DEVELOPMENT OF MITIGATION MEASURES TO REDUCE SEABIRD MORTALITY IN PELAGIC LONGLINE FISHERIES

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INTRODUCTION

Fishing operations attract and provide a feeding opportunity for a range of pelagic seabird species. Their incidental mortality on these vessels has been well documented and mounting evidence suggests that this is the leading cause of observed decreases amongst albatross and petrel populations (Gales 1998). Mitigation measures work by either keeping birds away from baited hooks (e.g. tori lines), reducing the time the hook is available to the birds (e.g. line weighting or line setting chutes), avoiding peak periods of bird foraging (e.g. night setting) or making vessels or bait less attractive to the birds. It is vital that these measures are simple, easy to implement and cost effective. This paper reviews mitigation measures a) tested and found effective, b) those still under refinement c) tested and found ineffective and d) those suggested for future testing.

MITIGATION METHODS TESTED AND EFFECTIVE

1) Setting lines at night

Albatrosses generally feed during the day, but lower numbers may forage at night. Therefore by setting lines between dusk and dawn, the danger of catching these birds is greatly reduced (Harper 1987). However the smaller petrels e.g. White-chinned Petrel, may feed at night and are therefore less protected (Harper 1987). Thus this measure in isolation is not sufficient to adequately reduce seabird bycatch. Seabirds will be especially vulnerable on clear, bright nights such as those during full moon periods.

Gilman *et al.* (2005) showed a 97-100% reduction in the capture of Laysan *Phoebastria immutabilis* and Black-footed *Phoebastria nigripes* Albatrosses in the Hawaiin longline fishery and Klaer and Polacheck (1998) a 91% reduction in the capture of all seabird species in the Japanese pelagic longline fishery when setting took place at night as opposed to during the day. In a study conducted in South African waters, it was found that the pelagic longline fishery, which sets a high proportion of their sets during daylight, catch approximately 0.2 birds per 1000 hooks while the demersal longline fishery which sets their lines primarily at night only catch 0.04 birds per 1000 hooks. This difference can in part be accounted for by the difference in setting time (Petersen *et al*. 2006). There is further evidence from a pilot study conducted in Namibia which revealed higher catches of 0.3 birds per 1000 hooks between full and half moon compared to no birds caught during between quarter and new moon periods (Goren 2007).

2) Line weighting (and reducing setting speeds)

Albatrosses are relatively shallow divers, 0.3-12.4 m (Prince *et al.* 1994) although some petrels can dive considerably deeper than this depth e.g. Sooty Shearwater *Puffinus griseus* can dive to a maximum depth of 67 m (Weimerskirch and Sagar 1996). By maximising the rate at which the longline sinks, you will minimise the time the hook is within the reach of the birds, and thus reduce the chance of birds being drowned.

Various "line weighting" regimes have been investigated and proposed for demersal and pelagic longlining (Brothers *et al.* 2001, Anderson and Mcardle 2002, Robertson *et al.* 2003, Moreno *et al.* 2006, Honig and Petersen 2006). Although the gear will be configured according to the particular fishery, a line sink rate of 0.3 m/s is recommended. This sink rate will allow the hooks to reach a depth of at least 10 m while under the aerial coverage of a well constructed bird-scaring line (150 m).

Time depth recorders have been deployed on pelagic vessels in South African waters and preliminary findings suggest that the use of two 60 gram swivels (total 120 gram) on the branchline, 3.6 m from the baited hook will result in optimal line sink rates (Honig and Petersen 2005) (Fig. 1).

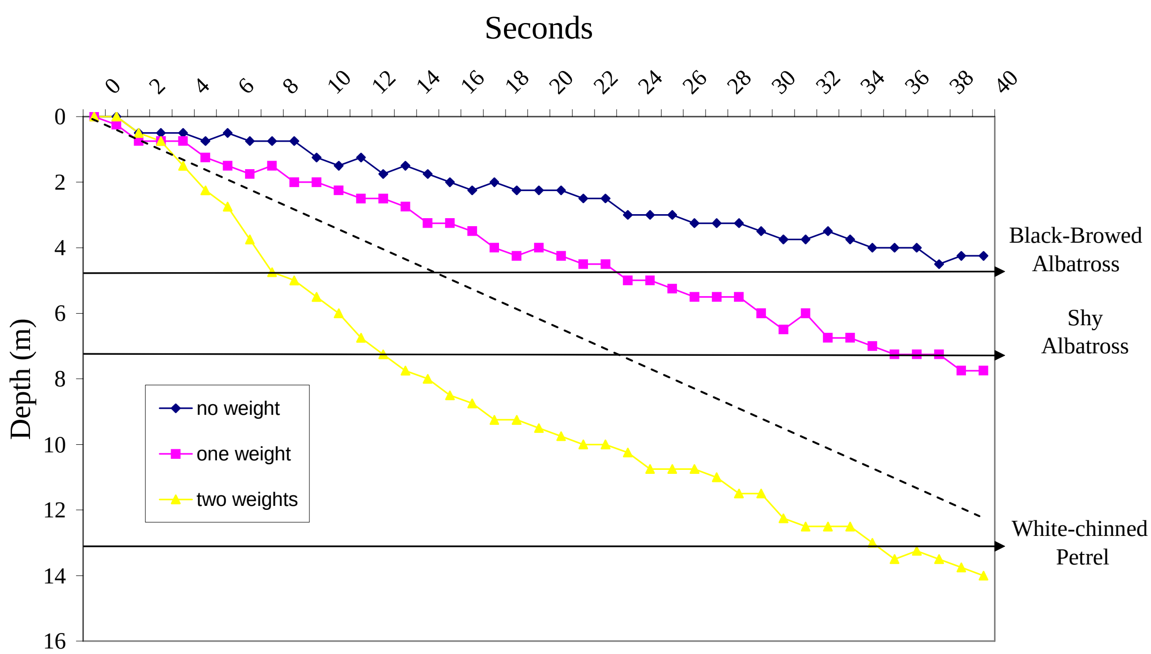

Fig. 1: Line sink rates of pelagic longliners under three different weighting regimes (no weight, one 60 g weight and two 60 g weight (i.e. 120 g) 3.6 m from the hook (adapted from Honig and Petersen 2005).

Similar studies have been conducted in pelagic longline fisheries operating off New Zealand (Anderson and Mcardle 2002) and Australia (Brothers *et al.* 2001). These studies found that during normal line setting using unweighted branchlines a considerable proportion of hooks were within the known diving range of a number of seabirds frequenting these vessels (Brothers *et al.* 2001, Anderson and Mcardle 2002). The addition of a 60 g swivel weight within 1-2 m of the hook attained a line sink rate of 0.45 m/s. This results in the hook being out of the reach of most seabirds, excluding Sooty Shearwaters, after 30 seconds (it was estimated that the bird-scaring or *tori* line provided protection for 29.3 sec) (Anderson and Mcardle 2002). Brothers *et al.* (2001) found that the heavier the weight, and the closer it is to the hook, the more rapidly it will sink. In this study sink rates of 0.26 m/s to 0.30 m/s were attained using either an 80g weight within 3m of the hook, or a 40g weight at the hook. However, for such line weighting regimes to be effective in reducing seabird bycatch, they need to be deployed in conjunction with an effective bird scaring or *tori* line.

3) "*Tori*" or bird-scaring line

A *tori* or bird-scaring line consists of a line with a number of streamers attached to it. This line is towed from the stern of the vessel while the baited fishing lines are being set. The streamers are designed to cover the point where the bait enters the water and distracts foraging birds from taking the baited hooks. The system works well for surface feeding birds, however, diving birds can still dive down to the bait outside of the effective area of the streamers. Still, this method has been demonstrated to reduce bycatch rates by up to 96% (Brothers *et al* 1999(a)). Mc Namara *et al*. (1999) showed a 79% reduction in the capture of Laysan and Black-footed Albatrosses in Hawaii. However the success depends on design and setting conditions as well as crew willingness and input.

SPECIFICATIONS:

A number of trials were conducted in South African waters and produced the following specifications as a guideline for a best-design. These specifications have been included in South African fishing permit regulations. A bird-scaring line should achieve at least 150 m aerial coverage. It needs to be attached to the vessel at least 7 m above sea level, be at least 150 m long, have at least 28 paired streamers spaced 5 m apart (starting 10 m astern the vessel) and have sufficient drag (e.g. buoy, road cone or sea-anchor) (Fig.3). The bird-scaring line must be deployed on the windward side of the main line, unless two streamers are used, in which case they must be deployed on either side of the main line.

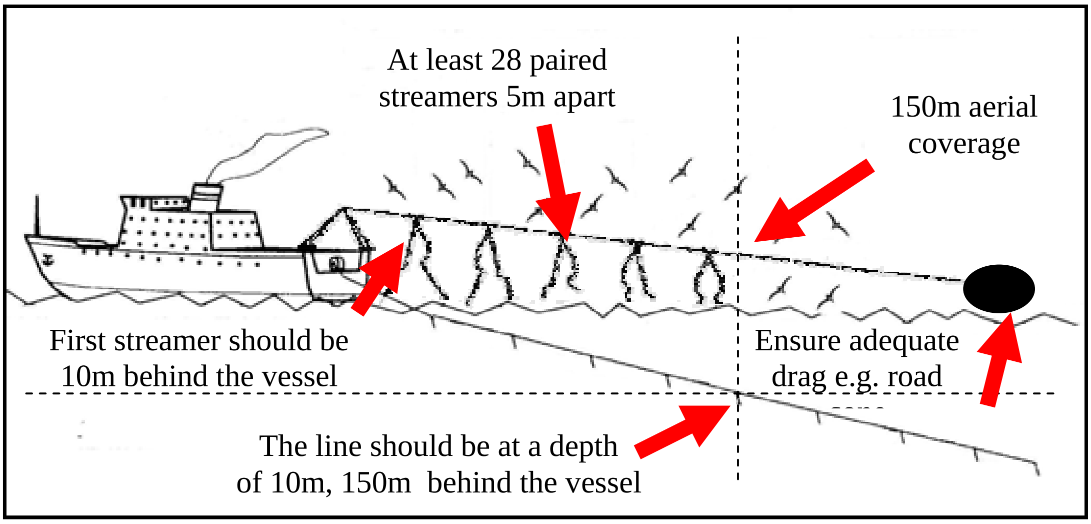

Fig. 3 Bird-scaring line and longline sink rate specifications

WHAT MAKES AN EFFECTIVE BIRD-SCARING LINE?

The key to an effective bird-scaring line is maximising the portion of the line which is in the air. The best way to achieve this is to make the point of attachment on the vessel as high as possible. On small vessels where a high attachment point is not accessible, an outrigger pole can be mounted to provide this height. The aerial coverage is also improved by attaching an item, e.g. a buoy, which creates drag to lift the line out of the water.

Streamers can be made from plastic strapping or PVC tubing. They should be a bright colour, preferably red. Streamers shall be placed at least 5 m intervals along the entire aerial section of the line. The erratic movement of the streamers increases it efficacy. Attaching light sticks to streamers may increase the efficacy of the bird-scaring line when setting at night.

Once a bird-scaring line is operating at its full height, a “lazy line” may be attached and tied off at a convenient point on the stern. This allows the bird-scaring line to be quickly retrieved. This is particularly important if the line gets snagged, as it can be quickly pulled down, unclipped and clipped onto the backbone, allowing the vessel to continue setting. The bird-scaring line can then be retrieved during hauling. The lazy line also allows the bird-scaring line to be adjusted according to wind conditions. To be effective, a bird-scaring line should be over the point where the gear enters the water. By attaching the “lazy line” on the windward side of the vessel, it can be effectively used to adjust the bird-scaring line so that it is positioned directly over the gear or on the windward side of the line.

It is important that the bird-scaring line is easy to use. To save space it can be stored on a plastic hose reel or in a fish bin. It is important that the line does not foul the gear being set. To prevent this from happening floats and mid-buoys should be thrown downwind so that they do not float back onto the bird-scaring line. Altering the course slightly when radio buoys are thrown into the water may also prevent them from becoming snagged.

4) Frozen versus thawed bait

Thawed baits sink more rapidly than frozen baits. In experiments conducted on Japanese pelagic longliners, Brothers *et al* (1998) found that on average 1.1 birds per 1000 hooks were caught using frozen bait, compared to 0.6 birds per 1000 hooks using partly thawed and 0.3 birds per 1000 hooks using thawed bait demonstrating the effectiveness of this measure.

5) Offal management

Albatrosses and petrels are opportunistic scavengers and fishing vessels processing at sea and discarding offal provide a feeding opportunity for these birds (Ryan and Moloney 1988). Therefore by minimising or eliminating discards seabirds will not be attracted to fishing vessels. Seabirds are most at risk of being caught during setting (Brothers *et al.* 1999(a)) therefore discarding should not take place during this time. If discarding is necessary during hauling, crew should be instructed to do so on the opposite side thereby reducing the risk of capture to the birds.

OTHER METHODS STILL UNDER REFINEMENT

1) Underwater setting chute

Baited hooks may be set below the surface using a funnel fitted to the stern of the vessel, which guides the line directly from the vessel to below the water surface (Ryan and Watkins 2002). The system still requires refinement and is not widely used. A South African toothfish vessel used this system in 1998-2000 with some success, indicating its potential use (Ryan and Watkins 2002). At present funnels are designed mainly for a single line system however, investigations are underway to modify the system to accommodate the double line system. Gilman *et al.* (2005) demonstrated a 100% reduction in seabird bycatch levels in the Hawaiian pelagic longline fishery although later demonstrated less success. There have been serious problems with its effectiveness reported especially when entanglements occur and cause the line to lie on the surface for extended periods of time (Gilman *et al.* 2002), resulting in higher than normal mortalities of seabirds. A study conducted in Australia reported 0% reduction (AFMA unpublished data)

2) Underwater setting capsule

This method is similar to the underwater setting chute. In this case, baited hooks are deployed in a capsule attached to a cable, which is designed to open at a depth of 5-10 m and release the baited hook (Brothers *et al*. 2000). As with the underwater setting chute, line entanglements have been reported to occur. Further testing and modification is underway (G Robertson pers. comm.).

3) Side setting

This method requires the line to be set from the side of the vessel resulting in hooks sinking by the time they reach the stern of the vessel. This method was tested in combination with 60 g weights and a "bird curtain" (pole out the side with streamers) in the Hawaiian pelagic longline fishery and found to reduce the incidental mortality of Laysan and Black-footed Albatrosses up to 100% (Gilman *et al.* 2003). This method is currently employed in the Hawaiian and Australian pelagic longline fleet (Gilman *et al.* 2003). It needs wider testing in a number of localities with other species complexes (e.g. deeper diving species).

4) Fish oil

This method won the WWF "Smart Gear" award in 2005 for the most innovative idea to reduce seabird mortality. It has been tested in the Spanish and New Zealand demersal longline and some success has been demonstrated. Fish oil is released on the surface of the water during setting and has been shown to reduce seabird activity in the vicinity of the vessel (www.wwf.org).

5) Dyed baits

Dying baits blue so that they are less visible to seabirds was investigated as a measure to reduce seabird deaths. A number of studies were conducted and reported mixed successes (Gliman *et al.* 2003, 2005). Gliman *et al.* (2003) found a 95% reduction in mortality of Laysan and Black-Footed Albatrosses in Hawaii, but in a later study they found it less successful (63% reduction) than side-setting. This method is more successful using squid rather than fish bait. At this stage this method is not practically feasible as there is no commercially available dye and it is a rather messy job (Gilman *et al.* 2005).

6) Bait casting machine

This measure has the potential to reduce bird bycatch because a) bait can be cast outside turbulent area caused by the propeller theoretically resulting in an increased line sink rate, b) bait can be cast into area protected by a tori line and c) bait can be cast in varying positions to avoid concentrations of seabirds. Where direction and distance can be altered, Brothers (1993), in a study conducted in the South East Indian Ocean, showed a reduction in the level of seabird bycatch by 50% when the bait caster was used in combination with a tori line and thawed bait. Since this study conflicting results have been reported (e.g. Brothers 1999).

METHODS TESTED AND FOUND INEFFECTIVE

1) Live bait

The concept of using live versus dead bait was investigated. It was thought that live fish would actively swim down from the surface. Observations suggest that fish may also swim to surface and thus be ineffective as a mitigation method. Brothers *et al.* (1999(b)) compared catch rates of live versus dead bait and found little evidence of a reduction in seabird catch rates

2) Water cannon

This method involves the use of a high-pressure fire hose that produces directed high-pressure water above baited hooks and thus deters seabirds from baited hooks. This method was tested by the Japan Tuna Fisheries Co-operative Associations in 1997, although its effectiveness against seabird bycatch was not quantified. The distance reached was considered inadequate and insufficient to avoid incidental capture of seabirds on its own (Kiyota et al. 2001). According to the observer the cannon was switched off due to cold water affecting crew (Brothers, Cooper and Lokkerborg 1999)

FUTURE POSSIBILITIES

1) Hook design

It has been suggested that hook designs (J-hooks, circle-hooks) have differing influences on seabird bycatch rate (Borneo workshop report 2005). However, little or no work to investigate this has been conducted to date.

CONLUSION

There is no one magic solution, but rather a suite of measures that should be used in combination to mitigate seabird bycatch. The choice may differ from fishery to fishery depending gear configuration, preferred operation and species complexes involved. Fisheries regulations in South Africa addresses seabird bycatch, however two issues remain unresolved. Firstly, line sink rate trials need to be completed in order to advise on appropriate measures in this regard. Secondly, implementation of these regulations has been poor and requires improved enforcement. At present no such regulations exist for fisheries operating in Namibia and Angola. As a minimum we recommend the use of night setting, bird-scaring lines and a weighting regime that will ensure the gear sinks at a rate of at least 0.3m/sec in these fisheries.

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