

# Protocols for large vessel trawl seabird bycatch mitigation data collection: progress report on initial at-sea trial

Report prepared by Joe English for Department of Conservation

Project MIT2024-06

## Executive summary

A range of seabird bycatch mitigation options have been used in large vessel trawl fisheries in New Zealand for over 20 years. However, existing data collected by observers on these vessels has proven to be of limited utility in assessing the relative effectiveness of seabird bycatch mitigation options being used, which limits the ability to inform continual improvement of mitigation in a drive towards a vision of zero seabird bycatch. This report forms part of work to develop new data collection protocols to assess seabird warp strikes and net interactions in the large vessel trawl fleet and reports initial at-sea testing of a range of potential protocols. As part of the trial, cameras were installed onboard a vessel to separately test whether there is potential to automate some of the data collection currently or historically done by observers. Preferred data collection protocols have been identified and are ready for use in further trials by observers in the large vessel trawl fleet. The new warp strike protocols are ready to use and need minimal development. Further refinements would be beneficial for the net capture protocols, mainly determining whether the single metric of birds within five metres of the net is sufficient or whether using multiple metrics to account for internal and external net capture risk is more suitable. The protocols provide a good system for capturing bird abundance in risk areas, allowing a comparison to be made between trawl gear and mitigation equipment across different vessels. The cameras in this trial were effective at recording bird abundance in high-risk areas and with some adjustments could be a very effective monitoring tool for assessing the relative effectiveness of seabird bycatch mitigation options. Further developments in technology will likely only increase their usefulness further.

## 1. Introduction

The large vessel trawl fleet is responsible for a high proportion of bycatch risk to several species of seabirds in New Zealand. This is despite ongoing efforts to reduce bird attendance around fishing vessels through discharge management, and to reduce seabird warp strikes through the use of seabird bycatch mitigation. Current observer

data could not adequately quantify the relative effectiveness of seabird mitigation options (Large et al. 2024) thus limiting avenues to inform the ongoing reduction in captures in line with national policy objectives.

Observer bird count data consists of total seabird abundance around the vessel, recorded from a count done usually only once a day. Because of health and safety concerns from both vessel operators and Fisheries New Zealand, observers spend less time at the stern of fishing vessels than they did in the past, meaning that tasks such as warp observations are no longer possible. Cameras have the potential to supplement observer collected data, particularly in this crucial area at times when observers cannot access the stern. With a high level of potential cryptic mortality in trawl fisheries, the use of bird capture rates has proven to have limited utility in assessing the relative effectiveness of mitigation options (Large et al. 2024). Therefore, bycatch proxy metrics are usually used to assess mitigation effectiveness, such as warp strike observations (Middleton and Abraham 2007, Koopman et al. 2018), bird behaviour and abundance (Goad and Peatman 2021).

Previous projects, such as Goad and Peatman (2021) have monitored bird abundance in defined high risk areas, allowing for a comparison of relative risk and effectiveness of different mitigation measures, which generally act to deter birds from entering high risk areas around fishing gear. This project is aimed at identifying and developing protocols to capture this data and act as suitable proxies for risk. Cameras also have the potential to record capture events, increasing the understanding of how these events occur and how to better mitigate them. Additionally, seabird interactions with fishing gear which aren't necessarily captured by existing observer protocols (such as injuries that don't involve an animal being brought onboard) could also be understood and accounted for.

This report forms part of DOC CSP project MIT2024-06. The wider project had two main goals:

1. To develop new data collection protocols to assess seabird warp strikes and net interactions in the large vessel trawl fleet.
2. To better characterise seabird interactions with large trawl vessel fishing gear and assess the efficacy of warp cable and net capture mitigation practices using the first year of data collected.

This report describes an initial at-sea trial of potential data collection protocols onboard a New Zealand deepwater fishing trawler, with the goal of identifying the most effective means of assessing seabird risk from interactions with, as a proxy for risk of bycatch from, both warps and nets. Further work under the wider project will aim to more widely test the protocols proposed here, before considering how ongoing implementation could be progressed.

As part of the trial, cameras were installed onboard a vessel to separately test whether there is potential to automate some of the data collection currently or historically done by observers. Currently, bird abundance data collection is limited in scope and only records total abundance without focusing on specific risk areas. The camera trial aimed to test whether cameras can collect sufficient data, compared to that of observers and whether such data can be collected in areas observers cannot currently access (e.g. directly astern of the vessel).

## 2. Methods

### 2.1 Protocols

Potential protocols were developed prior to sailing (Appendix 1), with additional protocols refined and trialled while at sea. There were 25 protocols trialled in total and were focused on the mitigation equipment in use, primarily counting birds within the area defended by the bafflers or tori lines. The net capture protocols could only be done during shooting and hauling and were designed to measure the risk to seabirds from internal and/or external net captures. Some protocols counted a “risky” behaviour, such as diving in the pooling area, while others counted birds in a set proximity to the net. Warp strike protocols could not be trialled during hauling as access to the stern to conduct counts was restricted for health and safety reasons. This meant that all warp strike protocols were tested during fishing. These were designed to assess risk of death or injury to seabirds from coming into contact with the warp cables. The warp strike protocols were focused on counting birds within a proximity to the warp cables rather than a specific behaviour. Table 1 summarises all protocols trialled.

**Table 1.** List of protocols in order of when they were first trialled.

Protocol	Proxy	Number of trials	When it was used
1. Birds coming into a box within 20m of the warps	Warp strike proxy	1	During fishing
2. Snap count of birds within 100m of the stern	Warp strike proxy	1	During fishing
3. Snap count of birds within the pooling area	Internal net capture proxy	6	During hauling
4. Snap count of birds between the headline and stern	Internal capture proxy	2	During hauling

5. Birds coming into a box within 5m of the warps	Warp strike proxy	3	During fishing
6. Birds coming between the warps and the stern during 5 minute count	Warp strike proxy	7	During fishing
7. Birds on top of the net	Net capture proxy	11	During hauling or shooting
8. Birds in the pooling area during shooting	Internal net capture proxy	2	During shooting
9. Large seabirds coming within 10m of warp during 5 minute count	Warp strike proxy	1	During fishing
10. Snap count of birds within 5m of warp once a minute for five minutes	Warp strike proxy	4	During fishing
11. Snap count of birds within a box extending 10m from the stern once a minute for five minutes	Warp strike proxy	2	During fishing
12. Snap count of birds within a box extending 20m from the stern at doors up, kite onboard and codend onboard	Net capture proxy	2	During hauling
13. Continuous count of birds within a 1m box around the warps	Warp strike proxy	2	During fishing
14. Continuous count of dives by birds around the net	Net capture proxy	2	During hauling
15. Continuous count of birds within 1m of the net	Net capture proxy	2	During hauling
16. Snap count of birds within 5m of the net at the point the codend surfaces	Net capture proxy	3	During hauling

17. Snap count of birds within 5m of the net at the point the codend surfaces and the point only the codend is left on the water	Net capture proxy	3	During hauling
18. Snap count of birds within 1m of the net at the point the codend surfaces	Net capture proxy	2	During hauling
19. Snap count once a minute for five minutes of large birds within a 10m box around the stern	Warp strike proxy	1	During fishing
20. Birds between tori lines continuous count	Warp strike proxy	4	During fishing
21. Continuous count for five minutes of birds between tori lines albatross only	Warp strike proxy	2	During fishing
22. Continuous count of birds eating fish	Net capture proxy	2	During hauling
23. Continuous count of birds between tori lines on the water only	Warp strike proxy	1	During fishing
24. Continuous count of birds diving for 5 minutes	Net capture proxy	4	During hauling
25. Birds within a box defended by the bafflers, snap count at doors up, headline onboard and codend onboard	Net capture proxy	1	During hauling

For each count, there was also a list of associated data to be collected (Figure 1). This included environmental and technical information about the vessel equipment, as well as recording discards and any relevant comments.

Once the count was completed and all information recorded on the sheet this was then transferred to a spreadsheet. A separate document was kept describing each count in detail and assessing the protocol being trialled. Here, comments were made on the

difficulty of using each protocol in person, the relationship between each protocol and bird activity, as well as any useful observations such as bird behaviour or vessel activity.

STow (S/M/E)		Comments		
Observation point				
Area of count				
Protocol				
Swell height/direction				
Wind speed/direction				
Current speed/direction				
Vessel speed/direction				
Turns during count				
Cameras		Discards Y/N		
Bottom depth		Type (all that apply)	Continuous/batch	Quantity
Mitigation gear in use				
Trawl gear				

**Figure 1.** Data sheet used during the trial

## 2.2 Cameras

Different camera options were considered for use in the trial (Table 2). Previous DOC projects have utilised all three options in various specifications. In the end however GoPro Hero 12 cameras were selected. The main reasons behind this choice were the low cost, high quality and adaptability. Being able to easily position the cameras prior to sailing without having to mount semi-permanent security cameras minimised the amount of preparation. The goal of the trial was to experiment with the protocols and so the cameras themselves could be of a lower cost. If the trial showed the protocols to be effective but the equipment less so, further experimentation with different camera setups would then be possible.

**Table 2.** Pros and Cons for different types of camera installation.

<b>Approach</b>	<b>Pros</b>	<b>Cons</b>
<b>GoPro</b>	Cheap cost Temporary installation Easy to move Good for proof of concept High quality, wide angle	Limited battery life / hard to power continuously. Manual footage retrieval and download Limited resolution options Need to access camera for footage retrieval, battery changes and lens cleaning– limits mounting location
<b>Security camera</b>	Moderate cost Can be set up to record straight to hard drive – hassle free operation “Off-the-shelf” hardware Many resolution settings Flexible mounting options Cameras are cheap Options for easily adding (for example) thermal cameras Approach proven on inshore fleet.	Probably needs to be wired (solar powered wireless cameras are an option) Cameras likely to have limited lifespan Lenses would need cleaning - limits mounting location
<b>Marinised camera</b>	Pros as per security camera, except cost	Expensive
<b>High spec security camera</b>	Can be gyro stabilised Self-cleaning cameras available Fully sealed cameras available, which would last longer More specialised hardware	Need to be wired

Three of the GoPro Hero 12 cameras were purchased along with other necessary equipment. This consisted of:

- Three magnetic door and charging cable kits
- Three tube clamps
- Three SD cards
- A GoPro Bluetooth remote
- A 5TB hard drive

There are a wide variety of frame rates, video quality, field of view and other options that can be changed. In this instance, all three cameras were set to record in 1080p HD, 60fps. Neither of these settings are the maximum capable from the camera, but these were selected to reduce the amount of data produced.

The positioning of the cameras was done by the observer in conjunction with vessel and Seafood NZ staff prior to sailing. The arrangement consisted of two cameras mounted on the fantail, one pointed at a sharper angle down to capture the area immediately behind the doors, with the other aimed at a higher angle and using a wider field of view.

Another camera was positioned on the port side looking down at the vessels discard chute.

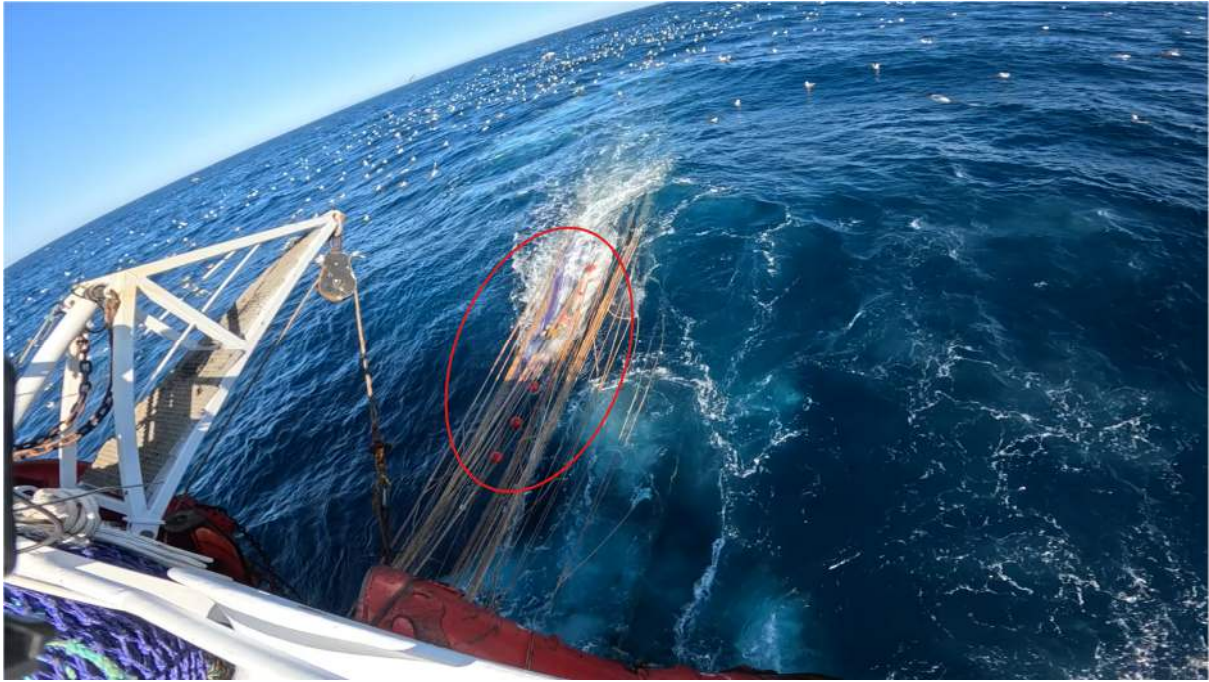
To allow the cameras to be continuously powered using the magnetic doors a system to provide power to the stern of the vessel was installed by contractors. This consisted of wires running from another power source connected to two waterproof boxes at the stern, from which the magnetic cables could be used.

## 2.3 Vessel

The vessel chosen for the trial was a Sterkoder vessel, built in Norway. There are six of these currently fishing in New Zealand waters. The vessel mainly targets hoki and is equipped with both Baader 192 and Baader 212 filleting machines. It has a meal plant which can process all offal and bycatch produced at maximum production, except for large quantities of silver warehou heads, which contain high oil quantities and block the hasher. These are usually discarded. The freezer hold can take over five hundred tonnes of frozen product and voyages usually last 4-6 weeks.

### 2.3.1 Midwater trawl

Fishing on this trip was based mainly around the hoki spawn. On the west coast, fishing began as the spawn began to tail off but there were still significant quantities of midwater fish, particularly at night. Once fishing had tailed off on the west coast and the vessel had made it around to Pegasus canyon, midwater fishing resumed again, mainly at night. The large size of the midwater trawl net, with a headline height of around 60m, meant that large catches of fish were routine. No bird captures occurred with the midwater net until fishing on the east coast. The midwater trawl net surfaces a significant way behind the stern (up to approximately 250 metres behind) and takes a long time to sink. This greatly increases the risk of birds getting into the net but did not seem to be an issue on the west coast.



**Figure 1.** Hauling of the midwater net showing the headline monitor coming onboard

### 2.3.2 Paired bottom trawl

Most trawling done by this vessel is with a paired bottom trawl system. They have a greater wingspread than single trawl nets, which does mean they have a larger pooling area when at the surface. However, due to the weight of the extra ground gear they typically surface at the stern, with the headline coming straight out of the water up the stern ramp. The time between headline reaching the surface and the codend coming onboard was usually between 2-4 minutes. Twin trawls also sink very rapidly during shooting, again reducing the risk of bird captures significantly.

### 2.3.3 Single bottom trawl

Two kinds of single bottom trawl were used during the trip. The first was simply a single net from the twin trawl system. This was employed at some points during the trip when the weather was too rough to use the twin trawl and the dedicated single trawl was not yet rigged up on the secondary roller as the vessel was still using midwater gear at night. Later in the trip they switched to a dedicated single trawl system. This was larger in size but functioned broadly the same. Both were slower to sink and quicker to rise than the twin trawl but much less so than the midwater net. Because of the smaller size there was a smaller pooling area for birds to be caught in. No captures occurred in either of these nets.

#### 2.3.4 Mitigation

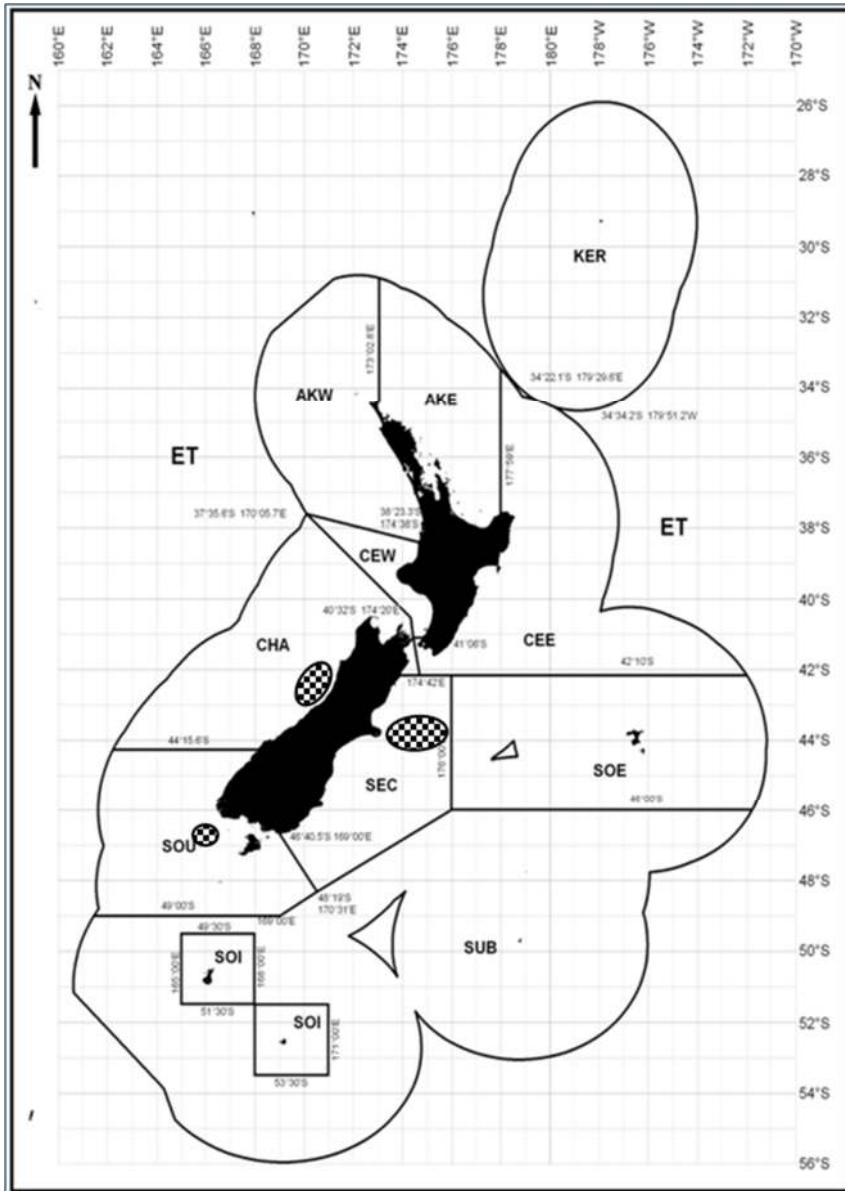
Bird bafflers were run continuously throughout the trip. These bafflers were a simple design consisting of a single pole running perpendicular to the vessel from the sides. The droppers reached the water and would scare birds to an extent, but the observer noted while observing bird behaviour at the stern that seabirds could easily keep up with the bafflers during towing and feed immediately behind them. The effectiveness of these bafflers at deterring birds seemed limited, based on observations during the trip. In contrast, the tori lines were very effective at keeping birds away from the warps, at least during calmer weather. In strong winds they were prone to being blown over the warps which would enable birds to feed on the windward side of the vessel. During calm weather they were perceived to be effective and it's notable that the three warp captures all occurred during strong winds. None of the captures were recorded on the cameras however and so this is just based on observations from the trip.

### 3. Results

For this voyage, the vessel departed Nelson in late August steaming directly to hoki grounds off Greymouth in Fisheries Management Area Challenger (FMA 7) (Figure 2). Fishing commenced with hoki being the target species using the twin bottom trawl, single bottom trawl, and midwater trawl. The vessel fished in this area until early September when it steamed to FMA Southland (FMA 5) and fished there for a few days. The vessel was then ordered to head north to Pegasus canyon off Christchurch in FMA South-east Coast (FMA 3). Fishing began there in mid-September and continued until the end of September. Fishing on both the east and west coast generally consisted of bottom trawling during the day and midwater fishing at night, when hoki follow feed up into the water column and the large spawning aggregations can be targeted effectively.

The weather was typical for the time of year, with rough weather followed by prolonged calm periods, with "glass off" conditions for much of the trip. The weather complicated the camera trial, as the vessel would usually restrict access to the stern in particularly rough weather. This caused issues if the cameras disconnected from the Bluetooth remote as it wouldn't be possible to reconnect them until the weather calmed down.

The average time between hauling and doors up was 15 minutes for the bottom trawl and 18 minutes for the midwater.



**Figure 2.** Map of fishing grounds

### 3.1 Effectiveness of protocol types

The protocols which most accurately captured bird activity tended to be the most difficult to undertake through in person observations. A continuous or full count of birds provided the most complete picture of bird activity but was difficult to do due to the sheer numbers involved. The best option for observers which simplified counting but also illustrated how bird numbers can change during an observation was to conduct snap estimates. These were done once or twice a minute for five to ten minutes, or at key points during a haul or shot such as when the headline and codend came onboard. They could be done with relative accuracy as shown in Table 3.

**Table 3.** Comparison of results from a count using protocol 11.

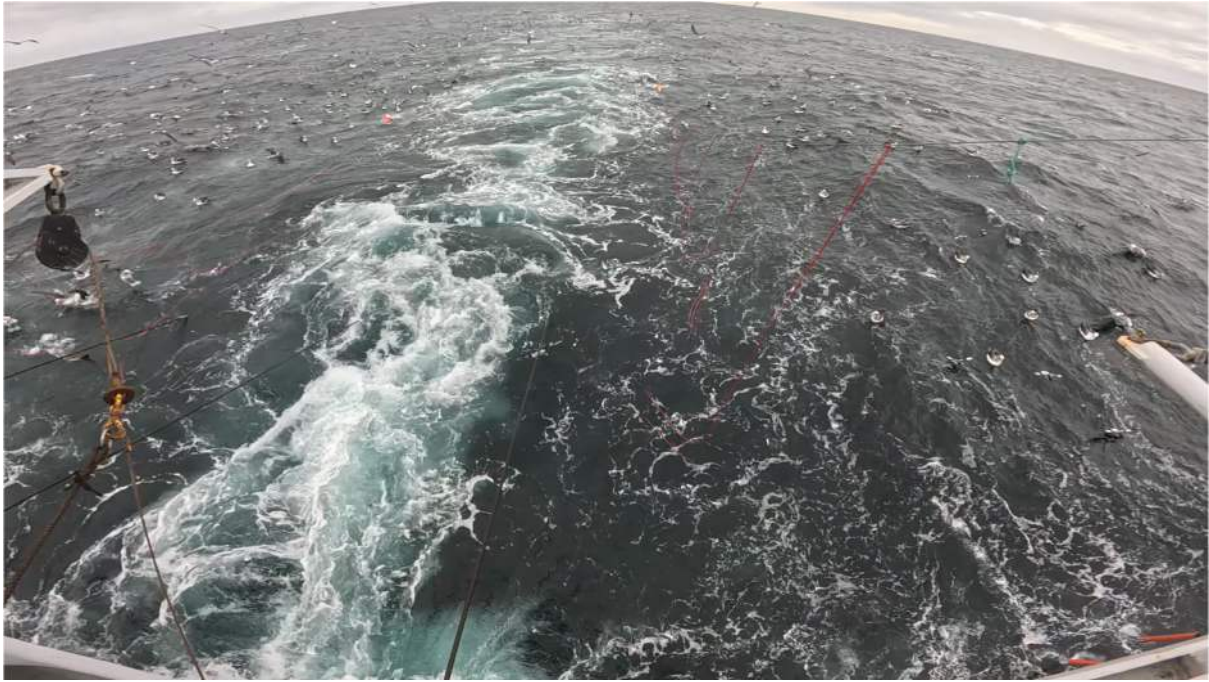
Time (minutes)	XCP		XMA		XTP	
	In person	Camera	In person	Camera	In person	Camera
1	50	45	2	2	0	0
2	40	40	3	4	1	1
3	5	4	1	1	0	0
4	20	15	1	1	0	0
5	5	5	1	1	0	0

**Table 4.** Comparison of results from a count using protocol 21.

Time (minutes)	XMA	
	In person	Camera
1	9	9
2	11	10
3	7	7
4	9	9
5	8	7

Counts of seabird behaviours such as eating fish or climbing on top of the net were simplest to count but probably don't provide a particularly good indicator of overall seabird behaviour and actual risk. On a trawl net there are multiple places where birds can be caught, ranging from the pooling area of the headline to the chafing material of the net. Both areas caught seabirds during the trial trip. Because of this, counting a singular risky behaviour, such as diving, may work very well to quantify the risk to birds within the pooling area, but doesn't account for other ways that birds can be killed or injured in a trawl net.

In person counts of seabirds can be challenging. Both the vessel and the birds themselves are in constant motion, which can completely change the view from one moment to the next. Frequently there can be hundreds or even thousands of birds following a vessel at any one time.



**Figure 3.** Birds feeding on discarded offal during towing

Even during periods of decreased abundance, such as during towing when no offal is being discharged, certain styles of count can still be difficult to achieve accurately. This is particularly true when attempting to accurately count every bird for a continuous period.



**Figure 4.** Birds behind the vessel when no offal is being discarded

The two main types of count trialled during this trip were continuous counts and snap counts.

- Continuous counts have the advantage of accounting for every bird during the count period. A continuous count of birds within a risk area, for example within 5m of a warp, will show exactly how many birds have come into that area during the count period. This method is difficult to do accurately with anything other than extremely low bird abundance. Based on the experience of the sea trial this method is too difficult for observers to do consistently.
- Snap counts are singular abundance counts/estimates done at set intervals. During warp observations this usually was every minute or second minute for a set period. This method provides a snapshot of the total abundance at that instant. It is useful for seeing changes in abundance over time, such as during hauling when bird numbers typically increase dramatically from the point the winches start to the codend coming onboard. Continuous counts are difficult to do at this stage because of the sheer number of birds. This also means accuracy is limited even if attempting to do a continuous count, as there is very likely to be double counting.
- During hauling or shooting snap counts were usually done at important points such as when the headline came onboard. This was a much simpler method to use as quick and accurate estimates could be used (see table 3, reducing the time spent counting and allowing the observer to conduct other duties while still recording good data.

After trialling the 25 different protocols, it was determined that two protocols, which were very similar in nature, worked the best. Protocol 10 (as shown in Table 2) was the most effective for warp observations and protocols 16-18 worked well for net observations. Both were snap counts of birds within a set distance of the warps or of the net, whichever is applicable. For this trial distances of between one and five metres were used for both protocols, and different distances may be more suited for other vessels.

The main advantages of this proximity-based method over others were as follows:

a. Consistency

- Using a distance-based metric simplifies the issue of applying the protocols across the wider fleet. Quantifying the difference is relatively simple as it is only based on the length of the net, a metric that is simple for observers to measure. This removes one of the issues that arose from counting birds within the pooling area of the headline, namely that

different trawl gear configurations have significantly different size pooling areas, which can also change from tow to tow. By accounting for net length, it's possible to make a direct comparison between different vessels and mitigation practices, by comparing birds per square metre within the risk zone.

b. Proxy

- While certain behaviours exhibited by the birds, such as diving around the net or landing on top of it, may be riskier than simply being within a certain distance of the gear, counting a single behaviour is both difficult and doesn't fully capture the risk. This method has the advantage of including every part of the net, from the headline to the codend, and assuming a retained risk simply from being in proximity to the gear.

c. Simplicity

- Both protocols were simple to understand and simple to count. Using behavioural indicators, such as birds diving, leaves room for subjectivity. The only subjective part of this protocol is the distance, with people likely to judge distances slightly differently. These differences can probably be minimised by relating it to a known distance (such as the height of the fantail above water or the length of warp out of the water). This instruction can be included on the data collection forms.

### 3.1.1. Net capture protocols

For net captures, recording birds inside the pooling area between the headline and the stern was also an effective method but doesn't necessarily capture every potential area where a capture could occur, highlighted by two bird captures that happened in the chafing material on the codend during this trip. Counting birds within the pooling area may be a better method in some contexts that needs exploring further. This method is better for assessing the risk of internal net captures but may miss external captures.

### 3.1.2. Warp strike protocols

Warp observations need the same data collected for net capture observations for every count with the addition of:

- Tori lines in use Y/N
- Tori lines cover aerial extent of warp Y/N
- Tori line average distance from warp, inside or outside
- Is the vessel discarding, and is this whole fish, minced or just through sumps
- What quantity is being discarded

- Is this coming from one side or both sides of the vessel



**Figure 5.** Tori lines sitting close to warps during towing

### 3.2 Camera functionality

The cameras broadly performed as expected.

Counts by the observer and the camera when both positioned at the stern were broadly similar. However, differences did seem to occur when:

- Small seabirds, mainly cape petrels, couldn't be picked up on the camera footage
- Judging distance from the cameras alone
- Birds were at the very edge of the cameras field of view

The cameras placed at the stern were significantly better at picking up seabirds compared to observer observations from the bridge. Review of one camera count showed 13 times the number of seabirds than what had been recorded by the observer from the bridge. Most of the counts had a disparity of less than two times and some

observer counts were higher. This could be due to overestimation as the limited field of view afforded from the bridge made estimation necessary for some counts.

- Continuous counts of a behaviour, such as birds on top of the net or birds diving, would be counted in full. This is where the highest disparities could emerge as the net could not always be seen from the bridge. The cameras did provide a better picture for this style of count because they could see everything that was going on, but it could be difficult to determine these behaviours when birds were present in high abundance. This was particularly true of counts of diving birds.
- Snap counts, such as those of birds within a box around the stern or within 5m of the net, were done as estimates. There were far too many birds to attempt to count fully, and so either a rough count or an estimate would be used instead. These were done based on observations of the total number of birds, taken over the whole observation period. This meant that it was possible to estimate the number of birds in the areas which couldn't be seen from the bridge with a degree of accuracy. This wasn't possible with continuous counts, especially those of behaviours, as doing estimates of the number of birds displaying a behaviour wouldn't be accurate. The movement of the vessel, which restricted the view during continuous counts, provided a better view of the area for these counts. This meant that the numbers were generally similar between camera and observer counts, with some observer counts showing higher numbers. Camera footage provided a more accurate number, but was more time intensive.

### 3.2.1 Benefits of using cameras

#### a. Accessibility

Because of health and safety requirements from both the fishing vessel and the observer programme, access to the stern of fishing vessels is restricted during hauling and shooting operations. The stern, particularly the fantail, provides the best vantage point for bird observations. Normal observer procedure when conducting CSP counts is to be on the bridge during hauling to monitor vessel operations, and on most fishing vessels the bridge has a significantly reduced view of the area at the stern. This is especially noticeable on twin trawl vessels as the trawl doors and clump further reduce the area which can be seen from the bridge. Normally only the view directly down the stern ramp is clear and if the net is paying out to one side of the ramp it can be impossible to even see the codend. The cameras allowed for observations to be made of bird activity during this crucial period.

## b. Review

Recording shooting and hauling events may allow more accurate information on seabird abundance and risk to be collected. The camera footage provides the opportunity to both review any issues that may arise, such as after capture events, as well as monitor the efficacy of vessel mitigation practices. Based on the data gathered during this project (Tables 3 and 4) the cameras are similarly effective as observer counts in capturing the number of birds present, and the ability to review this footage allows for very accurate counts of bird abundance.

## c. Continuous monitoring

Current observer protocols require a bird abundance count to be undertaken at least once a day during fishing on factory trawl vessels. The preference is for these counts to be done during the first daylight haul of each shift. Hauls are normally observed from the bridge of a trawl vessel and so this is where these bird counts are also normally conducted. These counts are typically of birds within 100m of the vessel and are recorded on a conservation services programme sheet. These logs provide an estimate of bird abundance around vessels but only count overall abundance and don't account for behaviour or other trends, unless this is recorded by observers. This means that qualitative data, such as bird feeding behaviour, is missed from these records and therefore can't be analysed. Cameras have the potential to allow long term monitoring of these behaviours by experts back on land who can gain a more accurate understanding of what is happening at sea without the need for extended sea deployments.

### 3.2.2 Disadvantages of using cameras

#### a. Resolution

The cameras recorded in 1080p 30 frames per second to conserve storage. When looking at birds close to the stern it was simple to count and distinguish between large and small seabirds. At times it was even possible to distinguish between different species of albatross. At greater distances this was not possible. When fishing with the midwater net, which would surface at least two hundred metres behind the vessel, it was usually not possible to conduct any kind of review until the lengthener meshes were coming onto the stern. Conducting counts at these distances was difficult in person too, but with binoculars it could at least be attempted. At this resolution the cameras are not effective at capturing bird abundance but still provide other useful data showing the characteristics of different gear on the surface. Higher resolution cameras could maybe improve this but due to the distances involved any possible solution, such

as using a zoom lens instead of wide-angle, will come with compromises in other areas which means it's unlikely to be fully solvable.



**Figure 6.** Midwater net being hauled, showing how far from the stern the codend surfaces.

b. Footage review

The review of the camera footage is time intensive, especially for certain metrics. Warp counts were generally faster to review than net counts. Snap counts are easier to review than continuous counts but require good timekeeping, an issue which came up with the cameras. Continuous counts would have to be replayed numerous times to focus on different sections of the net. Once protocols have been settled on the review process would become simpler, especially for a person doing it consistently.

### 3.2.3 Camera setup

There were several issues that arose with the GoPro cameras specifically.

The main issues were:

a. Power

- At the beginning of the trial the GoPro's were powered continuously from a system installed by contractors before sailing. Custom boxes were wired in to allow the magnetic charging doors to be used. The boxes were not initially large enough to allow the cables to pass through but after some adjustments by the vessel crew during sailing they performed

adequately. Because of the harsh environment the exposed metal prongs of the cable which powered the cameras were all rusted within a matter of weeks. Despite attempts at cleaning and scrubbing these elements the salt had done too much damage and they no longer functioned. After this the camera batteries had to be changed manually which didn't end up being too much of an impediment as they had to be brought inside anyway to offload the footage.

b. Memory

- This was more of an issue as it was time consuming and could interfere with observer duties having to download and delete footage at the end of the day. It required removing the memory cards and manually sorting and labelling the footage, a time-consuming process. Doing it in this way did, however, allow for all footage to be categorised and organised at sea, simplifying the review process. This system worked well enough for the trial but is probably not the best solution long term. For this trial the cameras were set to record at 1080p resolution at 30 frames per second. This was done to reduce the amount of storage required for the footage. Even at this resolution each camera would use approximately 8GB of storage per hour. Higher resolutions use considerably more, which would turn storage into an issue. Due to the low resolution used, speciation was difficult during review. Distinguishing between large and small albatross or albatross and petrels was usually possible, but differentiating species of albatross was usually impossible.

c. Positioning

- The positioning of the cameras was done by the observer in conjunction with the vessel and Seafood New Zealand staff prior to sailing. The arrangement consisted of two cameras mounted on the fantail, one pointed at a sharper angle down to capture the area immediately behind the doors, with the other aimed at a higher angle and using a wider field of view. Because of the clump used for the paired trawl, there is a gantry that extends out from the middle of the stern. This means it wasn't possible to centre the cameras, and they were instead placed on the port side pointing at a slight angle towards the centre. This meant that coverage of the starboard side wasn't quite as good as that of the port side.

d. Communication

- One camera was positioned on the port side looking down at the vessels discard chute. During the voyage when the vessel began discarding some offal it transpired that the offal discard chute was through the sump on

the starboard side and the port discard chute was only used for sponge and benthic material. This meant this camera was essentially pointless, but by the time that discards had begun, one camera had already been lost and so the discard camera had been repositioned to the stern.

e. Bluetooth connection

- To initiate recording on all three cameras simultaneously a GoPro Bluetooth remote was used. This functioned well when near the cameras and could be used from the bridge to activate them. When the cameras were receiving continuous power from the charging door the remote would work perfectly without any connection issues. Once these had stopped working and the cameras were switched to battery power only, they tended to place themselves in sleep mode to conserve battery, which seemed to have the effect of reducing the effective range of the remote. Oftentimes this meant that the cameras could not be activated from the bridge and this meant that many counts took place without attached camera footage. Switching to battery also caused the cameras to forget the remote's Bluetooth signature, meaning that even if they were active, they would not connect. This required accessing the cameras themselves to reconnect them, something that took time and wasn't possible during fishing operations.

f. Timekeeping

- To accurately review counts, particularly warp observations which are all based on set times, accurate timekeeping was extremely important. It emerged during the sea trials that the cameras have slightly different times despite syncing up to the same device on several occasions. The time recorded in the metadata for each video was also out by half a minute, further complicating syncing up footage. These issues made review impossible for some counts.

g. Lighting

- Glare from the sun reflecting off the sea surface was an issue when towing away from the sun. This could make it very difficult to see birds within the affected area. This issue could potentially be solved with the use of polarised lenses that can be purchased from GoPro.
- The cameras did function well at night but only within range of the vessel's lights. Birds within the light cast by deck lights were easily picked up, however outside of this area counts were not possible. This made hauling

and shooting observations, particularly of the midwater net, difficult to undertake.

Some positive features of the GoPro system did emerge, namely:

a. Durability

- The cameras themselves, magnetic door aside, were very tough and handled the harsh conditions very well. No issues occurred with the cameras themselves and they consistently worked. Issues occurred with other associated gear, such as the clamps used to mount the cameras and the remote, but the cameras themselves performed very well.

b. Adaptability

- Because of the nature of the camera mounts it was relatively simple to change the position of the cameras as needed throughout the trial. When one camera was lost during vessel operations it was very simple to take the discard camera and reposition it. More permanent fixed systems would struggle in this regard but would of course be set up better.

### 3.3 Bird behaviour

The first part of the trip was on the west coast of the South Island in FMA 7. Fishing was focused on the canyons off Greymouth and Westport for the HOK spawn and this vessel as well as others had already been fishing these grounds for at least two months. The hoki spawn was coming to an end and so the number of vessels fishing in the area was decreasing as the fish got less abundant. Because of these factors there were several hundred birds following the vessel. Smaller species, mainly the cape petrels (XCP) and *Procellaria* petrels (XPC), as well as the occasional albatross and giant petrel (XTP) would feed on the offal coming from the sumps during processing.



**Figure 7.** Buller's albatross (left) and white-capped albatross.

Greater albatross (XGA), white-capped albatross (XWM) and Buller's and Pacific albatross (XPB) (Figure 7) would arrive in large numbers during hauling (Figure 8) and feed on stickers and any fish falling from the codend. The large birds especially were feeding aggressively, and competition was fierce for any fish that fell or could be pulled out of the codend. The species and abundance of birds stayed roughly the same during the three tows conducted in FMA 5. No birds were captured during fishing on the west coast.



**Figure 8.** White-capped and Buller's albatross behind a trawl vessel off Greymouth

After steaming to the east coast in FMA 3, fishing began in the Pegasus canyon. The species makeup changed with the XPB's and XWM's being replaced largely by Salvin's albatross (XSA) (Figure 9) which were present in the hundreds. These birds breed at the Bounty islands and breeding season runs from August-April which meant birds were even more aggressive than on the west coast. Bird numbers slowly increased as fewer boats were fishing inside the canyon. It was not uncommon to see 300-400 XSA within 100m of the stern with even more birds further behind the vessel. More birds were observed exhibiting risky behaviour (such as diving within the headline) than on the east coast, which is where all bird captures occurred. None of these captures were recorded on video as the events were at night or during rough weather when the cameras were not connected.



**Figure 9.** Salvin's albatross

## 4. Discussion

### 4.1 Warp strike protocols

The warp strike protocol (protocol 10 from Table 1) is suitable to be used across the wider fleet, with minimal changes needed. Warp observations should consist of five-ten snap counts, taken at one or two-minute intervals of birds within a five-metre box around the point where the warps enter the water. Five-minute counts are an attractive option, as they reduce the time needed for in-person observations and leave observers free to complete other duties.

If these are being done solely in person, or solely using cameras, timekeeping isn't as important. If the goal is to sync up the footage with the observer count, better care needs to be taken. A possible way to do this is to flash a card or some other indicator in front of the camera at the point where the count begins.

Extra variables should be noted when conducting these observations, to allow for comparisons to be made between different mitigation practices. While standardising the distance being counted would simplify review and comparison, having the flexibility to change the count distance based on environmental and technical variables would allow for more precise counts. This was particularly noticeable when using tori lines, as using distances of less than five metres would mean that only birds within the area "defended" by the tori lines were counted. This system would complicate comparisons

between vessels however and so it's simpler to stick with a set distance of five metres. Ideally these counts should be done randomly to ensure the representativeness of the data, but it's likely that they'll be focused on higher risk periods, particularly when the vessel is discarding. Conducting counts both when discarding and not discarding is important to enable comparison. This may be more difficult on some vessels in the deepwater fleet, particularly Korean trawlers which discard regularly.

## 4.2 Net capture protocols

More work is needed to properly refine the net capture protocols. This trial was able to narrow down the preferred option to a count of birds within a set distance of the net (i.e. protocols 15-18 in Table 1). Further experimentation on different vessels with different gear configurations is needed to determine whether it is preferable to conduct a singular count at the point the codend reaches the surface or to conduct further counts during hauling.

Potential options include:

- A count at every point the brakes are put on the winches after the codend reaches the surface
- A count at the point the codend surfaces and another when everything but the codend is onboard

One advantage of a single count is only needing to estimate net length once per count. This is a relatively minor detail but is one more thing to consider during the count when attention is best focused on birds. One disadvantage is that the period at which bird abundance is generally highest around the net is usually a half a minute to a minute after the codend surfaces. This gives the birds in the area time to congregate. Counting at the moment the codend breaks the surface may miss this peak. By doing another count when the codend is almost onboard it would be possible to demonstrate how numbers increase during hauling, as while there may be fewer birds within the 5m risk zone the surface area being counted is also significantly smaller.

There were numerous different options trialled for the net capture protocols. Having selected the best options for further trial it will be important to compare these across different vessels in the wider trawl fleet. One of the reasons these protocols were selected was because of their adaptability. It's difficult to foresee any major issues arising on different vessels but that will have to be tested.

Something that wasn't tested at sea but is could also be an option, is the use of multiple protocols. This would mean utilising different metrics which more accurately capture risk in different areas, such as internal vs external net captures. This could involve counting behaviours (such as birds diving on the headline for internal, birds on top of the net for external) or simply abundance in different risk zones (such as birds within

pooling area for internal, birds within 5m of the net for external). This method has the advantage of individually accounting for different risk areas, instead of assuming a retained risk from simple proximity, but is more time consuming and might not be doable in person during crucial periods. For example, attempting to count both birds on top of the net and birds diving within the pooling area would be very difficult to do simultaneously because the observer would have to focus on two separate areas of the net. Attempting to do these counts one after the other would also produce difficulties, as there is only a brief window during which the net is at the surface to conduct the counts, at least with bottom trawl gear.

### 4.3 Cameras

Results from the camera trial demonstrated a few key points.

Firstly, cameras have the potential to be very useful in quantifying the relative effectiveness of seabird mitigation options, particularly when data collection is required in areas observers cannot safely access.. There was a comparable level of accuracy to in-person observations, albeit at times with less detail. This meant that species level identification wasn't usually possible. Whether or not species identification is needed is a different question, but there are a couple of ways this issue could be overcome.

- a. Linking camera footage to overall abundance estimates done by an observer. For instance, if cameras record 150 small albatrosses within the risk zone and the observer records 200 Salvin's albatross and 50 Buller's albatross around the vessel, it could be assumed that the ratio probably remains the same in both instances. In practice, however, as demonstrated by this trip, different species tend to feed differently. Birds foraging during breeding season are more aggressively competing for food than those that aren't. This led to a disparity in numbers between species in the highest risk zones. Because of this, it probably isn't practical to attempt to link camera footage to observations for species identification.
- b. Recording in a higher resolution is potentially a better way to solve this issue. Reducing the number of cameras from two or three to just one, set to record in 4k60fps, would produce similar levels of data but of a much higher quality. Most of the footage reviewed for the project ended up coming from just one camera anyway, so increasing the quality of data from this camera makes sense. Most footage was reviewed from the wide angle camera as the view from the camera with the narrow field of view was no better for identifying birds close to the vessel and sometimes missed birds towards the horizon as it was pointed further down. The main reason to use two cameras is to capture a better view of both sides

of the stern. Because of the gantry blocking the view from the centre of the vessel, the cameras were set up on the port side. Having one on the port and one on the starboard would have produced better results than having two set at different angles on the same side. On other vessels without the gantry, it may be possible to get a full picture with only one camera positioned centrally, but this would have to be experimented with. For this style of vessel, having two cameras to capture both sides of the stern would be advantageous. Previous trials on smaller fishing vessels haven't had issues with video clarity as there is a smaller area being recorded (Goad & Peatman, 2021). It seems likely that increasing the resolution would almost certainly deal with the issues that arose from filming in 1080p.

Having the temporary GoPro setup was an advantage when working with the companies, as it doesn't have the same connotations that the security cameras do. With the sensitivity around recording onboard fishing vessels, increased public scrutiny and the contentious nature of the MPI camera program on inshore vessels, the temporary nature of the deployment made setting up the trial significantly simpler.

Another interesting option that would facilitate this data collection was raised during discussions with the officers onboard the ship. A lot of factory trawlers have a system of onboard cameras allowing the bridge crew to monitor important areas. On this vessel this included the winches and several views of the engine room. Other vessels use cameras inside the factory and at the stern where crew operate. These cameras feed to a monitor on the bridge which can be cycled to show different views as required. In cooperation with the fishing companies and the vessels themselves it could be possible to tap into this system and install extra cameras for the purpose of conducting bird counts. This would benefit both the observer and the vessel crew, allowing a better understanding of what happens during the crucial moments of hauling and shooting. Counts employing the protocols developed during this project could potentially be conducted in real time from the safety of the bridge, providing the superior view offered by cameras as well as removing the need for time-consuming review.

This internal camera system would have to be tested in another trial to confirm if it is effective, but it does seem promising. This avenue is worth pursuing for other reasons as well. It took nearly three months of review before the footage was sent to DOC for review. If this project was to be rolled out across more vessels this process could take significantly longer. If all data collection and review could be completed at sea it would simplify folding this project into existing observer work. This is the preferred option and needs to be discussed further with industry.

Another interesting technology that's showing promise is artificial intelligence (AI). MPI is already developing AI software to streamline review of the onboard monitoring

cameras in the inshore fishing fleet. Overseas AI has been used to monitor seabird colonies onshore (Schenkler et al., 2025), to check compliance with mitigation devices (Acharya et al., 2024) and is being trialed in Australia to conduct counts of seabirds behind fishing vessels. Current AI may struggle to deal with the number of birds behind the large trawlers in New Zealand compared to overseas, but as the technology progresses it has significant potential. The ability to count bird abundance in real time, without the need for human involvement, is a tantalizing possibility. Assuming these AI models are developed successfully it would be important to test the AI's ability at counting using the protocols developed in this trial by trying it on camera footage.

## Conclusion

The protocols developed here are ready for use in further trials by observers in the large vessel trawl fleet. The new warp strike protocols are ready to use and need minimal development. Further refinements would be beneficial for the net capture protocols, mainly determining whether the single metric of birds within five metres of the net is sufficient or whether using multiple metrics to account for internal and external net capture risk is more suitable. The protocols provide a good system for capturing bird abundance in risk areas, allowing a comparison to be made between trawl gear and mitigation equipment across different vessels. A copy of the draft data collection forms for observer use is available in Appendix 2. The cameras in this trial were effective at recording bird abundance in high-risk areas and with some adjustments could be a very effective monitoring tool for assessing the relative effectiveness of seabird bycatch mitigation options. Further developments in technology will likely only increase their usefulness further.

## References

Acharya, D., Saqib, M., Devine, C., Untiedt, C., Little, L. R., Wang, D., & Tuck, G. N. (2024). Using deep learning to automate the detection of bird scaring lines on fishing vessels. *Biological Conservation*, 296, 110713.

Goad, D. and Peatman, T. 2021. Hauling mitigation for small longline vessels. MIT2018-02 final report prepared by Vita Maris for the Conservation Services Programme, Department of Conservation. 34 p. Available at: [www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/202021/hauling-mitigation-for-small-longline-vessels/](http://www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/202021/hauling-mitigation-for-small-longline-vessels/)

Koopmann, M.; Boag, S.; Tuck, G. N.; Hudson, R. 2018. Industry-based development of effective new seabird mitigation devices in the southern Australian trawl fisheries Endangered Species Research 36: 197–211, 2018. doi:10.3354/esr00896

Large, K.; Berkenbusch, K.; Richard, Y.; Neubauer, P. 2024. Warp strike mitigation in large-vessel trawl fisheries in New Zealand. Final report prepared for Department of Conservation. 33 p. Report prepared for by the Department of Conservation, Wellington. Retrieved from <https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202223-annual-plan/mit2022-05-large-vessel-trawl-warp-mitigation-final-report.pdf>

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 Ministry of Fisheries contract IPA2006-02. Retrieved from: [https://files.dragonfly.co.nz/publications/pdf/Middleton\\_Abraham\\_2006\\_WarpStrikeTrials.pdf](https://files.dragonfly.co.nz/publications/pdf/Middleton_Abraham_2006_WarpStrikeTrials.pdf)

Schekler, I., Halabi, E., Sapir, N., Shimshoni, I., Hatzofe, O., Perlman, Y., & Kiat, Y. (2025). Integrating AI into ecology for fully automated monitoring of endangered seabird breeding colonies. *Ecological Informatics*, 103380.

## Acknowledgements

Thanks to the following people for making this report possible.

The officers and crew of the vessel for their time and patience, willingness to help and their professionalism.

The shore staff at the company for facilitating the installation of the cameras and for all their work behind the scenes.

Ben from Seafood NZ for sorting the logistics, organising cameras and generally liaising between all the parties involved.

Igor and Tiffany at DOC for help and support throughout the project and review of the report.

## Appendix 1: Protocol development

From MIT2024-06 Large vessel trawl seabird mitigation data collection report by D. Goad

### Developing data collection fields and protocols

Suggestions for protocols to be trialled at sea are outlined below. Further refinement and selection (or addition) of specific metrics would be necessary during at-sea trials to match the time available for observation and the suitability of suggested metrics. Compromises will have to be made, especially for real-time in-person observations. This is not a problem per se as the aim would be to test whether similar results are obtained from the camera versus in-person observations. The limitations of camera footage should also be explored, for example in terms of species identification and how well counts from a limited field of view correlate with total abundance. Linking in-person observations to camera footage with accurate timekeeping will be necessary.

General descriptions of bird behaviour and flight paths should also be made under different conditions. Whilst only subjective these may provide insights into reasons why, for example, bafflers are more or less effective under certain conditions.

### Protocols to assess baffler / tori line efficacy

Warp strike protocols can remain largely unchanged but, as per Appendix 2, should include:

- Linking recovered birds to particular warps / tows
- Recording birds which fell off warps during the haul
- Recording whether the observer was watching the whole haul
- Warp length
- Water and net depth
- More detail around discarding including estimated quantities, species, and state.

Additional metrics to be collected to provide proxies for warp strike risk and monitoring of baffler efficacy include:

- Describing the area 'defended' by the baffler – this is reasonably easy in terms of square metres for a 'burka baffler' which encloses an area astern. For 'Brady bafflers' this is less explicit and so boom length may be appropriate.
- Assessing how much of the warp is protected by a 'burka baffler' and how often. The proportion (or estimated length) of the warp 'unprotected' (outside the droppers) should be recorded.
- Assessing how well birds are excluded from the protected area – Another repeat 'CSP' count inside the protected area or counts of birds moving into the area in a set time period.

- A proxy for warp strike: Define a ‘danger’ or ‘risk’ area. The metric would be either birds moving into that area in a set time or a periodic snapshot count/estimate. Candidate areas include:
  - Five metres either side of a warp
  - An arc behind the vessel
  - A box bounded by the stern of the vessel and where the warps enter the water
- The ability to split counts of birds by whether they are in the air or on the water, and by species group, should be investigated. This may be difficult for in-person observations. Choosing to look at albatrosses only may be an option when abundance is high.
- Linking to baffler specification

Covariates should include:

- Swell height and direction relative to the vessel
- Wind strength and direction relative to the vessel
- Net depth
- Warp length (net depth and target species could be a proxy for this)
- Block height
- Turns during observation period
- Fish waste discharge during the observation period, including
  - Type (offal, minced, sump pumps, whole heads, whole fish etc.)
  - Frequency
  - Quantity
  - State
  - Species
  - How it is controlled (leading hand, factory manager, skipper/mate)
- Bird abundance within 100m semi-circle astern (a CSP bird count)
- Other mitigation (tori lines)
- Vessel approach to mitigation including the plan they are operating to, whether ‘extra’ mitigation is in place in response to perceived risk.

### Protocols to assess risk of net capture during shooting and hauling

Assuming bird bafflers continuously provide a degree of protection a similar approach can be taken during shooting and hauling.

Instead of defining risk areas relative to the warps, areas relative to the net should be considered.

Candidate risk areas or counts include:

1. Count of birds on the net
2. Within five metres of net

3. Between the stern and the headline
4. Between the stern and the codend
5. Between the headline and the codend
6. Successful 'steals of fish' from the water or net
7. Dives on the net
8. 'Dives' between the stern and the net (note the definition of a dive can be flexible – it may be looking underwater or fully submerged, or include landing on the water)

A similar list of covariates may be appropriate, with the addition of:

- An estimate of the size of the 'pooling area'
- Appropriate gear metrics to act as proxies for the 'pooling area' size including:
  - Mesh sizes
  - Headline length
  - Design headline height
  - Use of net restrictors
  - Design wingspread
  - Trawl type – MW vs BT vs multi-rig
- Whether the gear had to be cleared or not i.e. needing to put the brakes on the winches during shooting
- Fish loss from the net should be quantified and split by whether it is through meshes or windows or burst bags.
- The abundance / presence of marine mammals
- Whether stickers are removed prior to shooting

## Appendix 2: Draft Protocol and Data Collection Forms

### Instructions for completing the bird observation form

Trip no: Use the trip number, e.g. 1739

Date: Current date

Time: The time the count begins, in NZST

Tow (S/M/E): Tow number for the trip, and what point you're observing. S for start, M for middle and E for end.

1: Where observations are being conducted from. Usually from the bridge or stern, record if other.

2: What type of count is being conducted, either net observation or warp observation, and how long observations are being conducted for e.g. once a minute for five minutes.

3: Beaufort number at time of count.

4: Speed and direction of the vessel at time of count.

5: Bottom depth.

6: Trawl gear number, the same as the MPI trawl gear form e.g. 1BT1.

7: Bird bafflers in use. If yes, record the baffler gear number e.g. B1.

8: Tori lines in use. If yes, record the tori line gear number e.g. T1, T2.

9: Other mitigation in use. If yes, record the gear number.

10: Record yes, no or N/A if not in use.

11: How far from the warps in metres are the tori lines on average.

12: Are cameras in use alongside the in-person count.

13: Are discards happening? If yes, record the type and location.

13a. Discard chute refers to whatever system the vessel uses to deliberately discard offal or whole fish. On some vessels the sumps may be used to discard offal. This is different from the sump column on this form which records whether offal or whole fish from the factory is going through the grating into the sumps. This is usually a yes during processing.

13b. Record if offal is being discharged through the sumps separate to any deliberate discarding.

13c. If answering yes, record where and how in the comments.

Make detailed comments for anything unusual or that may be of interest.

#### [Instructions for completing bird observation form table](#)

In the species column, record each species seen during the count using the three letter codes e.g. XGA for greater albatross. Use generic codes if unsure of species identification.

Use the numbered columns to record the quantity of birds. Each number records one count so for a five-minute count column 1 would be the first minute, 2 the second etc. For a count at points during hauling or shooting, such as when the codend surfaces and when it comes onboard, column 1 would be the first count, column 2 the second etc. In this instance comments need to be made describing when each count takes place.

#### [Instructions for carrying out bird observations](#)

##### Warp observations

The best place to conduct a warp strike observation is from either the fantail or the stern deck. Once in place and ready to conduct a count, find a known distance on the vessel to compare to your count area. For instance, the amount of warp exposed above the water or the height of the fantail above the sea surface. Use this to help estimate 5m from the warp on all sides. Once the count area has been established, use a five-minute timer. Count all birds within the 5m-by-5m box once a minute for this period. Record each count in a separate column.

# Observer Bird Observation Form

Record Yes (Y), No (N), Unknown (U), or Not Applicable (N/A) in the orange box for items 7-13. Make detailed comments if:

- a) you answer other for item 1.
- b) you answer yes to 13c.
- c) you answer U for any question.
- d) you notice anything else of interest, using the item number if relevant.

<b>Trip no:</b>	1234	<b>Date:</b>	26/5/26	<b>Time:</b>	0950	<b>Tow (S/M/E)</b>	104E
<b>1</b>	Observation point (Bridge, stern, other):					Bridge	
<b>2</b>	Count area (time, net or warp):					5 minute warp count	
<b>3</b>	Beaufort number:					5	
<b>4</b>	Vessel speed/direction:					3.5kts SE	
<b>5</b>	Bottom depth:					395m	
<b>6</b>	Trawl gear:					1BT2	
<b>7</b>	Bird bafflers:					B1	
<b>8</b>	Tori lines:					N/A	
<b>9</b>	Other mitigation in use?					N	
<b>10</b>	Tori lines cover aerial extent?					N/A	
<b>11</b>	Tori line average distance from warps?					N/A	
<b>12</b>	Cameras in use?					N	
<b>13</b>	<b>Discards</b>	<b>a. Discard chute</b>	<b>b. Sump</b>	<b>c. Other</b>			
	Whole fish	N	Y	N			
	Offal	N	Y	N			
	Minced fish	N	N	N			
	Batch/continuous	Batch					
Comments							

## Observer Bird Observation Form

Boat was listing slightly to starboard due to wind. Bird activity was focused on the starboard side of the net as minor amount of offal was coming through the sumps and wind conditions made it harder to operate on port side.

Species	1	2	3	4	5	6	7	8	9	10
XSA	4	15	150							
XPB	1	12	12							
XCP	2	4	15							
XGA	3	2	10							
XPC	3	0	3							

--	--	--	--	--	--	--	--	--	--	--