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SEABIRD INTERACTIONS WITH LONGLINING OPERATIONS FOR *DISSOSTICHUS ELEGINOIDES* AT THE SOUTH SANDWICH ISLANDS AND SOUTH GEORGIA

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Abstract

During seven days of operations involving the setting and hauling of longlines to catch the toothfish *Dissostichus eleginoides* around the South Sandwich Islands, actual and potential interactions with seabirds were assessed. Bird numbers increased rapidly after dawn and large numbers of Cape, giant and storm petrels and smaller numbers of white-chinned petrels and black-browed albatrosses were present during day hauling operations. No incidental mortality was seen and only one bird was caught on a hook; nevertheless many species in these aggregations of birds are clearly potentially vulnerable to setting operations in daylight hours. Several species of the seabirds present presumably originated from South Georgia populations; however wandering and grey-headed albatrosses, whose populations are in serious decline at South Georgia, were rare; their vulnerability to longlining operations in the South Sandwich Islands may, therefore, be low. Quantitative data and observations of longline vessels fishing around South Georgia, however, indicate significant catch rates of albatrosses.

Résumé

Les interactions réelles et potentielles des oiseaux de mer et des opérations de pêche à la palangre ont été évaluées au cours de sept jours de pêche de légine *Dissostichus eleginoides* impliquant la pose et le virage de palangres autour des îles Sandwich du Sud et de la Géorgie du Sud. Le nombre d'oiseaux augmentant rapidement au lever du jour, il était possible, lors des opérations de virage menées de jour, d'observer de nombreux pétrels - pétrels du Cap, pétrels géants antarctiques et pétrels tempête - ainsi que quelques pétrels à menton blanc et albatros à sourcils noirs. Aucune mortalité accidentelle n'a été repérée et un seul oiseau s'est pris sur un hameçon; il est néanmoins évident, que parmi les oiseaux rassemblés, de nombreuses espèces risquent d'être affectées par les opérations de pose réalisées de jour. Plusieurs espèces d'oiseaux de mer présents appartenaient sans doute aux populations de la Géorgie du Sud; il est à noter toutefois que les grands albatros et les albatros à tête grise dont les populations subissent un déclin sérieux en Géorgie du Sud n'étaient rencontrés que rarement; ceux-ci seraient donc vraisemblablement peu vulnérables aux opérations de pêche à la palangre aux îles Sandwich du Sud. Cependant les données quantitatives et les observations concernant les palangriers en activité autour de la Géorgie du Sud indiquent que le taux de capture des albatros est significatif.

Резюме

В течение семи суток промысловых операций, включающих установку и выборку ярусов для лова клыкача *Dissostichus eleginoides* в районе Южных Сандвичевых о-вов, были изучены фактические и потенциальные взаимодействия морских птиц с промыслом. Наблюдался быстрый рост количества птиц с наступлением рассвета. При дневной выборке ярусов наблюдалось большое количество капского голубка, гигантского буревестника и малой качурки и небольшое по сравнению с этим количество белощекого буревестника и чернобрового альбатроса. Случаев побочной смертности замечено не было - лишь одна птица попалась на крючок. Несмотря на это,

очевидно, что установка ярусов при дневном свете потенциально представляет опасность для многих видов скапливающихся птиц. Предполагается, что некоторые виды встретившихся здесь птиц являются частью южногеоргианских популяций. Однако, странствующий и сероголовый альбатросы, популяции которых на Южной Георгии находятся в состоянии серьезного упадка, встречались редко; в связи с этим степень уязвимости этих птиц в отношении ярусного лова в районе Южных Сандвичевых о-вов может оказаться незначительной. Тем не менее, количественные данные и наблюдения за ярусоловными судами, ведущими промысел вокруг Южной Георгии, указывают на существенный уровень поимки альбатросов.

Resumen

Durante siete días de operaciones que comprendieron el calado y recuperación de palangres dirigidos a la captura del bacalao de profundidad *Dissostichus eleginoides* en las islas Sandwich del Sur, se hizo un estudio de las interacciones reales y potenciales de las aves marinas con esta pesquería. La cantidad de aves aumentó rápidamente luego del amanecer y se observó una gran cantidad de petreles moteados, gigantes y de las tormentas así como petreles de mentón blanco y albatros de ceja negra, aunque en menor número, durante la recuperación de los palangres. No hubo mortalidad incidental y solo un ave fue cogida en un anzuelo; no obstante, muchas especies presentes en estas concentraciones son claramente vulnerables a las operaciones de calado realizadas durante las horas del día. Varias especies de aves marinas observadas provienen probablemente de las poblaciones de Georgia del Sur; sin embargo se observaron pocos albatros errantes y de cabeza gris, cuyas poblaciones sufren una grave disminución en Georgia del Sur; por consiguiente su vulnerabilidad a la pesca de palangres llevada a cabo alrededor de las islas Sandwich del Sur podría ser mínima. La información cuantitativa y las observaciones de los buques pesqueros que faenan en la vecindad de Georgia del Sur indican que los índices de captura de albatros son significativos.

Keywords: incidental mortality, Southern Ocean, albatross, petrel, line setting, hook vulnerability, CCAMLR

INTRODUCTION

In recent years, decreases in populations of several species of Southern Ocean albatrosses have been reported (Croxall, 1979; Tomkins, 1985; Weimerskirch and Jouventin, 1987; Weimerskirch *et al.*, 1987; Copson, 1988; Croxall *et al.*, 1990; Prince *et al.*, 1994). There is increasing evidence that these declines are related to incidental mortality associated with fishing operations in general and with longline fisheries in particular (Croxall and Prince, 1990; Croxall *et al.*, 1990; Brothers, 1991; Bartle, 1991; Murray *et al.*, 1993; Prince *et al.*, 1994).

Brothers (1991) reported a catch rate of 0.41 seabirds/thousand hooks in the southern bluefin tuna longline fishery off Tasmania. Nearly all these birds were albatrosses and he calculated that the worldwide southern bluefin tuna fishery would be killing around 44 000 albatrosses annually in southern oceans. He showed that the use of a streamer line (to deter birds from attempting to take baits from hooks during setting operations) could reduce bait loss to birds by up to 69% - representing a saving of $A4.9 million and 30 300 albatrosses annually. The Japanese tuna fishery is in the process of agreeing in principle to the widespread introduction of streamer lines in their longline fishery. In respect of longline fisheries for *Dissostichus eleginoides* in the Southern Ocean, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) adopted Conservation Measure 29/X (Minimisation of the Incidental Mortality of Seabirds in the Course of Longline Fishing or Longline Fishing Research in the Convention Area) in 1991. This required the use of streamer lines and gave specifications for the line in an appendix to the measure. Based on experiences in the Japanese tuna longline fishery, other mitigating techniques were also agreed: accelerated sinking of baited hooks, reduction of lights at night, and avoidance of the dumping of offal during longline operations. This measure was readopted with minor modifications as Conservation Measure 29/XI in 1992.

At CCAMLR-XI, Chile proposed to conduct a new (exploratory) fishery for *D. eleginoides* in Subarea 48.4 (South Sandwich Islands). The preamble of Conservation Measure 44/XI, which

regulates this fishery, notes and welcomes the invitation from Chile for one scientist to participate as an observer on board the fishing vessel conducting the exploratory fishing. The tasks of this scientific observer included participation in the collection of scientific data and particularly the responsibility for a study of interactions between seabirds and the fishing operation. The original cruise objectives included an experiment to compare interactions with and without a streamer line in operation but the paucity of fish caught caused the cruise to be terminated prematurely. This paper reports on the observations made and includes some additional data reported from similar fishing operations in the South Georgia area.

METHODS

Fishing Equipment

The *Friosur V* is a longliner of Japanese construction: full specifications are given in CCAMLR (1992). The vessel has a maximum complement of 31 crew and a maximum speed of 10 knots.

Fishing for *D. eleginoides* was carried out by bottom longline (Figure 1). This consisted of a 9 mm diameter main line made of mixed polyester and polyethylene rope, to which were tied secondary lines 1.2 m long, made of Vinylon Twine™ #20. Eyeless hooks of size #26 Maruto™ (28 mm) were tied to the free ends of the secondary lines. The main line was subdivided into four sections by marker buoys. Each section consisted of 75 coils, each coil 75 m long with 30 to 38 hooks, giving a total length of main line of 22 500 m and a total of approximately 10 500 hooks. The buoy lines were made of the same material as the main line but were 10 mm in diameter. Pieces of the squid *Illex argentinus* were used for bait, with roughly 20-30 g/hook. Although expensive, squid was preferred as it was considered to have a greater probability of being retained on the hook during the setting operation than other baits commonly used by Chilean longliners (e.g., salted sardines or jack mackerel).

Fishing Operations

Seven full longline operations were performed; the first on 25 February and the last on 3 March 1993, with one operation per day. Positions are indicated in Figure 2.

A fishing operation consisted of three stages: locating a suitable site (based principally on the experience of the Japanese Fishing Master), followed by setting and then hauling of the longline. Hauling was carried out by winch through a forward hatch set on the starboard side of the vessel. Incoming fish were gaffed to prevent escape at the surface, detached from the hook before reaching the winch and then killed and processed, including descaling, filleting, packaging and freezing. The viscera and skeleton were discarded immediately over the side. The recovered line was separated into its constituent coils before being sent aft to a general work-deck at the stern where it was repaired, baited and prepared for the next operation. Setting was done from two hatches at the stern of the ship, where each coil was paid out after being weighted and tied to the preceding coil. Hauling and setting were conducted into the wind.

The mean time for setting was 1 h 29 min. (i.e., a rate of about 100 hooks per minute), followed by a mean rest period of 1 h 33 min and a mean hauling time of 11 h 51 min. The mean maximum depth was 1 730 m (SD = 325.38 m) and the mean minimum depth was 1 230 m (SD = 139.39 m), inside a full range of between 930 m and 2 400 m. Surface water temperature was between 0.5° and 2.0°C.

Observation Methods

Observations were made during both setting and hauling. Information was recorded on data sheets as used by the New Zealand Ministry of Agriculture and Fisheries for the southern bluefin tuna fishery. Four categories of bird activity were recorded during setting: strikes at baits, birds hooked, bait stealing and baits dived for. During hauling, the number of birds hooked and the number released alive were recorded.

One observer undertook all setting observations, standing at the stern hatches or on the deck directly above. All interactions with seabirds for the period observed were noted. The number of birds of each species in the vicinity of the ship was recorded every 30 minutes. Almost all setting took place at night. The ship's lights permitted visibility of 50 m during the hours of darkness: this extended beyond the point at which the baits sank and thus bird species could readily be identified at this distance. Observations were made for all but 1.5 hours of total setting time. The streamer line was used for

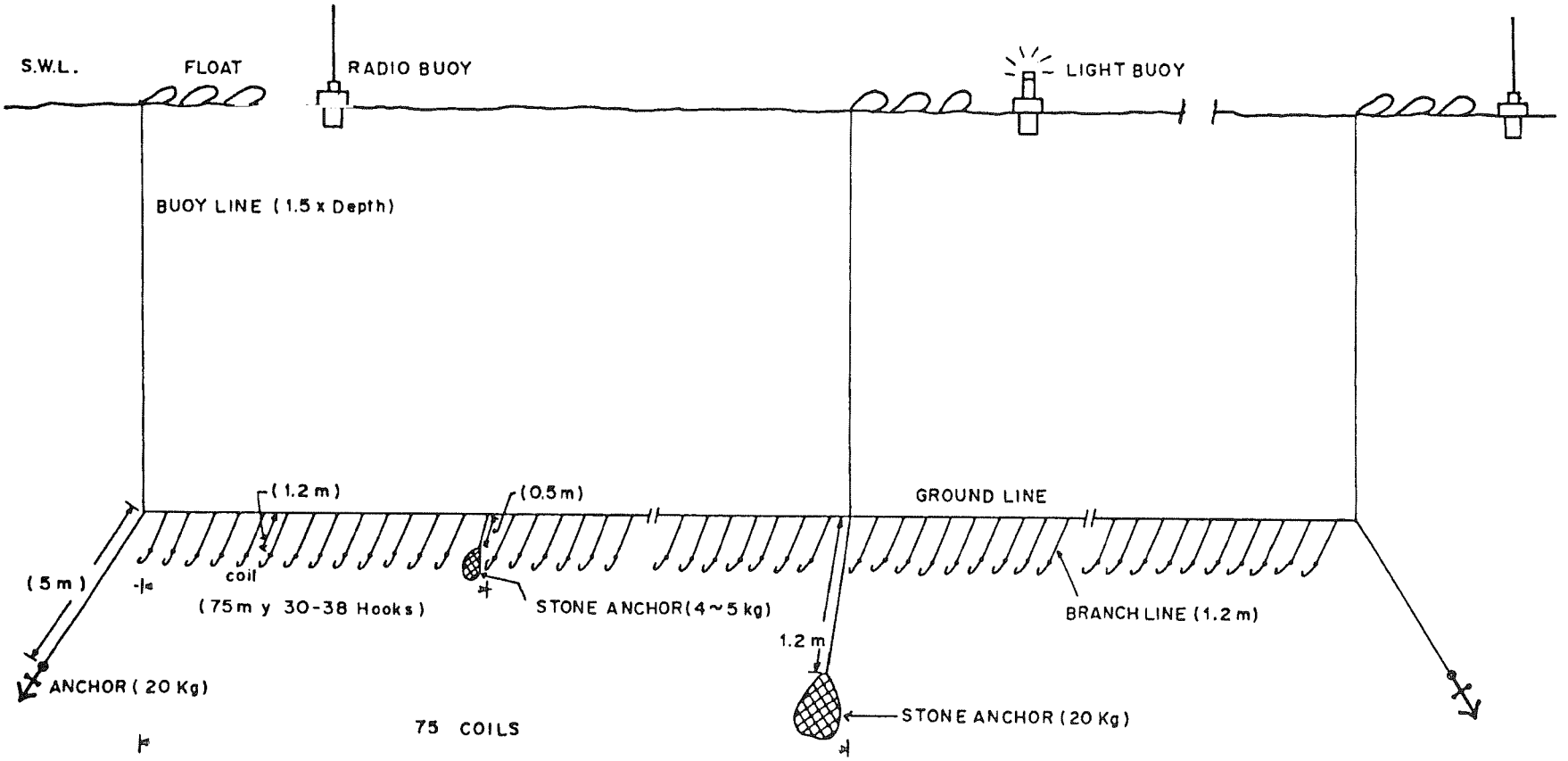

Figure 1: Configuration of bottom line used by *Friosur V* for capture of *D. eleginoides*.

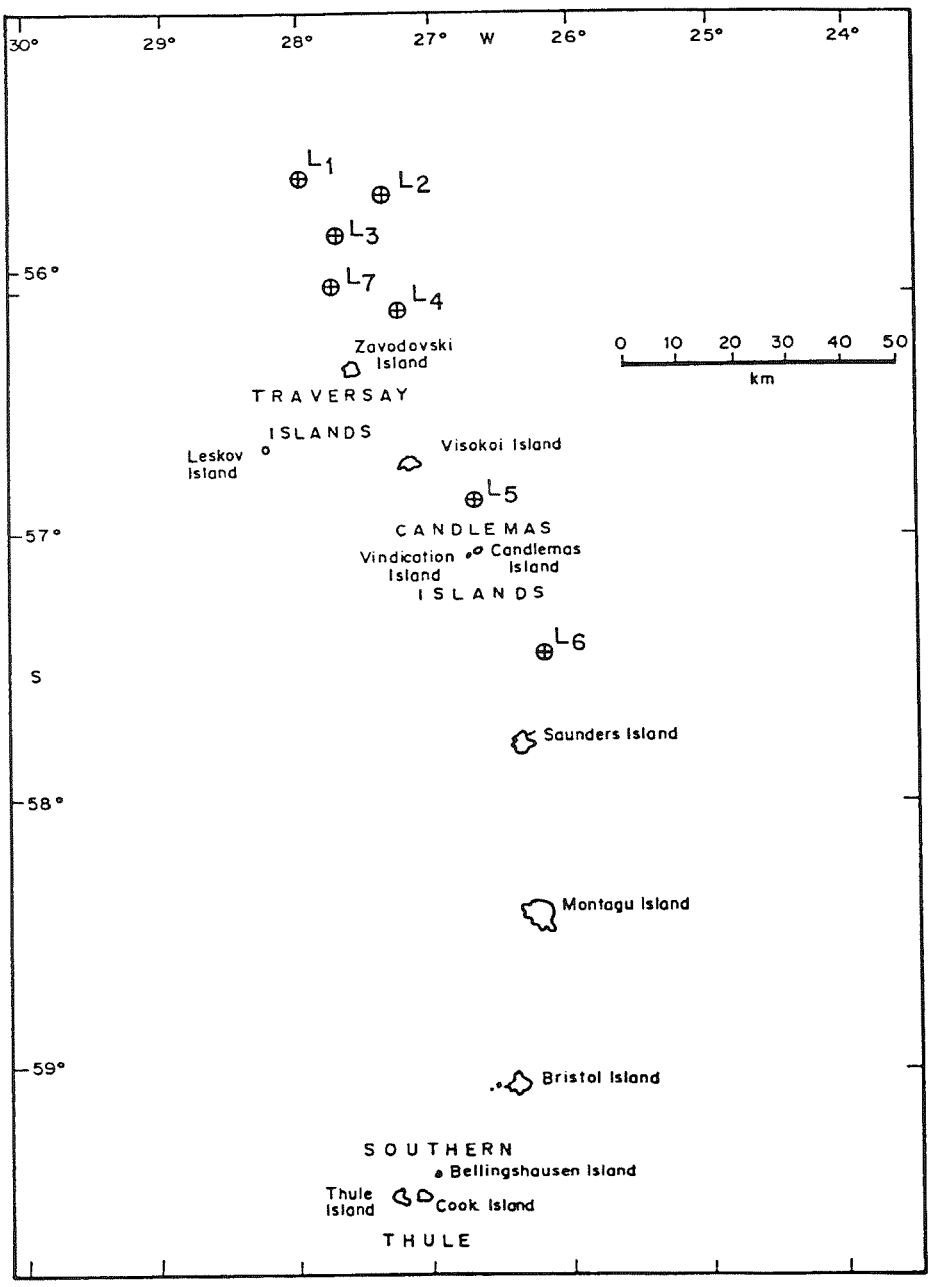

Figure 2: Position of exploratory fishing operations conducted.

three of the seven sets. This was not exactly to CCAMLR specification: although attached to the ship at the right height from the aft gantry on the port side, the main line was more than 1 cm thick, there were no swivels and the streamers consisted of clear plastic, each of approximately 1.5 m, along the length of the line; they did not therefore reach sea level until well aft of the ship's stern. Additionally, the distance between the last streamer and the final weight was considerably less than 125 m and, after three sets using the streamer line, the plastic streamers were showing evidence of wear. The streamer line was located very close to (over) the main line.

Observations of hauling operations were made on a rota system, the duty observer standing to one side of the winch, with a clear view of the line. All hauling operations were covered by at least one observer. At hourly intervals, estimates were made of the total number of birds of each species associated with the vessel; these were all made by a single observer, to reduce variation due to observer error.

To avoid interference with activities on the ship's bridge, data on weather and the day's fishing operations were provided by the first mate after the end of each haul.

RESULTS

Incidental Mortality

No incidental mortality associated with the actual fishing operations was seen. A single prion (identified as *Pachyptila belcheri*) was found dead on the foredeck on 1 March.

Interactions During Setting

Few birds were observed during setting in the hours of darkness (Table 1). Giant petrels (*Macronectes* sp.), Cape petrels (*Daption capense*), white-chinned petrels (*Procellaria aequinoctialis*) and black-browed albatrosses (*Diomedea melanophris*) were present at the end of the two sets which overlapped with the early dawn light. No birds were hooked during setting, no baits were taken from hooks, and no instances of diving for baited hooks were observed.

Interactions During Hauling

One chinstrap penguin (*Pygoscelis antarctica*) attempted to take bait off a hook during hauling and was knocked off by the winchman before it reached the winch. Blood was later observed from a wound in the mouth area. Another chinstrap leapt aboard through the hauling hatch. The period of potential vulnerability of birds during hauling is fairly brief, only about five seconds elapsing between a hook being visible in the water and coming on board. No data are available on the proportion of hauled hooks still retaining bait.

The numbers of seabirds associated with the ship increased rapidly after first light, and species composition changed with site. The main species encountered were Cape petrels, both northern and southern giant petrels (*Macronectes halli* and *M. giganteus* respectively), white-chinned petrels, both black-bellied and Wilson's storm petrels (*Fregetta tropica* and *Oceanites oceanicus* respectively - the latter occurring more frequently), and black-browed albatrosses.

Table 2 shows the mean number of birds associated with day-hauling operations at each site, and Table 3 gives the mean bird abundance at different times of the day for all observations combined. In both sets of data, because of differences in sampling between sites and the paucity of data for certain times of day, the only data allowing realistic comparison are those for the time period between 12.00 and 17.00 GMT. Numbers of giant petrels and storm petrels increased with increasing latitude, while numbers of white-chinned petrels and black-browed albatrosses decreased.

Behavioural differences between species were also noted. Birds gathered on the surface forming a plume downwind of the hauling point out to 500 m astern of the vessel. In encounters over offal or discarded by-catch, a hierarchy developed with giant petrels the most successful, followed by black-browed albatrosses and Cape petrels; white-chinned petrels were not observed contesting food. Similarly, species approached the vessel to different degrees, Cape petrels clustering on the surface around the hauling point, and giant petrels occasionally coming close during periods of high activity but more often standing off at 10 m or more. Black-browed albatrosses rarely approached to within 10 m on the surface, more often circling the boat on the wing or staying well aft of the vessel when on the surface. White-chinned petrels rarely approached within 50 m of the vessel.

Observations of Longlining off South Georgia

Brief observations were also made of three longliners hauling in the South Georgia area (Subarea 48.3) on 22 February. The first two were sighted during daylight. Large numbers (n = 100+) of at least four species of birds (Cape, giant and white-chinned petrel, black-browed albatross) were observed around the first longliner. Large numbers of black-browed and wandering albatrosses, together with giant and Cape petrels were also associated with the second. The third vessel was sighted at night: no birds were seen, despite the ship's lights, on a single pass along the starboard side from stern to bows.

According to the first mate, setting operations without the use of streamer lines by the *Friosur V* around South Georgia do cause incidental mortality. He estimated that up to six seabirds were hooked per operation, the main species caught being the black-browed albatross.

DISCUSSION

South Sandwich Islands

No incidental mortality was seen and no birds were hooked during setting at night, reflecting the

Table 1: Number of seabirds observed near setting operations. Hours are in Greenwich Mean Time; first light was at 0400. Species code: a = Cape petrel, b = giant petrel, c = black-browed albatross, d = white-chinned petrel, e = prion. The position of sites (L_1 to L_7) is shown in Figure 2.

Time	Fishing Site						
	L_1	L_2	L_3	L_4	L_5	L_6	L_7
02.30						2e	0
03.00					0	1e	0
03.30					1a1e		0
04.00					0		0
04.30	1a				1a		
05.00	1a	1a		1a			
05.30	0	4a		2a			
06.00	2a	4a1c1d	0	1a			
06.30		No record	0				
07.00		30a5c3d	5b3c				
07.30			10a7b4c				

Table 2: Mean number of seabirds associated with hauling operations at each site, for period between 12.00 and 17.00 hours GMT. N = number of observations made.

Site	N	Species				
		Petrels				Black-browed Albatross
		Cape	Giant	White-chinned	Storm	
L_1	5	136.0	14.0	17.2	5.4	7.4
L_2	5	120.0	41.2	3.2	12.2	7.6
L_3	5	192.0	49.0	7.4	16.4	5.2
L_4	6	116.7	61.3	5.7	25.0	1.7
L_5	6	77.0	40.7	1.3	32.5	4.8
L_6	3	52.7	100.0	1.3	83.3	0.7
L_7	5	60.2	24.8	11.2	21.6	5.4

Table 3: Mean number of seabirds associated with hauling operations in relation to time of day for period between 12.00 and 17.00 hours GMT. N = number of observations made.

Time	N	Species				
		Petrels				Black-browed Albatross
		Cape	Giant	White-chinned	Storm	
12.00	5	87.4	28.6	5.0	15.4	5.2
13.00	7	85.6	43.6	8.9	17.3	3.6
14.00	7	105.3	43.7	4.7	28.1	4.6
15.00	6	95.5	46.0	6.3	31.7	3.0
16.00	4	147.5	58.0	6.7	24.0	7.2
17.00	6	154.2	49.7	9.3	32.0	6.5

low numbers of birds attracted. With first light at the end of two of the sets, numbers of birds rose rapidly but still no mortality was observed. Cape petrels were predominant and this species may be less likely to be caught on the hooks because of the size of bait and hook relative to the birds' gape. However, no attempts were made by birds of any species to dive for baited hooks.

Insufficient repeats of the experiment using the streamer line were made and too few birds observed for any conclusions on its effectiveness as a mitigating device during setting. There is a problem of potential entanglement with the main or buoy lines, for which reason the officers on the *Friosur V* preferred to use a noise-scare based on the release of compressed air, rather than the streamer line. However, the navigating officer found that by directing the boat slightly to port when the marker buoys were being released, the streamer line could be brought out to port, allowing the buoy lines to pass without interference. This manoeuvre did not affect setting operations. The potential cost in lost time, equipment or fishing efficiency should not be under-estimated, however, and may lead to opposition to using the method on longliners in the South Georgia area. Alternatively, other configurations of streamer lines might be easier to accommodate, e.g. two lines, one to port and the other to starboard of the main line.

Apart from one chinstrap penguin, no interactions with the line were observed during hauling. The area of vulnerability was small, the line coming in vertically with a distance of approximately 2 m between the water surface and winchman, and too quickly for birds to take bait by diving.

While some seabirds commonly observed may have been indigenous to the South Sandwich Islands, others must have come in from breeding sites elsewhere (Croxall *et al.*, 1984). Black-browed albatrosses, northern giant petrels and white-chinned petrels do not breed on the Antarctic Peninsula or in the South Sandwich Islands and most likely derive from South Georgia. The few wandering and light-mantled sooty albatrosses (*Phoebetria palpebrata*) also presumably originate from South Georgia. The black-bellied storm petrels seen may have come from either South Georgia or the Antarctic Peninsula. On the other hand, southern giant petrels, Cape petrels, Antarctic fulmars (*Fulmarus glacialoides*) and Antarctic prions (*Pachyptila desolata*), Wilson's storm petrels and chinstrap penguins were most likely to be South Sandwich Islands birds, but could have come from elsewhere (especially in the case of giant petrels).

Thus, wandering albatrosses and grey-headed albatrosses (*Diomedea chrysostoma*), the species whose breeding numbers at South Georgia are most in decline, were respectively rarely or never seen from the *Friosur V* in the South Sandwich Islands area. This indicates that these species either do not visit the islands in any great numbers at this time or were not attracted to the longlining operations described here. Their vulnerability to longlining operations in the South Sandwich Islands may therefore be low, but the brevity of observations must render any conclusions preliminary.

Observed numbers and therefore potential vulnerability of seabirds observed followed a distinct diurnal pattern: few birds were observed during setting at night, numbers rising with the early morning light; large numbers of birds were then associated with daytime hauling activities. The considerable number of ship's lights used at night did not attract large numbers of birds.

The seabird-fishery interactions reported here are not necessarily typical of all longline situations. Important variables will include the location and methods of the fishery. The location fished will significantly affect seabird species composition (e.g., many more albatrosses and white-chinned petrels are observed around South Georgia, compared with the South Sandwich Islands area). Different fishing equipment and techniques are used by Russian, Japanese and Spanish fisheries. The Japanese system of longlining was used on board the *Friosur V*; all other Chilean vessels in the fishery for *D. eleginoides* use variations on the Spanish system. Bait used for the latter is fish, usually jack mackerel or sardine, and hooks are often baited mechanically. Bait loss during setting is higher than with hand-baited squid, according to the operations manager of Frioaysen S.A., resulting in more loose bait in the water to attract seabirds immediately around setting operations. The Spanish system also uses more and thicker line, with a second line above the main line and/or larger secondary lines. Monofilament is used which has a lower density than the mixed polyester and polyethylene rope used on the *Friosur V*. More weights are used to compensate but the line sinks more slowly and at a greater distance from the stern. It should also be noted that if line is lost during fishing operations, mixed polyester and polyethylene rope degrades more quickly.

Vulnerability may also vary with catch: offal and the by-catch species *Macrourus holotrachys* and *Raja* (*Amblyraja*) *georgiana* were discarded during fishing operations, and could be broken down into digestible fragments to differing degrees, in the order: offal, *M. holotrachys*, *R. georgiana*. The quantity and proportion of offal and different by-catch species may influence the nature and number of birds attracted.

South Georgia

The larger numbers and different composition of species observed near the three longliners suggest that seabirds may be at greater risk around South Georgia. In particular, vulnerability of threatened species is likely to be higher as considerable numbers of wandering albatross were observed to be associated with at least one of the three longliners seen.

From the estimate of incidental mortality provided earlier (see 'Observations of Longlining off South Georgia' above), assuming that a streamer line was not used and given one fishing operation/day/vessel and 406 longlining operations completed in the 1992/93 season, a value for seabird mortality of 2 436 birds/year

(0.57 birds/1 000 hooks) can be calculated for the 1992/93 season. This is likely to be a conservative value, especially given the presence of vessels actively fishing in Subarea 48.3 after the official closure of the fishery for *D. eleginoides* for the 1992/93 season. This rate is not dissimilar to those estimated by Brothers (1991), who reported a maximum catch rate of 1.8 birds/1 000 hooks with a mean catch of 0.41 birds/1 000 hooks for the southern bluefin tuna fishery off Tasmania. Mortality of albatrosses there was sufficiently high to substantiate claims that serious declines in populations were due to pelagic longlining. Our South Georgia observations indicate that further studies are urgently needed on seabird interactions with longliners operating in this area.

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Légendes des tableaux

Tableau 1: Nombre d'oiseaux de mer observés à proximité des opérations de pêche. Les heures données sont celles du Greenwich Mean Time; aurore à 04h00. Code des espèces : a = pétrel du Cap, b = pétrel géant antarctique, c = albatros à sourcils noirs, d = pétrel à menton blanc, e = prion. La position des sites (L_1 à L_7) est illustrée à la Figure 2.

Tableau 2: Nombre moyen d'oiseaux de mer associés aux opérations de virage à chaque site, pour la période allant de 12h00 à 17h00 GMT. N = nombre d'observations effectuées.

Tableau 3: Nombre moyen d'oiseaux de mer associés aux opérations de virage selon l'heure, pour la période allant de 12h00 à 17h00 GMT. N = nombre d'observations effectuées.

Légendes des figures

Figure 1: Configuration de la palangre de fond utilisée par le *Friosur V* pour la capture de *D. eleginoides.*

Figure 2: Position des opérations de pêche exploratoire.

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Таблица 2: Среднее количество морских птиц, присутствовавших при выборке ярусов на каждом участке - за период с 1200 по 1700 часов по Гринвичу. N = количество проведенных наблюдений.

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