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BRIEF REPORT ON THE SINK RATES OF SPANISH SYSTEM LONGLINES WITH SPECIAL REFERENCE TO THE LINE WEIGHTING REGIMES OF AGNEW ET AL. (2000)

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BRIEF REPORT ON THE SINK RATES OF SPANISH SYSTEM LONGLINES WITH SPECIAL REFERENCE TO THE LINE WEIGHTING REGIMES OF AGNEW *ET AL.* (2000)

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Summary

A line sink rate trial was conducted on a Spanish system vessel to estimate the sink rates of the line weighting regimes of Agnew *et al.* (2000) so that Agnew's seabird mortality levels could be interpreted in the context of line sink rates. Lines with 4.25 kg/40 m, 8.5 kg/40 m and 12.75 kg/40 m sank to 20 m depth at 0.4 m/s, 0.54 m/s and 0.68 m/s, respectively. Juxtaposing those rates on Agnew's seabird mortality estimates for the three weighting regimes suggests that even sink rates as high as 0.4 and 0.5 m/s might still have potential to kill seabirds. Methodological nuances aside, the results suggest there is still much to be learnt about the relationship between longline sink rate and seabird mortality in demersal longline fisheries.

Introduction

The sink rates of baited hooks is one of the key considerations in efforts to minimise the mortality of seabirds in longline fisheries. A recent trial in the New Zealand ling autoline (single line) fishery revealed that lines sinking to 20 m depth at 0.25 m/s – in combination with a single streamer line - substantially reduced the mortality of white-chinned petrels (by virtue of their flying and diving capabilities, and their diurnal/nocturnal feeding habits, white-chinned petrels are one of the most difficult species of seabird in the southern hemisphere to prevent from attacking longlines). This finding suggest that a line sink rate of about 0.25 m/s, and a single streamer line, might be a desirable mitigation prescription for deep diving seabirds.

The Spanish system (double line) of longline fishing is widely used in the CCAMLR Convention Area to catch toothfish and is responsible for most of the seabird mortality that has hitherto occurred in Convention waters. The Spanish system uses buoyant gear that sinks to the seabed due to weights attached at intervals to the hook line. Conservation Measure 25-02 requires vessels deploy 8.5 kg weights at 40 m intervals on hook lines. This line weighting regime arose from work by Agnew *et al.* (2000) who showed a statistically significant reduction in mortality of black-browed albatrosses and white-chinned petrels between 4.25 kg/40 m (higher kill rate) and 8.5 kg/40 m (lower kill rate), but not between 8.5 kg/40 m and 12.75 kg/40 m. Agnew's trial was conducted on the *F/V Argos Helena* in the South Georgia Patagonian toothfish fishery, in the seabird breeding season (February), in daylight and with a single streamer line as constant. Because measurement of the sink rate of the hook line was not part of Agnew et al's. experiment it is not possible to interpret their seabird mortality rates for the three line weighting regimes in their trial in the context of the line sink rate (0.25 m/s) used successfully in the trial in the New Zealand ling fishery (trial in seabird breeding

season; 340,000 hooks deployed; single streamer line in use; one white-chinned petrel caught). Determining the sink rates of Spanish system hook lines subjected to Agnew's three line weighting regimes - and relating the sink rates to Agnew's seabird mortality levels - might provide valuable insights into the adequacy of the line weighting previsions in CM 25-02 regarding the prevention of seabird mortality with the Spanish method of fishing. It would also be insightful to determine if Spanish system hook lines could be set in a manner that achieved the 0.25 m/s achieved in the New Zealand trial referred to above.

We conducted a trial to address these questions about the sink rates of Spanish system gear:-

1) what is the sink rate of the hook line with the three line weighting regimes of Agnew *et al.* (2000)?

2) is it possible to achieve a line sink rate of 0.25 m/s with the Spanish system?

In the process of answering these questions we also sought to determine the sink rate of Spanish system gear. To our knowledge this has never been done by direct means (ie. depth sensors attached to lines). The only estimates of the sink rates of Spanish system lines are those by Brothers (1995), who made theoretical calculations of sink rates of gear with various line weighting regimes.

Methods

Fishing vessel

The trial was conducted on the *F/V Valiant*, operated by Consolidated Fisheries Limited, Falkland Islands. The *Valiant* is a 48 m long 825 t ex Japanese tuna longliner converted to the Spanish method to operate in the Falkland Island Patagonian toothfish fishery. The *Valiant* uses a main line of 18 mm polysteel rope, to which the hook line is attached by a series of 20 m branch lines made of 8 mm polysteel rope spaced 80 m apart. The hook line consists of 5 mm diameter polysteel with hooks attached at 1.5 m intervals by 0.5 m monofilament snoods. All hooks were size 10/0, and had a straight shank and offset tip and were baited manually with approximately 25 g of Argentinean short-fin squid (*Illex argentinus*) and set to rest on the seabed.

Line weights (baskets of rocks) used in normal fishing operations were attached to the hook line at 40 m intervals. The setting window was located 1.8 m above sea level in the stern of the vessel. Average setting speed during the trial was 8.4 knots. The average number of hooks set in a line was 9,497.

Sink rate trial

The three weighting regimes used in the trial were those of Agnew *et al.* (2000): 4.25 kg, 8.50 kg, and 12.75 kg at 40 m intervals on the hook line. We had 50 weights of each class manufactured from steel anchor chain. Sink rates were measured using MK 9 Time Depth Recorders (TDRs) from Wildlife Computers. These were accurate to 0.5 m and recorded the depth every second. The TDRs were used following a protocol designed to maximise the accuracy of the data retrieved from them

Each line weight treatment consisted of 20 weights of one of the three weight categories with a TDR placed mid-way between line weights. The remainder of the longline (the non-experimental part) was weighted every 40 m with cement blocks weighing 7.0 kg (SD 2.1 kg, $n = 60$).

Initially, it was intended that each line would consist of the three weight regimes comprised of 40 weights of each category placed in sequence on each line with a TDR positioned mid-way between weights. The order of the three weights was to be chosen randomly. However, during the first treatment the main line broke during hauling and 57 weights were lost (3 x 4.25 kg weights, 23 x 8.50 kg weights and 31 x 12.75 kg weights). This left only 19 x 12.75 kg weights available for the trial (data retrieved from the first set were not included in the analysis). Because of limited number of weights remaining, all subsequent lines comprised a single treatment consisting of 20 weights of one weight category with a TDR placed in the middle of the treatment. This meant that each TDR in the experimental sections of line was located 400 m from the non-experimental sections of line (i.e that used for normal fishing). This distance was thought to be sufficiently great so as not to affect the sink rates to 20 m depth (depth of relevance to seabird conservation) of the experimental sections of line.

Over a six-week period seven repetitions of each line weighing regime were completed. During the eighth deployment of the12.75 kg regime the hook line broke and the TDR was lost, leaving only five 12.75 kg weights to work with.

Results

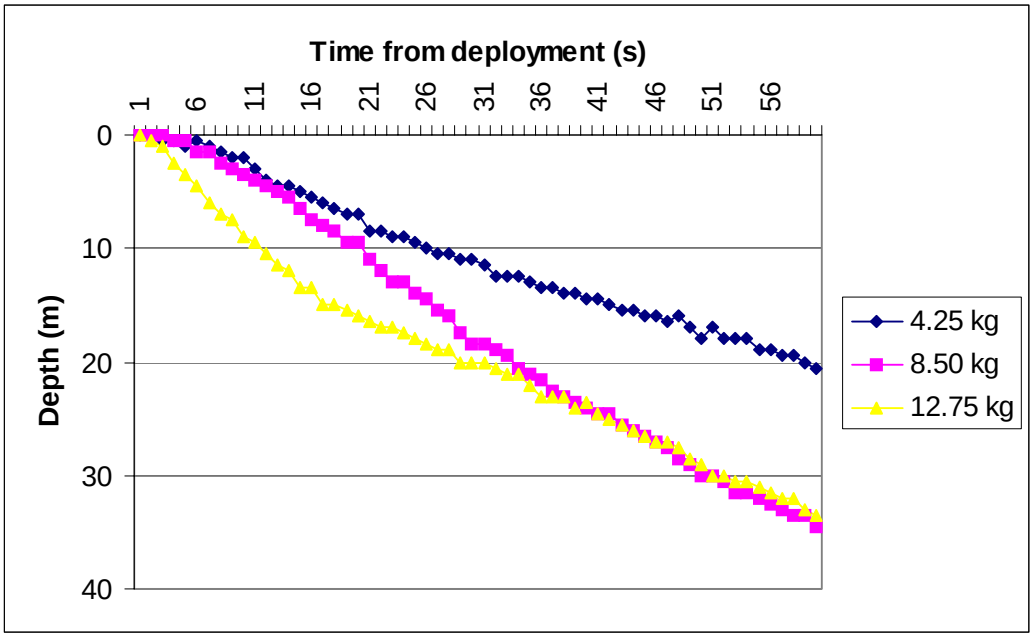
The 4.25 kg, 8.5 kg and 12.75 kg regimes averaged 0.4 m/s, 0.54 m/s and 0.68 m/s to 20 m depth, respectively (Table 1). The 8.50 kg and 12.75 kg regimes sank significantly faster to 10 m and 20 m depth than the 4.25 kg regime. The 12.75 kg regime sank to 4 m depth significantly faster than the 4.25 kg regime. The 8.50 kg and 12.75 kg regimes sank at similar rates to all measured depths.

Table 1: Sink rates (± s.d., m/s) to 4 m, 10 m and 20 m depth for the three line weight regimes used in the trial.

	4.25 kg	8.50 kg	12.75 kg	$F_{2,19}$	p
n	7	8	7		
4 m	0.33±0.08	0.40±0.08	0.51±0.14	5.10	0.017
10 m	0.40±0.08	0.51±0.07	0.67±0.14	12.47	<0.001
20 m	0.40±0.09	0.54±0.09	0.68±0.13	12.68	<0.001

Representative depth profiles of the three line weighting regimes are shown in Figure 1.

Figure 1. Examples of depth profiles of the three line weighting regimes used in the trial.



The line sink rates of the CFL *Valiant* and seabird capture estimates of the *Argos Helena* are juxtaposed in Table 2. For the information in this table to be useful it must be assumed that the line of the *Argos Helena* during its trial sank at the same speed as the line set from the *Valiant*. Whether or not this is the case is unknown. The information in the table is indicative only.

Table 2: Line weighting regimes, feeding attempts by black-browed albatrosses/approx. 3,500 hooks set and seabird mortality by the *F/V Argos Helena* at South Georgia in February 1999 (Agnew *et al.* 2000), and line sink rates of the same line weighting regimes of the *F/V Valiant* in the Falkland Islands in August 2003. To be succinct – but to still capture the salient points – only the response variables in columns 1, 2 and 4 of Table 4 of Agnew *et al.* (2000) have been used. Feeding attempts are approximations.

Line weight	**Feeding attempts**		**Seabird mortality**		**Line sink rate**
(kg)	**BBA**	**W-CP**	**BBA**	**W-CP**	**(m/s)**
4.25	c.250	c.200	33	29	0.40
8.5			6	7	0.54
12.75			3	1	0.68

Conclusions (in brief)

- the sink rates calculated by Brothers (1995) of 4.25 kg/40 m and 8.5 kg/40 m are about 0.38 m/s and about 1.0 m/s, respectively (rate for 8.5 kg is extrapolated – Brothers estimated rates using weights up to 7 kg only). These estimates are about 5% lower and about 46% greater than the 0.4 m/s and 0.54 m/s, respectively, recorded to 20 m depth by time-depth sensors in this trial.

- the results indicate that even with light weights (4.25 kg/40 m) the lofted section of the hook line of the *Valiant* might sink faster (0.4 m/s) to 20 m depth than autoline longlines with

either integrated weight (50 g/m, 0.25 m/s) and autoline longlines conforming to the requirements of Conservation Measure 41-09 (0.3 m/s).

- the results imply that a sink rate of 0.25 m/s and a single streamer line might not be sufficient to reduce substantially white-chinned petrel mortality (and BBA mortality) in demersal longline fisheries.

- the depth profiles of 4.25 kg/40 m and 8.5 kg/40 m to 5 m depth are almost identical, yet Agnew's seabird catch rates differ markedly for these regimes.

- the picture created by the comparison in this trial – particularly when compared to the results from the New Zealand trial - is not clear.

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By the first author: Tim Reid did nearly all the work for this report. He did the TDR work on the ship, analysed the data and wrote drafts of the Methods and Results. Ben Sullivan and Janet Robertson also did a lot of work behind the scenes to support this project. Their support is gratefully acknowledged.

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