Small longline vessel hauling mitigation development

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Introduction

A proportion of seabirds captured by longliners are caught during the hauling of longlines, and are alive when they reach the vessel (Gilman et al., 2014; DOC, 2011).

Data collected by government observers over the period 2002–03 to 2015–16, and publicly available online (Dragonfly, 2018), provides some indication of the proportion of live captures in New Zealand demersal and pelagic longline fisheries.

Of the 855 observed captures of seabirds in the demersal longline fishery, excluding deck captures, 168 (20%) were alive. When examining the data more specifically 29 out of 66 (44%) black petrel captures and 32 out of 94 (34%) flesh-footed shearwater captures were alive. In the snapper target fishery 54 out of 150 (36%) captures were alive and 24 out of 31 (77%) captures in the bluenose target fishery were alive.

In the pelagic longline fishery 1040 captures, excluding deck captures, were recorded and of these 273 (26%) were alive. Eleven out of 31 (35%) black petrel captures were alive and 12 out of 13 (92%) flesh-footed shearwater captures were alive.

The current risk assessment (Richard and Abraham 2015) includes all live captures in calculating potential fatalities, and also applies a cryptic multiplier. Consequently, reducing live captures has the potential to reduce harm to birds at sea, reduce the estimated potential fatalities in the risk assessment, and contribute to the goals outlined in the National Plan of Action - Seabirds (MPI 2013).

To date regulations (New Zealand Government 2010, 2014) and the liaison programmes (Goad, 2017; Wells & Cleal, 2017) have largely been focussed on reducing the number of dead captures and promoting good handling practices for releasing live birds.

In the pelagic longline fishery observer reports have detailed specific haul mitigation devices in use in New Zealand in both the domestic vessel and joint venture fleets (Filippi, 2012). Gilman & Musyl (2017) demonstrated that a bird curtain over the area where pelagic longline branchlines are retrieved 'holds promise at being both effective at avoiding bird captures during haulback and being commercially viable'.

Mitigation devices employed at the hauling station in bottom longline fisheries, and reported in the literature, are from large autoline vessels (typically over 50 m in length) and aim to fully exclude birds from the area immediately around the line being hauled (Brothers et al., 1999; Snell, 2008; Reid et al., 2010). Skippers in the north-eastern New Zealand small vessel demersal longline fleet (typically less than 15 m in length) report successfully deterring birds from the area around the line during hauling using ad-hoc methods such as controlling discharge of used baits and fish, waving gaffs or arms, water spray, towing floats, and shouting (Goad, 2017). However, no vessels have developed specific deterrent devices such as those employed on the larger automatic longline vessels. The Agreement for the Conservation of Albatrosses and Petrels (ACAP) recommends the use of a bird exclusion device for demersal longline hauling, encircling the entire hauling bay (ACAP, 2016).

Best practice advice from ACAP (2016) considers that 'Ideally offal should be retained onboard, but if that is not possible offal and discards should be either, preferably, retained on board during hauling or released on the opposite side of the vessel to the hauling bay'. This is consistent with the New Zealand requirements for discarding of offal and fish on the 'off side' during hauling of demersal longlines (New Zealand Government, 2010).

Objectives

The specific objectives of this piece of work were to:

- Develop one or more mitigation measures for reducing captures during the hauling of longlines on small vessels.
- Conduct initial testing of these measures during a single trip to sea on a small longline vessel targeting bluenose.

Methods

Methods aimed to make most use of the time at sea and strike a balance between trialling different mitigation options and different data collection protocols, and collecting some representative data in a consistent and robust manner.

Two different mitigation devices were installed on the vessel, and were modified and trialled during the first day fishing (Figure 1).

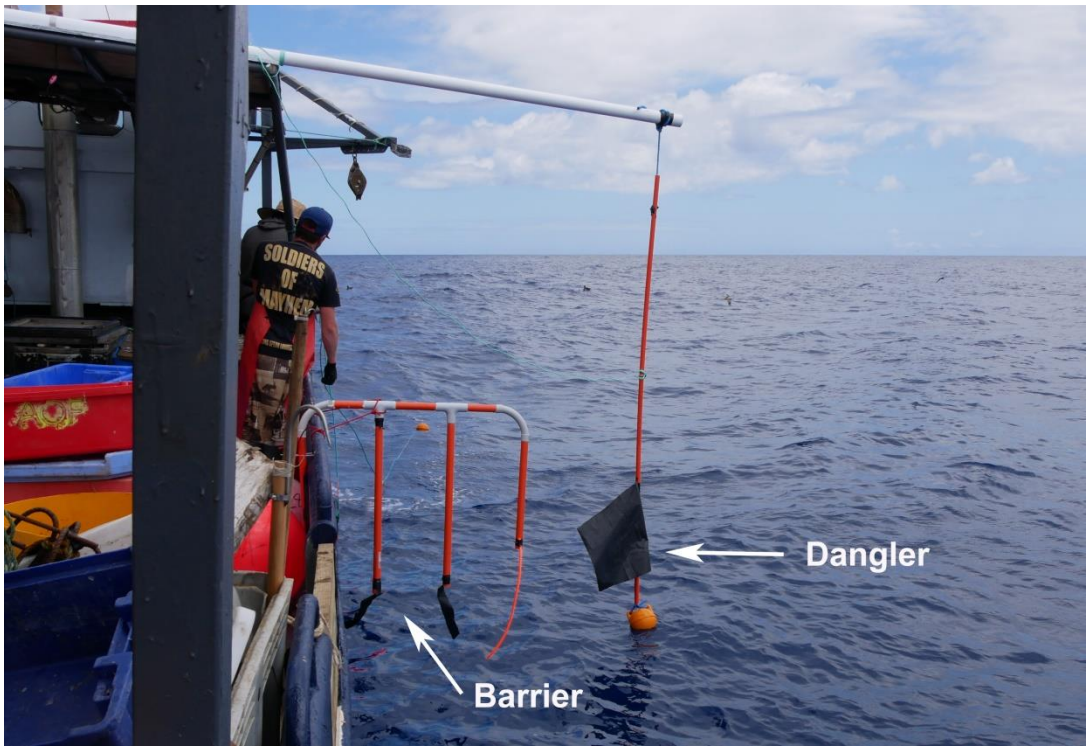

Figure 1: Photograph looking forwards form behind the hauling station showing the two mitigation devices deployed simultaneously.

The dangler was chosen as most promising for quantitative data collection over the following 6 days. Treatments of no mitigation device and the dangler were alternated. Treatments were changed approximately half way through hauls, based on the number of hooks hauled, and at the beginning of each day. For the final two days treatment duration was modified to produce roughly equal sample sizes for both treatments.

Data collection

Environmental conditions and gear setup were recorded including wind strength and direction relative to the vessel, and swell height and direction relative to the vessel.

Each hook hauled was observed for any seabird bycatch.

Quantifying bird behaviour and abundance was split into two protocols, which were alternated during hauling from set three onwards. Typically abundance counts took three minutes, followed by a five minute observation period

Firstly, instantaneous abundance counts were made in separate areas (Figure 2) of:

- Number of birds in the air within 100 m of the vessel
- Number of birds on the water within 100 m of the vessel
- Number of birds within two metres of the longline
- Number of birds in an area two to five metres from the longline

Counts were split into the following categories: great albatrosses, small albatrosses, and small seabirds. Notes were also made on identification to species level, though this was not used in quantitative analysis.

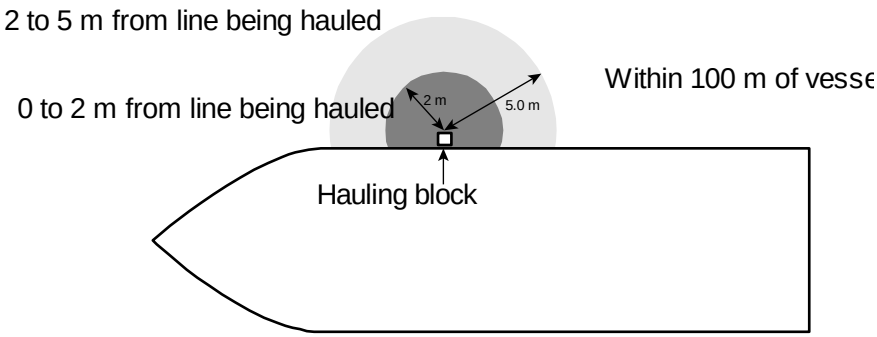

Figure 2: Diagram showing areas used for abundance counts.

Secondly, five-minute observation periods were conducted between abundance counts. During each period counts were made of:

- Number of hooks hauled
- Number of baits returned
- Number of submerged dives
- Number of contacts with baited hook
- Number of contacts with the mainline or a branchline
- Number of times a bird entered the area 0-2 m from line
- Number of times a bird entered the area 2-5 m from line

Observation periods were ended prematurely if hauling stopped, either at the end or the longline or to deal with a tangle or break-off.

Throughout hauling all discarded or lost bait or fish were recorded individually, with the time of discharge.

A go pro camera was set up above the hauling station and used to capture video footage of all longline hauling. Clips were extracted to show bird behaviour and operation of the dangler. Footage from the first haul of each of the last two days of the trip was analysed. The whole of each haul was split into 10 second observation periods and number of individual birds within two metres of the hauling station was recorded for each observation period.

Results

Trip summary

A single trip was undertaken on a 17 metre long bottom longline vessel, north and north-west of North Cape. The skipper typically set two lines per day between 0100 and 0400 hours. The vessel fished clip-on gear and the repeated line sequence comprised a weight and float together, hooks, float, hooks. A mixture of 12/0 and 14/0 circle hooks were set on 500 millimetre long branchlines, with a five millimetre diameter monofilament nylon mainline. Gear was left to soak for several hours and lines were hauled between 0700 and 1400 hours. This gear and operation is typical of deeper water demersal longliners operating in north-eastern New Zealand.

Discarding was controlled as per the vessels normal practices, with baits retained during the haul and then batch discarded at the end of each haul. Sharks were processed and offal was discarded at the end of each haul. Occasionally whole live fish, damaged fish or baits were accidently discarded or lost at the hauling station.

Dangler description

A 3.9 metre long, 62 millimetre diameter, carbon fibre pole was attached to the top of the vessel's shelter deck, using u-shaped clamps, two metres aft of the hauling station. To extend the pole over the side of the vessel at the start of the trip it slid outboard such that the end was 1.8 m from the side of the vessel. A rope was attached to the end of the pole and threaded through a 2.5 metre long 25 millimetre diameter plastic pipe, and tied to a 150 millimetre float. The length of rope was adjusted to hold the float just above the sea surface in calm conditions, and a 500 x 400 millimetre black plastic flag was taped to the pole above the float. The carbon pole remained extended over the side of the vessel throughout the trip and the dangler could be retrieved using a rope to swing it inboard and tie it to the underside of the shelter deck (Figure 3).

Figure 3: Photographs showing dangler stored on the underside of the shelter deck and deployed beside the vessel.

The dangler did not tangle with the fishing line and was easily retrieved and deployed as required. It was deployed prior to starting the haul and was retrieved once all hooks and been hauled on board, and before the anchor was brought on board. On two occasions the dangler was swung inboard and stored part way through a haul – once to allow a thresher shark to be released, and once to deal with a tangle in

the mainline. Feedback from the skipper and crew indicated that they would continue to use the dangler and that it fitted around their fishing operation well.

Bird abundance and behaviour

Average bird abundance within 100 metres of the vessel during the hauling of longlines was 0.3 wandering albatross, 6.7 white-capped albatross and 35 small seabirds. The typical split of small seabirds was 85% black petrels and 15% flesh-footed shearwaters, although storm petrels, sooty shearwaters, grey-faced petrels, and Buller's shearwaters were seen occasionally, in small numbers. There was considerable variation in numbers of birds attending the vessel and albatrosses were noticeably less abundant during the final day's fishing closer inshore and further south (Figure 4).

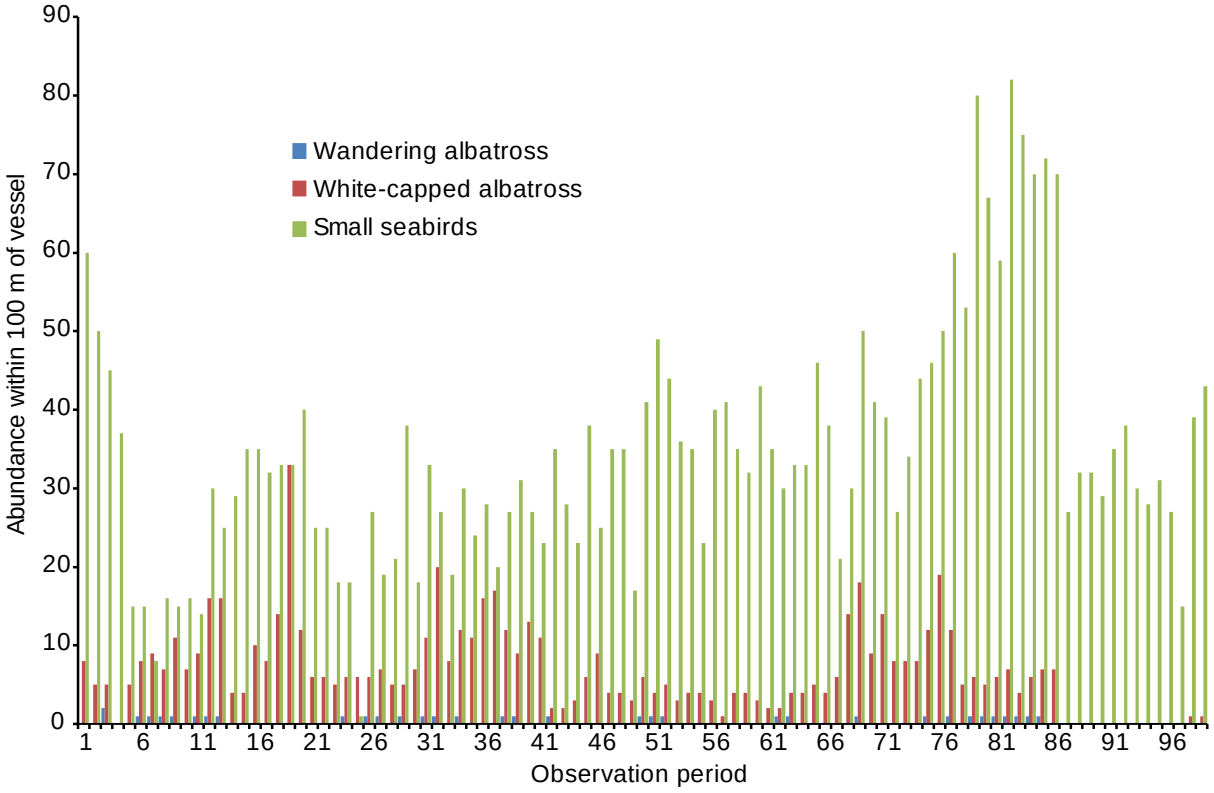

Figure 4: Bird abundance within 100 m of the vessel throughout the trip, plotted by observation period.

Qualitative observation of bird behaviour around the hauling station indicated that several variables influenced whether birds chose to attempt to enter the area close to the longline or, how easy this was for them, and / or whether they attempted to take a bait on a hook (Table 1).

Table 1: Summary of factors influencing bird behaviour and attendance in the area adjacent to the longline during hauling.

Factor	Effect
Speed of the boat through the water	Birds had to expend more time and effort paddling on the surface of the water to keep up with the vessel at higher speeds.
Wind strength and angle relative to the vessel	Above 10-12 knots birds could fly with little effort and so spent more time in the air and could follow the vessel easier on the wing. When the vessel was hauling into the wind birds could hold station above and behind the longline, otherwise they had to fly in circuits and time landing on the water to access the longline.
Line angle	A shallower hauling angle provided access to a greater number of hooks close to the surface at greater distances from the vessel. The extreme situation was floating sections of line or hauling loose ends of a broken line on the surface. Similarly hauling angles away from, as opposed to underneath, the vessel provided easier access to hooks.
Discarding and baits / fish falling off the longline	Generally small fish and lost or discarded baits attracted birds towards the hauling station. Birds showed little interest in spiny dogfish discards and moved away from discarded skate.
Number and frequency of returned baits	Higher bait return frequency provided more and more consistent feeding opportunities and attracted birds to the line.
Catch	Fish caught on hooks resulted in fewer baits accessible to birds, however discarded and lost fish provided extra feeding opportunities.
The presence and location of loose floating fish	Loose fish ('floaters') provided an easier alternative feeding opportunity and attracted birds away from the longline.
Presence of sharks	Sharks underneath birds made them wary and took their attention away from the longline.
Behaviour of other birds	One bird getting some food or even attempting to get at the line would trigger other birds to move into the same area. Larger and / or more aggressive birds were seen to displace other birds.

Dangler efficacy

At sea observations

The presence or absence of the dangler provided another variable operating alongside those in Table 1. Birds on the water were aware of and avoided the dangler, more so with more movement of the dangler. The dangler provided a barrier to birds moving into the area around the hauling station and birds spent some time actively avoiding it. The dangler disrupted the flight pattern of birds in the air and it prevented direct access to the hauling station. This was particularly apparent when hauling into wind speeds over 10 knots.

Abundance of both small albatrosses and small seabirds within 100 m of the vessel was similar for both treatments (Figure 5). Processing of sharks following the completion of hauling and discards of fish, offal and old baits presented feeding opportunities for birds.

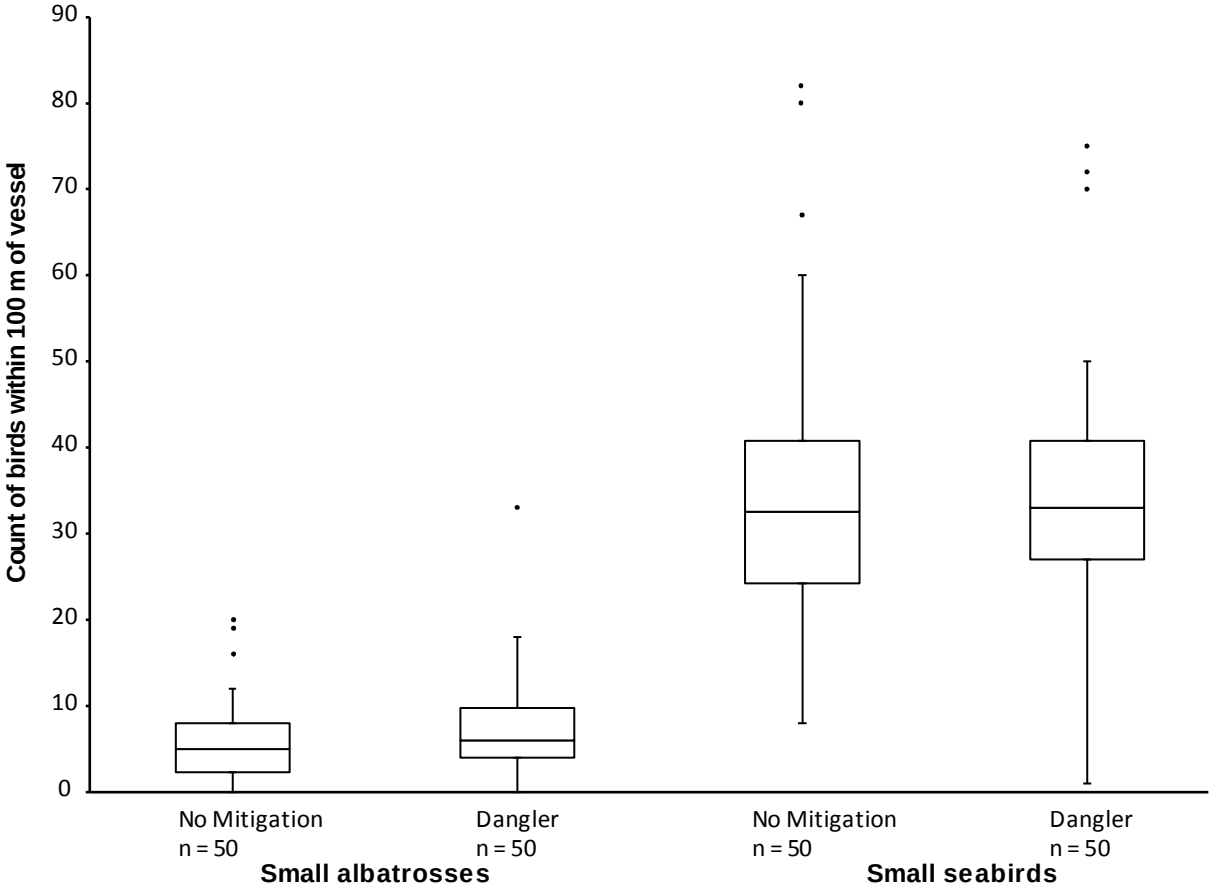

Figure 5: Abundance of small albatrosses and small seabirds within 100 m of the vessel, for no mitigation and dangler treatments.

Unpaired t-tests also suggested no significant difference in the number of birds within 100 metres of the vessel for different treatments (small albatrosses p-value = 0.2, test statistic = -1.29 with 92 d.f; small seabirds, p-value = 0.92, test statistic = -0.10, with 97 d.f.)

No seabird bycatch (alive or dead) was observed during the trip. Birds were not regularly observed attacking the baited hooks on the line as the author has seen on some previous trips. Over 325 minutes of observations, covering 2584 hooks hauled, three contacts with a baited hook, one dive towards a baited hook, and one contact with the longline were observed. Additionally 37 dives on loose baits or fish were observed. Birds would follow loose baits or fish out of the area around the hauling station. Birds appeared to be able to appreciate the different behaviour of a loose bait or fish compared to a hooked bait or fish and appeared to dive on these more readily.

Due to low instances of dives on baited hooks and contacts with the line the more data rich but distant proxy of counts of birds moving into the area around the longline was used to assess efficacy of the dangler. Box-whisker plots were chosen as a means of visually examining the data.

Real-time counts of birds moving into the area zero to two metres from the longline were lower and showed less variation with the dangler deployed, compared to no mitigation (Figure 6).

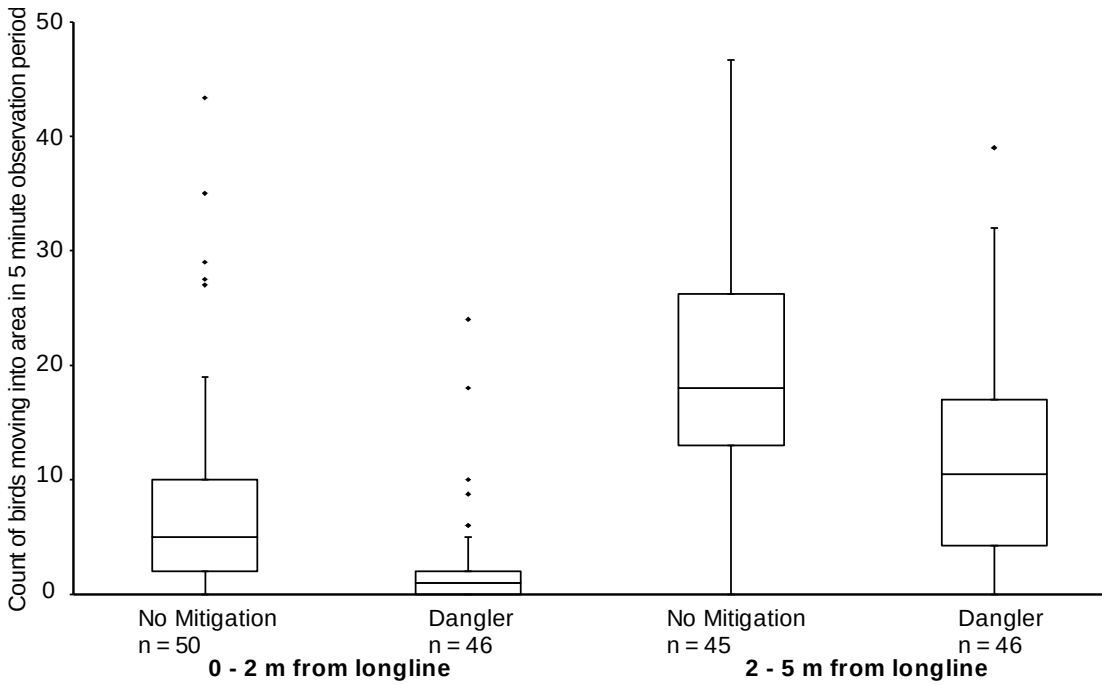

Figure 6: Counts of birds moving into the areas 0 – 2 m from the longline and 2—5 m from the longline, for no mitigation and dangler treatments.

Unpaired t-tests showed a significant difference in the number of birds entering both areas (0 – 2 m, p-value = 0.0004, test statistic = 3.71 with 71 d.f; 2 – 5 m, p-value = 0.0006, test statistic = 3.54 with 88 d.f.)

Whilst observations were consistently made by the author of birds moving towards discarded or lost baits and fish, counts of birds moving into the areas 0 - 2 m and 2 - 5 m from to the longline did not change (Figure 7).

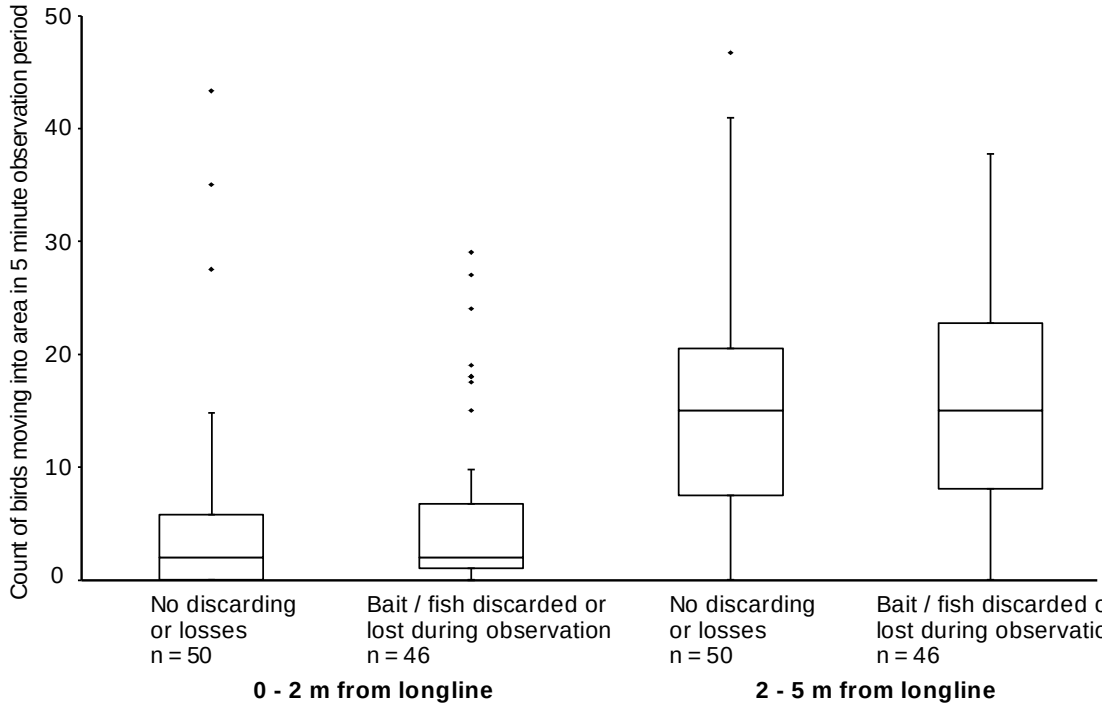

Figure 7: Counts of birds moving into the areas 0 – 2 m from the longline and 2—5 m from the longline, for observation periods with no losses or discards and observation periods during which bait or whole fish were lost or discarded.

Unpaired t-tests also suggested no significant difference in the number of birds entering both areas (0 – 2 m, p-value = 0.56, test statistic = -0.58 with 94 d.f.; 2 – 5 m, p-value = 0.83, test statistic = -0.21 with 86 d.f.)

Video footage

The main differences between the methods of recording count data from the video and in real time are outlined in Table 2.

Table 2: Comparison of real time data collection and collection of video and subsequent analysis ashore.

Factor	Video analysis	Real-time analysis
Area observed	Within 2 m of hauling station. Relative to camera / hauling station, measured on video.	Within 2 m of longline. Relative to longline, measured 'by eye'.
Visibility	Some of area obscured by crew / vessel structure, at times.	Able to see whole area
Completeness	Whole haul analysed	Approximately two thirds of haul analysed in between abundance counts.
Accuracy	Able to rewind for complete accuracy.	No way of verifying data with a single observer
Observation period length	Short period, leading to precise but varying numbers over time	Longer period, leading to summed numbers of birds.
Count type	Number of birds spending some of the observation period in the area. Individual birds counted once only.	Number of times a bird moved into the area. The same bird may have been counted several times if it moved in and out of the area.

Counts from the video footage were plotted with real time counts over the course of the first haul of the day on the final two days fishing (Figure 8). Both count methods showed greater bird abundance close to the longline with the no mitigation treatment, compared to the dangler treatment.

Counts from the different methods made at the same time showed similar responses. However, gaps in real time observations, for example when conducting abundance counts, resulted in some spikes in bird activity not being represented in the real time data (Figure 8).

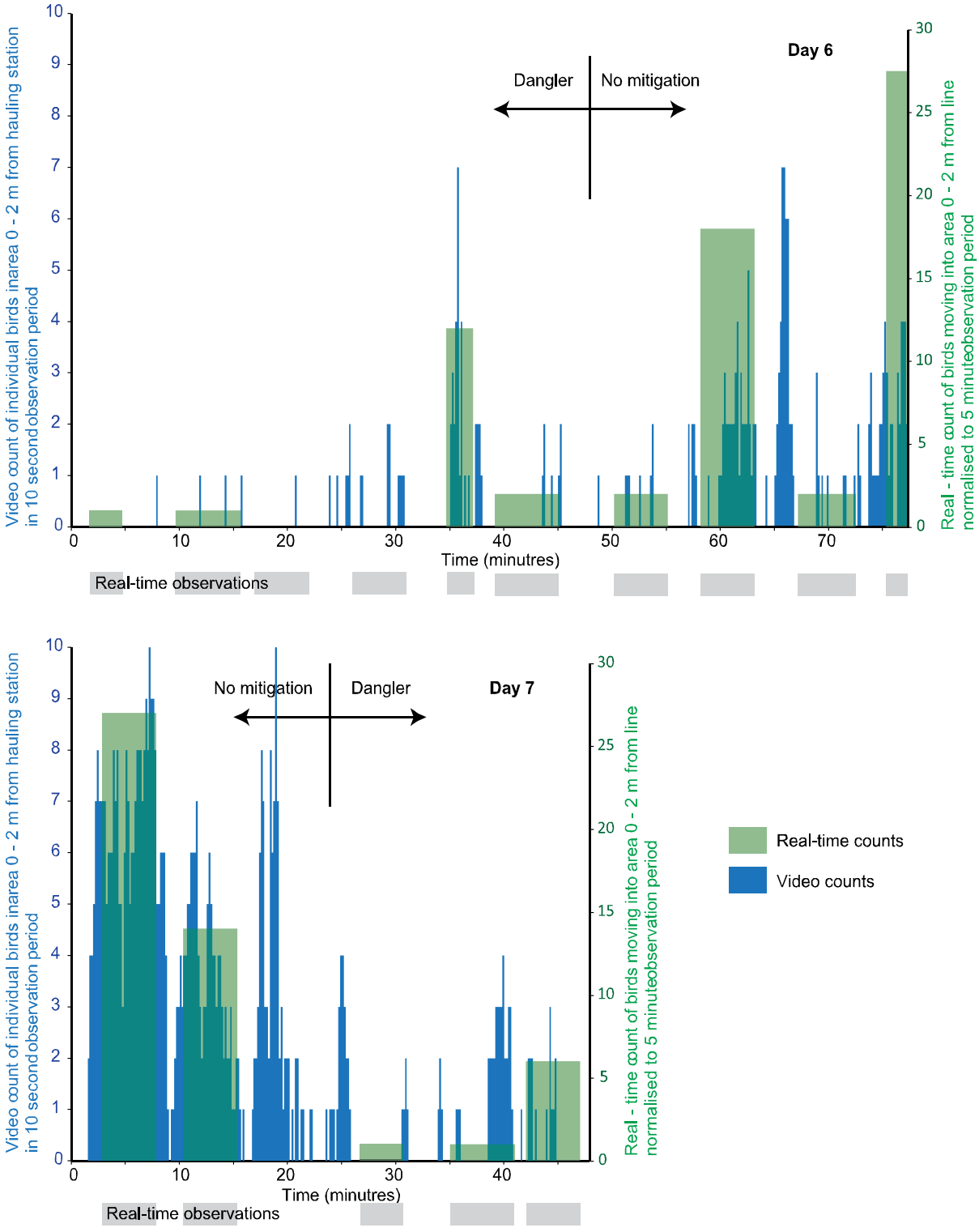

Figure 8: Comparison of different data collection methods: Real-time counts represent the number of times a birds entered the area within two metres of the longline during discrete five minute observation periods. Real-time counts are not continuous and observation periods are indicated below the x-axis. Video-counts represent the number of individual birds spending some time within two metres of the hauling station in consecutive 10 second observation periods.

Discussion

The bluenose target fishery in the north-east of New Zealand was chosen for the trial, due to high overlap with black petrels and flesh-footed shearwaters (Abraham et al., 2015). These species are some of the most at risk (Richard &Abraham, 2015), also proficient divers (Bell et al., 2014; Thalmann et al., 2009), and have been observed to attend vessels in numbers and be captured alive (Dragonfly, 2018).

These results represent a single trip in one area, and although birds were consistently attending the vessel in reasonable numbers (Figure 4) they were not foraging aggressively at the hauling station. Bird abundance within 100 m of the vessel was similar with and without mitigation in place. Direct contacts with baited hooks or the longline and dives towards baited hooks were rare. Using visual comparisons of both real-time and video counts, bird abundance close to the longline was higher with no mitigation deployed when compared to the dangler treatment.

Real-time counts provided a better assessment of the 'danger area' relative to the longline, rather than relative to the hauling station as per video counts. However, video counts provided continuous counts giving a more precise picture of bird movements over short time scales. Both methods produced similar results.

Positive feedback from the crew, and their willingness to continue using the device provided confidence in the approach. A more complex device may have the potential to provide better protection and exclude birds more fully but may also cause more inconvenience for the crew. Simplicity and the ease of deployment and recovery was an important factor in gaining acceptance from the crew, particularly the ability to swiftly recover the dangler to avoid interfering with the fishing gear. Use of hauling mitigation is currently voluntary in the fishery and introducing specific mitigation devices is likely to be easiest if they are easy to use as well as effective.

Birds were attracted to feeding opportunities including loose baits, offal and fish. Whilst these opportunities were largely outside of hauling and shooting of fishing gear birds consistently attended the vessel. Baits or fish lost or discarded during observation periods did not appear to influence bird abundance in the observation areas (Figure 7). This may in part be due to loose baits and fish moving away from the longline and outside of the observation areas, and providing an attractant for birds to also move out of the observation areas.

Management of feeding opportunities for birds should be considered as part of a successful haul mitigation strategy (ACAP 2016). Pierre et al. (2013) reported higher numbers of birds within six metres of the hauling station when used baits were discarded at the hauling station, compared to retaining baits. However, discarding at the hauling station is not currently common practice (Goad, 2017) or consistent with the regulations (MPI, 2010).

Whether discarding used baits on the off side of the vessel to attract birds away from baited hooks is preferable to holding all baits throughout the haul is debatable and untested to date. Different approaches may be appropriate in different situations, and will have different effects on bird abundance and behaviour around the vessel, and the likelihood of capture during the hauling or at the subsequent set. Some fishers report strategically discarding away from the hauling station, at times, to attract birds away from baited hooks and thereby minimise risk (Goad, 2017).

Conclusions

The dangler device designed and tested reduced bird abundance in the danger area around the longline, compared to the no mitigation treatment.

The dangler fitted into the fishing operation with little or no disruption to normal fishing practices, and the skipper and crew were willing to continue using it. Fishers are most likely to incorporate specific hauling mitigation devices if they fit around their current fishing operation, and are easy to deploy and recover.

A large number of variables influenced interactions between birds and fishing gear during the haul. Combined with a single trip, in a single area, and without aggressively foraging birds these variables limit the certainty around these conclusions. Similarly, with a small data set it was not deemed appropriate to attempt to quantify efficacy of the device.

Haul mitigation devices should be considered in conjunction with how the discarding of used bait, offal and fish can be best managed to minimise risk to birds.

Recommendations

Further investigate the efficacy of a dangler – type approach, in conjunction with managing the discarding of loose baits, offal and fish, in a wider range of conditions and fisheries.

Encourage wider uptake of specific hauling mitigation devices, supply similar setups to other vessels, and gather feedback from skippers.

Consider using camera footage collected under the Trident monitoring project to investigate the circumstances around live captures, and the possibility of trialling hauling mitigation devices on vessels fitted with cameras to investigate efficacy.

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