Plastic Particles Found in the Gizzard of a Starved Black-footed Albatross (*Diomedea nigripes*)

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Key words: *plastic ingestion, resin pellet, fragments of plastic products, Black-footed Albatross, pica phenomenon*

A Black-footed Albatross (*Diomedea nigripes*) was found exhausted on the beach of Hazaki Shinko Port (35° 45' N, 140° 51' E), Ibaraki Prefecture, 21 October 1992. This bird was recovered by the staff of the Nature Protection Section, Regional Government of Ibaraki Prefecture. Food and vitamins were force-fed daily, but the bird was so emaciated that it died on 27 October. Its subcutaneous and visceral fat had been completely depleted and its pectoral muscles were considerably reduced. The bird had been banded as a chick on Torishima Island, in the Izu Islands, on 21 April 1992 (Band No. BA-00695), hence it was 9–10 months old. It had spent approximately 4 months at sea after fledging. The cause of death seemed to be starvation.

The digestive tract was sent to the Yamashina Institute for Ornithology. In the gizzard, were 3 squid beaks, 1 plant seed, 47 pebbles, 2 minute pumice stones and 12 plastic particles. No items were in the proventriculus. One of the squid beaks was identified as *Chiroteuthis* sp. Two plastic particles (Nos. 1 and 2 in Fig. 1 and Table 1) were resin pellets, 3.5×3.8×3.5 mm, or a polyethylene cylinder and pill; the remainder were fragments of plastic products (Nos. 3 to 12) 6.9×9.4×2.0 mm in size. Particles Nos. 9 and 10 had been burned imperfectly in an incinerator before being shaped under ambient temperature.

Color preference for plastic particles by the Black-footed Albatross has been studied only during the breeding season (Sileo *et al.* 1990, Sievert and Sileo 1993). In the North Pacific, the color of plastic ingested by Sooty and Short-tailed shearwaters differed (Ogi 1990). The difference may be due to the different food and feeding habits between the two species of shearwaters. However, to properly evaluate color preferences for plastic among seabirds, color must be designated using technical analysis. In this study, we used the CIE 1976 L*a*b* method (Anon. 1974, Kuehni 1976), and a Handy Colorimeter (NR-3000, Nippon Denshoku Ind., Ltd.). In Table 1, the L* denotes the level of brightness ranging from pure black (L*=0) to pure white (L*=100). The a* and b* denote the green-red hue axis ranging from pure green to pure red in chroma, and the blue-yellow hue axis

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Fig. 1. Plastic particles found in the gizzard of a Black-footed Albatross.

Table 1. Measurements of plastic particles ingested by the Black-footed Albatross. L*: Brightness, a*: Chroma on the Green-Red (G-R) hue axis, b*: Chroma on the Blue-Yellow (B-Y) hue axis.

Code No. of plastic particle	Size				Color recognition		
	Weight (mg)	Shortest length (mm)	Longest length (mm)	Thickness (mm)	Brightness L*	Chroma (G-R hue) a*	Chroma (B-Y hue) b*
1	36.2	3.43	3.64	4.50	45.76	-6.64	14.20
2	20.4	3.60	4.01	2.50	46.46	4.29	13.50
3	23.2	3.40	7.61	1.20	96.25	-1.74	7.04
4	58.3	5.90	6.52	2.98	86.67	-1.63	16.10
5	50.4	4.12	8.27	2.58	67.09	-0.73	9.06
6	233.8	7.98	15.12	2.12	85.28	-2.49	11.61
7	84.1	10.10	10.82	0.88	51.57	4.39	9.47
8	73.9	9.18	9.92	1.22	52.42	-0.78	7.35
9	74.0	5.30	10.62	3.42	60.24	0.99	8.27
10	65.5	6.79	7.50	3.63	28.86	1.57	3.65
11	18.8	5.64	6.40	0.71	32.96	1.49	5.18
12	101.8	10.44	11.29	1.34	57.73	-4.49	-16.09
Total	840.4						
Average	70.0	6.32	8.48	2.26	59.27	-0.48	7.45
±SD	55.5	2.47	3.13	1.16	20.27	3.13	7.93

ranging from pure blue to pure yellow in chroma, respectively. The ranges of the chroma from -10 to +10 in a* and b* are difficult to classify by human eyes. The plastic particles in this study were mostly worn to dull color, except for No. 12, which was blue. However, as shown in Table 1, the value of brightness varied from 28.9 to 96.3, more than those of a* and b*. Therefore the plastic particles could be classified as follows: white (particle Nos. 3, 4, 5, and 6), grey (particle Nos. 1, 2, 7, 8, 9), and dark grey (particle Nos. 10 and 11).

In pelagic waters of the North Pacific Ocean, the average number and weight of plastic particles ingested by Black-footed Albatrosses were as follows: 1.3 ± 0.7 particles, 56.4 ± 43.7 mg ($N=9$) in Alaskan waters; and 12.6 ± 7.4 particles, 268.5 ± 305.4 mg ($N=5$) in Hawaiian waters (Ogi unpubl. data). Thus, the hatching-year albatross in this study had taken more plastic than on average. During the chick stage at breeding colonies on Midway Island, plastic particles are fed often to the chicks by parents; weights average 43 g ($n=25$, range 0–219 g) in 1986 and 36 g ($n=18$, range 6–182 g) in 1987 (Sileo *et al.* 1990). Sileo *et al.* (1990) also reported that Black-footed Albatross chicks regurgitate the plastic in their proventriculus before fledging. Until this time, the plastic would remain in the gizzard. The average residence time of plastic particles ingested by Short-tailed Shearwaters (*Puffinus tenuirostris*) was 10 months with a range of 3 to 12 months (Day 1980). If these rates are applied to the Black-footed Albatross in this study, most of the plastic particles found in the gizzard may have been fed by its parent during chick stage. The death of this bird seemed not to be caused by the ingested plastic because of its small amount.

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茨城県波崎新港で衰弱死したクロアシアホウドリの胃中から 見出されたプラスチック粒子

1羽のクロアシアホウドリが1992年10月21日に茨城県波崎新港で衰弱し保護され、同年10月27日に落鳥した。標識番号から、このクロアシアホウドリは1992年4月21日に鳥島で雛時に標識付後放鳥された個体であり、孵化後約5ヶ月目で巣立ち、海洋生活期の4ヶ月目で飢餓のため死亡した個体と考えられた。

胃内容物を調べた結果、砂嚢から12個のプラスチック粒子が出現した。粒子の種類はプラスチック原料粒子（レジンベレット）が2個、他は全てプラスチック製品類の破片であった。平均重量は 70 ± 56 mg、色は白色4個、灰色5個、濃灰色2個、そして淡青色1個であった。

クロアシアホウドリは巣立ち時に前胃中のプラスチック粒子などの異物を全て吐き出してしまうものの（Sileo *et al.* 1993）、砂嚢中のプラスチック粒子はそのまま保持されている可能性が高い。ハシボソミズナギドリでのプラスチック粒子類の胃滞在時間は約10カ月（範囲：3–12カ月）である（Day 1980）。これらのことから、クロアシアホウドリの胃中に見出されたプラスチック粒子類の多くは、繁殖地において親鳥から与えられた餌の中に混入し、巣立ち後も砂嚢中に残存していた可能性が高い。

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