STONE-SWALLOWING BY THREE SPECIES OF PENGUINS AT SUB-ANTARCTIC MARION ISLAND

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Stones have been recorded in the stomachs, regurgitation pellets or faeces of at least six penguin species: Adélie Penguin *Pygoscelis adeliae* (Cooper 1985, Kent *et al.* 1998), African Penguin *Spheniscus demersus* (stones in one of 247 stomach samples, Rand 1960), Emperor Penguin *Aptenodytes forsteri* (Splettstoesser & Todd 1999 and references therein), Gentoo Penguin *Pygoscelis papua* (Clausen & Pütz 2003), Magellanic Penguin *S. magellanicus* (Boswall & MacIver 1975) and Yellow-eyed Penguin *Megadyptes antipodes* (Moore & Wakelin 1997). It has been speculated that ingested stones may provide ballast for deep diving or may act as a grinding agent for food, and also that stones are accidentally ingested, either directly or indirectly through the ingestion of prey with stones in stomachs (Splettstoesser & Todd 1999).

We report on the deliberate swallowing of stones by King *A. patagonicus,* Rockhopper *Eudyptes chrysocome* and Macaroni *E. chrysolophus* Penguins at sub-Antarctic Marion Island (46°54'S, 37°45'E). Published reports of the stomach contents of these three species at this locality do not include references to stones (Adams & Klages 1987, Brown and Klages 1987, Adams & Klages 1989), although stones have been found in the stomachs of Gentoo Penguins at Marion Island (B.M. Dyer pers. comm.).

During April 2004, six adult King Penguins were observed by MSdV to swallow small (*c.* 5-mm diameter) stones (Table 1). The birds appeared to be in good physical condition. Stones were selected within a two-metre radius of a bird's position, on a broad path carrying fresh-water runoff from a King Penguin breeding colony towards the sea. Penguins selected one stone at a time, briefly held it in their bill and then threw back their head, allowing the stone to slip down their throat. Up to 31 stones were swallowed by a single bird, and rates of swallowing ranged from six to 24 stones per minute. Two penguins responded aggressively [direct-stare display (Marchant & Higgins 1990)] when neighbouring birds displayed an interest in the stones they were holding. After swallowing the stones, four of the penguins headed toward the sea, one headed toward the colony and one remained where it was.

TABLE 1
Observations of stone-swallowing by three species of penguin on Marion Island, 2004

Species	Date	Observation period	Age	Stones swallowed [n (period)]	Notes
King Penguin	16 Apr	30 min	Adult	31 (5 min)	45 other King Penguins moving between colony and sea did not swallow stones
	23 Apr	35 min	Adult	28 (5 min)	70 other King Penguins moving between colony and sea during the observation period did not swallow stones
			Adult	15 (1 min)	
			Adult	4	
			Adult	6	
			Adult	8 (20 s)	
Rockhopper Penguin	8 Jan	15 min	Chick, 2–2.5 weeks	1	Chick regurgitated stone (10-mm diameter) after *c.* 3 min
	16 Jan	5 min	Chick, 3 weeks	1	*c.* 30-mm diameter
Macaroni Penguin	2 Jan	10 min	Chick, 2.5–3 weeks	1	*c.* 15-mm diameter
	15 Jan	10 min	Chick, 4–5 weeks	2	*c.* 20-mm diameter
	23 Jan	20 min	Chick, 5–6 weeks	3	*c.* 10-mm diameter

On five occasions between 2 and 23 January 2004, Rockhopper and Macaroni Penguin chicks were observed by PJNdB to swallow from one to three *c.* 10-mm to 30-mm diameter stones (Table 1). The two Rockhopper Penguin chicks and one of the three Macaroni Penguin chicks were attended by parents. One of the Rockhopper Penguin chicks subsequently regurgitated the swallowed stone.

It appears that the occurrence of stomach stones among penguin species is widespread and that stone-swallowing may sometimes be deliberate rather than accidental. Swallowed stones may have more than one effect. For Rockhopper and Macaroni Penguin chicks, swallowed stones may help with the trituration of food, such as the exoskeletons of the crustaceans that form an important part of their diet (Brown & Klages 1987). The swallowing of stones may also help to appease hunger sensations [one reason that Cape Fur Seals *Arctocephalus pusillus* were thought to swallow stones (Rand 1959)]. Stones swallowed by adult birds may also serve to reduce buoyancy when diving: "10 pounds" (*c.* 4.5 kg) of stones were reported from the stomach of an Emperor Penguin (Sparks & Soper 1967).

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