Sink rate of baited hooks on New Zealand pelagic tuna vessels

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Crispin Keith

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Crispin Keith

Science & Research Unit, Department of Conservation, Wellington

ABSTRACT

Time Depth Recorders (TDRs) were used to determine the rate at which baited hooks sunk on four pelagic tuna longline vessels in New Zealand waters. TDRs were successfully deployed 21 times. Using no extra weight and no line shooter, at a vessel speed of approximately 7 knots (3.6 m/s), baits were recorded at a mean (± SD) depth of 1.83 ± 1.67 m (range 0–6 m) at a point 50 m astern of the vessel. Possible causes of the variation and the implications for effective incidental seabird catch mitigation measures, such as tori line deployment, are discussed.

Keywords: seabirds, time depth recorders (TDRs), pelagic, tuna, longlines, sink rate, bycatch, tori line

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1. Introduction

1.1 GENERAL

Demersal and pelagic longline fisheries overlap with foraging zones for a number of seabird species. Seabirds appear to have learned that longliners provide food in the form of squid or fish used to bait hooks. Incidental mortality of seabirds predominantly occurs after the baited hook has been set and before it has sunk beyond their diving depth. This diving depth varies with species: Among albatrosses, the wandering albatross (*Diomedea exulans*) is the shallowest diver with a maximum recorded dive depth of 0.06 m (Prince et al. 1994). Prince et al. (1994) also recorded light-mantled sooty albatrosses (*Phoebetria palpebrata*) diving to 12.4 m. Petrels differ considerably, with white-chinned petrels *(Procellaria aequinoctialis)* known to dive to 12.8 m (Huin 1994) and sooty shearwaters (*Puffinus griseus*) to 67 m (Weimerskirch & Sagar 1996). A key factor for incidental seabird catch mitigation is, therefore, finding out how quickly baited hooks sink.

1.2 FISHING OPERATION

The New Zealand domestic tuna fleet consists of vessels ranging from 12–50 m in length. These vessels typically spend 3–6 h each day setting a monofilament longline (‘backbone’) which measures 20–45 n.m. The vessel steams at c. 7–10 knots (3.6–6.9 m/s) while crew members at the stern of the vessel attach ‘snoods’ (branchlines) and floats at intervals along the backbone specified by the skipper. Snoods are made of a 10–16 m length of monofilament (1.8–2.0 mm diameter) with a clip at one end and a hook at the other. Hooks are baited with squid or a small fish known as ‘sanmar’ (*Cololabris saira*). Bait is removed from the ice hold and thawed for several hours before the set.

Once the line setting is complete, the line is left to soak for a minimum of 8 h. The line is then hauled over an 8–12 h period. The whole operation takes about 24 h and is repeated every day.

1.3 SINK RATE TRIALS

The Department of Conservation employed an extension officer to work from March 1999 to February 2000 in an education liaison capacity with the New Zealand tuna longline fleet. As a part of this contract, the advisory officer undertook five sea-trips on four small domestic tuna longline vessels in order to give vessel-specific advice on the best ways to reduce the risk of incidental seabird mortality. While on these vessels, bait sink rate trials were carried out using time depth recorders (TDRs). These are archival data recorders. Our TDRs measured 95 × 21 × 27 mm and weighed 12 g (in water); they were constructed and distributed by Wildlife Computers (Redmond, Washington, USA).

2. Methods

TDRs were attached to snoods at a point approximately 1 m from the hook and deployed during the set as a part of the normal fishing operation. No line weighting was used, and no vessel utilised a line shooter during setting. (A line shooter is a hydraulic device which pulls the main line off the drum to allow the line to lie slack in the water.) Before deployment, TDRs were soaked for 30 min in a bucket of seawater. Soaking minimised erroneous readings caused by the rapid expansion or contraction of the pressure plate on the depth sensor. The seawater in the bucket was kept close to the temperature of ambient seawater by replacing the water every 10 min. For consistency, hooks on all snoods carrying TDRs were baited using medium-sized squid (150–200 g). TDRs were set to record depth every 2 s, at a resolution of 0.5 m.

Upon retrieval, data were downloaded from the recorders onto a PC, and then converted into Microsoft Excel files. The sink rate of baited hooks over for the first 30 s of deployment was calculated. Hook depth at the end of the protective coverage afforded by a tori line, approximately 50 m (14 s after leaving the vessel) astern of the vessel, was also calculated.

3. Results

TDRs were successfully deployed on 21 occasions on four vessels. Deployments were made in a range of conditions from calm (< 0.5 m swell, < 10 knot winds) to rough (1.5–2 m swell, 25–35 knot winds).

Table 1 provides various statistics on the depth of baited hooks 14 s (50 m) and 30 s after deployment. There was a wide range in depths reached at these time points: whereas some lines were virtually at the surface, others had reached up to 6 m (at 14 s) and 8.5 m (at 30 s).

TABLE 1. SUMMARY STATISTICS FOR BAITED HOOK DEPTH AT 14 S AND 30 S BEHIND VESSEL.

HOOK DEPTH (m) AT 14 s POST-DEPLOYMENT		HOOK DEPTH (m) AT 30 s POST-DEPLOYMENT	
n	21	n	21
Mean	1.83	Mean	3.79
Standard deviation	1.67	Standard deviation	2.46
Range	0–6	Range	0.5–8.5
Confidence level (95.0%)	0.76	Confidence level (95.0%)	1.12

4. Discussion

The results from the TDRs show that the sink rate of baited hooks is extremely variable. A number of factors may contribute to this. These include weather, propeller turbulence, bait size and thaw state, the variability of tension on the backbone and variable casting of snoods by the crew.

Although a wide range of weather conditions were encountered during these trials, the small sample size precluded any analysis of the effects of different weather conditions. A similar study undertaken on New Zealand's largest tuna vessel, the FV *Daniel Solander* (Anderson & McArdle 2002) found that higher winds can increase the sink rate of baited hooks during setting, and that the direction of wind relative to the fishing vessel can also have an effect on the sink rate.

Turbulence from the propeller wash may affect the sink rate of baited hooks. Furthermore, if the crew do not cast the snood outside the propeller wash during setting, the baited hook may be buoyed up by the turbulence and may remain on or near the surface for a considerable distance behind the vessel.

Although bait size and thaw state was kept as constant as practical, larger squid may have a propensity to trap more air under their mantles than smaller squid, making them more positively buoyant than smaller baits.

Variations in the tension of the backbone as it was spooled off the reel on different vessels were common, however no vessel spooled the line out at a speed greater than that of the vessel through the water. This meant that the relative variation in backbone tension during setting was minimal, and not likely to cause much variation in the sink rate of snoods. Further sampling would be needed to determine what effect each of these factors has on the sink rate of baited hooks.

The results show that at a point equivalent to the end of the aerial section on a tori line (c. 50 m), a considerable percentage of baited hooks are still within the diving range of many petrels and some albatrosses. This indicates that although employing a tori line will provide a degree of protection for baited hooks, it will not completely remove the risk of incidental seabird capture. However, the majority of sets made by the New Zealand tuna fleet are made at night and this, in combination with the use of a tori line, appears to significantly reduce the chances of catching most seabird species.

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