

Plastic particle pollution in great shearwaters (*Puffinus gravis*) from Gough Island

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The combined gut contents of two great shearwaters Puffinus gravis were found to contain 44 separate plastic particles with a total mass of 1,383 g. The particles were identified as high density polyethylene, low density polyethylene, crosslinked polyolefin and nylon. Analysis showed that 95 per cent of the particles were polyethylene. The source of the plastic particles was not determined but they were probably derived from their prey. In view of possible adverse physical and chemical effects monitoring of the occurrence of these plastic particles is necessary.

Die gesamentlike maaginhoud van twee groot pylstormvoëls het 44 los plastiek deeltjies bevat met 'n massa van 1,383 g. Die deeltjies is geïdentifiseer as hoë digtheid polietileen, lae digtheid polietileen, kruisgekoppelde poliolefin en nylon. Ontleding het getoon dat 95 persent van die deeltjies polietileen was. Die bron van die plastiek deeltjies is nie vasgestel nie, maar was miskien van hul prooi afkomstig. Aangesien fisiese en chemiese effekte moontlik is, is bepaling van die voorkoms van hierdie plastiek deeltjies noodsaaklik.

Introduction

During October 1980 two adult great shearwaters *Puffinus gravis* were collected by one of us (G.J.R.) after they had flown against the buildings of the meteorological base at Gough Island (40°21'S, 9°55'W). The gut contents of both birds were found to contain plastic particles, similar to those reported in several seabird species (Ohlendorf, Risebrough & Vermeer 1978, Pettit, Grant & Whittow 1981, Bourne & Imber 1982, Connors & Smith 1982).

Methods

The two samples were inadvertently mixed and the combined results of the samples are presented. The plastic particles were measured, weighed and then identified. They were first tested to establish if they were polyolefins by flotation in distilled water. Those that floated were then analysed using the crystalline melting point method under crossed polars (Collins, Bares

& Billmeyer 1973). The particle that sank was identified using pyrolysis gas chromatography (Smith & Myers 1981).

Results

Forty-four plastic particles with a combined mass of 1,383 g were found (Table 1). Ninety-five per cent of the particles were polyethylene, composed of 70 per cent low density polyethylene and 25 per cent high density polyethylene. The polyethylene particles constituted 74 per cent of the total mass. Many of the polyethylene particles had been stained black or brown, possibly by squid ink or other stomach contents. One button-shaped object that floated, but did not crystallize, was identified as a cross-linked polyolefin. The particle that sank was nylon, probably Nylon 6,9, and not the common Nylon 6,6.

Discussion

The occurrence of the nylon particle was particularly interesting, in view of the source of these particles in great shearwaters. Since nylon sinks it indicates that this particle, and possibly the others, were obtained from the prey of great shearwaters rather than having been picked up directly by the birds. The diet of great shearwaters in Canadian waters consisted mainly of squid, fish and crustaceans (Brown, Barker, Gaskin & Sandeman 1981). One of the fish prey species consumed, the herring *Clupea harengus*, was among eight species of fish from the same area found to contain plastic particles (Carpenter, Anderson, Harvey, Miklas & Peck 1972).

The geographic origin of the plastic particles is unknown, but the abundance of plastic pellets on New Zealand beaches (Gregory 1977), as well as in the South Atlantic (Morris 1980), and their occurrence in prions *Pachyptila* spp. from the Southern Oceans (Bourne & Imber 1982), indicates that plastic particle pollution is widespread at sea in the southern hemisphere. The great shearwater is not a reliable indicator species of localised plastic particle pollution since it migrates to the North Atlantic Ocean from May to October (Watson 1975). Plastic pellets were present in 39 per cent of the great

Table 1
Analysis of the plastic particles found in two great shearwater (*Puffinus gravis*) gut contents.

Plastic type	No.	Shape	Colour	Mean length (mm)	Mean height (mm)	Mean mass (g)	Total mass (g)
Low density polyethylene	31	cylinders/ spheroids	translucent	3,71 (1,70-5,14)	2,63 (1,72-3,67)	0,0215 (0,0035-0,393)	0,667
High density polyethylene	11	flattened	turquoise white translucent	6,16 (3,55-8,14)	0,98 (0,20-1,95)	0,032 (0,0024-0,151)	0,352
Cross-linked polyolefin	1	button	translucent	12,4	2,83		0,230
Nylon	1	flattened	translucent	10,15	2,45		0,134

shearwaters examined in 1974/1975 at Brier Island off Eastern Canada, and in 75 per cent of those examined at nearby Placentia Bay in 1978 (Brown *et al.* 1981). The retention time of plastic particles in the great shearwater is not known and it could not be determined if they regurgitate undigested material. It is likely that they regurgitate since they consume squid and the indigestible squid beaks would have to be regurgitated, or voided, from time to time to prevent excessive accumulation in the stomach.

The effect of ingested plastic particles on birds has not been resolved, but both physical and chemical effects have been suggested. Physical effects include localised ulceration of the stomach caused by larger plastic fragments and possible interference with digestion resulting from large quantities of plastic (Bourne & Imber 1982). Possible chemical effects relate to organochlorides which may be associated with plastic items thereby constituting a source of ingested chemical pollutants (Pettit *et al.* 1981). It has also been suggested that plastic particle pollution in birds may produce physiological effects threatening successful migration and breeding (Connors & Smith 1982). Clearly a knowledge of effects of plastic particle pollution on birds is required and its incidence both locally and regionally should be monitored.

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