EARLY RECORDS OF STONES (GASTROLITHS) IN STOMACHS OF ANTARCTIC PENGUINS

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ABSTRACT

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During 1915/16, A. H. Ninnis, on board S/Y *Aurora* of Shackleton's Imperial Trans-Antarctic Expedition of 1914–1917, collected penguins and seals to augment food supplies while the ship drifted in pack ice. Ninnis found stones (gastroliths) in 86 of 166 Adelie Penguin *Pygoscelis adeliae* stomachs (52%); numbers varied from 0 to 38 and averaged 2.1 per bird. He also examined eight Emperor Penguin *Aptenodytes forsteri* stomachs. Two birds had about a dozen stones each, three had some, and three had none. The function of stones in penguins' stomachs remains unknown, but Ninnis did not consider them essential for digestion.

Key words: Adelie Penguin, *Pygoscelis adeliae*, Emperor Penguin, *Aptenodytes forsteri*, pack ice, Shackleton's Trans-Antarctic Expedition 1914–1917

Stones (i.e., gastroliths) have been recorded in the stomachs of Adelie Penguins *Pygoscelis adeliae* by several authors, including Falla (1937), Emison (1968), and Cooper (1985), and in the stomachs of Emperor Penguins *Aptenodytes forsteri* by Falla (1937) and Splettstoesser and Todd (1999). There are also reports of gastroliths in other penguins: subantarctic species at Marion Island (de Villiers & de Bruyn, 2004) and chicks of King Penguins *A. patagonicus* (Beaune et al., 2009). Except for in Beaune et al. (2009), abundances of gastroliths have been reported only by Emison (1968), who listed them as common in 37 complete stomach samples that he obtained.

Here data on numbers of gastroliths found in Adelie and Emperor Penguin stomachs have been extracted from the diary of A. H. Ninnis, who was on board S/Y *Aurora*, a supply ship of Shackleton's Imperial Trans-Antarctic Expedition of 1914–1917. The ship was adrift in the pack ice as the windblown ice took it from Cape Evans, Ross Island, in May 1915, through the western Ross Sea to the open ocean in the vicinity of the Balleny Islands (66°55′S, 163°45′E) in March 1916. The ship had drifted north and northwest for 43 weeks and, upon becoming free, reached Port Chalmers, near Dunedin, New Zealand, three weeks later.

While the ship drifted in the pack ice, Ninnis often ventured out to collect penguins and seals to augment the sparse food resources on the ship. A transcription of most of the Ninnis diary was presented by Shaughnessy (1990), but material on the contents of Adelie Penguin stomachs was omitted. For this study, I consulted the copy of Ninnis's diary held in the archives of the Mawson Centre at the South Australian Museum, Adelaide; it was with papers associated with control number 130AAE.

Adelie and Emperor Penguins are distributed around the Antarctic continent: Adelie Penguins breed during spring–summer in colonies on rocky areas of the Antarctic coastline, and Emperor Penguins breed during midwinter and into spring in colonies formed on fast ice attached to the coast (Lynch & LaRue, 2014; Woehler, 1993). Adelie Penguins at the colony repeatedly manipulate small stones used to build nests (Morandini et al., 2021); Emperors have no nests and thus, residing on sea ice, the source of their stomach stones is obscure.

Ninnis killed 38 Emperor Penguins for food but examined the stomachs of only eight, taken on five different days. On 23 October 1915, two birds each had a dozen stones. After that, he recorded an unspecified number of stones in three birds and no stones in another three birds. From that information, numbers of stones varied from zero to 12, but with these data it is not sensible to compute an average number.

Overall, Ninnis killed 251 Adelie Penguins between 05 August 1915 and 27 February 1916. Beginning on 16 January 1916, he recorded numbers of stones in some stomachs as well as those with no stones; the dataset covers the period 16 January to 27 February 1916 (Table 1). In addition, on several days he noted that stomachs had stones without recording numbers. As data from those days are incomplete, they have not been included in Table 1 nor in calculations made herein.

Ninnis and colleagues examined 166 Adelie Penguin stomachs for stones and found them in 86 (52%). The number of penguins caught per day varied from one to 58, and numbers of birds recorded with stones in their stomachs varied from zero to 38. The average number of stones in stomachs of all the birds caught was 2.1. For the birds with stones in their stomachs, the average number was 4.0.

Ninnis did not record the sizes of stones in penguin stomachs other than 'small' for stones in the stomach of an Emperor Penguin taken on 10 December 1915. In general, he noted that stones were usually in the lower ends of stomachs; when food was present, stones were mingled with it. No stones were found in the lower intestine or elsewhere in the gastrointestinal tract.

TABLE 1
Number of Adelie Penguins *Pygoscelis adeliae* and the stones in their stomachs recorded by A. H. Ninnis in pack ice south of New Zealand in 1916

Date	Birds caught	Birds with stones	Total no. of stones
16 Jan	3	0	0
18 Jan	3	0	0
19 Jan	3	1	4
20 Jan	2	0	0
22 Jan	58	20	60
23 Jan	3	3	11
24 Jan	5	0	0
25 Jan	6	3	16
03 Feb	1	0	0
04 Feb	6	6	18
05 Feb	3	1	14
07 Feb	12	11	67
09 Feb	57	38	153
10 Feb	1	0	0
27 Feb	3	3	3
Totals	**166**	**86**	**346**

Emison (1968) noted for Adelie Penguin stomachs collected at Cape Crozier, Ross Island, as well as at Beaufort Island about 40 km away, that stones occurred either on the top of the food mass or at its bottom. He assumed that the ones on top were ingested when the bird landed on the beach, while those at the bottom of stomach contents were acquired while birds were in the colony, before going to sea. The stones in Emperor Penguin stomachs would have been found on the ocean floor or, perhaps, from gravel that fell from cliffs above the inner edge of the fast ice where they breed, as typically there are no stones on or in sea ice.

Fowl consume small stones and grit presumably to help with the breakdown of food, especially hard parts such as seeds; small stones/grit are typically found in their gizzards. The function of stones in seabirds' stomachs, however, remains unknown. Beaune et al. (2009) discussed some potential roles: digestion, buoyancy control during foraging, and as an adaptation to fasting. In cormorants, van Tets (1968) believed stones reduced buoyancy and assisted underwater locomotion, and Siegel-Causey (1990) favoured the suggestion that stones aided digestion. Ninnis did not consider stomach stones essential to digestion in Adelie Penguins, because many of the stomachs he examined had food but no stones. It is curious that Emison (1968) thought that stones were sometimes picked up and swallowed by Adelie Penguins on the beach, upon landing with a full stomach. They should not then have been hungry. Might this be some sort of 'displacement behaviour,' as part of an interaction with other birds? Additional observations would be needed to solve this question.

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REFERENCES

Beaune, D., Le Bohec, C., Lucas, F., Gauthier-Clerc, M., & Le Maho, Y. (2009). Stomach stones in king penguin chicks. *Polar Biology*, *32*(4), 593–597. https://doi.org/10.1007/s00300-008-0558-1

Cooper, J. (1985). Adelie Penguins breeding in eastern Enderby Land, Antarctica. *Emu - Austral Ornithology*, *85*(3), 205–206. https://doi.org/10.1071/MU9850205

de Villiers, M. S., & de Bruyn, P. J. N. (2004). Stone-swallowing by three species of penguins at sub-Antarctic Marion Island. *Marine Ornithology*, *32*(2), 185–186. https://doi.org/10.5038/2074-1235.32.2.622

Emison, W. B. (1968). Feeding preferences of the Adélie Penguin at Cape Crozier, Ross Island. In O. L. Austin (Ed.), *Antarctic bird studies* (pp. 191–212). American Geophysical Union.

Falla, R. A. (1937). *Birds* (British, Australian, and New Zealand Antarctic Research Expedition of 1929–31. Reports Series B, Vol. 2). B.A.N.Z.A.R. Expedition Committee.

Lynch, H. J., & LaRue, M. A. (2014). First global census of the Adélie Penguin. *The Auk*, *131*(4), 457–466. https://doi.org/10.1642/AUK-14-31.1

Morandini, V., Dugger, K. M., Lescroël, A., Schmidt, A. E., & Ballard, G. (2021). Maintenance of nest quality in Adélie penguins *Pygoscelis adeliae*: An additional benefit to life in the center. *Polar Biology*, *44*(8), 1553–1562. https://doi.org/10.1007/s00300-021-02894-5

Shaughnessy, P. D. (1990). Bird and mammal life recorded during the Antarctic drift of SY *Aurora*, 1915–16. *Polar Record*, *26*(159), 277–288. https://doi.org/10.1017/S0032247400011785

Siegel-Causey, D. (1990). Gastroliths assist digestion in shags. *Notornis*, *37*(1), 70–72. https://doi.org/10.63172/794039lhuwon

Splettstoesser, J., & Todd, F. S. (1999). Stomach stones from Emperor Penguin *Aptenodytes forsteri* colonies in the Weddell Sea. *Marine Ornithology*, *27*(1&2), 97–100. https://doi.org/10.5038/2074-1235.27.1.428

van Tets, G. F. (1968). White-breasted Cormorant swallows pebbles on land. *Emu - Austral Ornithology*, *67*(3), 224. https://doi.org/10.1071/MU967223b

Woehler, E. J. (1993). *The distribution and abundance of Antarctic and Subantarctic penguins*. Scientific Committee on Antarctic Research.