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ENTANGLEMENT OF PINNIPEDS AT MARION ISLAND

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During the period April 1991–March 1996, 10 entangled Antarctic fur seals *Arctocephalus gazella*, 28 entangled Subantarctic fur seals *A. tropicalis* and one entangled southern elephant seal *Mirounga leonina* were observed at Marion Island, Southern Ocean. Entanglement of fur seals was estimated at between 0.01 and 0.15% of the combined population of both species.

Key words: entanglement, marine debris, Marion Island, pinnipeds

Of all marine mammals, pinnipeds are the most prone to incidental entanglement because of their inquisitive nature and size (Wehle and Coleman 1983, Fowler 1987, Pemberton *et al.* 1992). Among pinnipeds, otariids are more often entangled than phocids (Laist 1987). Although entanglement in natural materials has been recorded (Bonner and McCann 1982), most debris causing entanglement is anthropogenic. The most common source of this material is the fishing industry (Fowler 1987, Stewart and Yochem 1987, Pemberton *et al.* 1992, Harcourt *et al.* 1994). However, other ship- and many land-based activities also generate considerable marine debris (Shaughnessy 1980, Wehle and Coleman 1983). Entanglement often leads to the death of the animal involved (Pemberton *et al.* 1992), and even if no direct damage is caused, movement may be restricted, which in turn may prevent escape from predators or lead to starvation (Feldkamp 1985).

Marion Island (46°54´S, 37°45´E) in the Southern Ocean supports breeding populations of three species of pinnipeds: the southern elephant seal *Mirounga leonina*, the Subantarctic fur seal *Arctocephalus tropicalis* and the Antarctic fur seal *Arctocephalus gazella*. Sightings of entangled seals at the island have been reported anecdotally (Ryan 1987, Cooper and Condy 1988), but no quantitative survey of such incidents has been published. In accordance with the directives of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to monitor and evaluate the impact of anthropogenic debris on marine living resources (Morris 1985), the aim of this study is to report on the incidence and types of entanglement of seals at Marion Island.

MATERIAL AND METHODS

Entangled seals were recorded from mid-April 1991 to mid-April 1996 on accessible beaches of Marion Island. Most were recorded opportunistically by observers engaged in another study, during which approximately 55% of the coastline was thoroughly surveyed every 7–10 days – henceforth called the Extended Study Area (ESA). Additional sightings were recorded both in the ESA (in addition to regular surveys) and on the remainder of the coastline. For each sighting, the date, site, species, sex and age-class, type of and severity of entanglement were recorded. Age-classes used were defined following Bester (1981). Severity of entanglement was classified following Croxall *et al.* (1990), with an additional category: animal dead, possibly owing to entanglement. When possible, attempts were made to remove entangling material from live animals.

The entangled proportion of the fur seal population was estimated using two methods. In Method 1, all fur seals present on Marion Island that were older than underyearlings were counted in December 1994 and the number entangled noted. In Method 2, the mean annual number of entanglements sighted over a five-year period in the ESA was calculated. This was considered as a proportion of the total population of that area, determined from its pup production during the summer of 1994/95. Population counts were taken from Hofmeyr *et al*. (1997).

RESULTS

Elephant seals

Only one entangled elephant seal was observed, a female tagged as a pup on Marion Island in 1987. The seal was first noted with a collar in 1991, at the age of three years, and was subsequently sighted nine times to 1995, but on all these occasions no collar could be

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Table I: Number of entangled fur seals *Arctocephalus* spp., by sex and age-class observed at Marion Island from April 1991 to April 1996. Figures in parenthesis indicate numbers of collars that were removed

Age-class	Males	Females	Unknown	Total
Adult	5 (1)	3 (2)	0 (0)	8 (3)
Subadult	6 (3)	8 (7)	10 (5)	24 (15)
Yearlings	0 (0)	1 (1)	4 (2)	5 (3)
Underyearlings	0 (0)	0 (0)	1 (1)	1 (1)
Total	11 (4)	12 (10)	15 (8)	38 (22)

seen. When the seal was examined under chemical immobilization in 1995, no collar was found in a healed scar that penetrated through the blubber layer right around the neck. The wound did not appear to affect her health and she hauled out to breed successfully over five years.

Fur seals

Of a total of 38 entangled fur seals, 28 were *A. tropicalis* and 10 were *A. gazella.* All entanglements were around the neck (where noted). Most entangled animals were subadults (63%), although animals of all age-classes were recorded (Table I). Neck collars were removed from 59% of live entangled animals and around half of the collars caused physical damage (Table II). Entanglement material consisted mostly of polypropylene packaging straps, but also included netting, synthetic rope and string, cloth and an elastic strap (Table III).

Only two of 14 718 fur seals counted over the entire coastline were entangled (0.01% of the population ashore; Method 1). In the ESA, 33 entangled animals were observed over five years. The average number of entangled per year (6.6) was equivalent to 0.15% of the estimated total population of 4 305 seals older than one year (Method 2). The annual incidence of entanglement of the two species was similar at 0.15% for *A. tropicalis* and 0.17% for *A. gazella*. The number of entangled seals observed per year increased from 4 to 12 between 1991 and 1996 (Table IV).

Table II: Severity of entanglement of fur seals *Arctocephalus* spp. observed at Marion Island from April 1991 to April 1996. Figures in parenthesis indicate numbers of collars that were removed

Severity	Frequency	Percentage
Loose	4 (3)	10.5
Tight	12 (6)	31.6
Cutting through skin	11 (7)	28.9
Cutting through skin and fat layer	9 (6)	23.7
Animal dead, possibly due to entanglement	1 (–)	2.6
Unknown	1 (0)	2.6
Total	38	100.0

Table III: Types of neck collar observed on entangled fur seals *Arctocephalus* spp. at Marion Island from April 1991 to April 1996

Material	Number	Percentage
Polypropylene packaging strap	15	39.5
Synthetic string (<10 mm diameter)	4	10.5
Synthetic rope (>10 mm diameter)	5	13.2
Fishing net	8	21.1
Elastic strap	1	2.6
Cloth strip	1	2.6
Unknown	4	10.5
Total	38	100

DISCUSSION

If most of the polyethylene packaging straps were from bait boxes, as suggested by Pemberton *et al.* (1992), then the fishing industry was responsible for the bulk of material (61%) entangling seals at Marion Island. Ryan (1987) found that most debris washed up on Marion Island was of fisheries origin, likely from fisheries in the South Atlantic region far to the west, because there were no fisheries operating around Marion Island during the present study. Therefore, marine debris must either have drifted toward the island from other areas, or seals could have become entangled when ranging away from the island. Southern elephant seals (Bester 1989, Jonker and Bester 1998), Antarctic fur seals (Payne 1979) and Subantarctic fur seals (Shaughnessy and Ross 1980, Bester 1989) have been shown to range far from their natal islands.

The population of elephant seals at Marion Island

Table IV: Number of entangled fur seals *Arctocephalus* spp. observed at Marion Island from April 1991 to April 1996

Period	Number
April 1991 – April 1992	4
April 1992 – April 1993	6
April 1993 – April 1994	6
April 1994 – April 1995	10
April 1995 – April 1996	12

has been subject to an unexplained decline since the 1950s (Bester and Wilkinson 1994). Death from entanglement does not appear to be an important contribution to this decline. Although it is possible that some entangled animals may die at sea before returning to the island, it is likely that some in the preliminary stages of entanglement would be observed on the island. Both fur seal populations at Marion Island have experienced rapid increases in recent years (Hofmeyr *et al.* 1997) and the present low levels of entanglement are unlikely to be a threat to their continued existence at the island.

The entangled proportion of the population estimated by the two methods differs by an order of magnitude (0.01 v. 0.15%). The larger value is possibly an overestimate, because animals may move into the ESA from more populous colonies outside it. On the other hand, the lesser value is possibly an underestimate, because it is unlikely that all seals with neck collars were counted in congested colonies and in the inshore surf zone.

Although pinnipeds are not as seriously affected by entanglement as cetaceans (Hofmann 1990), the number of deaths in some species is cause for concern. The effects of the high rates of entanglement of the California sea lion *Zalophus californianus* population of Los Islotes, Baja California (3.9–7.9%), and of the Australian fur seal *A. pusillus doriferus* (1.9%) are unknown (Pemberton *et al*. 1992, Harcourt *et al*. 1994).

The lower incidence of entanglement of fur seals at Marion Island relative to seal populations elsewhere (Fowler 1987, Croxall *et al.* 1990, Pemberton *et al.* 1992) is likely attributable to the relative isolation of the island from shipping routes and fishing activities, at least during the study period. However, exploitation of Patagonian toothfish *Dissostichus eleginoides* stocks in the waters around the island by fisheries began in 1996, and is likely to increase, at least while stocks remain healthy. A large proportion of this fishing has been illegal and its possible effects on the populations of seals and other marine vertebrates are unknown. The present data provides a baseline for evaluating some of the possible effects of future fishing activity on the seal populations of Marion Island.

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