Agreement on the Conservation of Albatrosses and Petrels

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Developments in experimental mitigation research – Demersal trawl fisheries (Argentina and Namibia)

Albatross Task Force
BirdLife International Global Seabird Programme

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INTRODUCTION

The primary cause of seabird mortality associated with trawl vessels is the presence of offal discards in the water, which attracts foraging seabirds to the vessel and thus into contact with fishing gear (Wienecke and Robertson *et al*. 2001, Abraham *et al*., 2009, Melvin *et al.* 2010). Offal discard management is therefore considered to be the long-term solution for trawl related mortality, but in order to reduce mortality of vulnerable seabirds in the short to medium term alternative measures are urgently needed. Bull (2009) summarises existing best practice mitigation measures for trawl fisheries.

In southern Africa and South America seabird mortality has also been identified as an important issue for trawl fisheries (Watkins, 2008; Gonzáles-Zevallos & Yorio, 2006) and constitutes an area of high overlap between the distribution of vulnerable seabird and large scale trawl fisheries (BirdLife International, 2004).

This report is written in two sections and provides a review of the work conducted by the ATF in Namibia and Argentina during 2010/11 to identify mitigation measures to reduce seabird bycatch. As the two sections are comparable in terms of fishery characteristics and results, a joint discussion is included.

The data collection protocols for trawl fisheries included operational and environmental variables that were consistent between teams.[1]

[1] Contact Oli Yates (ATF Coordinator) for specific details on data collection protocols oli.yates@gmail.com

1.0 NAMIBIA

Effectiveness of tori lines at reducing seabird bycatch in the Namibian demersal Hake trawl fishery

John Paterson & Kaspar Shimooshili

An experiment was designed to compare seabird interactions with trawl warp cables in the presence and absence of tori lines. Two experimental treatments were tested:

1): Trawls with tori lines deployed;
2): Trawls with no tori lines deployed (control).

The null hypothesis (H_0) is that the use of tori lines in the demersal trawl fleet does not reduce seabird bycatch.

1.1 Fishing vessels, gear and study area

Research was conducted onboard commercial trawl vessels in the Namibian hake (*Merluccius spp.*) demersal trawl fleet. Depths fished range between 200 to 700 meters from approximately 24^0 S to 18^0 S. All trips were conducted out of Walvis Bay, situated at 23^0 S. Typically four to six trawls are performed per day with two trawls occurring at night.

1.2 Mitigation measure

The tori line design replicates the standard tori line design supplied to the South African hake trawl fishery by Kommetjie Environmental Action Group (KEAG). The line consists of a 10 mm red polypropylene braided backbone rope with seven coloured paired streamers at 5 m intervals. The first streamer is positioned five meters from the stern of the vessel. The towed device is a 760 mm long orange road cone, with two small buoys tied on the inside of the cone (Figure 1).

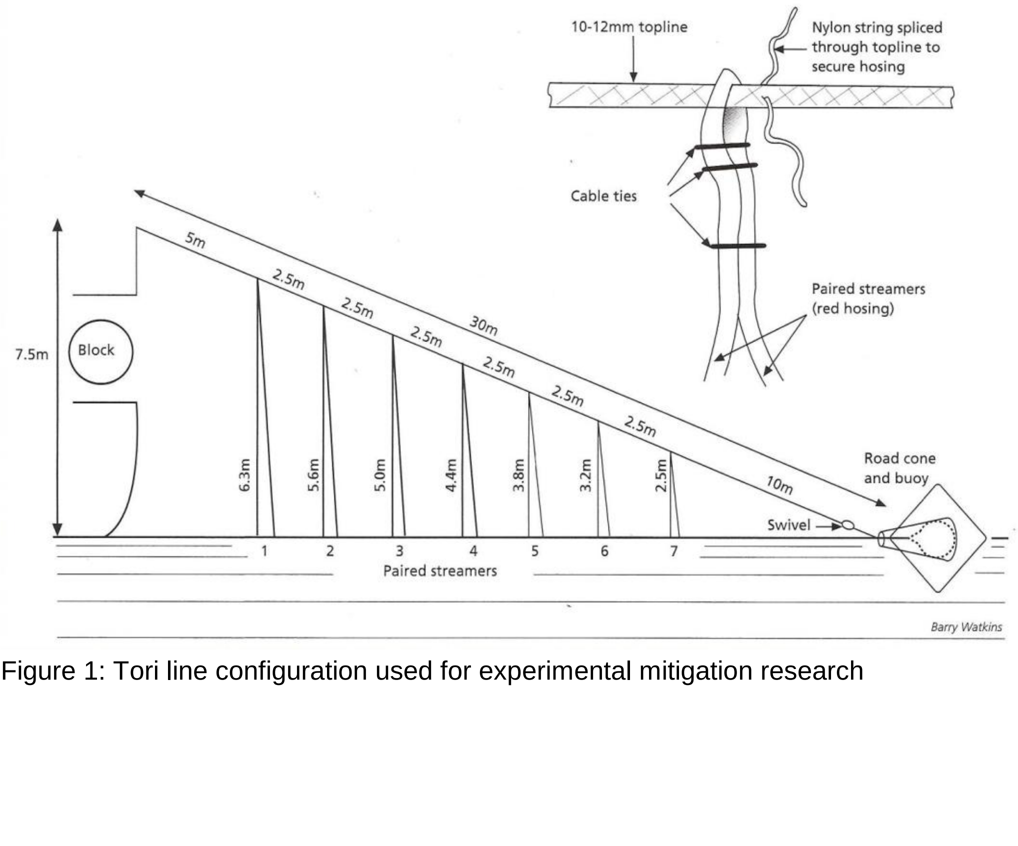

Figure 1: Tori line configuration used for experimental mitigation research

1.3 Onboard protocol

Seabird abundance was estimated at hourly intervals by conducting 15 minute counts extending 0 – 50 and 50 - 200 m aft from the stern gantry and 100 m to the port and starboard side.

Only trawls during periods with enough natural light for observations were sampled i.e. approximately 45 minutes before sunrise and 45 minutes after sunset. A single treatment was randomly assigned to each trawl. Observations of seabird interactions with warp cables were carried out in 30 minute periods, using a protocol adapted from Wienecke and Robertson (2001) (See Appendix 1). This included recording light and heavy contacts between birds on the wing and on the water, and the warp cable. Offal discard was recorded for each new observation period.

During Treatment 1, tori lines were set immediately after the winches stopped paying out and were retrieved after all factory processing and offal discard had terminated.

1.4 Data analysis

In order to identify the causes of seabird interactions in this fleet we performed a negative binomial General Linear Model on the data to investigate the effects of season, use of tori lines and the presence/absence of discards on seabird interaction rates. The model requires that the response variable be an integer rather than continuous, and so we were not able to investigate the rate *per se*. Therefore, to control for total observation time we included the logarithm of time as a covariate of interactions in the model.

Seabird mortality estimate

We are in the process of negotiating the provision of hake trawl fishing effort data for 2009/10 from the Ministry of Fisheries and Marine Resources, which once secured will enable us to conduct a statistically robust annual estimate of seabird mortality based on a spatial (fishing area) and temporal (seabird breeding season) stratification.

1.5 Results

Seabird abundance counts returned a mean of 206.3 (median, 105; SD, 246.9) birds per count. White-chinned petrels *Procellaria aequinoctialis* and Atlantic Yellow-nosed albatross *Thalassarche chlororhynchos* were the two most abundant species, occurring in 199 (94.31%) and 168 (79.62%) of the abundance counts, respectively (*n*=211). Together these two species accounted for over 58% of all seabirds present during fishing operations.

Effect of tori lines on seabird interactions

During 107 trawls, a total of 6,457 minutes of warp interaction observations were carried out during net setting, trawling and hauling. These observations are divided into four treatments;

1. Tori line deployed with offal discard present (23.4%)
2. Tori line deployed without offal discard (13.8%)
3. No tori line deployed with offal discard (30.8%) and
4. No tori line deployed without offal discard (32.0%).

A total of 578 interactions were observed, of which 98.6% were during periods with offal discard and 1.4% without discard. Of the 578 interactions observed, 86.5% were during sets where no tori line was deployed whereas 78 (13.5%) interactions were observed while a tori line was deployed (Table 1).

Table 1: Observer effort and total interaction (light, medium & heavy) rates per treatment

		No tori line		With tori line		
Season	Data	No Discard	With Discard	No Discard	With Discard	Grand Total
Summer	Total Interactions	0	7	0	0	7
	Observation effort (min)	825	460	264	320	1,869
	Rate (interactions / min)	0	0.015	0	0	
Winter	Total Interactions	8	485	0	78	571
	Observation effort (min)	1,242	1,526	626	1,194	4,588
	Rate (interactions / min)	0.006	0.318	0	0.065	
Total Sum of Interactions		8	492	0	78	578
Total Sum of Observation effort (min)		2,067	1,986	890	1,514	6,457

There were only seven interactions with trawl warp cables in summer, only 78 interactions with the warp cables when tori lines were deployed, and only eight interactions when no discarding occurred. The strong effect of tori line use on interaction rates is best illustrated by comparing winter periods when discarding occurred, under which circumstances the tori line caused a five-fold reduction in interaction rates (from 0.318 to 0.065 birds per minute of observation) .

The General Linear Model found that all three factors (Season, tori line use and discarding) were highly significant (Table 2). Thus limiting effort in winter, eliminating discard or deploying BSLs will all have a significant impact on reducing seabird interaction rates. Of these, tori line use is the most economical to implement and requires no seasonal closures, and no meaningful modifications to vessels, operational procedures or fishing profitability.

Table 2: Summary results from the General Linear Model on seabird interactions in the demersal trawl fleet

Factor	Estimate	Std Error	z value	P
Intercept	-10.1634	0.88	-11.62	<0.001
Tori line	-2.7027	0.26	-10.29	<0.001
Discard	4.2968	0.38	-11.17	<0.001
Season	3.3531	0.43	7.83	<0.001

2.0 ARGENTINA

Improving the performance of tori lines in the Argentinean trawl fishery with the use of an off-setting towed device

Leandro Tamini, Leandro Chavez & Fabian Rabuffetti

The objectives of the study were twofold:

1) To investigate the effectiveness of an off-setting towed device to minimise seabird collisions with the warp cable by reducing the exposure of the warp cables in cross winds;
2) To reduce entanglements of tori line streamers with warp cables

Three treatments were used in the experimental design:

1) Standard tori line with a weighted buoy as the towed device;
2) Standard tori line with an off-setting towed device;
3) Control (no mitigation).

H_0 = Tori line use does not reduce seabird interactions with trawl warp cables.

H_0 = An off-setting towed device does not reduce entanglements between tori lines and warp cables.

2.1 Fishing vessel and study area

The experiment was conducted on two industrial trawl vessels from the Argentinean demersal fleet between the 10th August and 22nd September 2009 and between the 13th January and 13th February 2010, 04th and 14th May, 22nd May and 25th June 2010. The vessels had a total length of 63 and 67m and carried 39 and 49 crew members. The main target species were common hake *Merluccius hubbsi,* red cod *Salilota australis*, hoki *Macrunorus magallanicus*, grenadier *Macrurus fasciatus* and rock cod *Patagonotothen ramsayi*. Fishing took place in the south west Atlantic along the Patagonian shelf between the approximate coordinates 45°20' S / 61°10' W and 53°36' S / 61°33' W.

2.2 Fishing gear and operation

A demersal trawl net was used with a 25-30 m by 4.5 m gape. The diamond mesh size varied from 130 to 200 mm and the net was towed by 24 mm warp cables with exposed splices every 500 m. Trawling took place between 06:00 - 21:00 hours each day and lasted an average of 2 hours 58 minutes (SD= 1:24). Trawling speed varied between 3.8 and 4.1 knots.

2.3 Mitigation measure

Treatment 1 - Standard tori line

The standard tori line used in the experiments was composed of a 30 m long green and bright yellow polyethylene 10 mm rope. The streamers were made from bright red 2 cm width 1.5 mm PVC tubing and were attached along the length of the backbone at intervals of 2.5 m (Figure 2). Aft of the buoy a 3.5 kg weight provided extra drag.

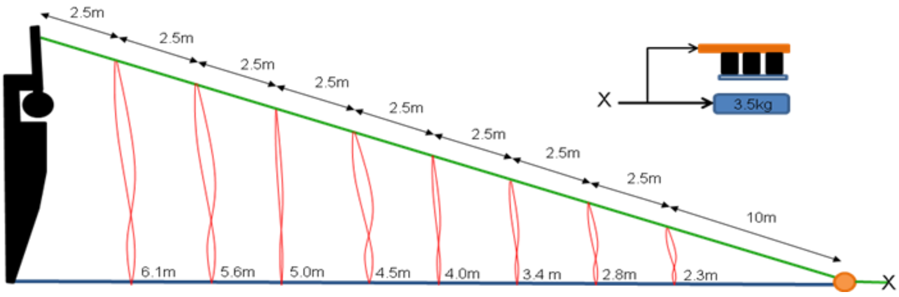

Figure 2: Tori line configuration used during experimental tests

Treatment 2 - Standard tori line with off-setting towed device
The tori line used in this treatment was identical to that in Figure 10, with the exception of the towed device. A wooden 40 x 20 x 2 cm board to which three 2 mm rectangular aluminium keels measuring 13 x 10 cm were fixed was used to replace the 3.5 kg weight behind the buoy on the standard tori line. On the lower surface of the three keels, six 400 g weights were added (Figure 3).


Figure 3: The towed device with 400g weights attached to the lower surface of the keels

Treatment 3
A control treatment of no tori line was used.

2.4 Onboard protocol
Seabird abundance was estimated for all experiments by conducting approximately 10-minute observations within a semi-circle extending 200 m aft of the stern of the vessel.

The three treatments were deployed sequentially during each experimental trawl. The order in which the three treatments were deployed on each trawl was randomly allocated. Experimental treatments began once the net was on the seabed, each treatment lasting 15 minutes. Data collected during trawls that finished before all three treatments could be deployed were excluded from data analysis.

Observations on seabird interactions with trawl warp cables were carried out in 45 minute periods (3x 15 minutes). A single warp cable was chosen for observations based on the side of the vessel where most offal was discharged. Interaction protocols were adapted from Wienecke and Robertson (2001). This included recording light and heavy contacts between birds on the wing and on the water, and the warp cable. Offal discard was recorded for each new observation period.

2.5 Data analysis

A total of 104 trawls and 4,995 minutes of observation were included in the analysis. During this observation effort it was possible to perform 111 experiments, as on seven occasions offal discard continued for long enough to perform two experiments.

Total contacts (light and heavy contacts on the water and in the air combined), heavy contacts (in the air and on the water) and mortality[2] of seabirds through collisions with the trawl warp cables were compared for each of the three treatments using a Kruskal-Wallis test for multiple comparisons.

Warp entanglement or risk of entanglement was analysed using a Chi-squared 2x2 contingency table. The total time (mins) in which the tori line was entangled ("crossed over") and not entangled ("in line" and "offset" combined) for the two tori line treatments was compared.

2.6 Results

Results from the Kruskal-Wallis test showed that the use of a tori line (both with buoy and with an off-setting towed device) significantly reduced seabird interactions with the trawl warp cable when compared with the control of no tori line (*P*< 0.001) (Figure 4). However, there was no significant difference in seabird interactions with the trawl warp cable when comparing between a buoy and the off-setting towed device (*P*> 0.05).

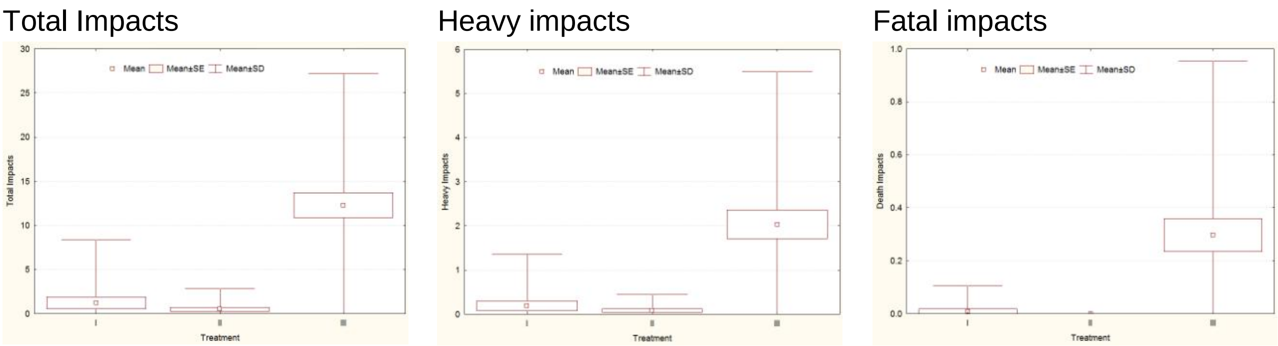

Figure 4: Total, heavy and fatal seabird impacts with warp cables recorded for each treatment. The X axis shows treatment; Treatment 1, tori line + buoy (left); Treatment 2, tori line + off-setting towed device (middle); and Treatment 3, control (right).

The Chi-squared test used to compare the effect of tori line state (crossed over versus not crossed over) during trawling indicated that the tori line with the off-setting towed devices (Treatment 2) crossed the warp cable significantly less than the standard tori line (Treatment 1) (*P*<0.0001).

[2] Seabird mortality included three subcategories that were grouped together; damaged, possibly dead and dead.

3.0 DISCUSSION

Our results in Namibia and Argentina demonstrate that the use of tori lines significantly reduces interactions between seabirds and trawl fishing gear. These findings agree with previous studies that report tori lines are an efficient mitigation measure for trawl fisheries (Watkins *et al*. 2008; Abraham *et* al. 2009; Bull, 2009, Melvin *et al.* 2010).

In Argentina, the fact that the towed device significantly reduced the amount of time that tori lines crossed the warp, therefore leaving the water and warp cable interface exposed, would suggest that over a longer time period tori lines with the towed device may well reduce the number of seabird interactions with warp cables compared to standard tori lines. Hopefully, once the towed devices are 'operational' these long term data can be collected.

The adoption of the FAO Best Practice Technical Guidelines (FAO 2009) which extend the application of the FAO IPOA-Seabirds to include trawl fisheries are directly relevant to our work in Namibia and Argentina. In 2010, Argentina adopted their NPOA-Seabirds which addressed trawl fisheries and based on our findings, specifically the increased effectiveness of tori lines with the off-set towed device, we plan to work with government and industry to have mitigation measures introduced to the trawl fleet.

In Namibia, the ATF have been working closely with the government and industry to strengthen the draft NPOA-Seabirds on the basis of the FAO BPTG and as a direct result of our work in this fishery, mitigation measures are included in the Namibian draft NPOA-Seabirds and the Hake Management Plan (HMP). Both the NPOA-Seabirds and HMP recommend the adoption of tori lines as mitigation measures and the NPOA-Seabirds calls for a seabird bycatch reduction of 80% in this fishery. Following stakeholder consultation the HMP has recently been accepted by the Minister of Fisheries and the draft NPOA-Seabirds is with the Ministry for final consideration.

In Namibia, we are in the process of negotiating the provision of hake trawl fishing effort data for 2009/10 from the Ministry of Fisheries and Marine Resources and in Argentina we are working with INIDEP on official trawl effort data. Within the next two months we plan to conduct a statistically robust annual estimate of seabird mortality for both fisheries based on a spatial (fishing area) and temporal (seabird breeding season) stratification.

The Argentinean towed device has been developed with marine engineers into a commercially available working prototype. We are currently undertaking final at-sea testing after which we hope to be able to make it available to the Argentinean trawl fishery (Figure 5). We will also have design specifications that we can distribute to fleets around the world that are interested in trialing the device.

Figure 5: Towed device developed in Argentina for use in industrial demersal trawl fisheries

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None of our work would be possible without the collaboration from the fishing industry, national observer programmes and government departments in each of the countries where ATF teams are active. We are very grateful for their ongoing support.

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APPENDIX 1:
Trawl data collection protocol

Basic data collection of seabird interactions with trawl warp cables included the categories displayed in Table 1, and were recorded in all observation periods during daylight operations.

Table 1: details of trawl data collection during interaction surveys

Item	Detail	
Interaction	Flying collision / Sea surface collision	
Impact	Heavy	Impact drags bird under or breaks wing (dragged under)
	Medium	Impact causes change in behaviour and direction (collides with warp)
	Light	Impact causes little or no change in behaviour and direction (touches warp)
Outcome	Injured / Dead / Possibly dead / not injured	
Scupper	Port / Starboard	
Discard type	Head / Guts / Whole fish	
Discard amount	Heavy / Medium / Light / Nil	