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Beach debris survey at Cape Shirreff, Livingston Island, during the Antarctic season 1996/97

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ABSTRACT

During the Antarctic season 1996/97 a beach debris survey was carried out on the beaches of Cape Shirreff, Livingston Island, South Shetland Islands, where a total of 1,609 articles were collected, with an accumulated weight of 49.03 kg. Besides, from a neighbouring area of Cape Shirreff, 178 plastic pieces were collected to avoid that this material may enter the site during storms and windy weather.

As it occurred in all previous seasons with monitoring activities, plastic was the main stranded item (n=1,517) with 94.3%, followed by glass (n=67) with 4.2%; metal (n=19) 1.2%; and paper (n=6) 0,4%. Of plastic items used in fisheries a total of 421 articles were collected (strapping bands=207, ropes=205, and net pieces=9). The total density of marine debris collected on the site has increased from 0.65 articles/m^2 in 1993/94 to 1.02 in 1994/95, 1.52 in 1995/96, and diminished to 0.46 in 1996/97. For the first time it was observed an important presence of pieces of expanded polyestirene (EP) (n=708) with 46.7% with respect to the total figure of 1,517 plastic articles collected. This situation leads us to think that this material may proceed from logistic operations, because many of those pieces present cavities similar to those provided to protect some electronic apparatus. This is a fact against to Annex V of the Protocol, and to the Code of Conduct prepared by SCAR, because it is forbiden to take into the Convention area this kind of synthetic material. Several plastic pieces (n=15) show evidence of having been partially burnt. This situation provides the possibility to infer that the ashes produced in incinerators may also have been disposed into the sea, as it was reported in previous seasons. If so, this is a continuous proof of an action contrary to the international agreements related to protection of the sea and its biota.

Some plastic fibres continue to appear in some nests of *Larus dominicanus* (kelp gull), and *Chionis alba* (sheathbill). Two specimens of *Arctocephalus gazella* (Antarctic fur seal) were seen entangled with plastic fibres, which were removed from the animals after being immobilized with a piece of net obtained from the stranded garbage.

It is expected that the new and complementary activities to the Conservation Measures adopted by CCAMLR, such as teaching and didactic material to be prepared for crews of several kind of ships which operate in the Southern Ocean and adjacent waters, may have a positive effect in diminishing the impact caused by man-made marine debris. As a future international issue, related to the protection and conservation of the sea and biota, to be kept in mind by shipbuilders and naval engineers, it is proposed to include in the working drawing a specific and adequate hold of a ship where the classified garbage produced on board can be stored, with the respective compartments with the international colour for plastic, glass, cans, paper, and other kinds of clean debris, with the purpose of being disembarked in all international ports, especially in those with appropriate facilities to receive and manage that kind of waste. Meanwhile, it is suggested that at present times, companies and owners of Antarctic fleets and ships, make an effort to accomodate on board a specific container to store the garbage produced in order to disembark it adequately in each port, if possible, outside the Convention area. The amount of garbage produced and disembarked would be a matter to be included in the respective logbooks.

Key words: Marine debris, entanglement, CCAMLR, SSSI N° 32, shipbuilders, waste industry, Antarctica.

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Investigaciones sobre desechos marinos en las playas de cabo Shirreff, isla Livingston, durante la temporada antártica 1996/97.

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RESUMEN

Durante la temporada antártica 1996/97 se continuaron las investigaciones sobre desechos marinos en las playas de cabo Shirreff (SEIC N°32 y Sitio CEMP), isla Livingston, Islas Shetland del Sur, donde se recolectaron 1.609 artículos, con un peso total de 49,03 kg. Además, se recolectaron 178 restos plásticos de playas aledañas al cabo, con el propósito de evitar que ese material pueda ingresar al área durante las tormentas.

Tal como ha sucedido en las actividades de seguimiento de los desechos marinos en las temporadas previas, el plástico es el principal ítem (n=1.517) con un 94%, seguido por el vidrio (n=67) con un 4,2%; luego el metal (n=19) con el 1,2% y finalmente el papel (n=6) con un 0,4%. De los artículos plásticos usados en las actividades pesqueras, se recolectaron 421 artículos (207 zunchos plásticos, 205 trozos de cordel; y 9 trozos de redes). La densidad total de los desechos marinos recolectados en el lugar ha ascendido desde 0,65 artículos/m^2 en la temporada 1993/94 hasta 1,02 en 1994/95, 1,52 en 1995/96, para disminuir a 0,46 en 1996/97. Por primera vez se registró la abundante presencia de trozos de poliestireno expandido (PE) (n=708) con un 46,7% en relación con el total de 1.517 artículos plásticos recolectados. Esta situación hace pensar que este material puede provenir de operaciones logísticas, porque muchos de estos trozos de PE presentan cavidades similares a aquellas que dan protección a los aparatos electrónicos, principalmente transportados por buques de abastecimiento. Lanzar este tipo de material sintético al mar es un hecho contrario a las disposiciones del Anexo V del Protocolo y al Código de Conducta preparado por el SCAR, ya que en éstos se prohíbe ingresarlos al área de la Convención de CCRVMA. Varios trozos de plásticos (n=15) presentaban evidencias de haber sido parcialmente incinerados. Esta evidencia permite inferir que las cenizas producidas en los incineradores también pueden haber sido lanzadas al mar, como se informó en temporadas previas. Si es así, esto es una prueba permanente de una acción contraria a los acuerdos internacionales sobre protección del mar y su biota.

Algunas fibras plásticas continuan apareciendo en nidos de gaviotas, *Larus dominicanus* y de paloma antártica, *Chionis alba*. Se avistaron dos ejemplares de lobo fino antártico, *Arctocephalus gazella*, enmallados en fibras plásticas, las que fueron removidas del cuello de los animales, luego de haberlos inmovilizado con un trozo de red recuperada hallada entre los desechos marinos.

Se espera que las nuevas actividades complementarias a las Medidas de Conservación adoptadas por la CCRVMA, tales como el material didáctico y educativo a ser preparado para las tripulaciones de diferentes tipos de buques que operan en el océano Austral y en las aguas adyacentes, puedan tener un efecto positivo en la disminución del impacto causado por los desechos marinos manufacturados. Como una futura materia de interés internacional relacionada con la protección y conservación del mar y de su biota, para ser considerada por ingenieros navales y constructores de naves, se propone incluir en los planos de construcción una bodega específica donde se almacene en los respectivos compartimientos con los colores internacionales para plástico, vidrio, latas, papeles y otra clase de desechos limpios, con el propósito de ser desembarcados en los puertos internacionales, especialmente en aquellos con apropiada infraestructura para recibir y administrar esa clase de basura. Mientras, se sugiere que actualmente las compañías y propietarios

de flotas y buques antárticos hagan un esfuerzo para acomodar a bordo contenedores específicos para almacenar la basura producida y desembarcarla adecuadamente, si es posible, en cada puerto fuera del área de la Convención. La cantidad de basura producida y desembarcada debería ser incluida en las respectivas bitácoras.

Palabras clave: Desechos marinos, enmallamiento, CCRVMA, SEIC N°32, armadores, industria de la basura, Antártica.

INTRODUCTION

As a continuous study of marine debris and its impact caused over the animal population at Cape Shirreff (SSSI N°32 and CEMP Site), Livingston Island, a monitoring activity has been developed. This document is the fourth report on the surveyed area, since a base line was established during the Antarctic Season 1993/94 (Torres and Jorquera, 1995). Therefore, the purpose of this paper is to inform the results of the survey carried out during the Antarctic summer 1996/97, and also to suggest to pertinent authorities, shipbuilders, naval engineers and owners of Antarctic fleets and ships, to elaborate and put into practice in the future, some ideas (such as the construction of an adequate hold in which to store the classified garbage produced on board avoiding so the "traditional" behaviour of throwing it into the sea), in order to contribute to the effort in the conservation of the Southern Ocean and its biota supported by the Antarctic Treaty System in general, and by CCAMLR in particular.

METHOD

All 36 places of Cape Shirreff (see Fig.1, original to a scale 1:4,200 from Torres, 1993) were surveyed by foot collecting marine debris and clasifying them into four items: plastic, metal, glass, and paper material. Other marine debris were also collected from inland valleys enfacing some of those mentioned places, which was attributed as coming from there. As it was done before (Torres and Jorquera, 1996; Torres *et al*, 1996), at the end of the breeding period, synthetic fibres and other plastic material were obtained from every accesible nest of kelp gulls, *Larus dominicanus*; and sheathbills, *Chionis alba*. Besides, two females of Antarctic fur seals, *Arctocephalus gazella*, were released from their neck collars of packing band, and plastic rope, respectively. In general, the survey was conducted following the guidelines proposed by CCAMLR (1993), and taking especial care in order to avoid any disturbance in the breeding colonies of penguins, seabirds, and fur seals.

The labeled garbage was stored into double plastic bags, in order to avoid any accidental loss during its transport by boat from Cape Shirreff to the ship sailing to Punta Arenas port, and from there to Santiago. There, all this material was analyzed, weighed, measured, and when possible identified by trade marks and other characteristics that made possible to infer its origin.

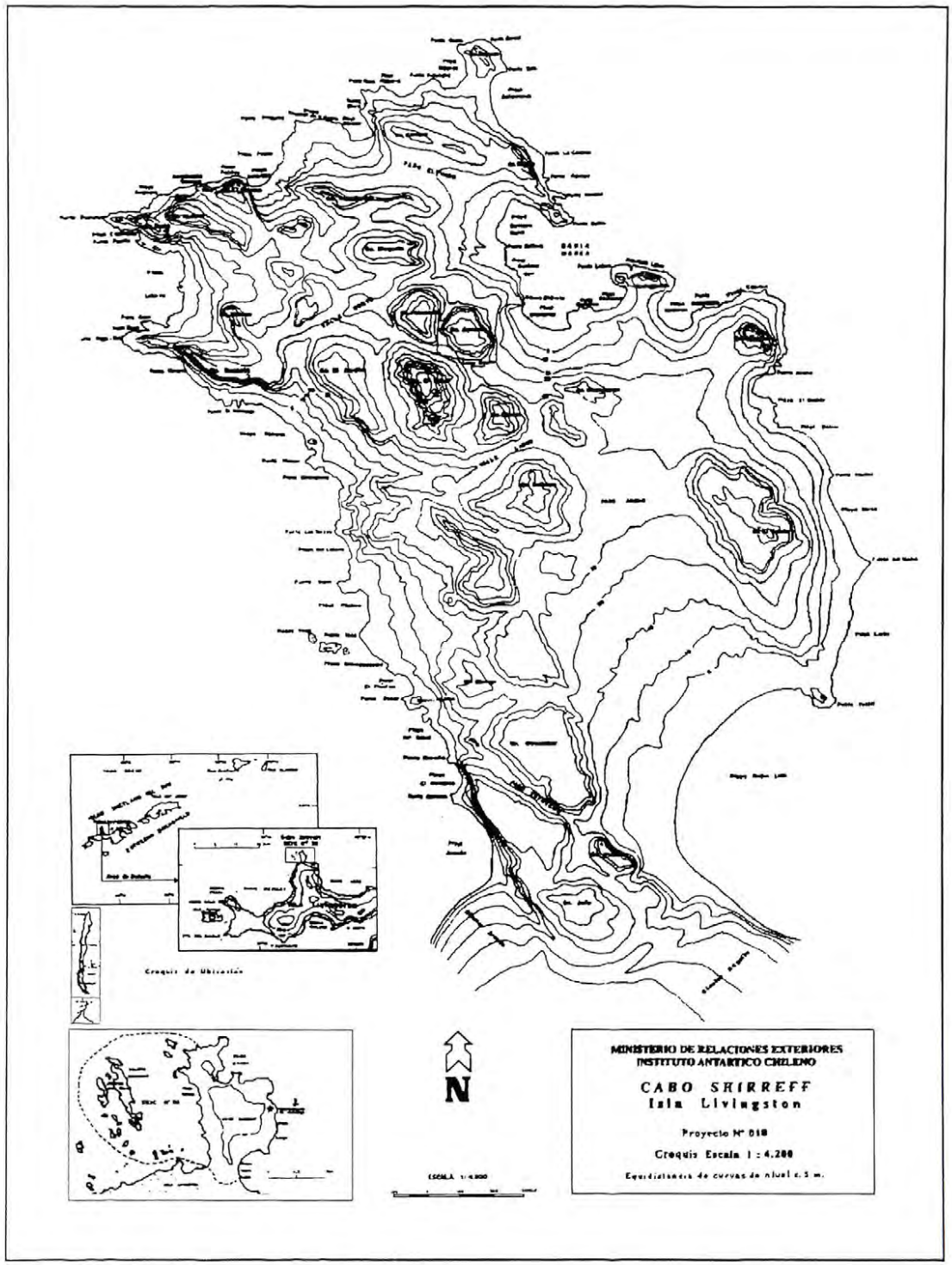

Fig. 1. Map of the SSSI N°32 and CEMP Site "Cape Shirreff and San Telmo Islets" (62° 27'S., 60° 47'W.) after Torres (1993)

RESULTS AND DISCUSSION

Plastic debris

The amount of pieces obtained by beach, and their correspondant weight are shown in Table 1. The total number of articles collected at Cape Shirreff was 1,609, with a total weight of 49.03 kg. It is interesting to note that the figure of articles collected has decreased, with weight which continue declining, as it is shown in Fig. 2. In this occasion there were 16.8 kg less than in the previous one. This is because the plastic item was the most abundant, especially 708 articles of expanded polyestirene (EP), which is evidently lighter with respect to other synthetic material such as ropes, plastic containers, and net pieces. As it is shown in Table 2, among all items collected, plastic was composed by 1,517 pieces (94.3%), while the glass articles were 67 (4.2%), the metalic pieces were 19 (1.2%), and 6 paper pieces (0.4%). With comparative purposes, Fig. 3 shows these percentages as well as those obtained in the previous three seasons. It is evident that plastic materials have maintained a relatively high importance of occurrence (more than 90%) in the lastest four seasons, while over the lastest two periods, values have been quite similar.

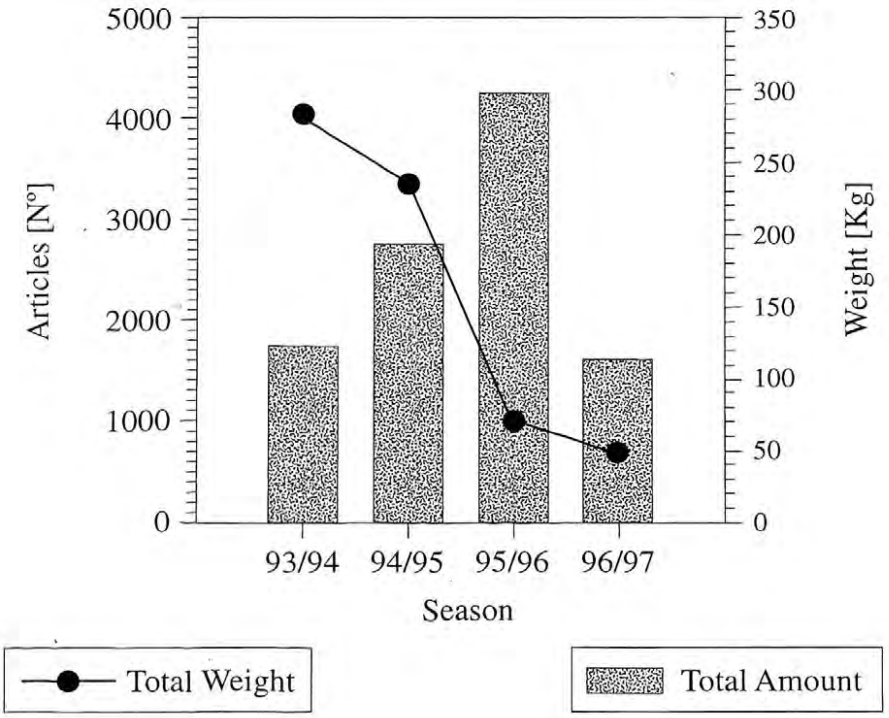

Fig.2 Amount and weights of all items of marine debris collected at Cape Shirrefff during the Antarctic seasons 1993/94; 1994/95, 1995/96, and 1996/97.

These results mean that plastic (n=1,517) continues as one of the most important items among all marine debris, and in this case it is represented by 708 pieces (46.7%) of EP, especially used in logistic and touristic ships; 421 elements (27.8%) used mainly in fisheries, such as strapping bands, ropes, and net pieces; and 308 pieces (20.3%) in which several kinds of plastic bottles, plastic cans, and several other articles of domestic use are included.

TABLE 1

Sites of Cape Shirreff cited from East (E) to West (W), with a total number and weight of pieces of marine debris collected during the 1996/1997 Antarctic summer.

SITES		PIECES	WEIGHT
1. Playa Media Luna	(E)	271	13.3
2. Playa Yuseff	(E)	0	0
3. Playa Larga	(E)	49	0.19
4. Punta del Medio	(E)	0	0
5. Playa Marko	(E)	139	3.51
6. Playa Daniel	(E)	63	0.55
7. Playa El Módulo	(E)	134	2.17
8. Playa Copihue	(E)	28	0.5
9. Punta Odontoceto	(E)	0	0
10. Playa Maderas	(E)	123	3.34
11. Playa Cachorros	(E)	56	2.99
12. Playa Chungungo	(E)	51	2.45
13. Roca Granito	(E)	0	0
14. Playa Ballena Sur	(E)	3	0.09
15. Punta Delfín	(E)	5	0.0114
16. Playa Bahamonde	(E)	14	0.189
17. Playa Roquerío	(N)	0	0
18. Playa Alcázar	(N)	8	1.26
19. Playa O.P. de la B.	(N)	5	0.39
20. Playa Papúa	(N)	13	0.23
21. Playa Antártico	(N)	19	0.23
22. Punta Poblete	(N)	28	0.41
23. Playa Escondida	(W)	57	0.31
24. Playa Lobería	(W)	74	1.61
25. Punta Rapa Nui	(W)	0	0
26. Playa Yámana	(W)	2	0.53
27. Punta Las Torres	(W)	27	0.189
28. Playa del Lobero	(W)	22	0.1
29. Playa Paulina	(W)	34	0.24
30. Playa Schiappacasse	(W)	21	0.24
31. Playa El Plástico	(W)	20	0.11
32. Playa del Canal	(W)	49	0.22
33. Playa El Remanso	(W)	59	7.49
34. Punta Antonio	(W)	0	0
35. Playa Aranda	(W)	96	1.49
36. Glaciar Aranda	(W)	0	0
37. Indeterminados	(W)	139	4.76
TOTAL		1,609	49

Eventhough the EP pieces have diminished comparing the obtained figures with the previous season (n=1,351), they have now become the principal article among all synthetic material. On one side, this fact explains the low total weight of marine debris collected, and on the other side it may suggest the origin of the EP, which probably comes from tourist groups and logistic activities. Another alternative is that the EP pieces could come from outside the Convention area during stormy and windy days. Some of the EP articles indicate a long permanence in the water due to the green algae growing on them, and because some of them have been rounded by a constant friction against the littoral or during their rolling on land and snow carried by the wind. Other articles are recent which indicates that in some way they have continued being used in the area. If this problem has occurred in the Convention Area after the elaboration of the Protocol to the Antarctic Treaty on Environmental Protection (04.10.91), this means

that a transgression to the Article 7 "Forbiden Products", Annex III, has taken place (Torres and Jorquera, 1996).

TABLE 2

Littoral places of Cape Shirreff from East (E) to West (W), and the respective quantities of items of marine debris collected during the 1996/1997 Antarctic summer.

SITES		PLASTIC	METAL	GLASS	PAPER
1. Playa Media Luna	(E)	261	5	3	2
2. Playa Yuseff	(E)	0	0	0	0
3. Playa Larga	(E)	49	0	0	0
4. Punta del Medio	(E)	0	0	0	0
5. Playa Marko	(E)	137	2	0	0
6. Playa Daniel	(E)	58	2	4	0
7. Playa El Módulo	(E)	92	1	40	0
8. Playa Copihue	(E)	24	0	4	0
9. Punta Odontoceto	(E)	0	0	0	0
10. Playa Maderas	(E)	103	4	14	2
11. Playa Cachorros	(E)	55	0	0	1
12. Playa Chungungo	(E)	51	0	0	0
13. Roca Granito	(E)	0	0	0	0
14. Playa Ballena Sur	(E)	3	0	0	0
15. Punta Delfín	(E)	5	0	0	0
16. Playa Bahamonde	(E)	14	0	0	0
17. Playa Roquerío	(N)	0	0	0	0
18. Playa Alcázar	(N)	8	0	0	0
19. Playa O.P. de la B	(N)	5	0	0	0
20. Playa Papúa	(N)	13	0	0	0
21. Playa Antártico	(N)	18	1	0	0
22. Punta Poblete	(N)	28	0	0	0
23. Playa Escondida	(W)	57	0	0	0
24. Playa Lobería	(W)	72	2	0	0
25. Punta Rapa Nui	(W)	0	0	0	0
26. Playa Yámana	(W)	2	0	0	0
27. Punta Las Torres	(W)	27	0	0	0
28. Playa del Lobero	(W)	21	0	1	0
29. Playa Paulina	(W)	34	0	0	0
30. Playa Schiappacasse	(W)	21	0	0	0
31 Playa El Plástico	(W)	19	0	1	0
32. Playa del Canal	(W)	49	0	0	0
33. Playa El Remanso	(W)	57	2	0	0
34. Punta Antonio	(W)	0	0	0	0
35. Playa Aranda	(W)	96	0	0	0
36. Glaciar Aranda	(W)	0	0	0	0
37. Indeterminados	(W)	138	0	0	1
TOTAL		1,517	19	67	6

As it occurred during the surveys carried out in the seasons 1994/95, and 1995/96, some plastic debris collected (n=15) show evidence of having been processed into incinerators before being thrown into the water. Eventhough we have this time a low record compared to 51 collected in the previous season, it is possible to infer that the ashes produced out of this process have been also disposed into the sea (Torres and Jorquera, 1995). If such an action has been performed in the waters of the CCAMLR Convention Area, it would be against the Protocol to the Antarctic Treaty on Environmental Protection (Torres and Jorquera, 1996).

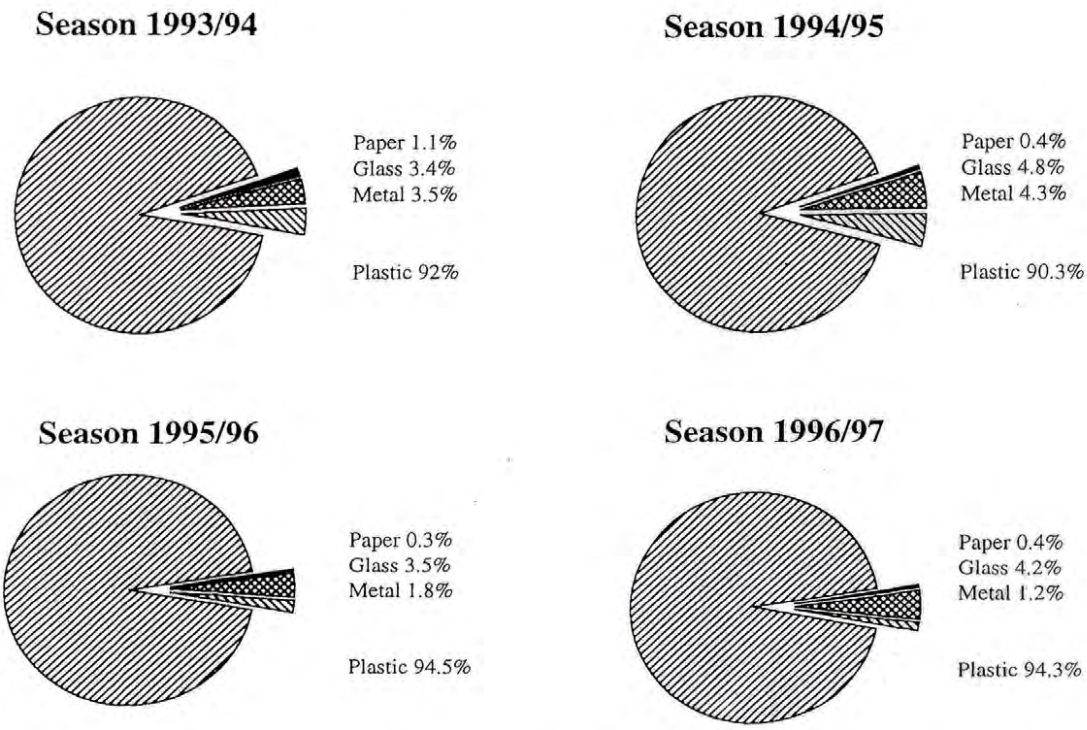

Fig. 3 Percentage of marine debris collected at Cape Shirreff in the 1993/94, 1994/95, 1995/96, and 1996/97 Antarctic summer seasons.

Glass debris

This time, 67 pieces of glass debris were collected, from which 64 were fragments and 3 empty whisky bottles, the latter carefully closed. As it was recorded in other occasions, all glass fragments have worn-out edges due to the tide action , which has revolved the littoral substrata. It is possible to infer that this kind of debris are produced when the waves break the bottles against the rocks, especially during the stormy days, when the sea conditions are very rough.

It is important to note that there have been recorded several ancient glass pieces, which have been found near the top of some hills, and also near some ruins of sealers settlements, taking note of the place on which they have been collected, because some of them may have an historical interest. All these materials are not included as debris, and it is possible to identify them because they are completly different from the modern glass in: size, colour, weight and thickness, and because they have no worn edges.

Metallic debris

The 19 metal pieces collected were mainly fragments and spray cylinders, and recording instruments of a sounding balloon. We also found two oval elements made of iron and aluminium that had two components: a male and a female, with a rubber seal between them. The male with a central bolt was attached to the female with a "butterfly-nut" (a nut with two "wings" named in

Spanish as "tuerca de mariposa") screwed to a bolt. It was not possible to determine to what kind of instrument they belonged to.

For the second time, it was impossible to remove from the area three big size garbages which still remain at the CEMP Site, as it was informed by Torres and Jorquera (1996): A black cylindric floater with iron holder in both of its apexes, stranded in "El Remanso" beach and trapped by the littoral snow and ice, difficult to remove; and two oil drums located in the "Norte" beach at San Telmo Islets, which also have been difficult to remove because they are located in a breeding area of *A. gazella.* All this material has not been considered here among the 19 metallic pieces. Efforts will be made in order to remove these garbages from the area.

Paper debris

With respect to the paper item, it was composed by six (6) cylinders or carton tubes with similar characteristics. Each of them seems to be the support of a big plastic roll, possibly used on board of a fishing ship to seal boxes with the obtained catch.

Marine debris density

It is important to note that the total marine debris density has declined from the maximum obtained (1.52 articles/m^2) during the 1995/96 Antarctic season, to 0.46 articles/m^2 during the 1996/97 Antarctic season. On the basis of these results it is possible to infer that from one season to another, the garbage thrown out to the sea by members of crews from various kinds of ships operating in the Southern Ocean has declined. It is hoped that this kind of evidence suggests a possible change of attitude and behaviour of people on board of ships operating inside and outside the Convention area.

Impact on birds and fur seals

During this season, as it occured in the previous one, marine debris were collected from nests of some kelp gulls, *Larus dominicanus*, and sheathbills, *Chionis alba.* Besides, two females of Antarctic fur seals, *A. gazella*, were seen with neck collars. As it was mentioned, all plastic material was removed from the nests, and from the neck of fur seals. All these findings have become "traditional" in the area, and reflect the continuing problem, eventhough the amount of plastic has been lower than what has been reported for previous seasons, but it continues to be the most abundant and predominant garbage dispersed on the shores of the CEMP Site.

Hucke-Gaete *et al.* (1997), give detailed information about the entanglement problem of *A. gazella* at the CEMP Site "Cape Shirreff and San Telmo Islets" from 1987/88 to 1996/97. A total of 20 entangled animals has been recorded, from which seven individuals (35%) have been released in the past three Antarctic seasons (1994/95 - 1996/97): four females, one juvenile male, and two pups three month old. Eventhough this means a low rate of entanglements, fluctuating around 0.026 (± 0.011 S.D.) compared to those for Bird Island informed by Arnould and Croxall (1995) with a 0.3 in 1989/90, and 0.07 for 1995/96 Antarctic season, this means that it is a persistent problem which sometimes causes severe wounds to animals, and it may possibly cause death.

During the last three seasons the release activity of *A. gazella* from neck collars has been succesful in 100% of animals recorded as entangled at Cape Shirreff, but the problem that follows after the releasing is that of the wound remaining on the animal. Eventhough we have used some medicine (iodine) on the wound, it is not sufficent to cure the damage caused by the entanglement.

General comments

Upon the basis of the results obtained from the analysis of all marine debris collected at Cape Shirreff during the Antarctic season 1996/97, it is possible to infer that at least for this season, an interesting decline of garbage stranded on the site has occurred. A possible reason to explain this trend would be a probable change in the behaviour of crews from ships operating in the Southern Ocean. If so, it is possible to say that education materials planned to be produced by CCAMLR as a didactic material for crews of ships dedicated to accomplish different kinds of activities in the waters of the CCAMLR Convention, will cause a change of attitude, and people involved will be able to work cleanly, giving an example to those who operate in other oceans. This would be a success of the owners of the Antarctic fleets, as well as of all crews working in the Southern Ocean. If so, the effort of the CCAMLR will have been fruitful and no entangled animals will occur in Antarctic or Subantarctic waters anymore.

CONCLUSIONS

1. The arrival of marine debris continues at Cape Shirreff, but in the latest season 1996/97 it has declined in number, weight, and density, compared to the previous season 1995/96.

2. Plastic continues to be the predominant material with a 94.3% of the total items collected.

3. From the total plastic articles collected (n=1517), the EP (expanded polyestirene) (n=708) has become the most important item among the synthetic material (47.7%), while the articles used in fisheries were less abundant (n=421) with 27.8%, and those of domestic use (n=308) with a relative abundance of 20.3%.

4. Among the plastic items collected, there were some pieces partialy incinerated. Then, it is possible to infer that other kinds of remains produced by this action, such as ashes, may have been thrown into the sea.

5. Some *L. dominicanus* (kelp gulls) and *C. alba* (sheathbills) countinue using some kind of marine debris in building their nests.

6. Some individuals of *A. gazella* (Antarctic fur seals) also continue arriving entangled; this season two females were released from their entanglement.

7. In the future, all ships should have an adequate hold in which store the classified garbage produced on board. In the meantime, the present companies and owners of Antarctic fleets and ships should make the effort to accomodate on board an specific container to store the classified garbage produced and disembark it in ports outside the Convention area.

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