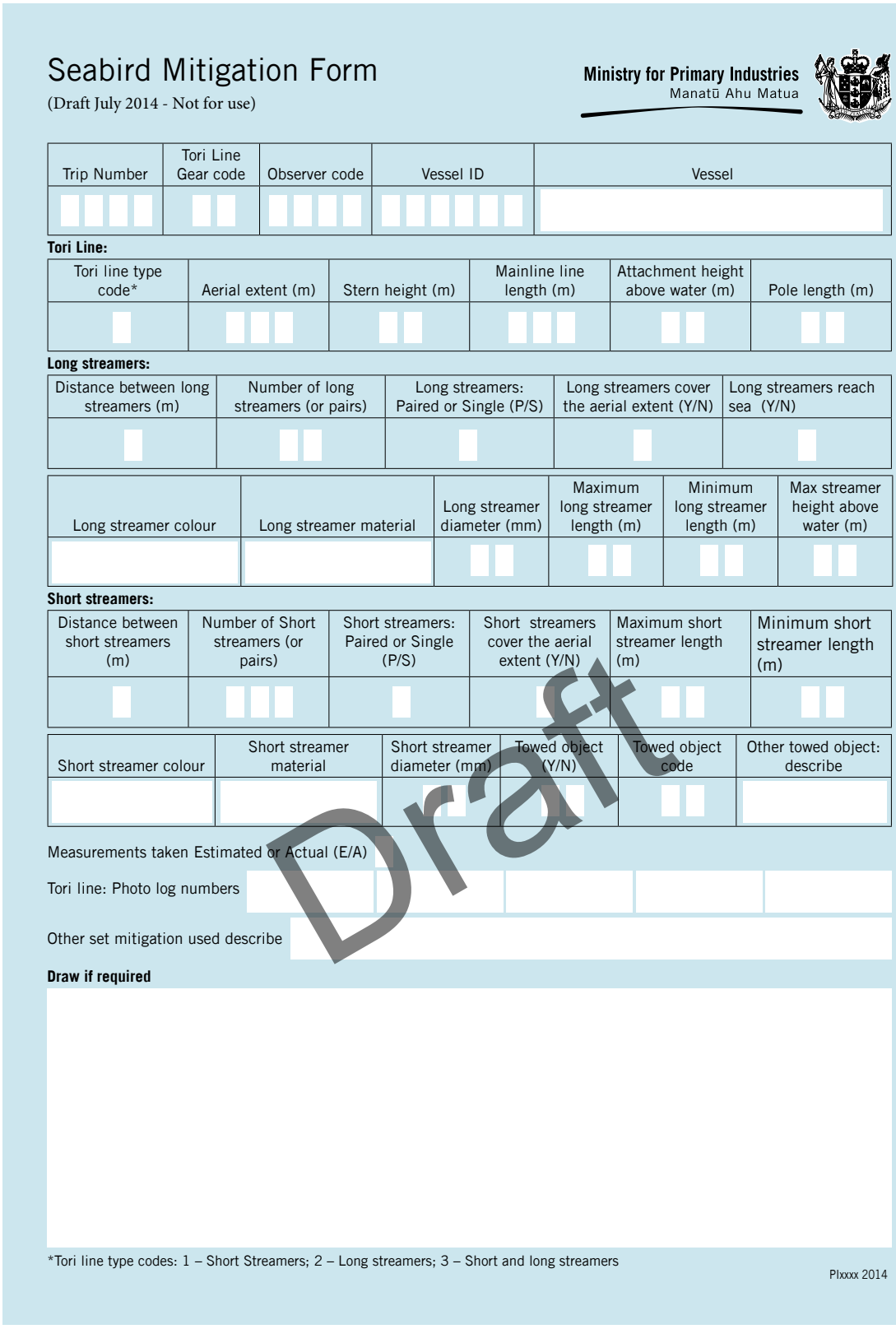
Protocols and forms that relate to protected species interactions and are used by observers are deployed in accordance with fishing method or target species (e.g., the Trawl Catch Effort Logbook, Observer SLED Details Form), or across all New Zealand commercial fisheries (e.g., the Non-fish Bycatch Form and the Benthic Materials Form) (Table 2). Here, we consider data collection using forms relating to fishing methods first, followed by forms used across all commercial fisheries. In the text, we discuss only the forms for which revisions are recommended to improve data collection relating to protected species interactions. A summary of changes proposed is presented in Appendix 2.

3.3.1 Forms deployed in specific fisheries

Longline fishery forms: These were under review at the time of writing and comments relate to draft forms produced by MPI in July 2014.

The MPI draft July 2014 Seabird Mitigation Form (Figure 1) records the characteristics of streamer lines deployed during setting and requests that observers describe other mitigation used on the set. A second side of the same form documents some information on haul mitigation. First, amending the scope of this form such that set and haul mitigation are documented separately is recommended. Observers would complete the set- and haul-related portions of the current draft form at different times during the fishing cycle. Therefore, there is no functional advantage to combining these onto one form.

Second, we propose that the specifications of tori lines are recorded on a dedicated form that does not also attempt to cover other mitigation measures deployed on the set. Note that a Tori Line Details Form



Seabird Mitigation Form

(Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Trip Number	Tori Line Gear code	Observer code	Vessel ID	Vessel

Tori Line:

Tori line type code*	Aerial extent (m)	Stern height (m)	Mainline line length (m)	Attachment height above water (m)	Pole length (m)

Long streamers:

Distance between long streamers (m)	Number of long streamers (or pairs)	Long streamers: Paired or Single (P/S)	Long streamers cover the aerial extent (Y/N)	Long streamers reach sea (Y/N)

Long streamer colour	Long streamer material	Long streamer diameter (mm)	Maximum long streamer length (m)	Minimum long streamer length (m)	Max streamer height above water (m)

Short streamers:

Distance between short streamers (m)	Number of Short streamers (or pairs)	Short streamers: Paired or Single (P/S)	Short streamers cover the aerial extent (Y/N)	Maximum short streamer length (m)	Minimum short streamer length (m)

Short streamer colour	Short streamer material	Short streamer diameter (mm)	Towed object (Y/N)	Towed object code	Other towed object: describe

Measurements taken Estimated or Actual (E/A)

Tori line: Photo log numbers

Other set mitigation used describe

Draw if required

*Tori line type codes: 1 – Short Streamers; 2 – Long streamers; 3 – Short and long streamers

PIxxxx 2014

Figure 1: Draft Ministry for Primary Industries' Seabird Mitigation Form (front side), July 2014.

Haul Mitigation

Bird baffler/Brickle curtains

Bird baffler gear code

Fore pole length (m)	Number of streamers on fore pole	Streamer length (m)	Streamer material	Streamer colour	Distance between streamers (m)

Aft pole length (m)	Number of streamers on Aft pole	Streamer length (m)	Streamer material	Streamer colour	Distance between streamers (m)

Distance between fore and aft pole (m)	Line joining poles (Y/N)	Number of streamers on line	Streamer material	Streamer colour	Distance between streamers (m)

Photo log numbers				

Acoustic baffler:

Blast type	Frequency used	Volume generated

Water cannon:

Cannon type	Frequency used	Direction

Photo log numbers				

Figure 1: (cont.) Draft Ministry for Primary Industries' Seabird Mitigation Form (back side), July 2014.

already exists (Sanders & Fisher 2010), but is focused on documenting the specifications of streamer lines deployed from trawl vessels (Table 2). We propose that this form is renamed "Trawl Tori Line Details" and that a longline-focused streamer line form is created.

A proposed alternative form entitled "Longline Tori Line Details" is shown in (Figure 2). The diagram of tori line types that is included on the proposed form is analogous to the tori line type code on the MPI draft July 2014 Seabird Mitigation Form. Four streamer line types are included (Sato et al. 2012) following research on the efficacy of designs deployed during surface-lining activity within the Western and Central Pacific Fisheries Commission (WCPFC). Including a fifth empty frame provides for observers to draw the tori line they see, if it is significantly different to the other types. Next, appropriately grouping the measurements to be collected should improve the user-friendliness of the form (e.g., all long-streamer measurements in one row, all short-streamer measurements in another row). Instructions and a diagram identifying the measurements required are included on the back side of the form (Figure 2). The form records all fields recommended as best practice relating to the documentation of tori lines (Dietrich et al. 2007, Wolfaardt 2011). In addition, measurements recorded on this revised form allow the comparison of streamer lines deployed against the specifications required by current regulations (New Zealand Government 2014).

The MPI draft July 2014 Seabird Mitigation Form (Figure 1) includes a box for observers to describe other mitigation used at the set. We propose recording the details of additional mitigation measures used at the set on revised versions of Surface and Bottom Longline Setting Logs, a Setting Event Log, Hauling Event Log and Hourly Haul Log, all discussed in more detail below. This provides set by set information on mitigation, and thereby, effective linking of measures deployed and bycatch events. Further, where observers complete the Setting Event Log and Hauling Event Log, the utilisation of mitigation can be recorded with even greater precision in terms of the times at which measures are deployed. In addition to increasing the utility of information about mitigation deployed, excluding additional set mitigation from the new Tori Line Details Form: Longline reduces duplication in observer tasking.

The MPI draft July 2014 Seabird Mitigation Form (Figure 1) includes fields to record some specifications of bird bafflers or Brickle curtains, acoustic bafflers and water cannons. Similar to the approach taken for mitigation used during the set, we propose a single form focused on haul mitigation measures broadly taking the form of the Brickle curtain. An alternative form to the MPI draft form is proposed in (Figure 3). Clarifying the language such that "bird baffler" is not used interchangeably with"Brickle curtain" is recommended. While both devices are intended to keep birds away from fishing gear, the baffler and the Brickle curtain are different in their design, construction, proximity to fishing gear and time of deployment (Bull 2007, Bull 2009). Given the diversity of designs of Brickle curtain-type devices, one design is provided as an example (Figure 3). The fields provide space to record dimensions as shown in the example diagram. However,

Longline Tori Line Details

Trip number | Observer Name | Vessel ID | Vessel Name | Tori line gear code

Tick the box by the diagram that is most like the tori line in use on the vessel. If the vessel's tori line does not resemble one of the four types show, draw it in the box provided.

Overview:

Number of tori lines deployed: Single ☐ Multiple ☐

Measurements taken: Estimated ☐ Actual ☐

Pole length (m) | Tori line length (m) | Aerial extent (m) | Distance from stern to first streamer that reaches sea surface (m)

Towed object:

✓ | Towed object code | Other towed object descibe:

Deployment system used for multiple tori lines:

Long streamers:

✓ | Paired ☐ Single ☐ | Number of streamers (or pairs) | Distance between streamers (m) | Streamers reach sea (y/n) | Streamers cover aerial extent (y/n) | Maximum length (m) | Minimum length (m) | Diameter (mm) | Material | Colours

Short streamers:

✓ | Paired ☐ Single ☐ | Number of streamers (or pairs) | Distance between streamers (m) | Max height above water (m) | Streamers cover aerial extent (y/n) | Maximum length (m) | Minimum length (m) | Diameter (mm) | Material | Colours

Photo log numbers

Additional comments

Longline Tori Line Details Form, 30 October 2014

Figure 2: Illustration of proposed fields for the collection of information describing tori lines deployed from longline vessels. (Front side).

Instructions - Tori Line Details Form: Longline

1. Complete this form on the first set of the trip, and then again each time the tori line is modified or a new tori line is deployed.
2. If paired or multiple tori lines were used, complete sections 2 and 3 on a separate form for each tori line
3. Give each tori line a Gear Code starting with "T1" for the line deployed on the port side
4. Describe the deployment system used for multiple tori lines in the box provided.
5. Complete cells describing tori line in use on the vessel. Dimensions are shown in Figure 1.

Type of towed object
F = inverted funnel or plastic cone
L = length of thick line
K = knot or loop of thick line
B = buoy
N = netted buoy
S = sack or bag
W = weight
Z = no towed object
O = other type of towed object

Streamer colour codes:
P = pink
R = red
C = carrot (orange)
Y = yellow
G = green
B = blue
W = brown
F = faded colour (any colour)
O = other

Streamer material codes
T = plastic tubing
S = plastic strapping
O = other

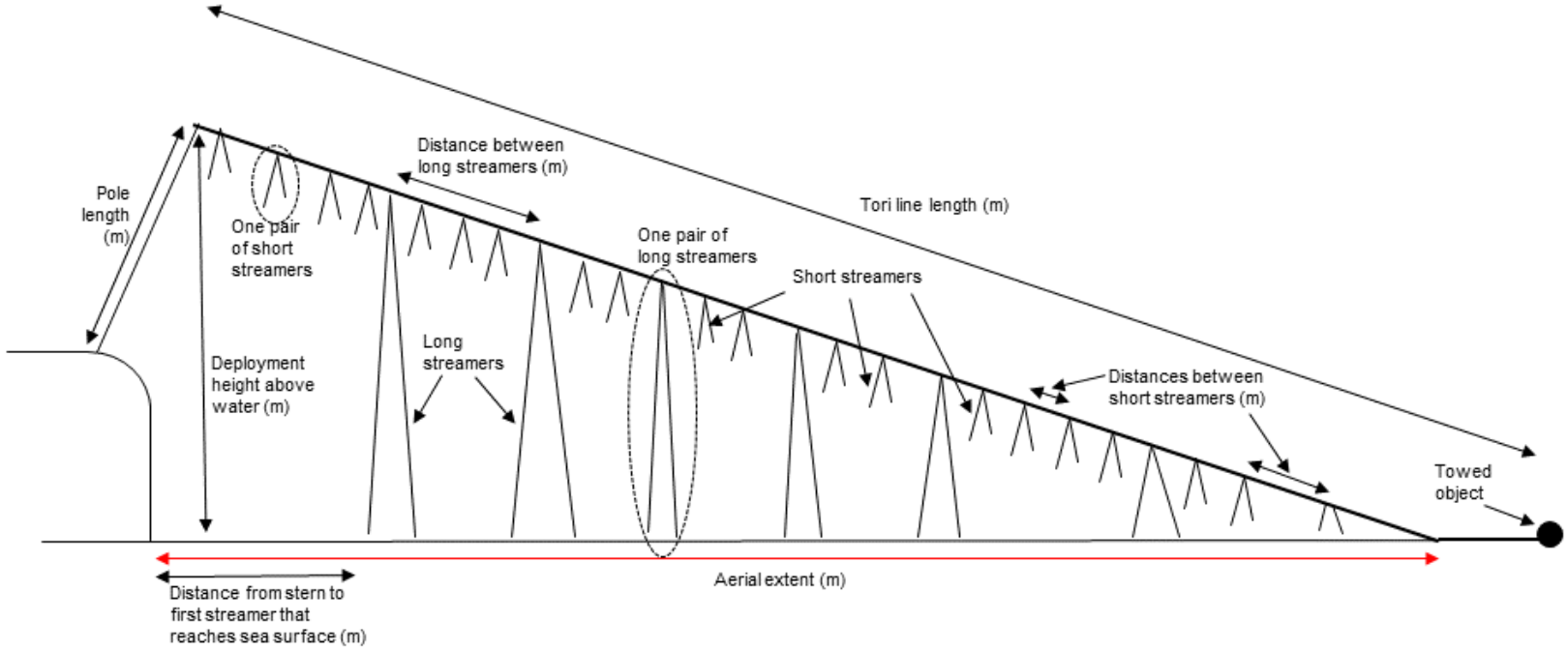


Figure 1. Example tori line showing dimensions to be measured and components to be described

Longline Tori Line Details Form, 30 October 2014

Figure 2: (cont.) Illustration of proposed fields for the collection of information describing tori lines deployed from longline vessels. (Back side).

observers are requested to draw a diagram where the example design does not match what they see, to facilitate an understanding of the nature of the devices used. Codes used to describe materials with which the device is constructed could be drawn from those already available (e.g., as used on the existing Tori Line Details Form, Bird Baffler Details Form, and Warp Scarer Details Form (Sanders & Fisher 2010)). Similar to the approach proposed to document mitigation used at the set, recording additional mitigation measures used at hauling is recommended on a revised version Haul Event Log (discussed in more detail below).

Separate setting logs for surface and bottom longline fisheries are presented in the MPI draft July 2014 forms. This facilitates clarity as most, but not all, field are shared between these forms. Some data collected on longline setting logs is not related to protected species interactions with fishing gear. Proposed revisions to these forms only encompass fields with relevance to protected species.

On the MPI draft July 2014 Surface Longline Setting Log (Figure 4), the addition of a"Vessel ID" field is recommended, for consistency with other forms. As noted above, fields relating to the set by set deployment of mitigation measures are also included. Including fields in which to record the deployment of "Other mitigation" is recommended. Observers would record when measures were deployed during a set and whether the deployment was for the entire set. Then, more detailed timing of deployments can be recorded on the Setting Event Log (or Longline Gear Form in the case of line-weighting in surface longline fisheries) as appropriate and as observer time and other duties allow. A revised version of the Surface Longline Setting Log is proposed (Figure 6). The addition of "Vessel ID" is also suggested for the MPI draft July 2014 Bottom Longline Setting Log, as are fields relating to the set by set deployment of mitigation measures (Figure 5). Other fields specific to the Bottom Longline Setting Log are the number of hooks observed and information on auto-baiting (Figure 7).

The Setting Event Log is common to both surface and bottom longline fisheries in the draft MPI July 2014 version of forms (Figure 8). This form provides the most detailed information on when mitigation measures were deployed during sets. The addition of a field for "Vessel ID" is proposed. Other suggested revisions include the addition of a column for the gear code of the tori line deployed, as taken from the Tori Line Details Form: Longline. This provides for observers to record deployment of tori lines for part of a set, or when the line deployed changed during a set. Adding a column for "Other mitigation" is recommended. This would be supported by the provision of a box for observers to add comments. Finally, a new column is recommended in which observers can record incidents of cryptic mortality, in accordance with protocols presented in Pierre et al. (2014b) (Figure 9). Note that observers may require more space to enter Photo Log references than is available on this form, and these could be added in the Comments box as needed.

In addition to the MPI draft July 2014 version of the Setting Event Log, a

Longline Brickle Curtain Details

Trip number | Brickle Curtain Gear Code | Vessel name | Vessel ID | Observer code

Fore pole

Fore pole length (m) .

Number of streamers	Distance between streamers (m)	Maximum streamer length (m)	Minimum streamer length (m)	Streamer material	Streamer colour	Streamers linked on water surface (Y/N)	Streamer linking material code
	.	.	.				

Distance between fore and aft poles (m) .

Aft pole

Aft pole length (m) .

Number of streamers	Distance between streamers (m)	Maximum streamer length (m)	Minimum streamer length (m)	Streamer material	Streamer colour	Streamers linked on water surface (Y/N)	Streamer linking material code
	.	.	.				

Backbone

Backbone present joining fore and aft poles? ✓ | Backbone diameter (mm) | Backbone material code

Number of streamers	Distance between streamers (m)	Maximum streamer length (m)	Minimum streamer length (m)	Streamer material	Streamer colour	Streamers linked on water surface (Y/N)	Streamer linking material code
	.	.	.				

Photo log numbers

Additional comments

Longline Brickle Curtain Details Form, 17 November 2014

Figure 3: Illustration of proposed fields for the collection of information describing Brickle curtains deployed from longline vessels. (Front side).

Instructions - Longline Brickle Curtain Details Form

1. Complete this form on the first haul of the trip, and then again each time modifications are made or a new Brickle curtain is deployed.
2. Give each Brickle curtain a Gear Code starting with "B1" for the first design deployed.
3. Complete cells describing the Brickle curtain in use on the vessel. Dimensions are shown in Figure 1.
4. If the arrangement on your vessel is significantly different to that in Figure 1, draw the design in the adjacent box.
5. Record any comments.

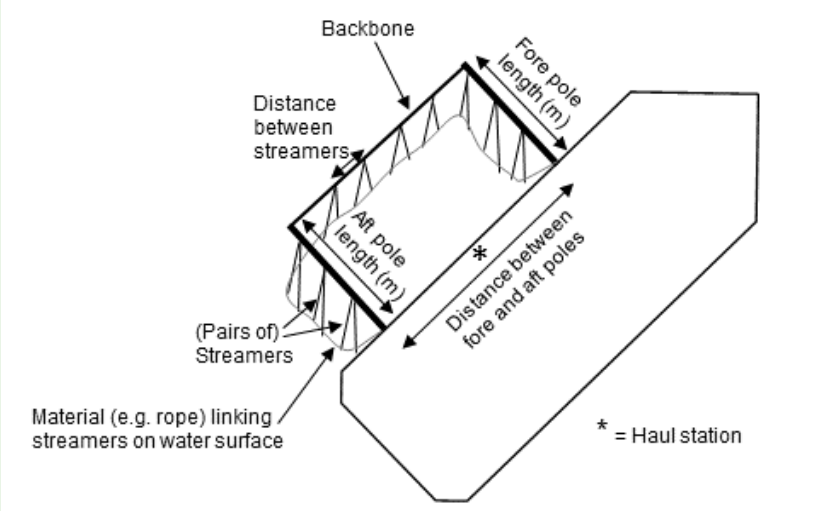


Figure 1. Example Brickle curtain showing dimensions to be measured and components to be described. Not to scale.

Streamer colour codes:

P = pink
R = red
C = carrot (orange)
Y = yellow
G = green
B = blue
W = brown
F = faded colour (any colour)
O = other

Streamer material codes

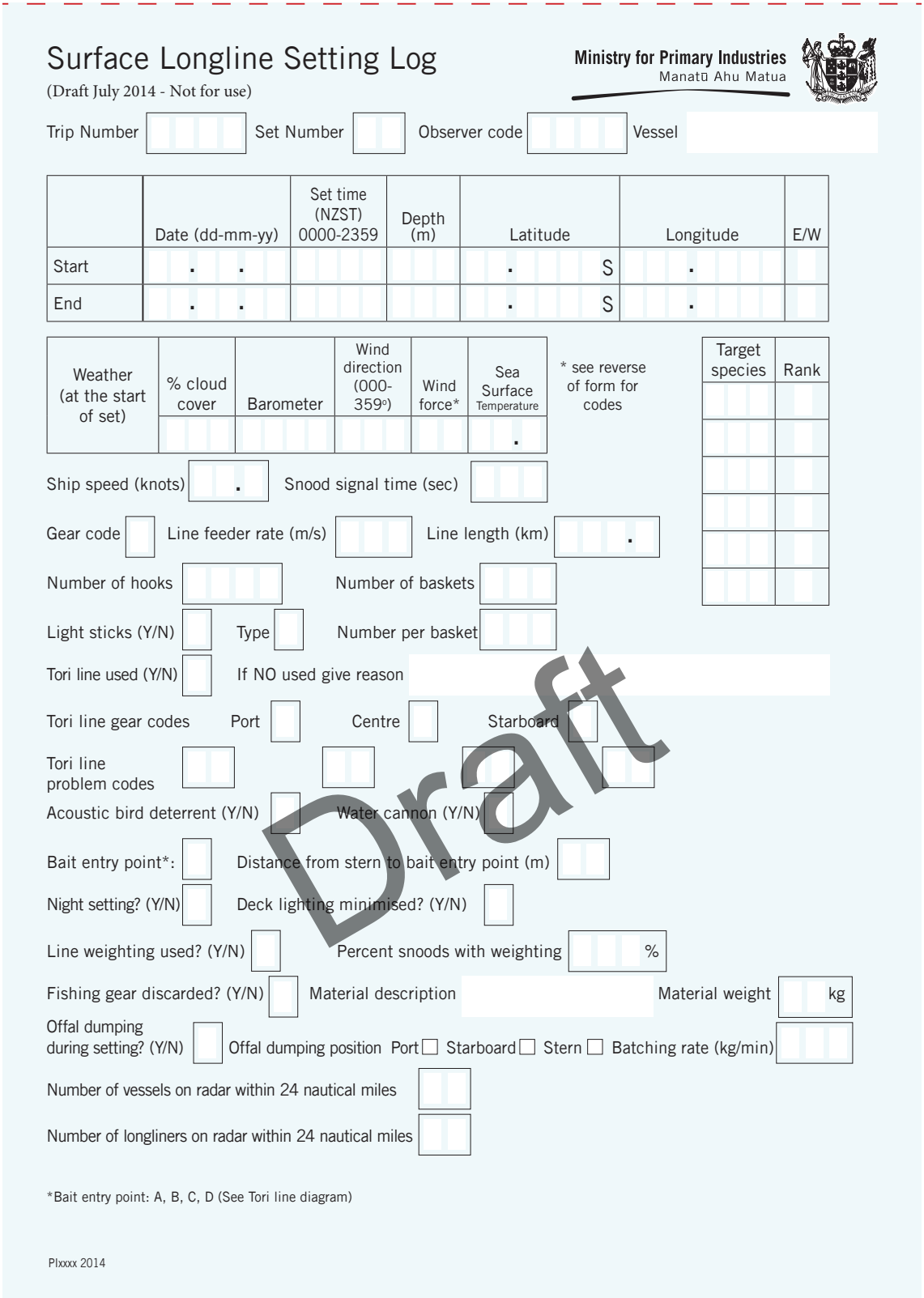
T = plastic tubing
S = plastic strapping
O = other

Diagram of brickle curtain on your vessel, if significantly different from Figure 1.

Additional comments

Longline Brickle Curtain Details Form, 17 November 2014

Figure 3: (cont.) Illustration of proposed fields for the collection of information describing Brickle curtains deployed from longline vessels. (Back side).



Surface Longline Setting Log

(Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Trip Number | Set Number | Observer code | Vessel

	Date (dd-mm-yy)	Set time (NZST) 0000-2359	Depth (m)	Latitude	Longitude	E/W
Start	. .			. S	.	
End	. .			. S	.	

Weather (at the start of set)	% cloud cover	Barometer	Wind direction (000-359°)	Wind force*	Sea Surface Temperature
					.

* see reverse of form for codes

Target species	Rank

Ship speed (knots) . | Snood signal time (sec)

Gear code | Line feeder rate (m/s) | Line length (km) .

Number of hooks | Number of baskets

Light sticks (Y/N) | Type | Number per basket

Tori line used (Y/N) | If NO used give reason

Tori line gear codes Port | Centre | Starboard

Tori line problem codes

Acoustic bird deterrent (Y/N) | Water cannon (Y/N)

Bait entry point*: | Distance from stern to bait entry point (m)

Night setting? (Y/N) | Deck lighting minimised? (Y/N)

Line weighting used? (Y/N) | Percent snoods with weighting %

Fishing gear discarded? (Y/N) | Material description | Material weight kg

Offal dumping during setting? (Y/N) | Offal dumping position Port ☐ Starboard ☐ Stern ☐ | Batching rate (kg/min)

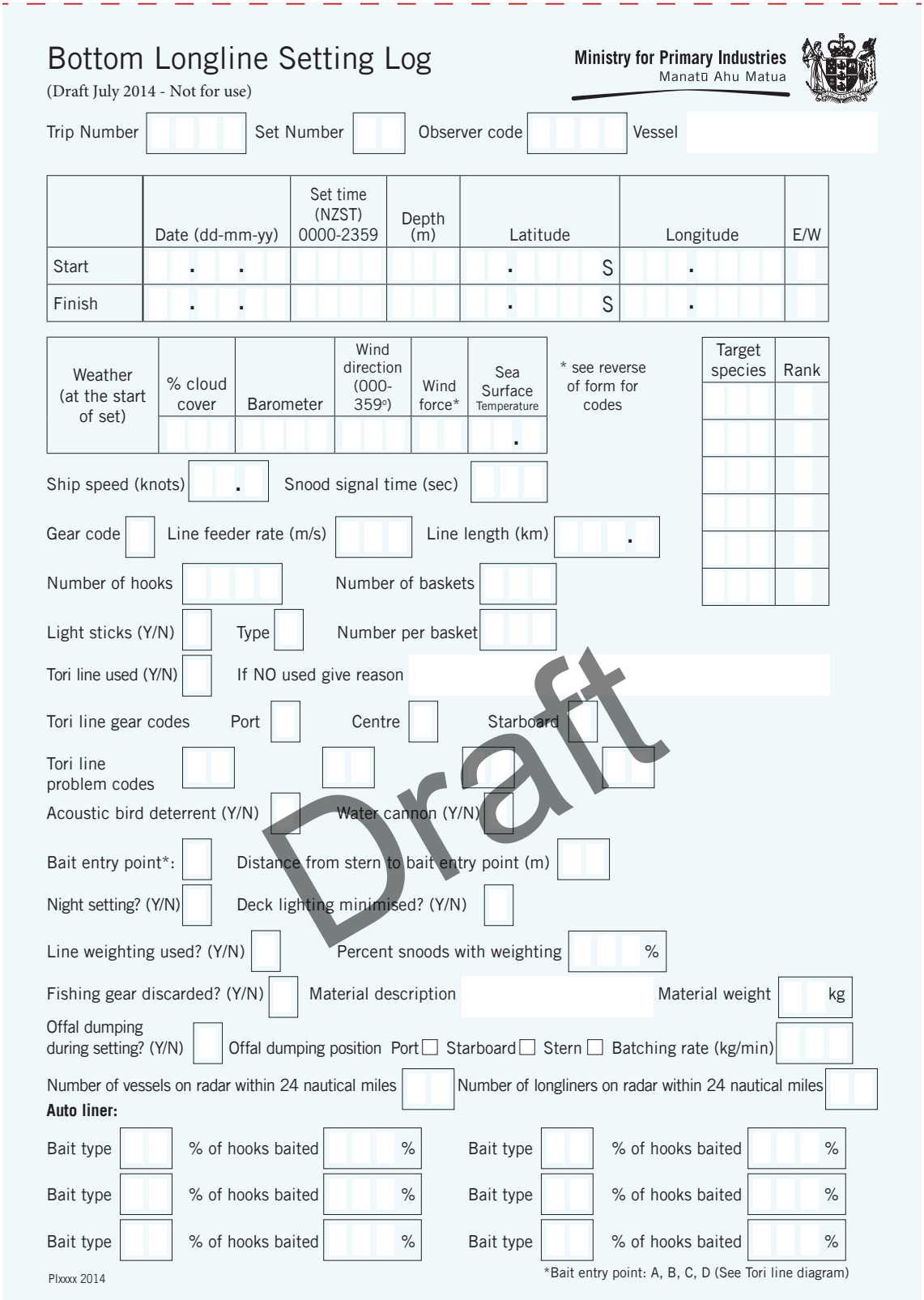
Number of vessels on radar within 24 nautical miles

Number of longliners on radar within 24 nautical miles

*Bait entry point: A, B, C, D (See Tori line diagram)

PIxxxx 2014

Figure 4: Draft Ministry for Primary Industries' Surface Longline Setting Log, July 2014.



Bottom Longline Setting Log

(Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Trip Number | Set Number | Observer code | Vessel

	Date (dd-mm-yy)	Set time (NZST) 0000-2359	Depth (m)	Latitude	Longitude	E/W
Start	. .			. S	.	
Finish	. .			. S	.	

Weather (at the start of set)	% cloud cover	Barometer	Wind direction (000-359°)	Wind force*	Sea Surface Temperature
					.

* see reverse of form for codes

Target species	Rank

Ship speed (knots) . | Snood signal time (sec)

Gear code | Line feeder rate (m/s) | Line length (km) .

Number of hooks | Number of baskets

Light sticks (Y/N) | Type | Number per basket

Tori line used (Y/N) | If NO used give reason

Tori line gear codes Port | Centre | Starboard

Tori line problem codes

Acoustic bird deterrent (Y/N) | Water cannon (Y/N)

Bait entry point*: | Distance from stern to bait entry point (m)

Night setting? (Y/N) | Deck lighting minimised? (Y/N)

Line weighting used? (Y/N) | Percent snoods with weighting %

Fishing gear discarded? (Y/N) | Material description | Material weight kg

Offal dumping during setting? (Y/N) | Offal dumping position Port ☐ Starboard ☐ Stern ☐ | Batching rate (kg/min)

Number of vessels on radar within 24 nautical miles | Number of longliners on radar within 24 nautical miles

Auto liner:

Bait type | % of hooks baited % | Bait type | % of hooks baited %

Bait type | % of hooks baited % | Bait type | % of hooks baited %

Bait type | % of hooks baited % | Bait type | % of hooks baited %

PIxxxx 2014

*Bait entry point: A, B, C, D (See Tori line diagram)

Figure 5: Draft Ministry for Primary Industries' Bottom Longline Setting Log, July 2014.

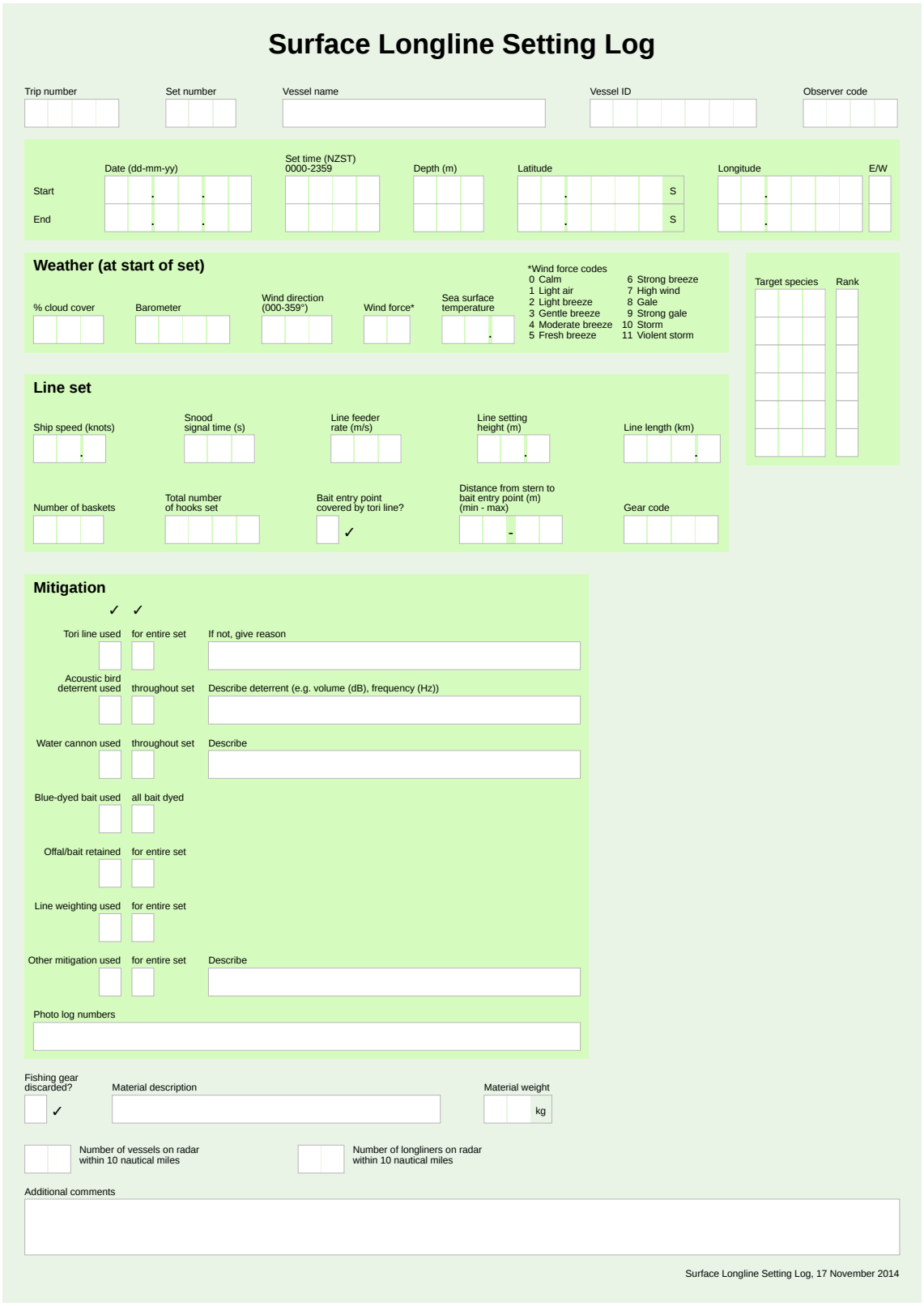


Figure 6: Illustration of proposed fields for a Surface Longline Setting Log.

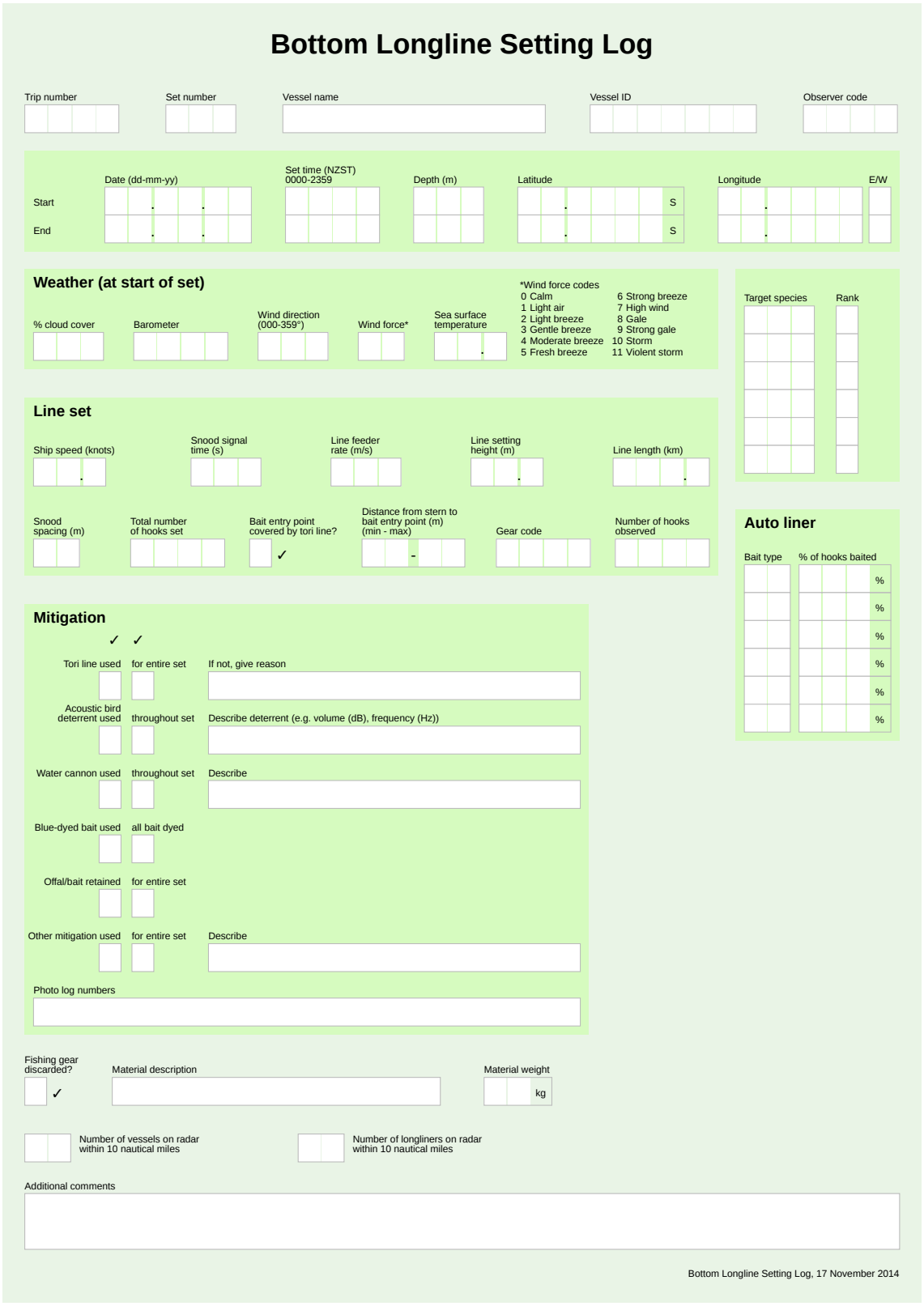


Figure 7: Illustration of proposed fields for a Bottom Longline Setting Log.

Setting Event Log (Draft July 2014 - Not for use)

Page   of

Observer   Vessel

1. Write the trip number   Set number

2. Event details

Start of Occurrence (NZST) 0000-2359	End of Occurrence (NZST) 0000-2359	Interruption Code	Offal dumping (kg)	Offal dumping position (Port/ Starboard/Stern)	Bait discarded (kg)	Bait dumping position (Port/ Starboard/Stern)	Type of Fishing gear discarded	Amount of gear discarded (kg)	Water cannon used (Y/N)	Acoustic bird scarer used (Y/N)	Photo log number
:	:										
:	:										
:	:										
:	:										
:	:										
:	:										
:	:										
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:	:										

Note: this is used to record events on the haul including start and stopping times for observers and gear interruptions

PIxxxx 2013

Figure 8: Draft Ministry for Primary Industries' Setting Event Log, July 2014.

Setting Event Log

Page ____ of ____

Trip number | Set number | Vessel name | Vessel ID | Observer code

Start of occurrence (NZST) 0000-2359	End of occurrence (NZST) 0000-2359	Interruption code	Offal dumping (kg)	Offal dumping position Port/Starboard /Stern/Other	Bait discarded (kg)	Bait dumping position Port/Starboard /Stern/Other	Type of fishing gear discarded	Water cannon used	Acoustic bird scarer used	Tori line gear code	Other mitigation	Photo log number	Cryptic mortality species and code (see back)
:	:												
:	:												
:	:												
:	:												
:	:												
:	:												
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:	:												

Additional comments

Setting Event Log, 17 November 2014

Figure 9: Illustration of proposed fields for a Setting Event Log.

Set and Haul Event Log was made available for review (Figure 10). It is recommended that this is restructured as a Hauling Event Log, and that the revised version follows a similar format to the Setting Event Log. A field recording Vessel ID could be added to the form. Further, including fields in which observers record whether they observed the entire haul, and the number of hooks observed, is recommended. The addition of a column for the gear code of the Brickle curtain deployed, as taken from the Brickle Curtain Details Form: Longline is recommended (Figure 11). This provides for observers to record deployment of Brickle curtains for part of a set, or when the curtain configuration changes during a set. Alternatively, as a Brickle curtain would only be expected in bottom longline fisheries, an "Other mitigation" column could be used and linked to a set of codes including one for the Brickle curtain, or a comments box. Note that observers may require more space to enter Photo Log references than is available on this form. Additional numbers could be added in the Comments box as needed. As for the Setting Event Log, a new column is added in which observers can record incidents of cryptic mortality in accordance with the protocols developed by Pierre et al. (2014b).

Between the Surface Longline Setting Log, the Bottom Longline Setting Log, the Setting Event Log, and the Hauling Event Log, data collected describing the mitigation measures in use is aligned with international best practice approaches for longline fisheries (Dietrich et al. 2007). Further, the information on these forms will allow the comparison of observed operations with the requirements of regulations relating to the use of mitigation measures (New Zealand Government 2010b, 2014).

In addition to a form recording information on events occurring during hauling, an Hourly Haul Log provides a snapshot of activity and may be especially important when observers are unable to monitor entire hauls. The draft Hourly Haul Log (Figure 12) developed by MPI provides for observers to identify when, at some point during the haul, mitigation measures were deployed or fish waste was dumped. With no reference to when during the haul mitigation was used, the utility of these observations is limited. Therefore, identifying points in time when mitigation strategies are in use during hourly haul observations is recommended. Note that the start and end of time periods during which mitigation strategies were observed to be in use would be recorded on the Hauling Event Log when possible. In the absence of a continuous record, the snapshots documented on the Hourly Haul Log will help indicate whether mitigation was in use consistently through time or not. A revised version of the Hourly Haul Log form is proposed (Figure 13).

The MPI draft July 2014 Snood and Bait Log (Figure 14) is the appropriate form on which to record the use of lightsticks. Lightsticks may affect the capture of marine turtles on longline gear (Wang et al. 2007, Gless et al. 2008). These can also slow the sink rate of snoods (Pierre and Goad, in prep.) and therefore may affect the risk longline snoods present to seabirds. In addition, information about the deployment of dyed bait could be recorded with other bait characteristics. Deploying blue-dyed bait is intended to

Set and Haul Event Log (Draft July 2014 - Not for use)

Page ___ of ___

Observer Code ☐☐☐☐ Vessel ____________________

1. Write the trip number ☐☐☐☐ Set number ☐☐

2. Event details

Start of Occurrence (HH:MM)	Time landed 24 hr clock (HH:MM)	Haul or Set (H/S)	Interruption Code	Offal dumping (kg)	Offal dumping position (Port/ Starboard/Stern)	Bait discarded (kg)	Bait dumping position (Port/ Starboard/Stern)	Type of Fishing gear discarded	Amount of gear discarded (kg)	Mitigation Events (W – Water Cannon; A – Acoustic Bird Scarer	Photo log number
:	:										
:	:										
:	:										
:	:										
:	:										
:	:										
:	:										
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:	:										

Note: this is used to record events on the haul including start and stopping times for observers and gear interruptions

PIxxxx 2013

Figure 10: Draft Ministry for Primary Industries Set and Haul Event Log, July 2014.

Hauling Event Log

Page ____ of ____

Trip number | Set number | Vessel name | Vessel ID | Observer code | Entire haul observed (✓) | Number of hooks observed*

Start of occurrence (NZST) 0000-2359	End of occurrence (NZST) 0000-2359	Interruption code	Offal dumping (kg)	Offal dumping position Port/Starboard /Stern/Other	Bait discarded (kg)	Bait dumping position Port/Starboard /Stern/Other	Type of fishing gear discarded	Water cannon used	Acoustic bird scarer used	Brickle curtain gear code*	Other mitigation	Photo log number	Cryptic mortality species and code (see back)
:	:												
:	:												
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:	:												
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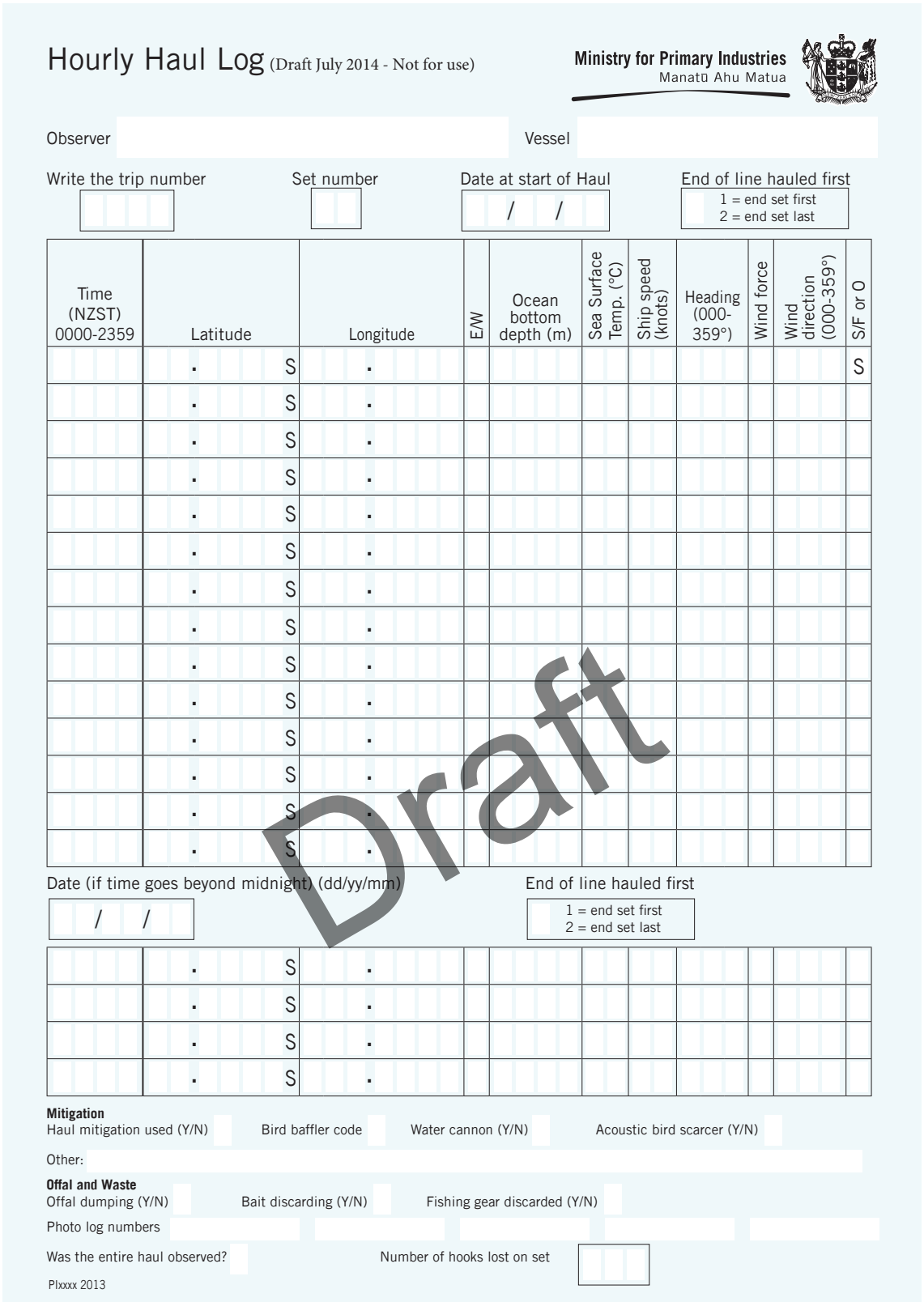
:	:												

*Bottom longline only

Additional comments

Hauling Event Log, 17 November 2014

Figure 11: Illustration of proposed fields for a Haul Event Log.



Hourly Haul Log (Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Observer

Vessel

Write the trip number

Set number

Date at start of Haul / /

End of line hauled first
1 = end set first
2 = end set last

Time (NZST) 0000-2359	Latitude	Longitude	E/W	Ocean bottom depth (m)	Sea Surface Temp. (°C)	Ship speed (knots)	Heading (000-359°)	Wind force	Wind direction (000-359°)	S/F or O
	. S	.								S
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								
	. S	.								

Date (if time goes beyond midnight) (dd/yy/mm) / /

End of line hauled first
1 = end set first
2 = end set last

	. S	.								
	. S	.								
	. S	.								
	. S	.								

Draft

Mitigation
Haul mitigation used (Y/N) Bird baffler code Water cannon (Y/N) Acoustic bird scarcer (Y/N)

Other:

Offal and Waste
Offal dumping (Y/N) Bait discarding (Y/N) Fishing gear discarded (Y/N)

Photo log numbers

Was the entire haul observed? Number of hooks lost on set

PIxxxx 2013

Figure 12: Draft Ministry for Primary Industries Hourly Haul Log, July 2014.

Hourly Haul Log

Trip number | Set number | Vessel name | Vessel ID | Observer code | Date at start of haul (DD/MM/YY) / / | End of line hauled first (1 = end set first, 2 = end set last)

Time (NZST) 0000-2359	Latitude		Longitude	E/W	Ocean bottom depth (m)	Sea surface temp (°C)	Ship speed (knots)	Heading (000-359°)	Wind force	Wind direction (000-359°)	S/F or O	Offal dumping (Y/N)	Offal dumping position Port/Starboard /Stern/Other	Fishing gear discarded (Y/N)	Brickle curtain gear code	Water cannon in use (Y/N)	Acoustic bird scarer in use (Y/N)	Other mitigation in use (Y/N)	Photo log number	Comments
:	.	S	.								S									
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	

Date (if time goes beyond midnight) (DD/MM/YY) / /

:	.	S	.																	
:	.	S	.																	
:	.	S	.																	
:	.	S	.																	

Hourly Haul Log, 17 November 2014

Figure 13: Illustration of proposed fields for an Hourly Haul Log.

camouflage bait in longline fisheries, and thereby reduce seabird captures (Pierre et al. 2013, Cocking et al. 2008). Suggested revisions to the MPI draft July 2014 Snood and Bait Log include adding extra columns such that the snood-by-snood deployment of lightsticks and dyed bait can be recorded. A box could also be added on the form to record the colour of dyed baits. Collecting additional details on weight deployment is also recommended (Figure 15).

Draft forms recording the dimensions of surface and bottom longline gear were produced by MPI in July 2014 (Figure 16, Figure 17). Given the differences between surface and bottom longline gear, developing two gear forms, one for each type of longline, is warranted. The MPI draft July 2014 surface longline form (Figure 16) provides a partial description of the components of surface longline gear that are relevant to protected species interactions. Streamlining data collection on the longline gear forms and the Setting Logs is recommended. For example, line setting height seems more appropriately located on the Setting Logs. Also, revised forms should encompass only the gear components appropriate to the respective longline method. (For example, removing the reference to integrated weight gear on the MPI draft July Surface Longline Gear Form is recommended). Proposed revised forms are attached at Figure 18 and Figure 19.

In the past, observers deployed in longline fisheries were tasked with completing a CSP Longline Fisheries form (Table 2). This form documented data elements including vessel and gear information, described the fishing operation, summarised protected species bycatch and factors that may have contributed to it (e.g., fish waste discharge) and listed specimens retained for onshore analysis. With the revised longline forms being considered by MPI with DOC, issuing the CSP Longline Fisheries form to observers is no longer necessary.

Trawl fishery forms: The Trawl Catch Effort Logbook provides for an extensive and detailed compilation of information describing trawl operations and catch (Table 2). To facilitate the linking of observer and fisher records, the trawl catch effort logbook could include the corresponding numbers of fisher-completed catch effort forms, as is currently the case for setnet and purse seine catch effort forms, and is under consideration for revised longline catch effort forms (S. Brouwer, pers. comm.).

In terms of describing risk factors for protected species interactions, an additional category to describe fish waste discharge practices is recommended in the Trawl Catch Effort Logbook. This would be added to each of sections of the Logbook identified as 1: Shooting, 2: During Tow and 3: Hauling. Existing codes record offal and whole fish discharge. Additional codes capturing the batch discharge of offal and the batch discharge of whole fish would be informative. A "batch" would be defined as a quantity of offal (or discards) that have been deliberately collected for simultaneous discharge. Batch discharge is a recommended discharge method for offshore trawlers in accordance with Vessel Management Plans (VMPs) (**J. Cleal**, **pers. comm.**, Deepwater Group Ltd 2009). It is also the waste discharge method that reduces seabird attendance at trawl vessels

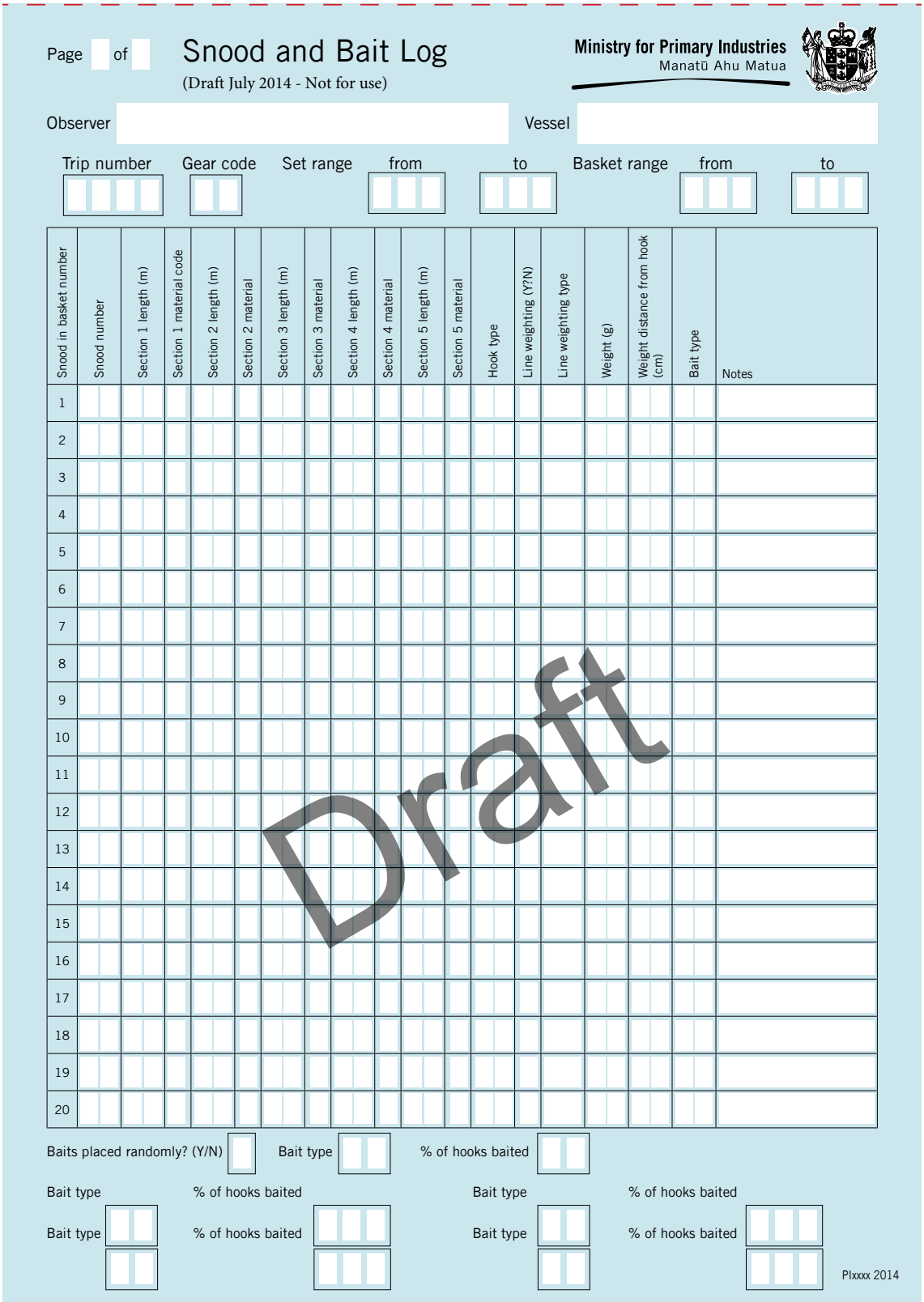


Figure 14: Draft Ministry for Primary Industries Snood and Bait Log, July 2014.

Page [ ] of [ ]

Snood and Bait Log

Trip number [ ]

Set range [ ] to [ ]

Basket range [ ] to [ ]

Vessel name [ ]

Vessel ID [ ]

Observer code [ ]

Snood in basket number	Snood number	Section 1 length (m)	Section 1 material code	Section 2 length (m)	Section 2 material	Section 3 length (m)	Section 3 material	Section 4 length (m)	Section 4 material	Section 5 length (m)	Section 5 material	Hook type	Location of weights on gear H = Hook C = Clip S = Snood	Hook weighting type	Hook weight (g)	Clip weighting type	Clip weight (g)	Snood weighting type	Snood weight (g)	Weight distance from hook (cm)	Bait type	Lightstick (Y/N)	Bait dyed (Y/N)	Notes
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2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
18																								

Baits placed randomly? [ ] ✓

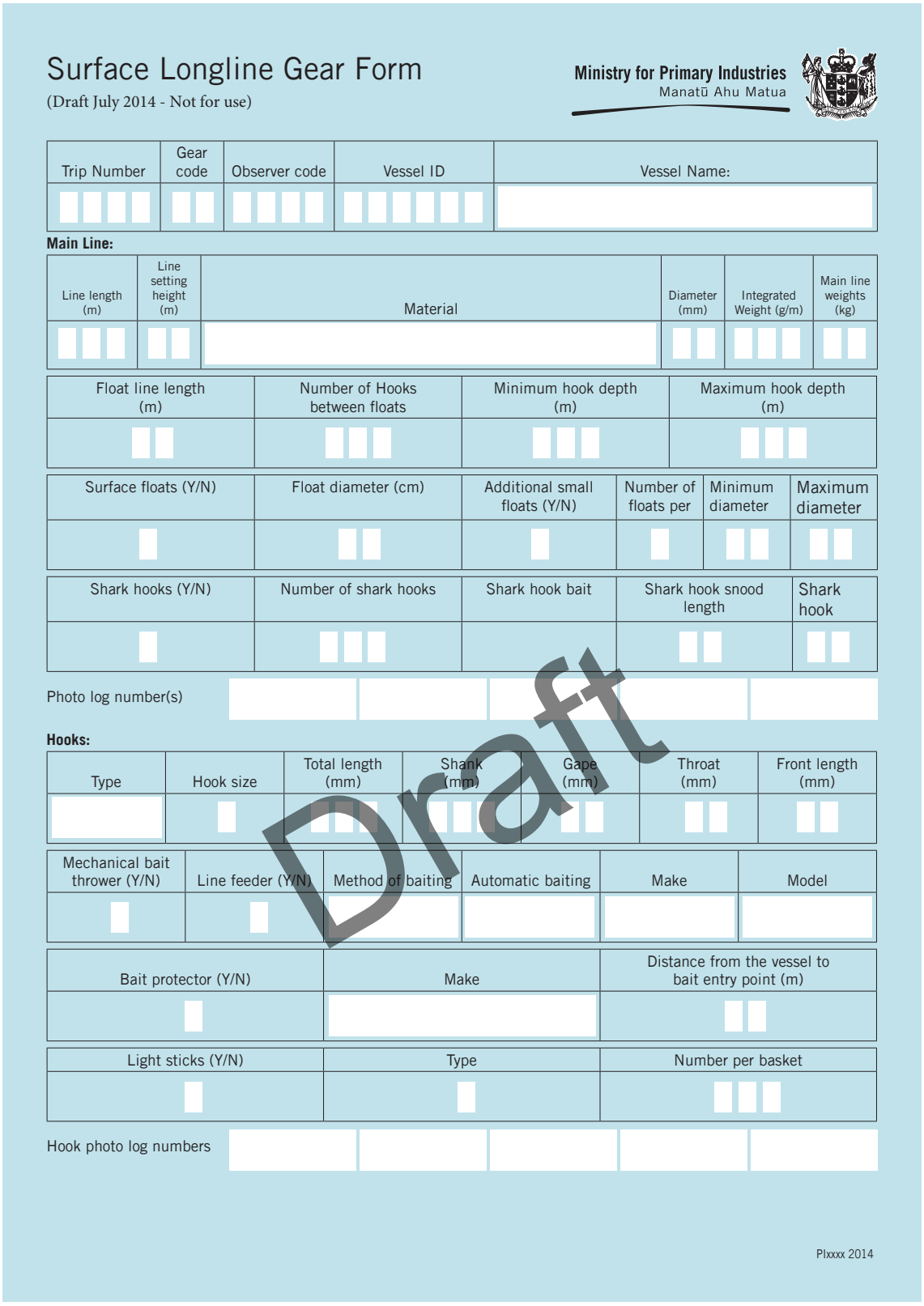
Bait type	% of hooks baited	Colour of dyed bait
	%	
	%	

Bait type	% of hooks baited	Colour of dyed bait
	%	
	%	

Bait type	% of hooks baited	Colour of dyed bait
	%	
	%	

Snood and Bait Log, 17 November 2014

Figure 15: Illustration of proposed fields for a Snood and Bait Log.



Surface Longline Gear Form

(Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Trip Number	Gear code	Observer code	Vessel ID	Vessel Name:

Main Line:

Line length (m)	Line setting height (m)	Material	Diameter (mm)	Integrated Weight (g/m)	Main line weights (kg)

Float line length (m)	Number of Hooks between floats	Minimum hook depth (m)	Maximum hook depth (m)

Surface floats (Y/N)	Float diameter (cm)	Additional small floats (Y/N)	Number of floats per	Minimum diameter	Maximum diameter

Shark hooks (Y/N)	Number of shark hooks	Shark hook bait	Shark hook snood length	Shark hook

Photo log number(s)

Hooks:

Type	Hook size	Total length (mm)	Shank (mm)	Gape (mm)	Throat (mm)	Front length (mm)

Mechanical bait thrower (Y/N)	Line feeder (Y/N)	Method of baiting	Automatic baiting	Make	Model

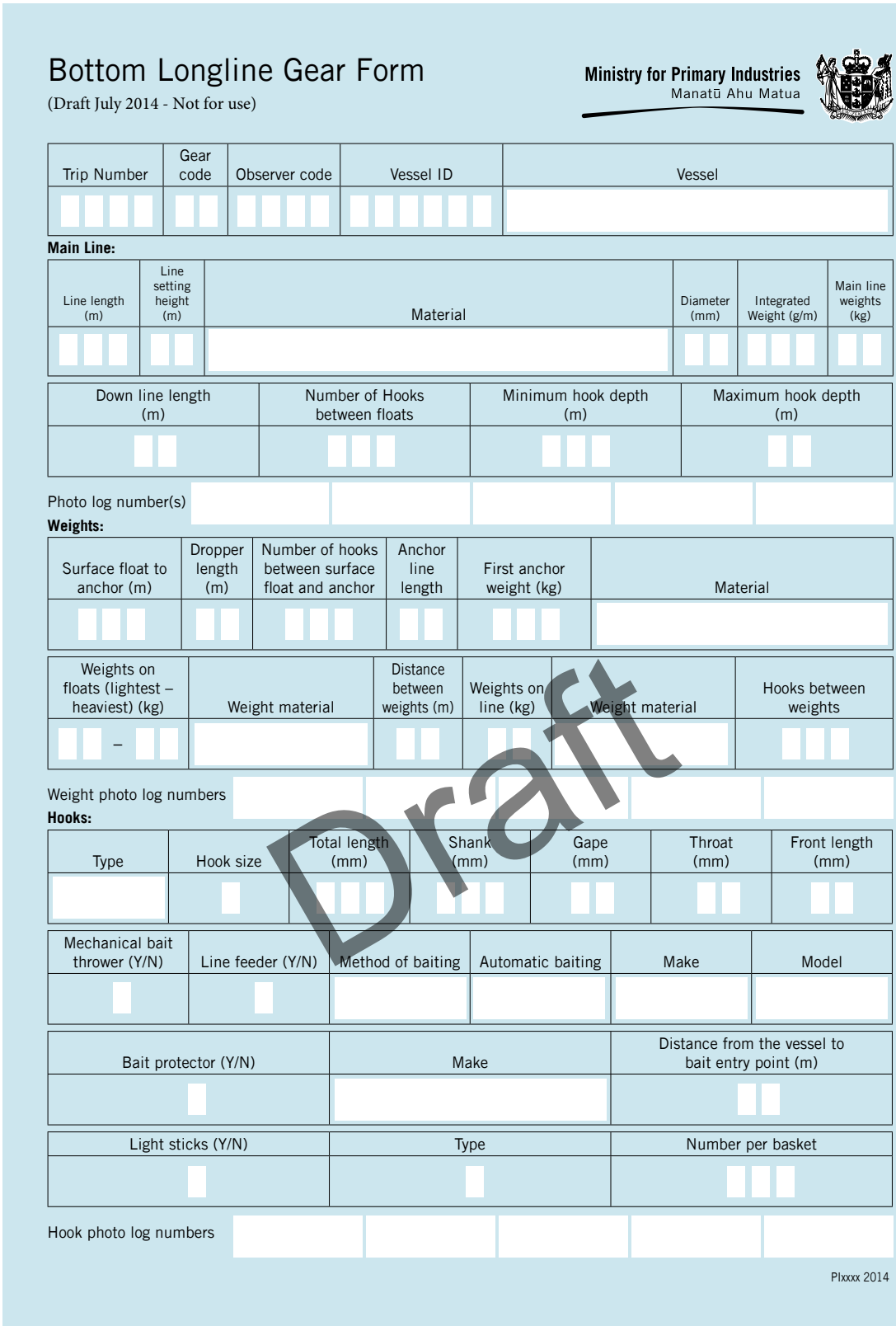
Bait protector (Y/N)	Make	Distance from the vessel to bait entry point (m)

Light sticks (Y/N)	Type	Number per basket

Hook photo log numbers

PIxxxx 2014

Figure 16: Draft Ministry for Primary Industries Surface Longline Gear Form, July 2014.



Bottom Longline Gear Form

(Draft July 2014 - Not for use)

Ministry for Primary Industries
Manatū Ahu Matua

Trip Number	Gear code	Observer code	Vessel ID	Vessel

Main Line:

Line length (m)	Line setting height (m)	Material	Diameter (mm)	Integrated Weight (g/m)	Main line weights (kg)

Down line length (m)	Number of Hooks between floats	Minimum hook depth (m)	Maximum hook depth (m)

Photo log number(s)

Weights:

Surface float to anchor (m)	Dropper length (m)	Number of hooks between surface float and anchor	Anchor line length	First anchor weight (kg)	Material

Weights on floats (lightest – heaviest) (kg)	Weight material	Distance between weights (m)	Weights on line (kg)	Weight material	Hooks between weights
–					

Weight photo log numbers

Hooks:

Type	Hook size	Total length (mm)	Shank (mm)	Gape (mm)	Throat (mm)	Front length (mm)

Mechanical bait thrower (Y/N)	Line feeder (Y/N)	Method of baiting	Automatic baiting	Make	Model

Bait protector (Y/N)	Make	Distance from the vessel to bait entry point (m)

Light sticks (Y/N)	Type	Number per basket

Hook photo log numbers

PIxxxx 2014

Figure 17: Draft Ministry for Primary Industries Bottom Longline Gear Form, July 2014.

Surface Longline Gear Form

Trip number | Vessel name | Vessel ID | Observer name

Gear code | Number of baskets examined | Drop line length (m) | First anchor line length (m)

Mainline:

Mainline diameter (mm) | Material code | All baskets approximately same length (y/n) | Mainline length per basket (m)

Weights:

Weight attached at the clip (y/n) | Weight (g)

Floats:

Surface "marker" float diameter (mm) | Distance surface float to mainline (m)

Subsurface floats used:

✓

Subsurface float diameter (mm) Min Max

Number of subsurface floats per basket Min Max

Length of float ropes on subsurface floats (m) Min Max

Number of hooks between subsurface floats OR subsurface float and the nearest float of any other kind Min Max

Hooks on drop lines:

Number of drop lines with hooks attached | Type of hooks on drop lines

Number of hooks on drop lines Min Max

Hooks on snoods:

Number of hooks per basket | Hook type on snoods | Hook size on snoods

Total length (mm) | Shank (mm) | Gape (mm) | Throat (mm) | Front length (mm)

Mechanical bait thrower:

✓

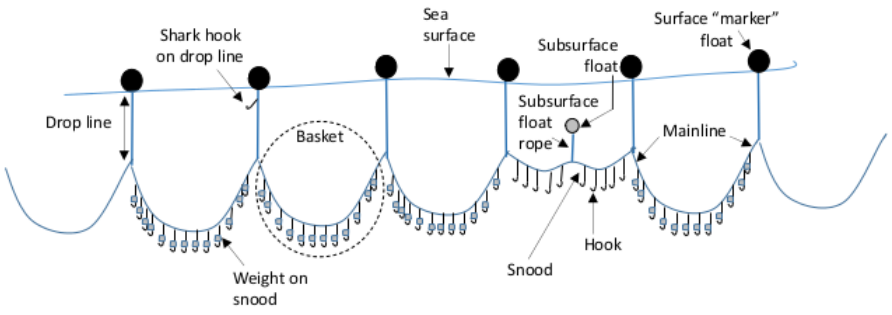
Automatic baiting:

✓ Make and model of autobaiter

Bait protector used:

✓ Make and model of bait protector

Photo log numbers



Surface Longline Gear Form, 28 October 2014

Figure 18: Illustration of proposed fields for a Surface Longline Gear Form.

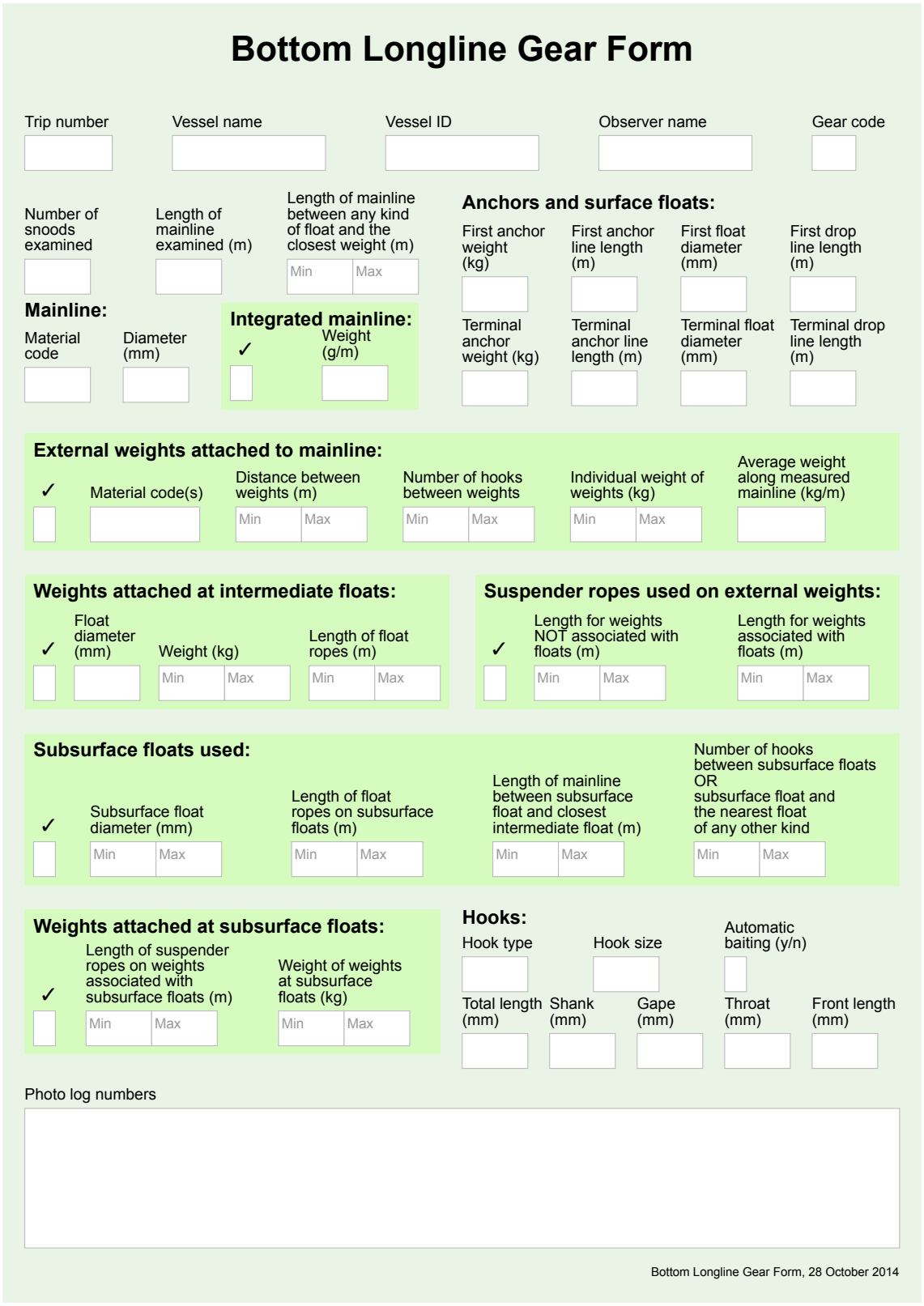


Figure 19: Illustration of proposed fields for a Bottom Longline Gear Form.

most consistently (e.g., compared to *ad hoc* continuous discharge or mincing waste prior to discharge) (Pierre et al. 2012a). Codes for continuous discharge and minced discharge could also be added. (Note that some trip-level information on discharge practices is recorded on a form completed by observers that is intended to document the implementation of VMPs. However, information collected on this form is not currently entered into COD, and therefore is not readily available to data users over time).

Section 6 of the Trawl Catch Effort Logbook provides a space for entering mitigation equipment codes. Currently, codes for mitigation devices such as bird bafflers and sea lion exclusion devices are available for this field. Adding codes for net restrictors (new on some scampi gear in 2013, (Pierre et al. 2012b)) and dolphin dissuasive devices (DDDs) is recommended. The use of DDDs has been recorded in the comments field of the Trawl Gear Details Form. Deployment of restrictors has also been recorded in the comments field of that form, as well as recorded as a comment in the Trip Diary (which renders this information inaccessible through database searches). In addition, if designs of warp strike reduction devices (Ramm 2012) become more standardised in inshore fisheries in future, additional codes identifying these devices may be necessary to enable observers to efficiently complete section 6 of the Trawl Catch Effort Logbook.

Observer comments on the Trawl Gear Details Form extracted from COD included detailed descriptions of gear elements and deployments. Comments tended to be specific rather than with commonalities and consequently do not support the need for additional changes to the Form.

Seabird warp strike information was collected in trawl fisheries from 2000–2009. Protocols used to structure warp strike observations were formalised in 2005 and observations conducted since January 2005 then have been included in COD (Sanders & Fisher 2010). Where the efficacy of trawl warp strike mitigation devices is unknown, tasking observers with conducting warp strike observations is recommended (when these observations can be undertaken safely). Examples of key knowledge gaps that could be filled by warp strike observations include assessing of the efficacy of two-boom compared to four-boom bird bafflers, and determining the efficacy of inshore warp strike mitigation devices (Cleal et al. 2013, Conservation Services Programme 2013a). The current protocols and forms for inshore and offshore trawl fisheries enable such data collection to occur. Note however that for inshore fisheries, the current protocol does not provide data allowing the estimation of representative warp strike rates. This is because the protocol tasks observers with making observations of the trawl warp seabirds are expected to interact with most frequently due to offal discharge patterns. When data collection protocols are intended to assess the efficacy of mitigation devices, using such "worst-case scenario" contexts is not uncommon (Melvin et al. 2013).

Internationally, warp strike monitoring protocols include an assessment of the fate of the seabird interacting with the trawl warp, e.g., in Australian and Falkland Island trawl fisheries (Falkland Islands Fisheries Department 2011, Pierre et al. 2014a). The protocol and Mitigation Assessment Worksheet

used to document seabird strikes on trawl warps in inshore fisheries includes an assessment of the status of the seabird after the strike. However, the current protocol for New Zealand offshore fisheries does not require observers to assess the fate of struck seabirds (Sanders & Fisher 2010). Recording the outcome of warp strikes categorically is recommended, in terms of whether aerial warp strikes resulted in birds losing control of their flight and hitting the water, or whether seabirds on the sea surface struck by trawl warps were pushed underwater. These outcomes are broadly aligned with international approaches to documenting the outcomes of warp strikes and would contribute to work on cryptic mortalities of seabirds in trawl fisheries (Pierre et al. 2014b).

In addition, the inshore Mitigation Assessment Warp Strike Form includes the documentation of haul observations recorded as seabird abundance and activity around the codend. Seabird mortalities due to captures in trawl nets are a key component of bycatch in New Zealand offshore trawl fisheries (Abraham et al. 2013). However, the risk factors associated with these captures are not well documented. Previous attempts to implement observer protocols to explore seabird captures at hauling in offshore and inshore trawl fisheries were unsuccessful due to the extent of other observer duties and safety concerns (A. Martin, pers. comm.).

Observer comments support changes to two forms completed in trawl fisheries that document the specifications of mitigation devices. Comments on the Tori Line Details Form extracted from COD focused on detailing the dimensions, materials, colours and states of repair of streamers. Tori line attachment locations were also highlighted. Based on observer comments, one amendment to this form is recommended. Tori lines will often incorporate streamers of varying age and states of repair. Tasking observers with recording the number streamers that reached the sea surface and the minimum and maximum distances between streamers that reached the sea surface would be informative in terms of the expected performance of tori lines (as well as their design relative to legal specifications (New Zealand Government 2010a)). Photographic Log frame numbers also featured in the comments observers recorded on Tori Line Details Forms. As described for the Photographic Log, storing photos with trip and frame numbers included would increase their accessibility and usability once the observed trip is complete. Second, comments recovered from COD on the Observer SLED Details Form included details on SLED deployments, construction (e.g., materials used for the kite), floats and photo log frame references. The current form provides for observers to record the number of floats on the hood of SLEDs, but not elsewhere. Dimensions and spacing of floats are not recorded on the current form and may relate to SLED performance and efficacy. Recording additional information on floats (numbers and placement in locations additional to the hood, colour, spacing, and size) would improve characterisation of SLEDs overall.

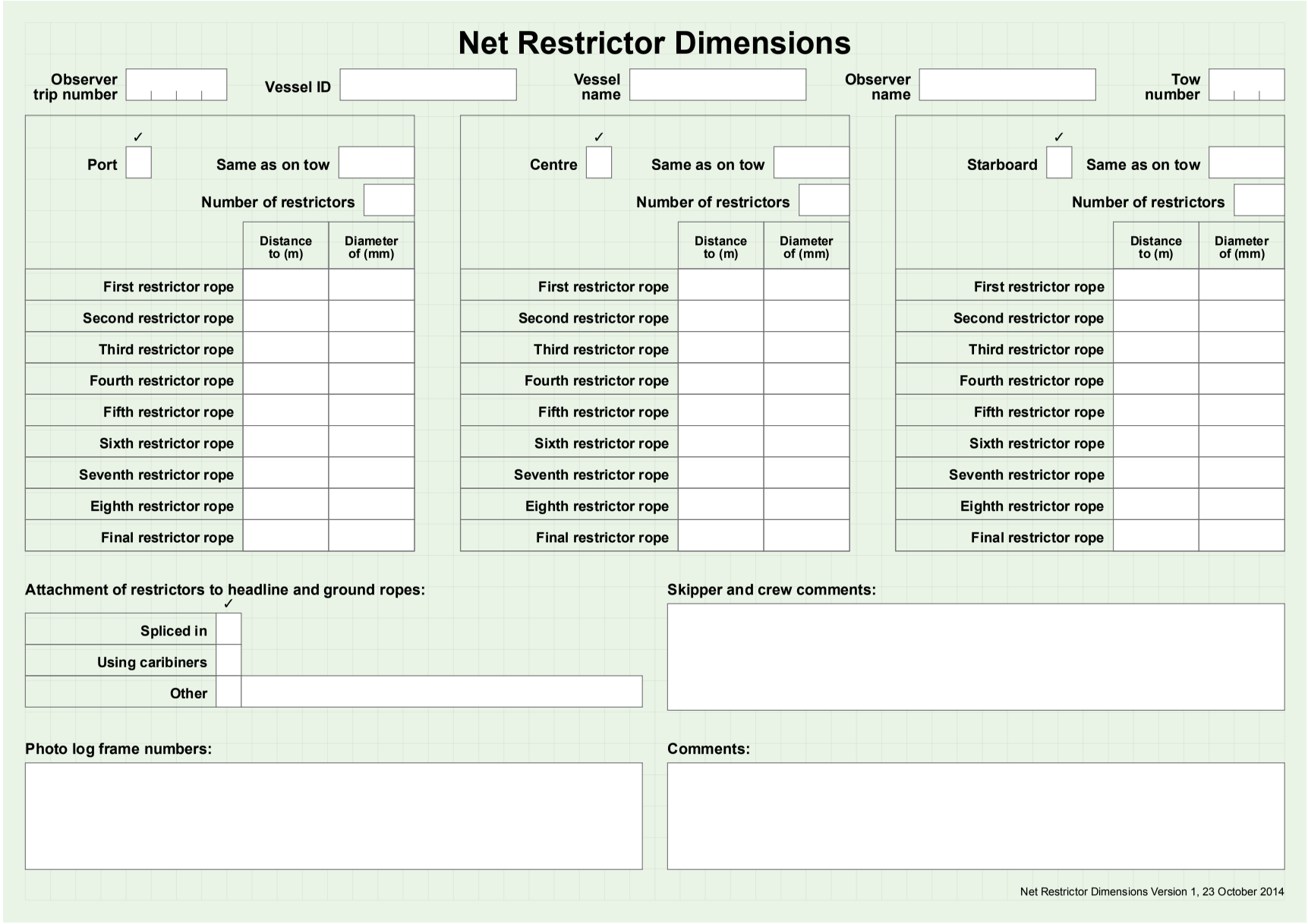
No changes are recommended to the Bird Baffler Details Form and the Warp Scarer Details Form currently deployed in trawl fisheries. Observer comments on the Bird Baffler Details Form were predominantly focused

on clarifying the structure and construction of bird bafflers and how dimensions were ascertained. The Form includes fields to record the latter. Given the diversity of designs used and comments recorded, creating or amending fields is unlikely to increase the quality or efficiency of data collection by this form. Observer comments on the Warp Scarer Details Form focused on construction details specific to the warp scarers assessed, and common threads were absent.

In addition to the amendments above for forms completed by observers working in New Zealand trawl fisheries, creating new forms to document the measurements of net restrictors deployed in the scampi fishery and interactions of seabirds with these restrictors is recommended (Pierre et al. 2012b) (Figure 20, Figure 21). Note that if desired, information on the at-sea testing of restrictors could be incorporated on the current Non-fish Bycatch Form (NFBC), with the development of additional codes for seabird capture location. It is recommended that this change be considered when the NFBC is next up for review.

Purse seine fishery forms: Currently observers complete two forms to describe purse seine fishing activities: the Vessel Activity Log and the Purse Seine Catch Effort Set Details forms (Table 2) (Sanders & Fisher 2010). Some information about the gear deployed is recorded in the Purse Seine Trip Report, e.g., net length and the number of panels. Gear specifications may relate to protected species captures (e.g., protected rays (Jones & Francis 2012)) and recording them with vessel activity information would be efficient. A small number of additional fields is required to describe key characteristics of the gear (Indian Ocean Tuna Commission 2010a, Western and Central Pacific Fisheries Commission 2013) and a new form that records all gear information together is recommended. The gear form would be linked to the Purse Seine Vessel Activity Log using a gear code (Figure 22). Separating vessel activities and gear descriptions for the purse seine fishery is analogous to the approach taken for other fisheries (Sanders & Fisher 2010)). The Purse Seine Gear Form (Figure 23) would include the following fields:

- Maximum depth of net (m): to be obtained from onboard documentation or skipper/engineer
- Maximum length of net (m): to be obtained from onboard documentation or skipper/engineer
- Average stretched net mesh size (cm): to be measured in the main body of the net when the net is wet, from knot to knot of the stretched mesh. Measuring multiple mesh lengths is recommended; at least 10 measurements are recommended by Indian Ocean Tuna Commission (2010a). Multiple mesh measurements would be recorded in a series of new boxes on the back side of the proposed revised form, with an average included in the main body of the form.
- Average bunt mesh size (cm): The bunt is the area of the net in which the catch is accumulated. As for the mesh size in the main body of



Net Restrictor Dimensions

Observer trip number | Vessel ID | Vessel name | Observer name | Tow number

	Port ✓	Centre ✓	Starboard ✓
Same as on tow			
Number of restrictors			
	Distance to (m) / Diameter of (mm)	Distance to (m) / Diameter of (mm)	Distance to (m) / Diameter of (mm)
First restrictor rope			
Second restrictor rope			
Third restrictor rope			
Fourth restrictor rope			
Fifth restrictor rope			
Sixth restrictor rope			
Seventh restrictor rope			
Eighth restrictor rope			
Final restrictor rope			

Attachment of restrictors to headline and ground ropes:

	✓
Spliced in	
Using caribiners	
Other	

Skipper and crew comments:

Photo log frame numbers:

Comments:

Net Restrictor Dimensions Version 1, 23 October 2014

Figure 20: Illustration of proposed fields for recording the dimensions of net restrictors (Pierre et al. 2012b) used by some operators in the scampi fishery.

At-sea testing of net restrictors

Trip number	Vessel ID	Vessel name	Observer name

* Please complete one line for each bird caught.

	As on observer Non-fish bycatch form		Birds caught in net (list species code)					
Date capture landed	Sample #	Tow #	Port net	Centre net	Starboard net	Net unknown	Caught on restrictor	Comments
/ /								
/ /								
/ /								
/ /								
/ /								
/ /								
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/ /								

Additional comments:

At-sea testing of net restrictors, 30 October 2014

Figure 21: Illustration of proposed fields for documenting seabird captures in scampi trawl nets, in relation to the presence of multiple nets and net restrictors.

the net, the bunt mesh size would be measured from knot to knot. Observers would be tasked with measuring multiple meshes (e.g., 10, as for the main net body) on the back side of the form and recording the mean size on the main body of the form.

- A gear code
- Capacity of the pump used at brailing

There were no observer comments on the purse seine Vessel Activity Log in COD.

Amendments to the Purse Seine Catch Effort Set Details Form are also recommended to improve the characterisation of fishing operations. To facilitate linking with other components of the data collected on observed purse seine trips, adding fields containing observer "Trip Number" is recommended. In addition, to reflect the processing time in relation to catch volume, a new numeric field recording the "Total number of brails" is proposed. Finally, documenting the stages of the fishing operation that observers actually observed would improve confidence in data returned (Figure 24). For example, if observers were occupied with catch sampling, they may not be in a position to note whether rays have been captured in a brail.

In addition to describing the gear and fishing operations, ray behaviour around fishing gear, detailing how, where, and when protected rays are caught in the gear, and recording the details of handling and release methods applied to protected rays are expected to be important for the development of measures to reduce captures and mortalities (Jones & Francis 2012). Documenting the condition of rays on release has also been recommended (Jones & Francis 2012), and this has been attempted internationally (Braccini et al. 2012). Continuing to "ground-truth" assessments of post-capture and release condition with tracking of released individuals will inform assessments of post-release and otherwise cryptic mortality (Francis & Sutton 2012).

Given the currently low level of knowledge on interactions of protected rays with purse seine fisheries in New Zealand, a new form dedicated to documenting ray interactions with purse seine operations in detail is recommended (Figure 25). The deployment of a detailed form, completed for every set during which rays are observed around the gear, is recommended at the outset of this data collection and for five years of observer coverage. At that point, the review and modification of this form may be appropriate given improvements to knowledge of interactions between protected rays and New Zealand purse seine fisheries.

Setnet fishery forms: Two forms are used by observers to record catch effort and gear information in set net fisheries: the Observer Setnet Gear Form and the Observer Setnet Catch/Effort Form (Table 2). Information recorded on these forms is broadly aligned with international approaches to data collection in gillnet fisheries (Indian Ocean Tuna Commission 2010a, 2010b,

Purse Seine Vessel Activity Log

Trip number | **Observer Name** | **Vessel ID** | **Vessel Name** | **Page of**

Trip Day	Date (dd/mm/yy)	Activity code	Set no.	Gear code	Start time (24hr clock)	End time (24hr clock)	Latitude (DD°MM.m') S	Longitude (DDD°MM.m')	E W	Port	Beu-fort Scale	School		Target species	FMA	Aircraft callsign	Comments
												Assoc	Detect				
	/ /				:	:	° . 'S	° .									
	/ /				:	:	° . 'S	° .									
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Additional comments

ACTIVITY CODES
1 Set (fishing activity)
2 Searching (for school)
2a Steaming (to spotted school)
3 Transit (to/from port or fishing destination)
4 No fishing - breakdown/maintenance
5 No fishing - bad weather
5a No fishing - waiting for sighting
6 In port - landing/offloading catch
6a In port - awaiting departure

7 Net cleaning set
8 Investigate school
11 No fishing - drifting/anchored at day's end
13a No fishing - other (specify)......................
13b No fishing - other (specify)......................

S1 Spotter plane takes of to search
S1a Spotter plane radios in sighting
S2 Spotter plane returns from search

H1 Helicopter takes of to search
H2 Helicopter returned from search

16O Other:..

NOTE: if for any reason the activity was unobserved (i.e. details relayed to you from a crew member), please prefix the code with an "X".

SCHOOL ASSOCIATION
A 1 Unassociated
A 2 Feeding (on baitfish / krill)
A 3 Drifting log, debris, dead animal
A 4 Drifting raft, FAD or payao
A 5 Anchored raft, FAD or payao
A 8 Other:..
A 9 Bird associated

SCHOOL DETECTION
D 1 Seen from vessel
D 2 Seen from spotter aircraft
D 3 Maked with beacon
D 4 Bird radar
D 5 Sonar / depth sounder
D 6 Info. from other vessel
D 8 Other:..

Purse Seine Vessel Activity Log, 28 October 2014

Figure 22: Illustration of proposed fields for the collection of information describing the activity of purse seine vessels.

Figure 23: Illustration of proposed fields for the collection of information describing purse seine gear. (Front side).

Stretched net size measurements (cm)

Gear Code	Main body of net (cm)											Bunt of net (cm)										
											Average											Average
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Figure 23: (cont.) Illustration of proposed fields for the collection of information describing purse seine gear. (Back side).

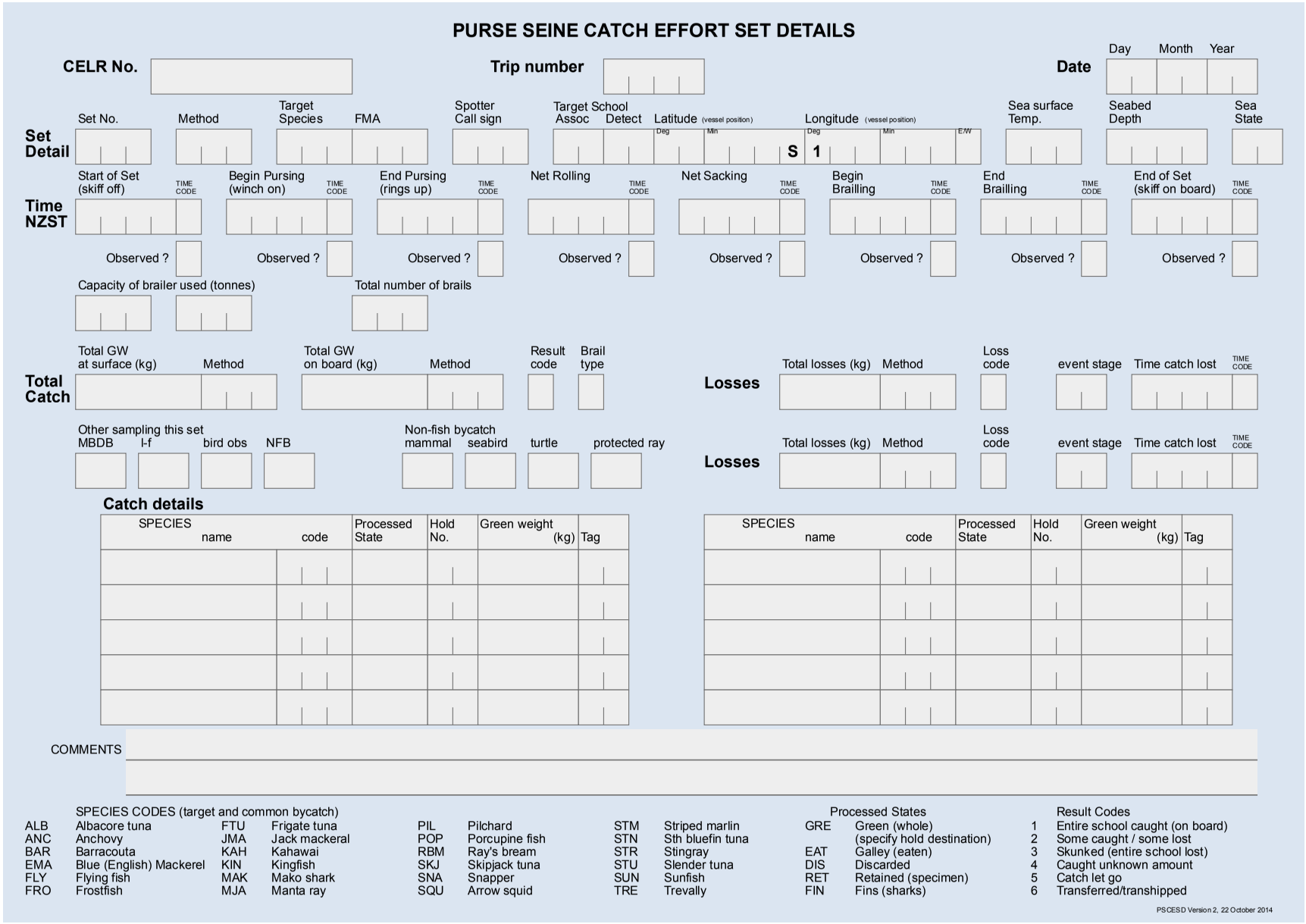


Figure 24: Illustration of proposed fields for the collection of purse seine catch effort data.

Protected Ray Interactions

Trip number | Observer name | Vessel name | Vessel ID | Set number

Method of initial ray detection | Ray location when first detected, in relation to target fish school | Stage of fishing when first ray detected

Sample number	Species code	Ray location in brail	Time ray out of water	Disc width (m)	Body length (m)	Sex	Ray returned to sea	Condition A W D R	Comments
1			:	.	.				
2			:	.	.				
3			:	.	.				
4			:	.	.				
5			:	.	.				
6			:	.	.				
7			:	.	.				
8			:	.	.				
9			:	.	.				
10			:	.	.				
11			:	.	.				
12			:	.	.				

Method of initial ray detection
OBS Observer
SPO Spotter plane or helicopter
CRE Crew
OTH Other (add description)

Ray location when first detected
SCH In amongst the school
PER On the periphery of school
>5M More than 5m away from school
NOT Not observed
OTH Other (add description)

Stage of fishing when ray first detected
BEF Before the set started
STA At the start of the purse
PUR During the purse
EPR At the end of the purse
ROL During the net rolling
SAK During net sacking
SBR At the start of brailing
DBR During brailing
EBR At the end of brailing
ABR After brailing (catch onboard)
OTH Other (add description)

Species code
RMB Manta ray
MJA Spinetail devil ray
MNT Unknown protected ray

Ray returned to sea
NET From the net
BRA From the brail
DEK From the deck
OTH From other location

Ray location in brail
SUR Surface
MID Middle
BOT Bottom

Sex code
F Female
M Male
U Unkown

Protected Ray Interactions Version 1, 22 October 2014

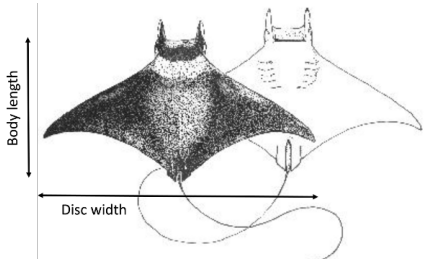
Figure 25: Illustration of proposed fields for the collection of information describing protected ray interactions with purse seine fishing operations. (Front side).

Ray behaviour during observations and interaction with fishing gear:

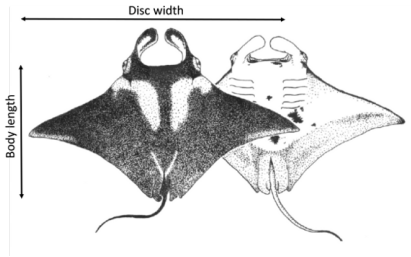
Method of ray release:

Type and extent of injury:

Spinetail devil ray



Manta ray



Condition codes:

	1	2	3	4
A: Activity during capture	Lively, able to move well on deck	Some movement including response if provoked	Minimal movement such as wing twitch or ripple only, appears limp with weak response to being provoked	No movement, appears lifeless
W: Wounds, bleeding	No cuts or bleeding	A small number of small surface cuts, may be some bleeding, no exposed organs	Some cuts visible or a single more severe wound, organs not exposed or if exposed are undamaged	Extensive cuts visible, obvious large wounds, damaged body parts, bleeding, internal organs exposed
D: Surface damage	No visible skin damage, including redness that indicates abrasion or bruising	< 5 % of animal's surface shows damage	5 - 40 % of animal's surface shows dammage	> 40 % of animal's surface shows damage
R: Activity on release	Swam strongly and normally, no detectable effects of capture	Swam reasonably well, though may have taken time to start	Swam weakly and not normally, possibly in intermittent bursts	Did not swim

Crew techniques to avoid capturing rays, and for handling rays:

Photo log frame numbers:

Comments:

Figure 25: (cont.) Illustration of proposed fields for the collection of information describing protected ray interactions with purse seine fishing operations. (Back side).

BirdLife International 2012). International approaches document stretched mesh size, rather than the nominal mesh size recorded in New Zealand fisheries. Additional fields collected could include the deployed net depth (i.e., depth of the topline), however while this is recognised as valuable it is often not possible to collect. Further, information could include the estimated length of lost gear, and confirming whether the haul was observed from a position at which any protected species dropping out of the net prior to being landed on deck would be detected (S. Northridge, pers. comm.). Following international practice where marine mammal captures are of particular interest, more detailed information could be collected on pingers to facilitate an assessment over time of their efficacy in reducing marine mammal bycatch. Fields could include (S. Northridge, pers. comm.):

- the distance from a captured marine mammal to the nearest pinger,
- confirmation of pinger operation when possible given pinger make and model, e.g., by checking the LED indicator light or voltage at the set to confirm pingers are operating before being deployed, and at the haul to confirm pingers were operating during the soak, and,
- documenting the location of pingers on the gear (e.g., on the topline, or elsewhere).

In addition, it is recommended that observers document the occurrence of integrated weight ground rope, net hanging ratio, and the existence of tears or holes in the net meshes.

Observer comments recovered from COD that were linked to the setnet catch effort forms related primarily to the statistical area of fishing effort and catch details, species discarded and the rationale for discards, and whether Middle Depth Biological Data (MDBD) forms were completed. Observer comments do not suggest additional changes are required to the Observer Setnet Catch/Effort Form currently in use, to better reflect information relevant to protected species captures. Statistical area is captured by recording the latitude and longitude of setting and the "Greenweight Catch" field describes the catch composition. Similarly, comments linked in COD to the Observer Setnet Gear Form are largely captured by the form's current structure.

The Cetacean Observations Programme (COP) (Ministry for Primary Industries, unpublished) is utilised by observers deployed in set net fisheries with electronic data collectors (the Trimble Nomad device). This programme provides a way to record details of observer deployments including shifts worked, vessel details, fishing events, non-fish bycatch events, and protected species sightings and activities. Lastly, the Programme allows observers to record whether a photo was taken for each sighting recorded. Fields appear comparable to those recorded on paper forms, with the exception of the activity information collected in association with protected species sightings. There appears to be scope to expand the deployment of Nomads to other fisheries, with other fishing methods appearing in the document describing the COP.

Table 2: Forms used to record data collected by at-sea observers that have relevance to protected species interactions with New Zealand commercial fisheries.

Trawl fisheries

Trawl Catch Effort Logbook
Trawl Gear Details Form
Warp Scarer Details Form
Bird Baffler Details Form
Tori Line Details Form
Observer Benthic Materials Form
Observer SLED Details Form
Mitigation Assessment Warp Strike Form (Inshore trawl fisheries only)
Mitigation Assessment Worksheet (Inshore trawl fisheries only)

Longline fisheries

Set Log
Haul Log
CSP Longline Fisheries Form
Deck Log (Surface longline fisheries only)
Trip Log (Surface longline fisheries only)
Events Log (Surface longline fisheries only)
Snood Log (Surface longline fisheries only)
Bait Log (Surface longline fisheries only)

Other fishing methods

Observer Setnet Catch/Effort Form
Observer Setnet Gear Form
Cetacean Observations Programme
Purse Seine Vessel Activity Log
Purse Seine Catch Effort Set Details
Observer Trolling Fishing Gear Form
Observer Trolling Hourly Observation Form

Forms used across all fishing methods

Protected Species Abundance Form
Non-fish Bycatch Form
Photographic Log
CSP White Pointer Form
Purse Seine Catch Effort Set Details
Whale and Dolphin Incident Form
Trip Report

Forms deployed across all fisheries: CSP Protected Species Abundance Form (PSAF): The intent of this form is to facilitate an understanding of protected species interactions with fishing activities and identify species at risk of being bycaught. The form compiles information on the type and number of protected species around vessels, and the behaviour of those species. Two types of observations are recorded on the PSAF, one collected at specified times during fishing cycles, and the second comprising opportunistic sightings of protected species made at any time during the trip. This format is common amongst sightings protocols used by observer programmes internationally.

For observations made from trawlers, more clearly linking the counts to operational stages of the hauling cycle is recommended. Therefore, instead of conducting observations at the start, middle, and end of hauling, it is recommended that counts are conducted after the start of the haul but before the doors are up, and either or both times when the cod end is on the surface or at the vessel stern. If observer time allows for additional counts, making a count during trawl towing, ideally while the discharge of processing waste is occurring, would provide another snapshot of information on the suite of seabird species at risk from trawl warp strikes. Providing observers with a column in which to indicate whether processing waste is being discharged would provide some context for the seabird abundances recorded at vessels (however, this may be beyond the objectives of the PSAF). Also, to increase the resolution of the dataset collected in terms of reflecting the risk fishing gear presents to protected species, including additional distance categories on the form is recommended, e.g., <20 m, 20 - 50 m, 50 - 100 m and >100 m. While observers will estimate distances with varying accuracy, animals within 20 m of the vessel are clearly more likely to interact with gear at setting or hauling than animals 50–100 m away. Maintaining a distance category at 100 m ensures the continuity of the current dataset.

Finally, observers are tasked with recording the sightings of banded birds on the PSAF. To maximise information captured when banded birds are seen, observer briefing packs could include the form used by DOC to record non-gamebird band sightings and recoveries. This form can be found at www.doc.govt.nz/conservation/native-animals/birds/bird-banding/reporting-a-bird-band/non-gamebird-band-report-form/. Its completion will ensure the capture of the maximum amount of information relating to the band sighting or recovery.

To increase clarity, revision of the instructions in the Observer Manual (Ministry for Primary Industries 2013d) is recommended where these relate to protected species counts and the completion of the Protected Species Abundance Form.

In the past, observers have been requested to record a "daily estimate" of seabird abundance around vessels. It is recommended that this is discontinued given the wide ranging seabird abundances that may occur around vessels. In addition, the PSAF is in place to collect seabird abundance information in a more structured way.

Non-fish Bycatch Form: The Non-fish Bycatch (NFBC) Form is generally effective in capturing relevant fields relating to protected species bycatch. Given the additional species legally protected in recent years, it is beneficial for the NFBC Form to include all protected species except corals (which are recorded on the Observer Benthic Materials Form). Species recorded on the NFBC would therefore encompass seabirds, marine mammals, marine reptiles, and protected fish. This more closely aligns the approaches to reporting protected species catches used by observers and fishers. (Fishers are currently required to complete a Non-fish and Protected Species Catch Return every time they capture a protected species, including corals (Ministry of Fisheries 2011)).

Including a column for Photographic Log numbers on the NFBC Form would facilitate the linking of specimens and photos, which has been problematic in the past. In addition, ensuring observers list each specimen on its own line of the form, or, including a box in which observers can enter the number of specimens they intend to describe with a single line would improve the accuracy of information transcribed from this form.

Note that the current instructions to observers for recording non-fish bycatch bias against the documentation of events resulting in cryptic mortality. For example, seabird strikes on trawl warps and birds getting snagged on gear are not classified as non-fish bycatch events when birds subsequently free themselves (Ministry for Primary Industries 2013d). Clearly, the outcome status of seabirds in these situations is unknown, but may involve injury or death. Adding a code to the non-fish bycatch form for recording these instances (so that they are not lost from the dataset, but are distinguishable from other non-fish bycatch events) is recommended and would contribute to an improved understanding of cryptic mortality (Pierre et al. 2014b).

Captures of marine turtles are included on the NFBC and when turtles are landed on vessels, observers are tasked with measuring their carapace length and taking tissue samples from dead turtles (Ministry for Primary Industries 2013d). International practice relating to captured turtles includes recording additional details, e.g., the number of scutes in various locations on the body (used for confirming identification) (National Oceanic and Atmospheric Administration 2013). While reported turtle captures are rare in New Zealand waters, fisheries capturing turtles are observed at very low levels of coverage, e.g., 0 – 5% (Abraham et al. 2013). When coverage of these fisheries increases, it is reasonable to expect that the number of reported turtle captures will also increase. Following the approach taken for species-specific data collection on the white pointer (Ministry for Primary Industries 2013d), the development of a dedicated form to record turtle identification and morphometric information may be warranted in future.

International approaches to recording non-fish bycatch also task observers with documenting any gear left on captured animals released alive (National Oceanic and Atmospheric Administration 2014). Such gear may affect the likelihood of survival of these animals (Epperly et al. 2012) and therefore cryptic mortality rates. Where post-release and cryptic mortality

is of interest, collection of this information is recommended.

Comments recorded by observers on the Non-fish Bycatch Form included descriptions of capture events and injuries evident on captured animals, crew involvement with captured animals, and photo frame numbers. Additional codes for the Form's "capture method" field are recommended, to increase the accessibility of information on capture location. Proposed new codes include paravane, mitigation device (which could be further split into tori line, bird baffler, warp scarer, net restrictor, SLED, and other), pound (for when bycaught animals are first found in the pound), and different parts of the trawl net (e.g., headline, lengthener, codend). Further, in some instances, observers were able to record the timing of a capture event during the fishing cycle. This information has particular relevance to bycatch mitigation approaches. Formalising the collection of this information on the Non-fish Bycatch Form is recommended by adding a new field for timing of capture. Codes for this field would include shooting, hauling, other (to be documented in comments) and unknown. Finally, observers sometimes recorded a specific geographic location for capture events in their comments. Because the general location of captures is identifiable using the tow or set location field, creating a new field to record precise capture locations is not considered necessary.

As noted for the Photographic Log, systematically linking stored photos and capture events would be valuable, and could be achieved by using frame numbers from Photographic Logs as part of stored image titles.

Observer Benthic Materials Form: The Observer Benthic Materials Form is also generally effective in collecting information on bycaught benthos. Two areas are identified for revision to improve observer services delivered. First, amending entries to the "Image" column from a yes / no response to an image number (or numbers) from the Photographic Log is recommended. Second, ensuring the Observer Manual is updated with a list of corals that are protected (in the text tasking observers with collecting corals for identification) would be helpful for observers, especially if they are discussing protected species with skippers and crew.

No comments were recovered from COD on this form.

In addition to the current data collection requirements for benthos including protected corals, the potential for new sampling programmes has been identified by end-users, for example, developing and implementing a targeted sampling programme for corals to enhance knowledge of coral biology including age, growth, size and form, and undertaking a sampling programme for animals associated with corals, to improve understanding of the value of corals as part of the marine environment (Baird et al. 2013).

Whale and Dolphin Incident Form: This form is used by observers and DOC officials to document whale and dolphin captures, strandings, and deaths. The form captures details of the event, environmental conditions, identification and measurements of the animals involved, photos, and samples taken. To facilitate the linking of this information with other data

collected by observers that may relate to cetacean bycatch events, including an observed trip number and set number is recommended.

Photographic Log: Through trip briefing notes and their Manual (Ministry for Primary Industries 2013d), observers are tasked with taking a diverse range of photographs including of captured protected species, bycatch mitigation devices, and gear components. Together with cameras that are set to the correct date and time, the Photographic Log is effectively structured to document events and items of interest that relate to protected species interactions with commercial vessels. Currently however, the identifying data associated with photos on storage is not optimal, and makes finding particular photos and photos relating to subjects of interest inefficient and time consuming. Storing photos with multiple searchable identifiers, including trip number, set number, correct date, frame number within the trip, keywords or subject, and activity codes (currently listed in the Trip Diary) would increase the accessibility and utility of photos to end users, as well as alignment with international approaches (National Oceanic and Atmospheric Administration 2014).

Note that for cetaceans, observer photos may be used to contribute to individual identification databases (National Oceanic and Atmospheric Administration 2014). This approach is most useful when coverage is intensive in a small area, and photos can be used for purposes including population estimation. However, in most cases in New Zealand, observer coverage is not sufficiently intensive to support this approach. In addition, observers would need to be issued with cameras capable of generating images of the appropriate size and resolution.

Trip Diary: In addition to the body of information collected by observers on forms, observers complete a Trip Diary every day of their contract. Trip diaries contain additional material describing observers' deployments including material relevant to protected species interactions, for example, bycatch mitigation devices and practices, and industry codes of practice (Ministry for Primary Industries 2013d). Diary entries are characterised using "Activity Codes" which facilitate the location of material of interest once a diary is in hand. Activity codes include descriptors such as mitigation equipment/practices (code A7), bird activity (code D4), and photos taken (code P1). However, there is currently no way to efficiently search diaries over time which means most information they contain is ultimately unavailable to potential end-users and is therefore effectively lost. For example, observers currently complete a form reviewing the implementation of vessel management plans and a marine mammal operating procedure in deepwater trawl vessels (Ministry for Primary Industries 2013d). Observers are instructed to assess "the vessel's 'usual' behaviour" because the "users of this information are more interested in the general intentions of the vessel rather than rare occasions of non-conformance which may be due to special circumstances" (Ministry for Primary Industries 2013d). Observers are tasked with recording instances of non-conformance in the comments sections of the form (V. Reeve, pers. comm.), and in their diaries. Beyond any consideration of conformance to

a procedure *per se*, this information may be associated with bycatch events, and therefore of particular relevance to otherwise rare events. Storing all information together or in a searchable linked form is desirable.

Many options are available to increase the usability of observer diaries. For example, an extremely low-effort option would be to maintain a list (searchable, in electronic form) of the activity codes attributed to diary entries by trip. This would allow users interested in mitigation, for example, to readily identify diaries containing entries of that nature. A more developed approach could include linking (digital) entries in text or scanned form to the activity codes such that entries recorded over time in particular subject areas could be readily utilised. Ultimately, minimising the information collected in diaries whilst ensuring this is collected in a structured way elsewhere (in usable forms) is preferable. Reviewing diaries annually to determine whether there are recurring entries that would be better recorded in a standardised form is recommended.

Finally, MPI briefing notes (Ministry for Primary Industries, unpublished) for observers deployed in domestic surface longline fisheries instruct observers to document sightings of banded birds in their trip diaries. As described for the PSAF, it is recommended that the standard DOC form (available online as above) is completed in that instance to ensure all relevant information is captured most effectively.

Trip Report: The trip report completed by observers in New Zealand fisheries is intended for distribution to clients including the vessel operator (Ministry for Primary Industries 2013d). The trip report is currently under review (V. Reeve, pers. comm.). In terms of protected species interactions, the trip report provides a qualitative summary of the content of the various forms completed during the trip. Ideally, the trip report should not include new information not captured on the detailed forms completed during the trip.

Currently, two new pieces of information observer tasking documentation requests observers to include in their trip report are the percentage of shots and hauls observed, and information that may inform the development of new mitigation measures. Amongst fisheries, only the Observer Setnet Catch/Effort Form currently requires observers to record whether they watched each set and haul. It is recommended that this information is also recorded for other fishing methods (e.g., on the purse seine and longline forms presented in this report) to inform a higher quality assessment of the level of observer coverage of fishing effort.

As for observer diaries, trip reports are currently not readily searchable or accessible electronically. Creating a storage system to improve the utility of trip reports is recommended. Similarly, reviewing all trip reports annually is recommended to determine whether there are recurring entries that could be captured more effectively using a new form (or by amending an existing form).

In New Zealand, traditional approaches to observer data collection using

paper forms are increasingly being augmented or superseded by recording data electronically at sea (Abraham et al. 2013). Similar to paper forms, the structure of the electronic interface will affect the nature and quality of the data recorded (e.g., whether fields support the entry of free text or a limited range of characters that reflect pre-specified codes). Fixed electronic interfaces are more difficult to override or add to than paper forms, should an observer feel the appropriate data are not being collected effectively. Interfaces should therefore be tested at sea to ensure their suitability for data collection prior to widespread deployment. However, electronic data recording streamlines the transfer of data into databases by minimising or eliminating the onshore data entry component. Given timeframes inherent in data entry following observer deployments in New Zealand fisheries, continuing the transition from paper to electronic data recording at sea is recommended.

To explore where data may be collected without a human observer, pilot studies evaluating the utility of electronic monitoring (EM) have been conducted in New Zealand fisheries including setnet, inshore trawl, and inshore surface and bottom longline (McElderry et al. 2007, 2008, 2011). These studies all included objectives relating to protected species interactions with fishing gear. All studies encountered technical and operational challenges such as camera angles needing refinement and maintaining the continuity of system operations (e.g., due to power failures and manual shutdown of the systems on vessels). The setnet study demonstrated that the EM system could detect Hector's dolphin (*Cephalorynchus hectori*) captures (McElderry et al. 2007). In the inshore trawl pilot study (McElderry et al. 2011), the strengths of EM were monitoring the deployment of bycatch mitigation devices and the detection of large or conspicuous protected species amongst the catch. Small and cryptic protected species are expected to be more challenging to detect amongst trawl catch and in this case, dead and waterlogged dark-coloured seabirds were not spotted. Catch handling methods would need to change to reliably detect these. Efficacy of EM was limited for seabird and dolphin identification and precise enumeration of seabirds from images of the water astern vessels. However, EM fields of view did allow the generation of an index of seabird abundance. Seabird strikes on trawl warps were not effectively monitored using EM in this pilot. In bottom longline fisheries, EM showed promise in terms of detecting protected species interactions (seabirds and a leatherback turtle in this case). For surface longline, results of the pilot study were more equivocal. One protected species interaction occurred during the study and this was not initially detected during the review of EM data (McElderry et al. 2008).

4. DISCUSSION

New Zealand is signatory to international agreements and has enacted acts of parliament and policy approaches generating information needs that can be met through the at-sea collection of data by fisheries observers. In general, these documents focus on either or both of two areas: the

achievement of sustainability in environmental management (including in the marine environment) or the conservation of biological diversity (either broadly, or focusing on particular species or species groups). In terms of commercial fishing interactions with marine protected species, the information needs that this framework of strategic documents creates for New Zealand can be grouped into five areas:

- characteristics of the fishing operation,
- nature and extent of protected species captures,
- status of captured animals,
- operational and environmental factors that may contribute to captures, and,
- measures in place to avoid or reduce captures.

The information collected from observer programmes internationally spans these same categories, with the scope of data collection in individual programmes ranging from narrow to comprehensive. Programmes tend to comprise a suite of core data collection implemented relatively consistently over time, which is augmented by shorter-term projects and protocols. Perhaps predictably given the longer focus of management attention on non-target species captures in longline fisheries (Brothers et al. 1999, Croxall 2008), data collection in these fisheries has been most thoroughly examined from the perspective of investigating marine species bycatch (Dietrich et al. 2007, Wolfaardt 2011, Turner & Papworth 2013). Amongst those marine species or species groups protected in New Zealand, seabirds, marine mammals, and turtles were the focus of observer taskings internationally.

Protocols and forms used by observers to collect data from New Zealand fisheries allow for the information needs highlighted by strategic documents relating to biodiversity and fisheries management to be partially addressed across all five categories above. Scope for four types of improvements was identified:

- clarity and consistency in observer instructions,
- addition of new fields or amendments to current fields on current data collection forms,
- creation of new forms to capture additional information, and,
- discontinuation of forms, fields, and metrics that are redundant (e.g., due to the duplication of data collected) or not useful (e.g., not capturing high quality relevant information).

In addition, the importance of supporting observers at sea appropriately, e.g., by providing up-to-date protected species identification guides, is recognised. An overview of changes recommended for observer data

collection and documentation is presented in Appendix 2. Recommended next steps for the forms developed as part of this project are at-sea testing and subsequent revision, prior to the deployment of a final version for longer-term data collection.

Priority areas in which to improve information collection include longline fishing gear and mitigation, purse seine gear and protected species interactions, trawl mitigation, cryptic mortality, and coral bycatch. Revised forms for longline gear and mitigation and purse seine fisheries are provided here. With respect to trawl warp strike mitigation, early work (Middleton & Abraham 2007) focused on assessing the efficacy of devices for which usage patterns and designs deployed have changed significantly in recent years (Cleal & Pierre 2012). Now, the bird baffler is the primary device used on offshore trawlers. This device may be deployed in accordance with legal specifications in a form with minimal or no warp strike mitigation effect (Cleal et al. 2013). Testing the performance of two-boom compared to four-boom bird bafflers is a priority if the efficacy of strategies intended to reduce seabird bycatch in offshore trawl fisheries is to be known. Observers using existing protocols and conducting warp strike observations on vessels deploying two-boom bird bafflers would address this information need.

Cryptic mortality is of increasing interest internationally, for both fish and non-fish species (Brothers et al. 2010, Swimmer & Gilman 2012, Gilman et al. 2013, Parker et al. 2013). A targeted project addresses this information need for seabirds in New Zealand trawl and longline fisheries (Pierre et al. 2014b). Initial attempts have also been made at assessing cryptic mortality for captured New Zealand sea lions (*Phocarctos hookeri*) and protected rays (Roe & Meynier 2012, Francis 2014). Monitoring setnet fisheries hauls for drop-offs is also recommended, where this does not already occur.

Corals are one of New Zealand's least understood protected species groups, and assessment of fisheries impacts tends to focus on their distribution and capture patterns in relation to bottom fishing activities over time (Black & Wood 2011, Black 2012, Baird et al. 2013). To understand the impacts of bottom fisheries on protected corals, increasing the knowledge base on their life history parameters is necessary. With expert input, observer data collection approaches could be developed to augment this knowledge base (Baird et al. 2013).

The specific improvements to data collection protocols recommended here can readily be made to extend the contribution of at-sea fisheries observers make to meeting New Zealand's information needs for marine protected species. Similarly, information needs arising through non-legislative frameworks, such as Marine Stewardship Council sustainability certification, can also be addressed through amending observer protocols. However, the most significant current impediment to meeting New Zealand's information needs is the paucity of observer coverage achieved in some fisheries, especially smaller-vessel fisheries operating in inshore areas. Inshore fisheries present particular challenges for human observer deployments both in New Zealand and internationally (Starr & Langley 2000, Koolman et al. 2007, Evans & Molony 2011, Pierre et al. 2012b). Ultimately, this lack of cov-

erage results in an understanding of protected species interactions with New Zealand commercial fisheries that is piecemeal at best. For example, a comprehensive understanding of bycatch patterns and the robust estimation of protected species bycatch rates are precluded (Francis & Sutton 2012, Baird et al. 2013, Pierre et al. 2012b, Richard & Abraham 2013). Consequently, performance against domestic and international obligations is compromised.

Given ongoing challenges with human-based monitoring approaches in small-vessel fisheries, deploying electronic monitoring is an effective alternative for achieving some protected species monitoring goals. Considering the potential role of EM as a fisheries monitoring tool requires confirmation that EM can meet the desired monitoring objectives, which are typically assessed through a pilot study (McElderry et al. 2011, Zollett et al. 2011). Further, culture and infrastructure must be developed to support EM implementation. For example, buy-in from skippers and crews on monitored vessels is essential so that manual shutdowns do not occur, and gear and catch handling procedures are implemented that allow the EM system to "see" effectively. As with all fisheries monitoring data, appropriate data management (including ensuring that imagery is secure) is also critical for imagery collected through EM systems.

In New Zealand and internationally, independent fisheries observers are a critical and best-practice component of fisheries management regimes (FAO 1995, 2009). Observers are also uniquely positioned to document information essential to assessing the contribution of the fishing industry to New Zealand's domestic and international obligations on sustainable environmental management and marine biodiversity conservation. Regular review of the data collection approaches observers implement, combined with ensuring effective coverage of commercial fisheries operating in New Zealand waters, will maximise the current and future benefits gained from observer placements and alternative monitoring technologies.

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6. REFERENCES

Abraham, E.R.; Thompson, F.N.; Berkenbusch, K. (2013). Estimated capture of seabirds in New Zealand trawl and longline fisheries, 2002–03 to 2010–11. Final Research Report for project PRO2010/01 (Unpublished report held by Ministry for Primary Industries, Wellington).

Alaska Fisheries Science Center. (2014). Observer sampling manual. Alaska Fisheries Science Center, Seattle, Washington. Fisheries Monitoring and Analysis Division, North Pacific Groundfish Observer Program.

Ames, R.T.; Williams, G.H.; Fitzgerald, S.M. (2005). Using digital video monitoring systems in fisheries: application for monitoring compliance of seabird avoidance devices and seabird mortality in Pacific halibut longline fisheries. U.S. Department of Commerce, NOAA Technical Memorandum: NMFS-AFSC-152.

Baird, S.J.; Tracey, D.; Mormede, S.; Clark, M. (2013). The distribution of protected corals in New Zealand waters. Final report prepared for the Department of Conservation. Retrieved from www . doc . govt . nz / Documents/conservation/marine-and-coastal/marine-conservation-services/pop-2011-06-coral-distribution.pdf

Barnes, A.; Loefflad, M.; Karp, W. (2005). New fisheries monitoring and analysis division assumes the role of the North Pacific groundfish observer program. Alaska Fisheries Science Center Quarterly Report: July – September.

BirdLife International. (2012). Seabird Bycatch in Gillnet Fisheries. BirdLife International Workshop 3-4 May 2012, Berlin, Germany. Retrieved from www . birdlife . org / europe / pdfs / 20120703 _ GillnetSeabirdBycatchWorkshopREPORT.pdf

Black, J. (2012). HOK bottom trawl grounds 2005-06 – 2009-10. Prepared for the Deepwater Group Ltd.

Black, J.; Wood, R. (2011). Analysis of New Zealand's trawl ground by the hoki fishery. Unpublished GNS Science Consultancy Excel Worksheets (2011a-o). Prepared for the Deepwater Group Ltd.

Braccini, M.; Rijn, J.V.; Frick, L. (2012). High post-capture survival for sharks, rays, and chimaeras discarded in the main shark fishery of Australia? *PLoS ONE 7*: e32547. doi:10.1371/journal.pone.0032547

Brothers, N.; Cooper, J.; Lokkeborg, S. (1999). The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation. *FAO Fisheries Circular No. 937*.

Brothers, N.; Duckworth, A.R.; Safina, C.; Gilman, E.L. (2010). Seabird bycatch in pelagic longline fisheries is grossly underestimated when using only haul data. *PLoS ONE 5*: e12491. doi:10.1371/journal.pone.0012491

Bull, L.S. (2007). Reducing seabird bycatch in longline, trawl and gillnet fisheries. *Fish and Fisheries 8*.

Bull, L.S. (2009). New mitigation measures reducing seabird by-catch in trawl fisheries. *Fish and Fisheries 10*: 408–427.

CCAMLR. (2011). Scheme of International Scientific Observation: Scientific Observers Manual (Observation Guidelines and Reference Materials) 2011. Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

CCAMLR. (2013a). CCAMLR Scheme of International Scientific Observation: Scientific Observers Logbook Longline Fishing. Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

CCAMLR. (2013b). CCAMLR Scheme of International Scientific Observation: Scientific Observers Logbook Trawl Fishing. Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

Cleal, J.; Pierre, J.P. (2012). Seabird scaring devices in use on trawlers $\geq$ 28 m in length operating in New Zealand fisheries. Department of Conservation, Wellington, New Zealand.

Cleal, J.; Pierre, J.P.; Clement, G. (2013). Warp strike mitigation devices in use on trawlers $\geq$ 28 m in length operating in New Zealand fisheries. Department of Conservation, Wellington, New Zealand. Retrieved from http://www.doc.govt.nz/publications/conservation/marine-and-coastal/conservation-services-programme/csp-reports/warp-strike-mitigation-devices/. 42 p

Cocking, L.J.; Double, M.C.; Milburn, P.J.; Brando, V. (2008). Seabird bycatch mitigation and blue-dyed bait: A spectral and experimental assessment. *Biological Conservation 141*: 1354–1364.

Commission for the Conservation of Southern Bluefin Tuna. (2001). CCSBT Scientific Observer Program Standards. Retrieved from www.ccsbt.org/userfiles/file/docs_english/operational_resolutions/observer_program_standards.pdf

Conservation Services Programme. (2004). Conservation Services Annual Plan 2004/05. Department of Conservation, Wellington.

Conservation Services Programme. (2013a). Conservation Services Annual Plan 2013/14. Department of Conservation, Wellington.

Conservation Services Programme. (2013b). Conservation Services Programme Strategic Statement 2013. Department of Conservation, Wellington.

Croxall, J.P. (2008). Seabird mortality and trawl fisheries. *Animal Conservation 11*: 255–256.

Deepwater Group Ltd. (2009). Vessel Management Plan (VMP) Deepwater Factory Trawler over 28 m. Version 4.0. Deepwater Group Ltd. Retrieved from http://www.fish.govt.nz/NR/rdonlyres/26260963-5C97-4C3D-946C-A62CAFC0A9DD/0/VesselManagementPlan.pdf

Dietrich, K.S.; Cornish, V.R.; Rivera, K.S.; Conant, T.A. (2007). Best Practices for the Collection of Longline Data to Facilitate Research and Analysis to Reduce Bycatch of Protected Species Report of a workshop held at the International Fisheries Observer Conference Sydney, Australia, November 8, 2004. NOAA Technical Memorandum NMFS-OPR-35.

Dietrich, K.S.; Turk, T.; Wynne, K.; Tiwari, M. (2010). West Africa Regional Scientific Observer Training Manual. Retrieved from %7Bwww.kimdietrich.com/WAfr-Manual/WAfr_obs_manual_V1.0_final.pdf%7D

Epperly, S.P.; Watson, J.W.; Foster, D.G.; Shah, A.K. (2012). Anatomical hooking location and condition of animals captured with pelagic longlines: the Grand Banks experiments 2002-2003. *Bulletin of Marine Science 88*: 513–527.

Evans, R.; Molony, B. (2011). Pilot evaluation of the efficacy of electronic monitoring on a demersal gillnet vessel as an alternative to human observers. fisheries research report no. 221. Department of Fisheries, Government of Western Australia, North Beach.

Falkland Islands Fisheries Department. (2011). Bird survey and interaction monitoring for Falkland Islands finfish fishery. Falkland Islands Fisheries Department. 18 pp.

FAO. (1995). Code of conduct for responsible fisheries. Food and Agriculture Organization of the United Nations, Rome.

FAO. (2009). Best practices to reduce incidental catch of seabirds in capture fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 41 Suppl. 2, Food and Agriculture Organization of the United Nations, Rome.

Francis, M. (2014). Survival and depth distribution of spinetail devilrays (*Mobula japanica*) released from purse-seine catches. Final report for project MIT2011-01 prepared for the Department of Conservation. Retrieved from www.doc.govt.nz/Documents/conservation/marine-and - coastal / marine - conservation - services / reports / mit2011 - 01 - tagging-report-final.pdf

Francis, M.; Sutton, P. (2012). Basking shark bycatch review. Final report prepared for the Department of Conservation. Retrieved from www.doc.govt.nz/conservation/marine-and-coastal/conservation-services-programme/csp-reports/2011-12/basking-shark-bycatch-review/

Gilman, E.; Suuronen, P.; Hall, M.; Kennelly, S. (2013). Causes and methods to estimate cryptic sources of fishing mortality. *Journal of Fish Biology 83*: 766–803.

Gless, J.M.; Salmon, M.; Wyneken, J. (2008). Behavioral responses of juvenile leatherbacks *Dermochelys coriacea* to lights used in the longline fishery. *Endangered Species Research 5*: 239–247.

Groeneveld, J.; Heinecken, C. (2010). Observer Manual: An illustrated manual for training fisheries observers for deployment on commercial fishing vessels active in the southwest Indian Ocean. Southwest Indian Ocean Fisheries Project. Retrieved from www.swiofp.net/quick-links/observer-program/observer-training-manual-en-fr/swiofp-observer-manual-english

Indian Ocean Tuna Commission. (2010a). IOTC Regional Observer Scheme: Draft Observer Manual (Version 01 July 2010). Indian Ocean Tuna Commission. Retrieved from www.iotc.org/files/proceedings/2010/wros/IOTC-2010-WROS-06%20Draft%20Obs%20Manual(July2010).pdf

Indian Ocean Tuna Commission. (2010b). IOTC Regional Observer Scheme: Observer Trip Report. Indian Ocean Tuna Commission. Retrieved from www.iotc.org/files/proceedings/2010/wros/IOTC%20Observer%20Trip%20Report.zip

Jones, E.; Francis, M. (2012). Protected rays – occurrence and development of mitigation methods in the New Zealand tuna purse seine fishery. Final report prepared for the Department of Conservation. Retrieved from www.doc.govt.nz/conservation/marine-and-coastal/conservation-services-programme/csp-reports/2011-12/protected-rays-occurence-

and-development-of-mitigation-methods-in-the-new-zealand-tuna-purse-seine-fishery/
Koolman, J.; Mose, B.; Stanley, R.D.; Trager, D. (2007). Developing an integrated commercial groundfish strategy for British Columbia: insights gained about participatory management. (Heifetz, J.; Dicosimo, J.; Gharrett, A.J.; Love, M.S.; O'Connell, V.M.; Stanley, R.D., Eds.). Alaska Sea Grant College Program AK-SG-07-01, Fairbanks.
Lewandowski, T. (2013). Common NE Deep-Sea Corals. Retrieved from www.nefsc.noaa.gov/fsb/training/CORAL_ID.pdf
McElderry, H.; Beck, M.; Pria, M.J.; Anderson, S. (2011). Electronic monitoring in the New Zealand inshore trawl fishery: A pilot study. *DOC Marine Conservation Services Series 9*.
McElderry, H.; McCullough, D.; Schrader, J.; Illingworth, J. (2007). Pilot study to test the effectiveness of electronic monitoring in Canterbury fisheries. *DOC Research and Development Series 264*.
McElderry, H.; Pria, M.J.; Dyas, M.; McVeigh, R. (2010). A pilot study using EM in the hawaiian longline fishery. Retrieved from www.wpcouncil.org/library/docs/Archipelago_EM_Pilot_Study_Final.pdf
McElderry, H.; Schrader, J.; Anderson, S. (2008). Electronic monitoring to assess protected species interactions in New Zealand longline fisheries: a pilot study. *Aquatic Environmental and Biodiversity Report 24*.
Melvin, E.F.; Dietrich, K.S.; Fitzgerald, S.; Cardoso, T. (2011). Reducing seabird strikes with trawl cables in the pollock catcher-processor fleet in the eastern bering sea. *Polar Biology 34*.
Melvin, E.F.; Guy, T.J.; Read, L.B. (2013). Reducing seabird bycatch in the South African joint venture tuna fishery using bird-scaring lines, branch line weighting and nighttime setting of hooks. *Fisheries Research 147*.
Middleton, D.A.J.; Abraham, E.R. (2007). The efficacy of warp strike mitigation devices: Trials in the 2006 squid fishery. Final Research Report for research project IPA2006/02. (Unpublished report held by Ministry for Primary Industries, Wellington).
Ministry for Primary Industries. (2012). Aquatic Environment and Biodiversity Annual Review 2012. Compiled by the Fisheries Management Science Team, Ministry for Primary Industries, Wellington. 387 p.
Ministry for Primary Industries. (2013a). Fisheries Assessment Plenary May 2013: Stock Assessment and Yield Estimates. Ministry for Primary Industries, Wellington, New Zealand.
Ministry for Primary Industries. (2013b). National Plan of Action - 2013 to reduce the incidental catch of seabirds in New Zealand fisheries. Ministry for Primary Industries, Wellington. Retrieved from http://bit.ly/X8Cd3L
Ministry for Primary Industries. (2013c). National Plan of Action for the Conservation and Management of Sharks. Ministry for Primary Industries, Wellington.
Ministry for Primary Industries. (2013d). Observer Manual. August 2013. Unpublished document held by Ministry for Primary Industries, Wellington.

Ministry of Fisheries. (2010). Fisheries Services Plan for 2010/11. Retrieved from www.fish.govt.nz/NR/rdonlyres/ACC789BF-123F-47D2-98E3-8EE3A08FDD71/0/Fisheries_Services_Plan_2010_11.pdf

Ministry of Fisheries. (2011). Non-fish and Protected Species. Compliance Information Sheet 8.

Mormede, S. (2008). Year of the skate sampling protocol: lessons from the 2007-08 season sampling protocol on NZ vessels. *CCAMLR WG-FSA 08 49*.

National Oceanic and Atmospheric Administration. (2010). American Samoa Observer Program Field Manual. Manual Version AS.10.10. National Oceanic and Atmospheric Administration, Honolulu.

National Oceanic and Atmospheric Administration. (2012a). Alaska marine mammal observer program observer manual 2012. Retrieved from http : / / alaskafisheries . noaa . gov / protectedresources / observers / observermanual_seak.pdf

National Oceanic and Atmospheric Administration. (2012b). NEFOP Digital Camera Protocols. Retrieved from www.nefsc.noaa.gov/fsb/manuals/Digital%20Camera%20protocols_vrs%206-7-2012%20Word_v.2003.pdf

National Oceanic and Atmospheric Administration. (2013). Hawaii longline observer program field manual. version LM.13.02. National Oceanic and Atmospheric Administration, Honolulu.

National Oceanic and Atmospheric Administration. (2014). West Coast Groundfish Observer Program 2014 Non-Catch Shares Training Manual. Retrieved from www.nwfsc.noaa.gov/research/divisions/fram/observation/data_collection/manuals/cs_manual_2014/CS_2014_Chapter_8.pdf

New Zealand Government. (2010a). Fisheries (commercial fishing) regulations 2001. seabird scaring devices circular 2010 (no. F517). *New Zealand Gazette 29*: 763–767.

New Zealand Government. (2010b). Fisheries (seabird sustainaibility measures - bottom longlines) notice 2010 (no. F541). *New Zealand Gazette 76*: 2120–2122.

New Zealand Government. (2014). Fisheries (seabird sustainaibility measures - surface longlines) circular 2014. *213*: 1–11.

Northeast Fisheries Science Center. (2013). Northeast fisheries observer program manual 2013. Northeast Fisheries Science Center, Woods Hole.

Parker, G.; Brickle, P.; Crofts, S.; Pompert, J.; Wolfaardt, A. (2013). Research into undetected seabird mortality in a demersal trawl fishery. SBWG5-07 Agenda Item 4, Fifth Meeting of the Seabird Bycatch Working Group of the Agreement on the Conservation of Albatrosses and Petrels, La Rochelle, France, 6–10 May 2013.

Pierre, J.P.; Abraham, E.R.; Y.; Cleal, J.; Middleton, D.A.J. (2012a). 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. (2012b). Seabird bycatch reduction in scampi trawl fisheries. Final Research Report for Department of Conservation project MIT2011-02. Retrieved from

www.doc.govt.nz/Documents/conservation/marine-and-coastal/fishing/mit2011-02-final-report.pdf

Pierre, J.P.; Gerner, M.; Penrose, L. (2014a). Assessing the effectiveness of seabird mitigation devices in the trawl sectors of the Southern and Eastern Scalefish and Shark Fishery in Australia. Available at: http://www.afma.gov.au/wp-content/uploads/2014/09/Seabird-Mitigation-Assessment-Report.pdf.

Pierre, J.P.; Goad, D.W.; Thompson, F.N.; Abraham, E.R. (2013). Reducing seabird bycatch in bottom-longline fisheries. Final Report on CSP Projects MIT2011-03 and MIT2012-01, Department of Conservation, Wellington.

Pierre, J.P.; Richard, Y.; Abraham, E.R. (2014b). Assessment of cryptic seabird mortality due to trawl warps and longlines. Draft Report on CSP Project INT2013-05, Department of Conservation, Wellington.

Porter, R.D. (2010). Fisheries observers as enforcement assets: lessons from the North Pacific. *Marine Policy 34*: 583–589.

Pria, M.J.; McElderry, H.; Dyas, M.; Wesley, P. (2008). Using electronic monitoring to estimate reef fish catch on bottom longline vessels in the Gulf of Mexico: a pilot study. Retrieved from www.nmfs.noaa.gov/by_catch/docs/pria_florida_empilot_oct08.pdf

Ramm, K. (2012). Conservation Services Programme observer report, 1 July 2009 to 30 June 2010. Final Report, Department of Conservation, Wellington, New Zealand.

Richard, Y.; Abraham, E.R. (2013). Risk of commercial fisheries to New Zealand seabird populations. *New Zealand Aquatic Environment and Biodiversity Report No. 109*. 58 p.

Roe, J.O. (2005). Mitigation trials and recommendations to reduce seabird mortality in the pelagic icefish (*Champsocephalus gunnari*) fishing (Subarea 48.3). *CCAMLR WG-FSA 05 59*.

Roe, W.; Meynier, L. (2012). Review of necropsy records for bycaught NZ sea lions (*Phocarctos hookeri*), 2000–2008. *New Zealand Aquatic Environment and Biodiversity Report No. 98*. 43 p.

Rowe, S. (2013). Level 1 risk assessment for incidental seabird mortality associated with fisheries in new zealand's exclusive economic zone. *DOC Marine Conservation Services Series 10*. Department of Conservation, Wellington, New Zealand.

Ruiz, J.; Batty, A.; McElderry, M.; Restrepo, V.; Lezama, N.; Murua, H.; Urtizberea, A.; Urrutia, X. (2013). Pilot study of an electronic monitoring system on a tropical tuna purse seine vessel in the Atlantic Ocean. *Collective Volume of Scientific Papers – ICCAT 69(5)*: 1995–2032.

Sabourenkov, E.N.; Appleyard, E. (2005). Scientific observations in CCAMLR fisheries – past, present and future. *CCAMLR Science 12*: 81–98.

Sanders, B.M.; Fisher, D.O. (2010). Database documentation for the Ministry of Fisheries Centralised Observer Database. *NIWA Fisheries Data Management Database Documentation Series*.

Sato, N.; Ochi, D.; Minami, H.; Yokawa, K. (2012). Evaluation of the effectiveness of light streamer tori-lines and characteristics of bait

attacks by seabirds in the Western North Pacific. *PLoS ONE 7(5)*: e37546 doi:10.1371/journal.pone.0037546.

South Pacific Regional Fisheries Management Organisation. (2014a). Conservation and management measure for the management of bottom fishing in the SPRFMO convention area. Retrieved from https://www.sprfmo . int / assets / Commission - Meeting - 2nd / Comm - 02 - report / Annex-M-CMM-2.03-CMM-for-Bottom-Fishing.pdf

South Pacific Regional Fisheries Management Organisation. (2014b). Conservation and management measure on standards for the collection, reporting, verification and exchange of data. conservation and management measure 2.02. Retrieved from https://www.sprfmo.int/assets/Commission-Meeting-2nd/Comm-02-report/Annex-C-CMM-2.02-CMM-on-Standards-for-the-Collection-Reporting-Verification-and-Exchange-of-Data.pdf

Starr, P.; Langley, A. (2000). Inshore fishery observer programme for Hector's dolphin in Pegasus Bay, Canterbury Bight, 1997/98. Department of Conservation, Wellington, New Zealand. Retrieved 6 April 2009, from http://www.doc.govt.nz/upload/documents/science-and-technical/CSL3020.PDF

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

Sullivan, B.J.; Clark, J.; Reid, K.; Reid, E. (2009). Development of effective mitigation to reduce seabird mortality in the icefish (*Champsocephalus gunnari*) trawl fishery in Subarea 48.3. *CCAMLR WG-IMAF 09 15*.

Swimmer, Y.; Gilman, E. (2012). Report of the Sea Turtle Longline Fishery Post-release Mortality Workshop, November 15–16, 2011. U.S. Department of Commerce, NOAA Technical Memorandum. NOAA-TM-NMFS-PIFSC-34. National Oceanic and Atmospheric Administration, Honolulu.

Turner, J.; Papworth, W. (2013). SBWG5-23: Review of seabird bycatch data collection in tuna RFMOs. Fifth Meeting of the Seabird Bycatch Working Group. La Rochelle, France, 1-3 May 2013. Agreement on the Conservation of Albatrosses and Petrels, Hobart.

Wang, J.H.; Boles, L.C.; Higgins, B.; Lohmann, K.J. (2007). Behavioral responses of sea turtles to lightsticks used in longline fisheries. *Animal Conservation 10*: 176–182.

Western and Central Pacific Fisheries Commission. (2012). Conservation and management measure for the oceanic whitetip shark. conservation and management measure 2011-04. Retrieved from www.wcpfc.int/doc/cmm - 2011 - 04 / conservation - and - management - measure - oceanic - whitetip-sharks

Western and Central Pacific Fisheries Commission. (2013). WCPFC ROP minimum standard data fields and instructions. Retrieved from www.wcpfc.int/doc/table-rop-data-fields-including-instructions

Wolfaardt, A. (2011). SBWG4: Data collection requirements for RFMOs to improve knowledge of fishery impacts on ACAP-listed species. Fourth Meeting of the Seabird Bycatch Working Group. Guayaquil, Ecuador,

22-24 August 2011. Agreement on the Conservation of Albatrosses and Petrels, Hobart.
Zollett, E.; Trumble, R.; Swasey, J.; Stebbins, S.; Bonzon, K.; Annand, C.; Amason, R.; Belay, B.; Gilroy, H.; Henninger, H.; Jones, M.; Leaman, B. (2011). Guiding principles for development of effective monitoring programs. Essex.

7. APPENDIX 1: MARINE SPECIES LEGALLY PROTECTED IN NEW ZEALAND

Protected marine species in New Zealand are listed in the Wildlife Act (1953) and the Marine Mammals Protection Act (1978).

These species include:

- all marine mammals;
- all seabirds (except black-backed gulls (Larus dominicanus));
- all marine reptiles;
- black corals (all species in the order Antipatharia);
- gorgonian corals (all species in the order Gorgonacea);
- stony corals (all species in the order Scleractinia);
- hydrocorals (all species in the family Stylasteridae); and
- nine species of fish (oceanic whitetip shark (*Carcharhinus longimanus*), basking shark (*Cetorhinus maximus*), deepwater nurse shark (*Odontaspis ferox*), white pointer shark (*Carcharodon carcharias*), whale shark (*Rhincodon typus*), manta ray (*Manta birostris*), spinetail devil ray (*Mobula japanica*), giant grouper (*Epinephelus lanceolatus*) and spotted black grouper (*Epinephelus daemelii*)).

8. APPENDIX 2: RECOMMENDED IMPROVEMENTS TO DATA COLLECTION PROTOCOLS UTILISED BY GOVERNMENT FISHERIES OBSERVERS IN NEW ZEALAND COMMERCIAL FISHERIES

Document or form	Recommendation
Longline fisheries:	
Draft Seabird Mitigation Form	Split into two forms (Longline Tori Line Details; Brickle Curtain Details) and capture other mitigation details separately
Longline Tori Line Details	Include additional diagrams of example tori lines and box for observer's own diagram if needed Group measurements of components of streamer lines Align information collected with legal requirements
Brickle Curtain Details	Clarify language used to identify haul mitigation measures Group related fields Include box for observer diagram of novel measures used Align information collected with legal requirements
Surface Longline Setting Log	Group related fields to faciliate completion Include data collection on mitigation measures
Bottom Longline Setting Log	Group related fields to faciliate completion Include data collection on mitigation measures
Setting Event Log	Refine the collection of mitigation information Add new fields to document observations of cryptic mortalities
Hauling Event Log	Refine the collection of mitigation information Add new fields to document observations of cryptic mortalities
Hourly Haul Log	Refine the collection of mitigation information
Snood and Bait Log	Refine the collection of information on weights deployed Add columns for the collection of information on deployment of dyed bait and light sticks
Bottom Longline Gear Form	Streamline fields (e.g., by grouping, or removal of fields more effectively located on other forms) to capture an increased level of detail about the appropriate gear type
Surface Longline Gear Form	Streamline fields to capture an increased level of detail about the appropriate gear type
Trawl fisheries:	
Trawl Catch Effort Logbook	Include fisher-completed catch effort form numbers Add codes for batch discharge of offal and discards, *ad hoc* discharge and mincing of waste prior to discharge to sections 1: Shooting, 2: During Tow and 3: Hauling Add codes for net restrictors and dolphin dissuasive devices to section 6: Mitigation
Seabird Warp Strike Observations Trawl	Add a field for each sampling period and develop codes to document the outcome of warp strikes
Tori Line Details Form	Add fields to record the number of streamers reaching sea surface in calm conditions and the maximum and minimum distances between these
Observer SLED Details Form	Add fields to document floats located away from the hood Add fields to document the dimensions of floats
Net Restrictor Dimensions Form	Create new form to document the specifications of net restrictors used in the scampi fishery
At-sea Testing of Net Restrictors	Create new form to document seabird captures on restrictors used in the scampi fishery, or, provide for relevant details to be recorded using new codes for seabird capture location on the Non-fish Bycatch Form

Document or form	Recommendation
Purse seine fisheries:	
Vessel Activity Log	Add Gear Code field
Purse Seine Gear Form	Create new form to document details of purse seine gear, e.g., length and depth of net, mesh sizes, etc.
Purse Seine Catch Effort Set Details Form	Add "Trip Number" field
	Add fields recording brailer capacity and number of brails
	Add field to document if protected ray captures occurred
	Add fields to document stages of fishing operation actually observed
Protected Ray Interactions	Create new form to document details of protected ray interactions with purse seine fisheries
Setnet fisheries:	
Observer Setnet Gear Form	Add field to record hanging ratio
	Add fields to record pinger make and model
	Add a Yes/No field to document the present of an integrated weight ground rope
	Add a Yes/No field to document the occurrence of holes or tears in the net meshes
	Document the location of pingers on the gear
Observer Setnet Catch/Effort Form	Add field to confirm haul was observed from a position where drop-outs could be detected
All fisheries:	
CSP Protected Species Abundance Form	Conduct additional count during trawl towing ideally while waste discharge occurs
	Add distance categories: <20 m, 20–50 m, 50–100 m and maintain the current >100 m category
Non-fish Bycatch Form	Add column to record Photographic Log frame numbers
	Include box for entering number of specimens each line relates to
	Implement new "Life status" or other codes to reflect incidents of cryptic mortality
	Create new field "Gear attached" for when animals released alive carry fishing gear
	Add new codes to "Capture method" field: paravane, mitigation device (tori line, bird baffler, warp scarer, net restrictor, SLED, and other), pound, net headline, codend, lengthener
	Create new field "Timing of capture" with codes for shooting, hauling, unknown, other
Observer Benthic Materials Form	Record Photographic Log frame numbers rather than Yes/No entries in "Image" field
Whale and Dolphin Incident Form	Add "Trip number" field
MPI Observer Manual	Ensure instructions relating to protected species tasks are up to date and consistent through the Manual
Observer briefing notes	Ensure names of forms included are up to date and instructions are consistent with the Manual as appropriate
	Task observers with completing the Department of Conservation form for reporting banded or marked birds