

Accumulation of stranded plastic objects and other artefacts at Inaccessible Island, central South Atlantic Ocean

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During 1987 a survey of macro-artefacts (>10 mm diameter) was conducted along a 900 m boulder beach at the western point of Inaccessible Island, central South Atlantic Ocean. This repeated the survey made at the same site during 1984, when the highest density of artefacts at the Tristan da Cunha/Gough and Prince Edward island groups (apart from Tristan settlement) was recorded at Inaccessible Island. The minimum rate of artefact accumulation was 88 objects $\text{km}^{-1} \text{year}^{-1}$. Total numbers of artefacts had increased by 47 per cent, with the greatest increase among plastic objects (65 %). Artefacts attributable to the local fishery were little increased in abundance, whereas those derived from distant sources had increased by at least 120 per cent, suggesting a recent increase in the density of artefacts adrift in the South Atlantic Ocean.

Gedurende 1987 is 'n opname gemaak van makro-voorwerpe (> 10 mm deursnee) oor 900 m rotsagtige strand aan die westelike punt van Inaccessible-eiland, sentrale Suid-Atlantiese Oseaan. Dit was 'n herhaling van die opname wat gedurende 1984 in die selfde gebied, Tristan da Cunha-/Gough- en Prins Edward-eilandgroepe (die Tristan-nedersetting uitgesluit), gemaak is en die grootste hoeveelheid voorwerpe by Inaccessible-eiland opgeteken is. Die minimum hoeveelheid opgehoopde voorwerpe was 88 stukke $\text{km}^{-1} \text{jaar}^{-1}$. Die totale aantal voorwerpe het met 47 persent gestyg, met die grootste toename in plastiese artikels (65 %). Voorwerpe afkomstig van die plaaslike visserij het min toegeneem, terwyl dié wat van verafgeleë bronne afkomstig is met ten minste 120 persent vermeerder het. Daaruit blyk dat daar 'n onlangse toename is in die hoeveelheid voorwerpe wat in die Suid-Atlantiese Oseaan voorkom.

Introduction

Plastic objects and other artefacts are widespread sea-surface pollutants which, through entanglement and ingestion, have many adverse impacts on marine organisms (Balazs 1985, Wallace 1985, Laist 1987, Ryan 1987a). There is concern about the increasing incidence with which artefacts are being recorded stranded on remote Antarctic and Sub-antarctic shores (Gregory *et al.* 1984, Burton & Williams 1985, Torres & Gajardo 1985, Gregory 1987, Keage 1987, Ryan 1987b), and parties to the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) have agreed to monitor artefacts in the Southern Ocean (Morris 1985). The incidence of artefacts stranded at islands in the Tristan da Cunha/Gough and Prince Edward Island groups has been reported (Ryan 1987b), but such single surveys allow no estimate of the rate of accumulation of artefacts. This paper details a repeat survey of artefacts on 900 m of beach at Inaccessible Island, three years after the original survey.

Study Area and Methods

Inaccessible Island ($37^{\circ}15'S$, $12^{\circ}30'W$), one of three main islands in the Tristan da Cunha group, is situated in the central South Atlantic Ocean (Fig. 1). Winds blow predominantly from the northwest (Fig. 1, Christophersen & Schou 1946). The island is uninhabited and is seldom visited by the Tristan islanders, but there is a ship-based commercial fishery for the rocklobster *Jasus tristani* around the island. The

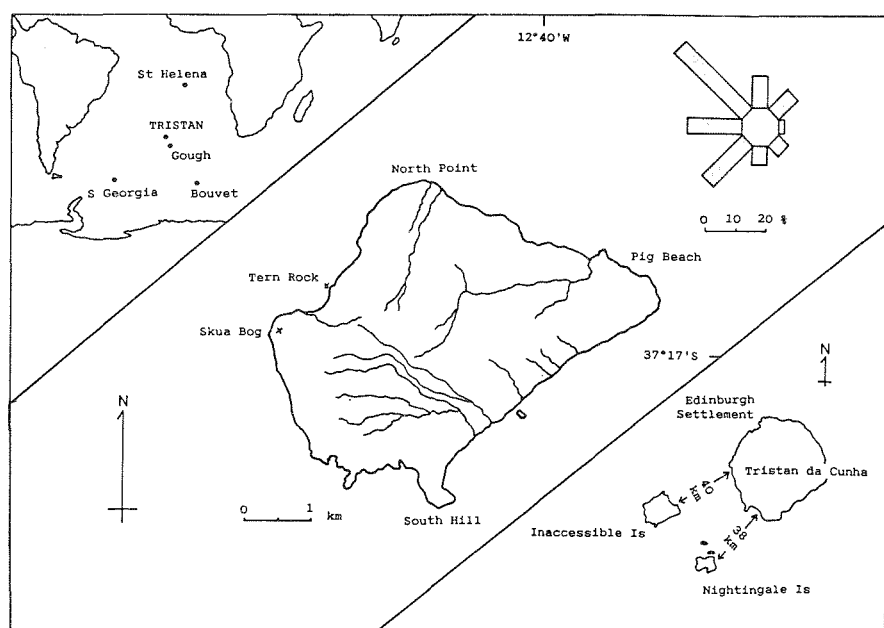


Fig. 1. Inaccessible Island, showing degree of isolation and the position of the survey area. The wind rose is based on frequency data from Tristan da Cunha (Christophersen & Schou 1946).

local fishery uses plastic and metal traps either singly or in groups on long lines attached to "soft" plastic buoys.

We visited the island briefly on 16 November 1984 and surveyed approximately 900 m of west and north-facing boulder beach between Skua Bog and Tern Rock at Blenden Hall, the western point of the island (Ryan in 1987b). All large artefacts (>10 mm diameter) were counted and identified as far as possible to determine their origin, but were not removed from the beach (see Ryan 1987b).

The island was revisited between 28 September and 14 October 1987, and a repeat survey for artefacts was conducted on 28 September. To standardize search effort, the duration of the survey was restricted to three hours, the period available in 1984. A few artefacts were noted subsequent to the survey, but these represented less than 2 per cent of the total number and were excluded from the analysis. The categorization of artefacts follows Ryan (1987b).

Results

The total number of artefacts had increased by 47 per cent, from 559 items km⁻¹ in 1984 to 823 items km⁻¹ in 1987. This represents a minimum accumulation rate of 88 objects km⁻¹ year⁻¹. The rate of increase was greatest for plastic articles (Table 1). Disposable plastic cooldrink bottles had increased from 2 to 12. Only two types of metal articles exhibited slight decreases in abundance (Table 1).

Table 1

Comparison of the numbers of artefacts found on 900 m of beach between Skua Bog and Tern Rock, Inaccessible Island, during 1984 and 1987 (1984 data from Ryan 1987b)

Type of artefact	1984	1987	% change
Plastic objects [totals]	[312]	[515]	[+ 65]
Fishery floats	80	118	+ 48
Fish boxes	41	65	+ 59
Polypropylene ropes	18	46	+ 156
Netting	34	44	+ 29
Rock-lobster traps	29	48	+ 65
Expanded polystyrene	21	39	+ 86
Other foamed plastics	3	4	+ 33
Bags and packing strips	1	5	+ 500
Bottles and containers	55	90	+ 64
Miscellaneous objects	30	56	+ 87
Metal objects [total]	[89]	[93]	[+ 4]
Fishery floats	12	17	+ 42
Rock-lobster traps	15	12	- 20
Drums, aerosols (floating)	9	8	- 11
Other objects (non-floating)	53	56	+ 6
Glass objects [total]	[13]	[16]	[+ 23]
Fishery floats	8	9	+ 13
Bottles and light bulbs	5	7	+ 40
Cork floats	22	25	+ 14
Wooden objects	67	92	+ 37
Total	503	741	+ 47

The overall pattern of origin of articles was similar to that recorded during 1984, with most artefacts deriving from the local fishery, South America and the orient (presumably from oriental fishing vessels operating in the South Atlantic and Southern Oceans). However, the number of artefacts attributable to the local fishery was little changed, whereas numbers of artefacts derived from distant sources had increased by at least 120 per cent (Table 2). This difference

Table 2

Countries or regions of origin of artefacts found stranded between Skua Bog and Tern Rock, Inaccessible Island, during 1984 and 1987 (data for 1984 from Ryan 1987b)

Country/region	1984	1987	% change
Tristan fishery	32	36	+ 13
Argentina	15*	33	+ 120
Uruguay	0	6	+++
Brazil	8	6	- 25
Orient	14	25	+ 79
South Africa	0	2	+++
Europe & USSR	6	14	+ 133
USA	0	1	+++
Australasia	1	1	no change
Total	72	124	

*includes five "Moscuza" floats, whose Argentinian origin was not known to Ryan (1987b)

was best demonstrated by plastic fishery floats; foreign floats increased from 43 per cent of the total in 1984 to 77 per cent in 1987.

Brazil was the only country of origin for which fewer artefacts were recorded during 1987 than during 1984. A message in a bottle posted from Buenos Aires, Argentina, on 14 March 1985 was recovered during the 1987 survey.

Discussion

The large amount of plastic and other debris on the section of shoreline surveyed at Inaccessible Island is largely due to the beach's orientation; it is exposed to the prevailing winds and currents (Ryan 1987b). The many artefacts from South America presumably are carried to the island by the eastward drift of the South Atlantic gyre, because there is virtually no trade between Tristan and countries in South America. Most of the supplies to Tristan arrive from South Africa or England.

The rate of artefact accumulation at a beach is a function of the rates of stranding and removal (through decay or transport off the beach). Because the turnover rate of artefacts on beaches is unknown, repeat surveys can only provide a minimum estimate of the rate of stranding. This applies particularly to surveys such as this where artefacts found during the initial survey were not removed from the beach. At Inaccessible Island, the stranding rate is probably much greater than the estimated minimum accumulation rate because storms wash many objects into the *Spartina* tussock that backs the beach, resulting in a fairly high turnover rate. Little attempt was made to search for artefacts in the dense tussock during these surveys, but casual observations revealed many objects lodged in the tussock up to 50 m inland.

This limitation is unlikely to affect the finding that certain types of artefacts have increased in abundance to a greater extent than have other types; decay rates of all items are probably greater than three years (e.g. cans from the Dentstone Expedition of 1982-83 were rusted but still intact and their numbers little altered from 1984, and wood and metal from 19th century shipwrecks are still present) and the rate of transport off the beach during storms probably is similar for different types of artefacts (although presumably is lower for non-floating metal artefacts). Only the accumu-

lation rate of very light articles such as expanded polystyrene may be underestimated relative to other artefact types, due to wind removal.

There have been no marked changes in fishing practices or in fishing effort at the Tristan da Cunha Island group during the last five years (D.E. Pollock pers. comm.). Consequently, the large increase in artefacts from oceanic rather than local sources suggests either that artefacts of oceanic origin have a longer life after stranding or that the density of artefacts adrift in the South Atlantic Ocean is increasing. There is no evidence to support the former possibility (the proportions of different artefact types [plastic, glass, etc.] are similar for artefacts of local and oceanic origin), thus it is likely that the density of drifting debris in the South Atlantic Ocean is increasing.

Because of the hazard drifting debris poses to both marine organisms and shipping (Wallace 1985, Laist 1987), active programs to prevent littering, at sea and on land, have to be adopted and enforced. Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL, 1978), which prohibits the dumping of all plastic at sea, comes into force in November 1988, but it is uncertain whether this will have any immediate effect on the amount of plastic in the South Atlantic Ocean. Much of the debris at Inaccessible Island is fishing gear that presumably is lost at sea, rather than dumped. Further monitoring of the distribution and abundance of plastic debris at sea in the Southern Ocean is warranted.

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References

- BALAZS, G.H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. In: Proceedings of the Workshop on the Fate and Impact of Marine Debris, 27-29 November 1984, Honolulu, Hawaii, eds R.S. Shomura & H.O. Yoshida. U.S. Dept Commerce, NOAA-TM-NMFS-SWFC-54 pp. 387-429.
- BURTON, H.R. & WILLIAMS, D.L. 1985. Heard Island ANARE 1985 Report. Antarctic Division, Kingston, Australia.
- CHRISTOPHERSEN, E. & SCHOU, G. 1946. Meteorological observations. In: Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937-1938, Vol. II, eds E. Christophersen & G. Schou. Det Norske Videnskaps-Akademi, Oslo number 10, pp. 1-24.
- GREGORY, M.R. 1987. Plastics and other seaborne litter on the shores of New Zealand's Subantarctic islands. *N. Zeal. Antarct. Rec.* 7(3): 32-47.
- GREGORY, M.R., KIRK, R.M. & MABIN, M.C.G. 1984. Pelagic tar, oil, plastics and other litter in surface waters of the New Zealand sector of the Southern Ocean, and on Ross Dependency shores. *N. Zeal. Antarct. Rec.* 6: 12-28.
- KEAGE, P.L. 1987. Management plan. In: Heard Island expedition, ANARE 1986-87, ed. R. Ledingham. Australian Antarctic Division, Kingston, Australia pp. 87-97.
- LAIST, D.W. 1987. Overview of the biological effects of lost and discarded plastic debris in the marine environment. *Mar. Pollut. Bull.* 18: 319-326.
- MORRIS, J. 1985. Antarctica's living resources: are they in safe hands? *Oryx* 19: 65.
- RYAN, P.G. 1987a. The incidence and characteristics of plastic particles ingested by seabirds. *Mar. Environ. Res.* 23: 175-206.
- RYAN, P.G. 1987b. The origin and fate of artefacts stranded at islands in the African sector of the Southern Ocean. *Environ. Conserv.* 14: 341-346.
- TORRES, D. & GAJARDO, M. 1985. Informacion preliminar sobre desechos plasticos hallados en Cabo Shirreff, Isla Livingston, Shetland del Sur. *Bol. Antarct. Chileno* 5(2): 12-13.
- WALLACE, N. 1985. Debris entanglement in the marine environment: a review. In: Proceedings of the Workshop on the Fate and Impact of Marine Debris, 27-29 November 1984, Honolulu, Hawaii, eds R.S. Shomura and H.O. Yoshida. U.S. Dept Commerce, NOAA-TM-NMFS-SWFC-54 pp. 259-277.