

## OCCURRENCE OF GASTROLITHS IN SOUTH AMERICAN SEA LIONS (*OTARIA BYRONIA*) FROM SOUTHERN BRAZIL

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Gastroliths are stones present in the stomach of many vertebrate species and their occurrence in fossil and living vertebrates is well documented in the scientific literature. Vertebrate groups, especially aquatic tetrapods, including Crocodilia, Spheniscidae, Mysticeti, Odontoceti and Pinnipedia, and the extinct Plesiosauroidea are examples of such occurrence (for a complete review see Taylor, 1993).

Although there is a paucity of detailed information about gastroliths in individual species of pinnipeds, there are records of their occurrence in species in all three families (Phocidae, Odobenidae and Otariidae, Taylor, 1993). In otariids, gastroliths have been described in *Zalophus californianus* (Scheffer and Neff, 1948), *Neophoca cinerea*, *Phocarcos hookeri* and *Arctocephalus pusillus* (Marlow, 1975), *Eumetopias jubatus* (Fiscus and Baines, 1966) and *Callorhinus ursinus* (Taylor, 1993). In the case of the South American sea lion, *Otaria byronia* (Pinnipedia, Otariidae) occurrence of gastroliths was first reported in 1934 (Hamilton,

1934), and more recently by Vaz-Ferreira (1981). Here we report the presence of gastroliths in seven specimens of South American sea lions collected on the southern coast of Brazil. We also present measurements and weight of the gastroliths (individual and total) from each specimen (see Table 1). The occurrence of gastroliths in the stomach contents of Pinnipedia has been identified as an important aspect of their biology (Riedman, 1990). However, no mention is made of gastroliths in recent textbooks on marine mammals (e.g. Berta and Sumich, 1999; Perrin *et al.*, 2001) the word 'gastrolith' appearing in neither the glossary nor the remissive index.

In total 47 specimens of *Otaria byronia* were collected during beach surveys along the coast of Rio Grande do Sul State (between 30° and 31° South), between 1990 and 1998. Skulls and gastroliths from specimens are deposited in Mammal Collection at Museu de Ciências Naturais (MCN), Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil. Condilo-basal length (CBL)

**Table 1.** Information about specimens of South American seal lions and the gastroliths found in their stomachs. Condilo-basal length (CBL) expressed in millimeters and suture-age (S.A.) according to Sivertsen's Method.

SPECIMEN	CBL	S.A.	N OF GASTROLITHS	INDIVIDUAL WEIGHTS (g)	MAXIMUM THICKNESS (cm)	TOTAL WEIGHT (g)
2459	329.6	25	2	44.02	2.06	403.47
				359.45	3.82	
2460	338.4	30	2	302.64	3.05	944.24
				641.60	3.92	
2462	268.4	36	2	301.36	4.39	650.26
				348.90	6.00	
2602	284.2	15	1	200.23	2.80	200.23
2629	348.9	34	2	186.73	3.65	430.59
				243.86	2.70	
2807	341.1	35	2	85.10	2.45	245.30
				160.20	2.95	
2832	345.3	36	1	720.00	5.10	720.00

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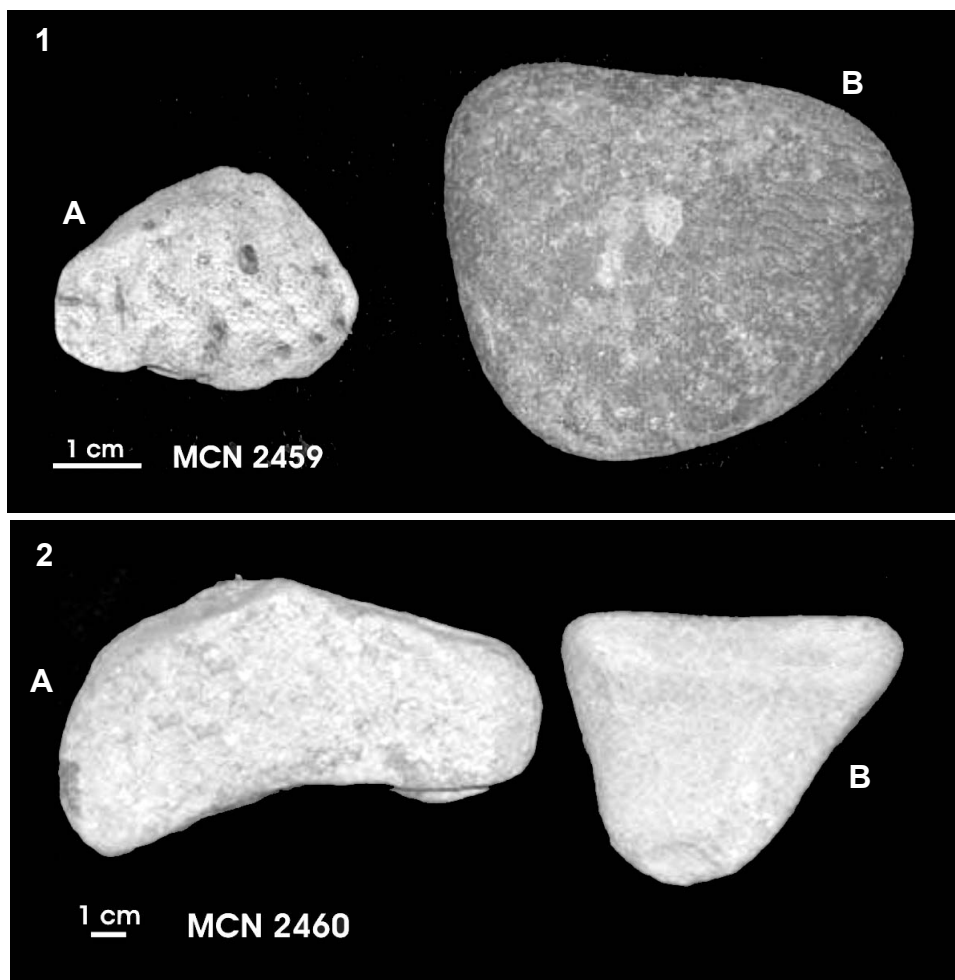
<sup>6</sup> Crespo, E.A., Nepomnaschy, P. and Garcia, N. (1990) *Análisis preliminar de la dieta de mamíferos marinos sobre la base de contenidos estomacales y fecas*. Page 70 in *Resúmenes, IV Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur*, 12-15 November, Valdivia, Chile.

<sup>7</sup> Oliveira, L.R. and Ott, P.H. (1996) *Estudo sobre a alimentação dos pinípedes ocorrentes no litoral norte do Rio Grande do Sul, sul do Brasil*. Page 44 in *Resúmenes, VII Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur*, 22-25 October, Viña del Mar, Chile.

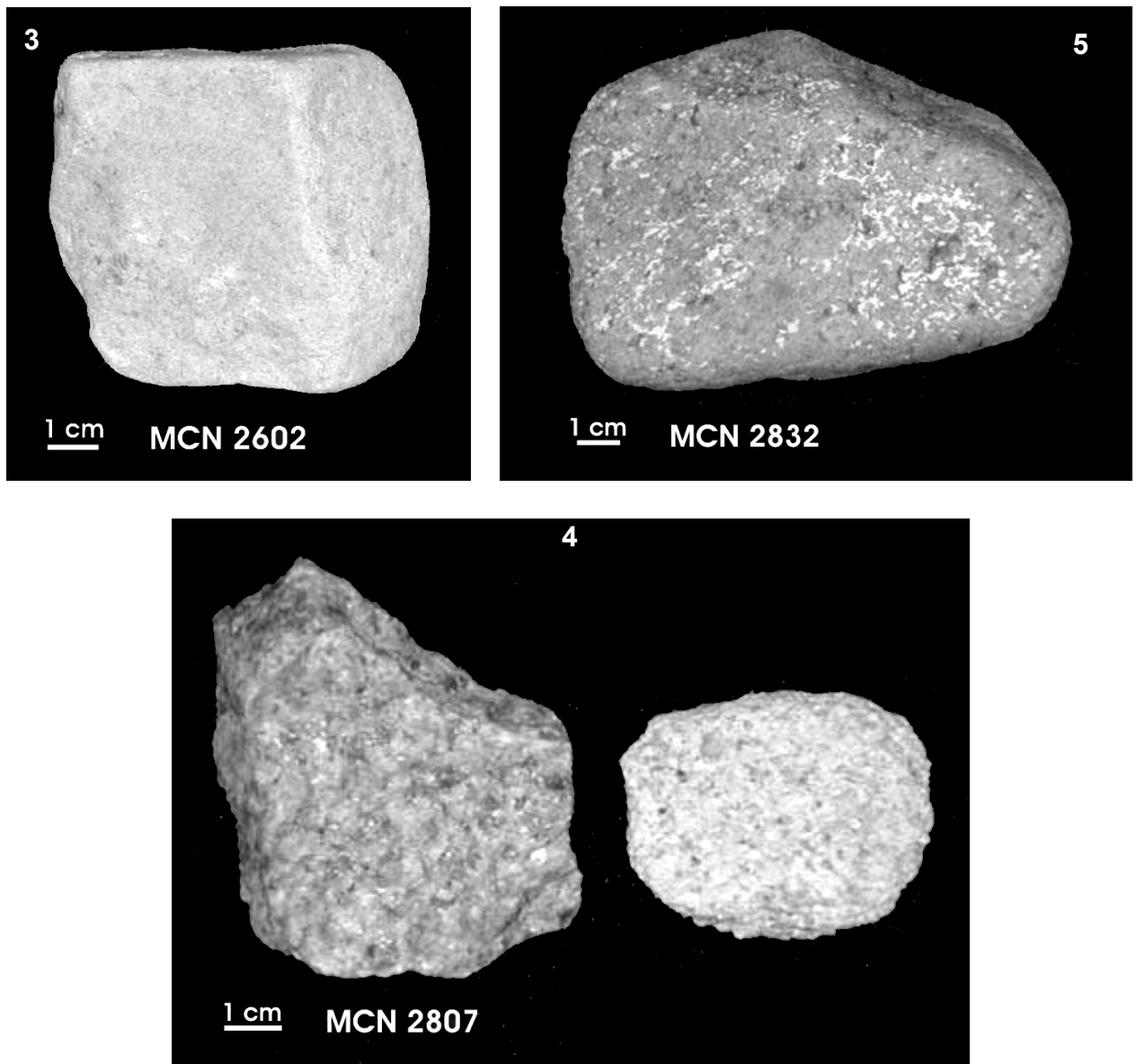
expressed in millimeters and suture-age (S.A.) according Sivertsen's method (Sivertsen, 1954) for each specimen are presented in Table 1. No records of total length of the specimens are available. Stomach content analysis information was available for only seven individuals. None of these seven specimens presented food or parasites in the stomach. However it is not known whether the collectors performed a detailed analysis, or collected gastroliths, rejecting other stomach contents.

Gastroliths reported here are in general of irregular shape, but the pebbles are flat (Figure 2B, 3), slightly flat (Figure 2A) or roundish (Figure 1B). Also gastroliths are smooth (Figure 3) or rough (Figure 4, 5). We suggest that the combination of roundish shape and smooth surface will facilitate the act of swallowing. Five hypotheses have been proposed to explain the presence and/or probable function of gastroliths (Riedman, 1990; Taylor, 1993) in pinnipeds: 1) gastroliths could be incidentally consumed during foraging; 2) to alleviate hunger during fasting periods; 3) to grind food acting as bird gizzard; 4) to crush parasites which infest their stomachs; and 5) to control buoyancy during foraging dives. The last hypothesis has been favored (Taylor, 1993) and related

to underwater flight, specifically in the case of plesiosaurs, penguins and otariids, which chiefly use forelimbs for swimming. Koen Alonso *et al.* (2000) analysed the stomach contents of South American sea lions from Argentine waters and corroborated the buoyancy control hypothesis. Koen Alonso *et al.* (2000) demonstrated that gastroliths are unrelated to parasite infestation but that gastrolith weight was positively correlated to the length of individual sea lions, suggesting their use as ballast for buoyancy regulation. No further information on the characteristics of the gastroliths was provided. The buoyancy control hypothesis could be strengthened by the benthic foraging behavior previously described for individuals collected along the species range (George-Nascimento *et al.*, 1985; Crespo *et al.*, 1990<sup>6</sup>; Oliveira and Ott, 1996<sup>7</sup>). Although the sample size of our analysis is small, information presented in Table 1 suggests some correlation between total gastrolith weight and the CBL of individual sea lions. Evidence from a greater number of samples may provide to support the application in Brazil, of the hypothesis formulated for Argentina by Koen Alonso *et al.* (2000).



Gastroliths from *Otaria byronia* specimens: figure 1. MCN 2459; figure 2. MCN 2460



Gastroliths from *Otaria byronia* specimens: figure 3. MCN 2602; figure 4. MCN 2807; figure 5. MCN 2832.

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