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Entanglement of Antarctic fur seals, *Arctocephalus gazella*, by marine debris at Cape Shirreff and San Telmo Islets, Livingston Island, Antarctica: 1988-1997[1]

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ABSTRACT

We compiled records of Antarctic fur seals (*Arctocephalus gazella*) found entangled by marine debris (neck collars) at SSSI N°32 and CEMP site 'Cape Shirreff and San Telmo islets', Livingston island, Antarctica, obtained during the summer seasons between 1988 and 1997.

Our results indicate that 45% of the entanglement material found in a total of 20 individuals corresponded to synthetic packing bands and other plastic debris, in contrast to the remaining percentage (55%) which corresponded to discarded fishing gear like net fragments and nylon ropes. The total percentage of entangled animals versus total population in the area per season is low (0,024% ± 0,012); nevertheless, we consider that the obtained values could be underestimations.

To reduce this type of occurrences, we propose: (1) the monitoring of entangled Antarctic fur seals by marine debris over the South Shetland archipelago area through a cooperative inter-institutional sighting network to assess with more complete data the impact that marine debris are causing on this species; (2) the implementation of more regulations over fishing vessels operating in CCAMLR's regulated areas of the Southern Ocean; (3) further instruction of scientific observers in relation to reporting detailed information on operational interactions between fisheries and marine mammals, sightings of entangled marine mammals at sea, and type and amount of discarded fishing gear; (4) directed education to captains and crews of fishing vessels with the aid of an informative booklet; and (5) the ratification and implementation of Annex V of MARPOL by members who have not yet done so.

Key words: Entanglement, Antarctic fur seal, *Arctocephalus gazella,* marine debris, CCAMLR, SSSI N°32, CEMP site, Antarctica.

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Enmallamientos de lobo fino antártico, *Arctocephalus gazella,* por desechos marinos en cabo Shirreff e islotes San Telmo, isla Livingston, Antártica: 1988-1997[1]

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RESUMEN

Se informan en este trabajo los registros de lobos finos antárticos (*Arctocephalus gazella*) encontrados enmallados con collares de material sintético en el SEIC N°32 y sitio CEMP 'Cabo Shirreff e islotes San Telmo', isla Livingston, Antártica, obtenidos durante las temporadas estivales comprendidas entre 1988 y 1997.

Veinte individuos fueron encontrados enmallados durante los nueve años de monitoreo y por tanto consideramos que la proporción de animales enmallados anualmente con respecto a la población total de *A. gazella* en la zona es baja (0,024% ± 0,012); sin embargo, estimamos que estos valores pudieran corresponder a una subestimación. El 45% del material de enmalle encontrado en los cuellos de los animales correspondió a zunchos y otros materiales plásticos; el porcentaje restante (55%) estuvo constituido por restos de redes pesqueras y cuerdas sintéticas.

Con el objeto de reducir este tipo de incidentes proponemos: (1) el monitoreo de lobos finos enmallados mediante una red interinstitucional de avistamientos que permita evaluar con una mayor certeza el impacto que los desechos marinos causan sobre esta especie; (2) la implementación de mayores regulaciones sobre las embarcaciones pesqueras que operan en el área regulada por la CCRVMA en relación con el tratamiento de los desechos plásticos; (3) una mayor instrucción a los observadores científicos embarcados en barcos pesqueros para informar detalladamente las interacciones entre los mamíferos marinos y la operación pesquera, avistamientos de animales enmallados en el mar y, la cantidad y tipo de desechos arrojados al mar; (4) educar a capitanes, jefes de pesca y tripulaciones de embarcaciones pesqueras mediante un folleto ilustrativo; y (5) la ratificación del Anexo V de la MARPOL por los países miembros que aun no lo hayan hecho.

Palabras clave: Enmallamiento, lobo fino antártico, *Arctocephalus gazella,* desechos marinos, CCRVMA, SEIC N°32, sitio CEMP, Antártica.

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INTRODUCTION

Incidental mortality of marine vertebrates caused by marine debris is a well known world-wide problem (see Northridge, 1985;1991;1992), which can influence survival rates of endangered or vulnerable species (Norse, 1993). This problem affects various marine mammals, and has generated concern given the negative consequences for marine mammal populations (*e.g.* Merrick *et al.*, 1987; Woodley and Lavigne, 1991).

In the Antarctic and sub-Antarctic islands the effects of marine debris on the marine biota are being monitored anually (*e.g.* Randall *et al.*, 1983; Torres and Gajardo, 1985; Ryan and Watkins, 1988; Torres and Aguayo, 1993; Torres and Jorquera, 1994; Lewis Smith, 1995), and one of the most frequently encountered marine debris derived problem is fur seal entanglement.

One of the most frequently encountered marine mammal entanglement involves synthetic collars found on necks of Antarctic fur seals *Arctocephalus gazella*. This species probably becomes entangled with marine debris while playing with buoyant synthetic loops and openings of discarded fishing gear, packing bands, six-pack rings from beverage containers and other items floating on the sea surface (Bonner and McCann, 1982; Norse, 1993). Entangling material found on *A. gazella* necks is usually inextensible, and as the animal grows, the collar inflicts increased pressure and abrasion on the skin (Torres *et al.*, 1996). In fact, with time, this provoques the strangulation and laceration of the epidermis (see Figures 1 and 2), which consequently diminishes its survival capacity, causes impaired ability to catch food, inhability to avoid predators, and perhaps death.

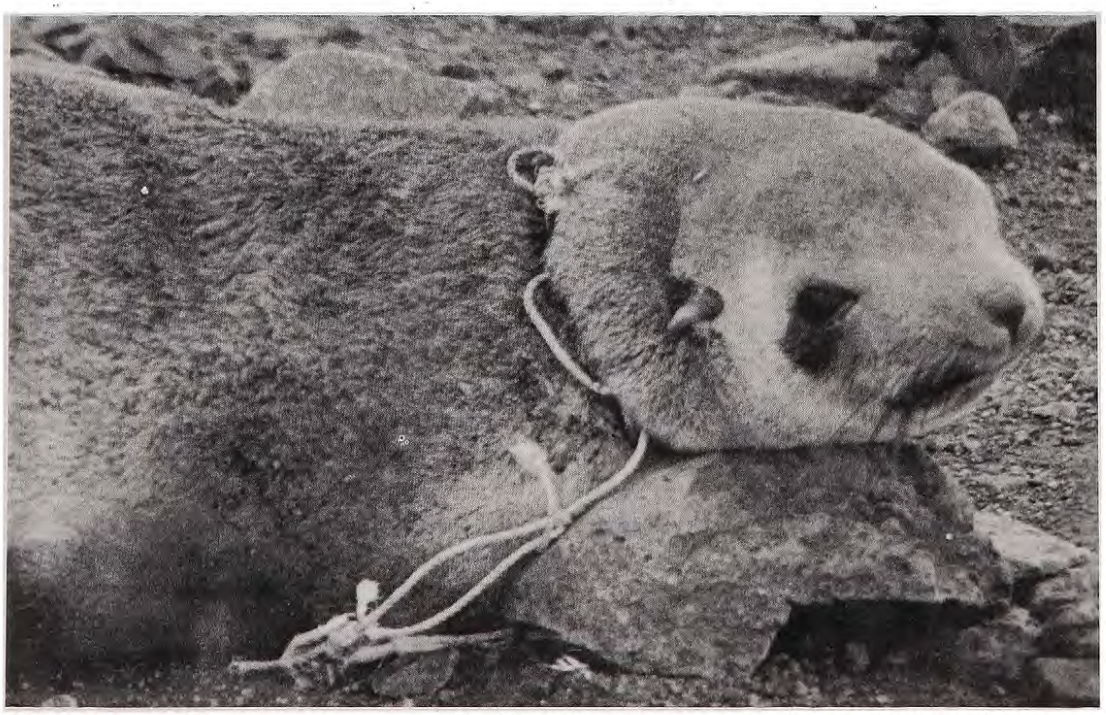

Fig. 1: Pregnant adult female *Arctocephalus gazella* with severe wound caused by a neck collar (nylon rope). Observed and liberated at cape Shirreff in the 1994/95 summer season (Photo by R. Hucke-Gaete).

Fig. 2: Subadult male with abrasion on its neck probably provoqued by entangling material; sighted at cape Shirreff in 1997. (Photo by R. Hucke-Gaete)

Early information on neck collars and *A. gazella* was reported by Payne (1979) and by Bonner and McCann (1982) for South Georgia (54°S., 38°W.), nearly nine years after the start of a large-scale finfish fishery in that area in the 1969/70 season (Kock, 1994) which employs packing bands to secure bait boxes on board. More recent information on this subject has been reported by Croxall *et al.* (1990), Torres (1990), Torres and Jorquera (1992; 1995a; b), Arnould and Croxall (1995), Croxall and Wace (1995), and Torres *et al.* (1996).

This issue has been discussed during the development of international meetings organized by the SCAR Group of Specialists on Seals, and by the Convention for the Conservation of Antarctic Marine Living Reosurces (CCAMLR). In the latter, reports and proposals have been submitted by delegations of several Parties of the Convention regarding this issue, and consequently in 1993, the Conservation Measure 63/XII 'Reduction in the use of plastic packing bands' was agreed, specially applicable to fishing countries that operate in the area, and thus reduce in this way the discarded plastic material thrown to the sea. In Chile this agreement was promulgated by Presidential Decree N°1537 of the Ministerio de Relaciones Exteriores (Ministry of Foreign Affairs) (for details of the text refer to Torres and Jorquera 1994). It is important to note therefore, that this Conservation Measure was modified by the CCAMLR Commission in 1996 through the Conservation Measure 63/XV and was published by Chile's government in the 'Diario Oficial' that same year.

Each country has been encouraged by the Commission of CCAMLR to report all incidence of entanglement in order to assess the scale, and any trends, and to implement appropriate conservation measures.

The aim of this document is to report the number of entangled fur seals by man-made marine debris recorded over nine years of monitoring *A. gazella's* population, during the research project 'Ecological studies on *Arctocephalus gazella*' (INACH Project 018) at the Site of Special Scientific Interest (SSSI) N°32 and CCAMLR Ecosystem Monitoring Program (CEMP) Site 'Cape Shirreff and San Telmo islets' (62°27'S., 60°47'W), Livingston Island, Antarctica (Figure 3).

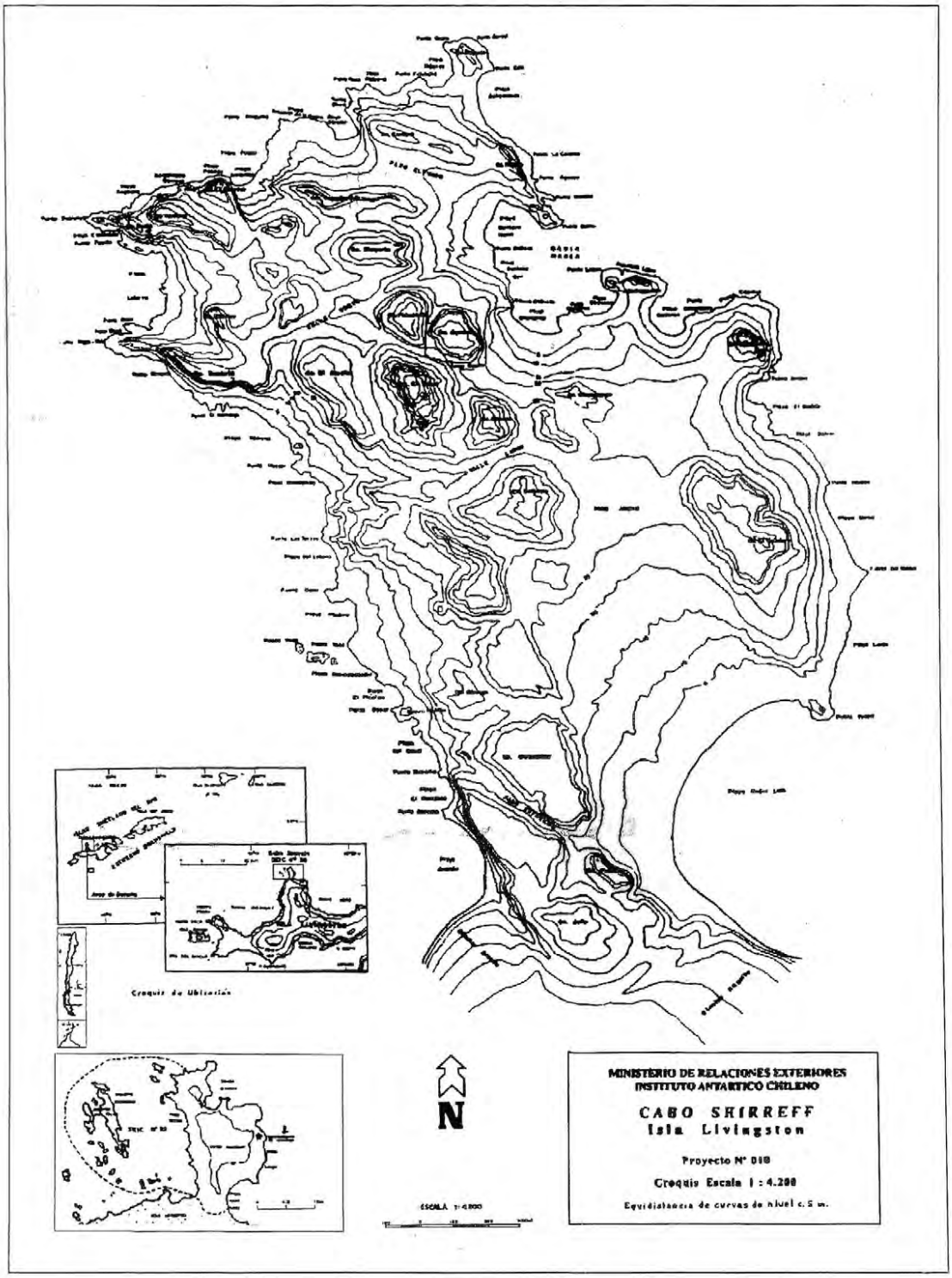

Fig. 3: SSSI N°32 and CEMP Site 'Cape Shirreff and San Telmo Islets' (62°27'S;60°47'W) after Torres (1993).

METHODS

Sightings of entangled animals were made during the Antarctic summers between 1987 and 1997 (except in the 1989/90 season when the area was not visited).

During the long-term population monitoring studies on *A. gazella* and complementary activities developed at the SSSI N°32, the perimeter of Cape Shirreff (*ca.* 14 km) was surveyed by foot several times each year, including all valleys, hills and inland areas. San Telmo islets (distant 1 nm East of Cape Shirreff) were surveyed usually once per season.

For each observation of an entangled animal, the individuals sex, estimated age, type of entanglement material, date, and locality were recorded. Types of neck collars were clasified into four distinct categories, following Arnould and Croxall (1995): (1) plastic packing bands, (2) synthetic rope, (3) fragments of net, and (4) plastic (six-pack and plastic bags).

Whenever possible we attempted to liberate the entangled animals by means of manual immobilization with nets or sacks, and proceeded then to cut the ligature and disinfect the wounds (if any) with alcohol containing iodine.

RESULTS AND DISCUSSION

A total of 20 entangled Antarctic fur seals with neck collars was recorded in nine years of monitoring (Table 1). Of these, we managed to release a total of seven individuals from their entangling material (four females, two pups and one juvenile male (35% of the total) in the past three summer seasons (1994-1997). Although we have never found dead fur seals because of entanglement, we have seen individuals with severe wounds on their necks due to ligatures (see Fig 1).

As it is shown in Table 1, entangled individuals correspond to medium-small sized fur seals, such as subadult males, juvenile males, females and pups. The rate of entanglement for each category is 45%, 20%, 25% and 10%, respectively.

During the 1995/96 and 1996/97 seasons we found three pups with 'natural collars' formed by skin of penguins, left floating probably after the predation by leopard seals (*Hydrurga leptonyx*) (Bonner and McCann 1982; Torres *et al.* 1996) and/or southern giant petrels (*Macronectes giganteus*) (W. Trivelpiece, Montana State University, pers. comm. to R. H.-G., 1997). Since this is a natural occurrence these were not considered in the total of entangled individuals.

Our results indicate that there is a low rate of entangled individuals *vs.* total population[5], fluctuating around 0,024% (± 0.012 S.D.) per year (see Table 1). These values never surpass percentages reported by Arnould and Croxall (1995) for Bird island, South Georgia, e.g. 0,3% in the 1989/90 season, and 0,07% for the 1995/96 season. Eventhough, we consider that our data corresponds to an underestimation of the total rate of entanglement due to the small area surveyed within a short period of time each year, and also, we have to consider possible deaths at sea, and the arrival of entangled individuals to other non reproductive sites in the South Shetland archipelago.

[5] Current population estimates for the whole SSSI were reported by Hucke-Gaete *et al.* (1997), which for 1996/97 the total population corresponded to 19.681 animals, including in this figure 9,015 pups.

TABLE 1

Sightings of entangled individuals of *Arctocephalus gazella* between 1987 and 1997 summer seasons at the SSSI N°32. Type of entangling material, percentage of entangled animals vs total population, and totals per sector are shown.

		Type of entangling material				Totals per sector	
Season	%	Packing band	Synthetic rope	Net fragment	Plastic	Cape Shirreff	San Telmo
1987/88	0.04	0	1J+1S	0	0	2	N.V.
1988/89	I.C.	0	2S	0	0	2	N.V.
1989/90	N.V.	-	-	-	-	N.V.	N.V.
1990/91	0.04	0	2S	0	0	2	N.V.
1991/92	0.03	1J+1S	0	0	0	2	0
1992/93	0.02	1J+1S	0	0	0	2	0
1993/94	0.02	1S	1S	0	0	2	0
1994/95	0.01	0	1F+(1F)	0	0	1	1
1995/96	0.02	(1P)	0	(1J+1F)	(1P)	2	2
1996/97	0.01	(1F)	0	0	(1F)	2	0
Totals		7	9	2	2	17	3

KEY: F = female; **I.C.** = incomplete census; **J** = juvenile male; **N.V.** = area not visited; **P** = pup; **S** = subadult male; ( ) = liberated animal; **%** = percentage of entangled animals with respect to total population size per sector (in seasons when we could census both sectors, the % corresponds to the total population in the SSSI N°32).

Bonner and McCann (1982) reported individual *A. gazella* showing signs of having been entangled previously but had freed themselves (or were freed). Similar observations were made at Cape Shirreff during the 1995/96 and 1996/97 seasons when four juvenile males (Torres *et al.*, 1996), one adult female and one subadult male (this paper) were seen with cicraticed scars on their necks undoubtedly produced by the abrasion of entangling material but were not considered in the total of entangled individuals (Figure 2).

We found a similar rate of occurence between fishing discarded material (such as net fragments and synthetic rope from krill and finfish fisheries), and plastic hoops (packing bands from finfish fishery and other plastic objects), with 55% and 45% of ocurrence, respectively. Data on marine debris collected at the SSSI N°32 (see Table 2), indicate that discarded fishing debris is common in the area and although specific conservation measures involve the reduction in the use of packing bands, they are still a common item in the beached marine debris collected. Note that not all plastic items and synthetic ropes pose a threat of entanglement to the Antarctic fur seal, but may sometimes be used by seabirds in the construction of their nests (Torres and Jorquera, 1992) or ingested by eating fish (Randall *et al.*, 1983), and small pieces can be fed to chicks by adults; even fur seals can indirectly consume particles ingested by fish (Benninghoff and Bonner, 1984; Group of Specialists on Seals, 1992).

TABLE 2

Plastic marine debris collected at SSSI N°32 between 1993 and 1996 summer seasons according to Torres and Jorquera (1992;1994;1996) and Torres *et al.* (1997).

Season	Plastic Items	Packing bands	Net and rope fragments
1993/94	1612	574	197
1994/95	2477	381	176
1995/96	4015	543	392
1996/97	1787	207	223
Mean between seasons	2473	426	247
Total items accumulated	9891	1705	988

Torres and Aguayo (1993) reported that some of this material could have drifted around the Antarctic continent with the aid of the Antarctic Circumpolar Current, from the FAO Statistical Fishing Areas 48, 58, and 88. This debris will continue to arrive to cape Shirreff and San Telmo islets shores as long as there is a source of this material on the above mentioned areas. Although, other marine debris such as the plastic six-pack and/or plastic bags could have been thrown in the vicinity of the SSSI N°32 from fishing, logistic, scientific or touristic vessels operating around the area.

RECOMMENDATIONS

There is evidence of a relatively constant rate of entangled animals and arrival of marine debris at Cape Shirreff and San Telmo islets (see Tables). This drives us to propose further enforcement of regulations on any vessel operating in the Southern Ocean, particularly fishing vessels, and also to encourage the instruction of Scientific Observers in relation to reporting detailed information on operational interactions between fisheries and marine mammals, sightings of entangled marine mammals at sea, and type and amount of discarded fishing gear.

In general terms, we consider that the fundamental basis for the reduction of the marine debris problem should be a broad-based education programme (particularly reaching fishing crews), active debris-removal in Antarctic and sub-Antarctic islands, and implementation of ship-based solid waste management strategies. We support the reccommendations of Torres and Jorquera (1996); to develop comprehensive educational material, specially directed to Captains, Fishery Chiefs and crews of fishing vessels that operate in the CCAMLR regulated fishing areas. The main purpose being to increase their understanding on the origin, amount, distribution, fate and effects of plastic and other synthetic objects such as packing bands and net fragments in the marine environment. A positive example of this, was the initiative of CCAMLR to develop adequate strategies for the reduction of the incidental mortality of seabirds in longlining fishing operations, and by publishing recently "Fish the Sea, not the Sky" (CCAMLR, 1996).

Likewise, it is important to establish in different Antarctic and sub-Antarctic areas a local network for sighting entangled *A. gazella* individuals, such as the whole area comprised by the South Shetland archipelago, by means of an inter-institutional program to assess with more complete data the impact that marine debris is causing on the marine biota. In particular individuals of *A. gazella*, which is a recognized indicator species of the status of the Antarctic marine ecosystem (Agnew, 1997). With this objective in mind, we have developed a form to record observations of entanglement to be completed by any personnel working in the Antarctic (see Annex 1, English version, and 2, Spanish version).

Finally, following Torres and Jorquera (1992) and Kock (1994), parties which have not yet accepted Annex V of the MARPOL (International Convention for the Prevention of Pollution from Ships), should consider ratifying and implementing its regulations, by providing appropriate containers for the storage and classification of solid wastes, and thus avoiding the discarding at sea of this kind of debris, and reducing the entanglement of marine animals.

CONCLUSIONS

1. Even though the rate of entangled Antarctic fur seals is low in the SSSI N°32 (0.024% (±0.012) compared to South Georgia, the problem persists and it could be a possible mortality factor.

2. For the first time we register pup entanglement of *A. gazella* with synthetic marine debris probably thrown in the vicinity of the SSSI N°32

3. We consider that our data corresponds to an underestimation of the total rate of entanglement and/or mortality due to the small area surveyed during a short period of time each year, and also, we have to consider possible deaths at sea, and the arrival of entangled individuals to other non reproductive sites in the South Shetland archipelago

4. The fundamental basis for the ultimate mitigation of the marine debris problem should be a broad-based education programme particularly reaching fishing crews as well as all segments of society, active debris-removal in Antarctic and sub-Antarctic islands, and implementation of ship-based solid waste management strategies.

5. We propose the establishment of local networks for sighting entangled Antarctic fur seals in different Antarctic and sub-Antarctic areas such as the whole area comprised by the South Shetland archipelago, by means of an inter-institutional programme, to assess with more complete data, the impact that marine debris is causing over the marine biota.

6. Synthetic marine debris will continue to arrive to cape Shirreff's shores as long as there is a source of this material on the FAO Statistical Areas 48, 58, and 88. Thus, we propose further enforcements on the regulations concerning plastic waste disposal.

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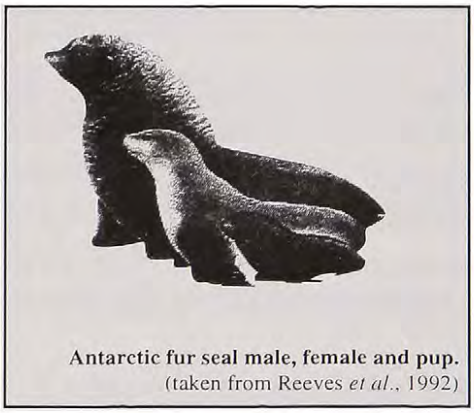
ANNEX 1 (English version)

Form for registering characteristics of entangled Antarctic fur seals with neck collars*.

•**Reported by** (Name, Institution and Address):	•**Sex and maturity stage of entangled animal:** **Adult male:** ☐ **Juvenile male:** ☐ **Female:** ☐ **Subadult male:** ☐ **Pup:** ☐	•**Form N°:** (internal use only)
•**Latitude:** ____°____' S •**Longitude:** ____°____'	•**Site:**	•**Date** (dd/mm/yy): ☐/☐/☐
•**Neck collar material:** *Packing band: ☐ *Other (please specify): ☐	*Synthetic rope[1]: ☐ *Net fragment[1]: ☐ 1 Please specify type, colour, width and/or mesh size in Additional Information.	
•**Was the animal disentangled?** (specify how below): *Yes ☐ *No ☐	•**Magnitude of the wound caused by the neck collar:** *Null: ☐ *Low: ☐ *Severe: ☐	•**Was the animal dead?** *Yes ☐ *No ☐
•**Additional information:**		



Antarctic fur seal male, female and pup.
(taken from Reeves *et al.*, 1992)

Please send the information recorded in this form to Prof. Daniel Torres N. (*Instituto Antártico Chileno, Departamento Científico, Casilla 16521, Correo 9, Providencia, Santiago, Chile. Fax: (56) 2 2320440, email: dtorres@inach.cl*) in order to establish one focal point of data gathering in the South Shetland archipelago area. Anyone who has cooperated and is interested in helping with data analysis and/or publishing final results is welcome to join us in the task.

ANEXO 2 (versión en castellano)

Ficha para el registro de características de lobos finos antárticos enmallados en collares plásticos*.

•Informado por: (Nombre, Institución y dirección):	**•Sexo y estadio del animal enmallado:** **Macho adulto:** ☐ **Macho juvenil:** ☐ **Hembra:** ☐ **Macho subad.:** ☐ **Cría:** ☐	**•Ficha N°:** (uso interno solamente)
•Latitud: ____°____' S **•Longitud:** ____° ____'	**•Lugar:**	**•Fecha** (dd/mm/aa): ☐/☐/☐
•Material del collar: ***Zuncho:** ☐ ***Otro (por favor especificar):** ☐	***Cuerda sintética[1]:** ☐ ***Fragmento de red pesquera[1]:** ☐ [1] Por favor especificar el tipo, color, abertura de malla y/o grosor de la cuerda en la sección 'Información Adicional'.	
¿Fue liberado el animal? (favor especificar como): ***Si** ☐ ***No** ☐	**•Magnitud de la herida causada por el collar plástico:** ***Nula:** ☐ ***Superficial:** ☐ ***Severa:** ☐	**¿Estaba muerto el animal?** **Si** ☐ **No** ☐
•Información adicional:		

Macho, hembra y cría de lobo fino antártico
(tomado de Reeves *et al.*, 1992)

* Por favor enviar la información registrada en esta ficha al Prof. Daniel Torres N. (*Instituto Antártico Chileno, Departamento Científico, Casilla 16521, Correo 9, Providencia, Santiago, Chile. Fax: (56) 2 2320440, email:dtorres@inach.cl*) con el fin de establecer un punto focal de almacenamiento de datos para el área del Archipiélago de las Shetland del Sur. Quien haya cooperado con la entrega de información está cordialmente invitado a participar en el posterior análisis de los datos y publicación resultante.