B

Baculum

Edward H. Miller

The baculum (os penis) is a bone in the penis that occurs in small insectivorous placentals (orders Afrosoricida, Erinaceomorpha, and Soricomorpha), Chiroptera, Primates, Rodentia, and Carnivora (Burt, 1960). Among marine mammals, it is present in Ursidae (polar bear, *Ursus maritimus*), all Mustelidae [including the marine otter, *Lontra felina* (undescribed but presumed) and the sea otter, *Enhydra lutris*], and Pinnipedia. The baculum is absent in Cetacea and Sirenia. The corresponding element in females is the little-studied clitoris bone (os clitoridis), which has been documented for polar bears and several pinniped species, but presumably is present in all pinnipeds, and in marine and sea otters (it is present in the northern river otter, *Lontra canadensis*; Mohr, 1963; Fay, 1982).

The baculum is one of several so-called heterotopic bones in mammals, like the kneecap (patella), which form through ossification in connective tissue. In rodents, the bacular shaft is true bone, and includes hemopoietic tissue in the enlarged basal portion. In the caniform Carnivora (which includes bears, otters, and pinnipeds) bacular development has been detailed only in the dog (*Canis familiaris*) but is probably similar in other Caniformia. The dog baculum develops in the proximal portion of the penis, in association with the fibrous septum between the paired corpora cavernosa penis, or in their fibrous non-cavernous portion; centers of ossification on left and right sides fuse early in development. The developing baculum grows dorsally above the urethra, and thickens. The bacular base becomes firmly attached to the corpora cavernosa and to the fibrous tunica albuginea which surrounds them.

The urethral groove in the baculum is deep in the dog but is shallow to absent in bacula of marine mammals (Fig. 1A lower, 1B lower),

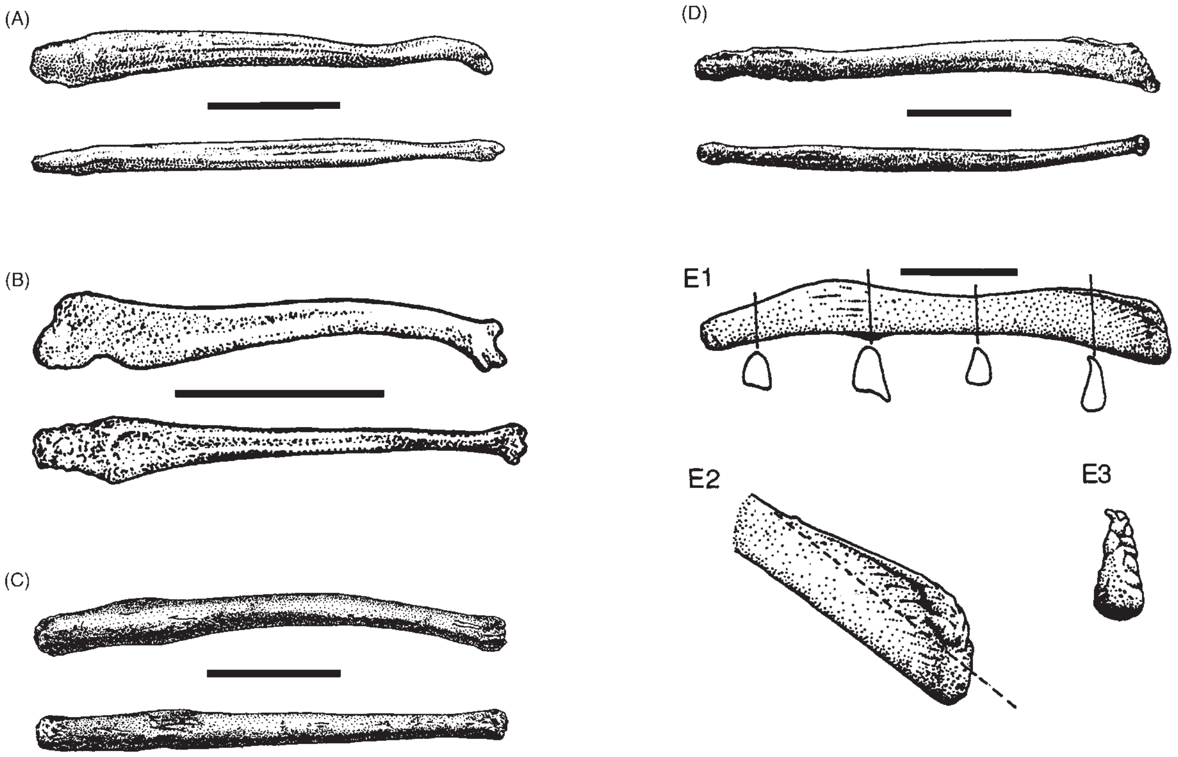

Figure 1 *Bacula of marine mammals are large, but most are morphologically simple: (A) polar bear* (Ursus maritimus)*; (B) subantarctic fur seal* (Arctocephalus gazella)*; (C) Mediterranean monk seal* (Monachus monachus)*; (D) crabeater seal* (Lobodon carcinophagus)*; (E) Weddell seal* (Leptonychotes weddellii)*. All scale bars, 5 cm (no scale bars for E2, E3). Bacula in (A)–(D) are shown in right lateral (upper) and ventral (lower) views. E1: Baculum in right lateral view (note cross-sectional shapes at the indicated points). E2: Oblique view (right side) of the bacular apex (same specimen); dashed line indicates how much growth occurs in the crest (above the line), following sexual maturity. E3: Apical view (dorsal surface above; same specimen). A from R. Didier (1950;* Mammalia **14**, *78–94); B from R. Didier (1952;* Mammalia **16,** *228–231); C from P. J. H. van Bree (1994;* Mammalia **16,** *228–231); D from R. Didier (1953;* Mammalia **17,** *21–26); E from G. V. Morejohn (2001;* Journal of Mammalogy **81**, *877–881).*

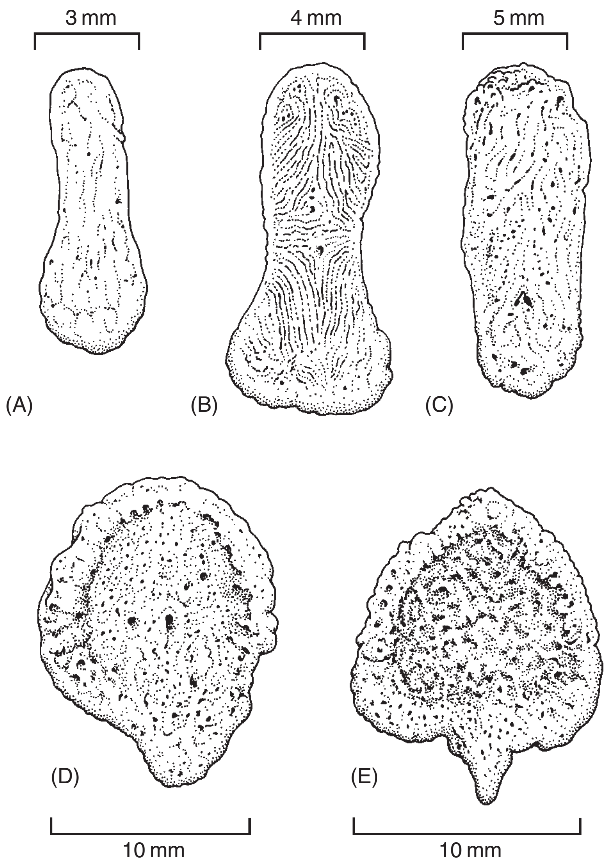

Figure 2 *The bacular apex is morphologically complex and interspecifically diverse in Otariidae. The apex is shown in apical view (dorsal surface up) for (A) unknown species of* Arctocephalus *fur seal; (B) northern fur seal* (Callorhinus ursinus)*; (C) California sea lion* (Zalophus californianus)*; (D) Australian sea lion* (Neophoca cinerea)*; and (E) Hooker's sea lion* (Phocarctos hookeri)*. From G. V. Morejohn (1975;* Rapports et Proces-verbaux des Reunions, Conseil International pour l'Exploration de la Mer **169**, *49–56).*

although is likely present terminally in the undescribed baculum of the marine otter, because this is the pattern in the northern river otter (Baryshnikov *et al*., 2003). Bacula of polar bears and phocid seals are fairly simple, being more or less straight or slightly curved (arched dorsally) structures, and lacking elaborate apices (Fig. 1). In at least some phocids, the bacular apex has a prominent cartilaginous cap (e.g., hooded seal, *Cystophora cristata*). Cross-sectional shapes of phocid bacula vary considerably among species, and a prominent crest develops on the anterior dorsal surface in some Antarctic seals (Fig. 1E). The bacular apex is larger and more elaborate in otariids than phocids, in keeping with the close proximity of the apex to (beneath) the glans penis in otariids where apical size and shape may be functionally important during copulation (Fig. 2). Mustelids possess some of the most diverse and morphologically elaborate elaborate bacula within the Caniformia, although that of the sea otter is relatively simple (Fig. 3; Baryshnikov *et al*., 2003). Within species, bacula are variable in size, shape, cross-section, and specific structural features, even among individuals of the same age. For example, a dorsal keel may be present or absent in southern elephant seals (*Mirounga leonina*); processes on the shaft near the apex are variably present in California sea lions (*Zalophus californianus*); and bacula may be bilaterally asymmetrical or slightly twisted (Fig. 1D).

Bacula of Carnivora are fairly large (Dixson, 1995; Lariviére and Ferguson, 2002; Ramm, 2007). Bacular length is approximately 6% of body length in otariids, but relatively longer in polar bears (~8%) and phocids (8% in hooded seals; 10% in harp seals, *Pagophilus groenlandicus*); the baculum is also much thicker in phocids than otariids (Mohr, 1963; Scheffer and Kenyon, 1963). In pinnipeds, and indeed among all mammals, the walrus (*Odobenus rosmarus*) has the largest baculum both absolutely (to 62.4 cm in length and 1040 g in mass) and relatively (18% of body length; Fay, 1982). Interspecific differences in bacular size in mammals have been linked to diverse selective pressures: reproductive isolation between species; aquatic vs terrestrial copulation; copulatory duration or pattern; sexual selection and mating system; climate; and risk of fracture (Scheffer and Kenyon, 1963; Eberhard, 1985; Dixson, 1995; Lariviére and Ferguson, 2002; Ramm, 2007). Fractures result from accidents (e.g., falls in walruses), sudden movements during intromission (e.g., in aquatically mating Caspian

Figure 3 *The baculum of the sea otter* (Enhydra lutris) *is fairly simple, except for the apex (to the right). Top: dorsal view; center, ventral view; bottom, right lateral view. Scale is in centimeters. From K. W. Kenyon (1969;* North American Fauna **68**, *1–352).*

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Figure 4 *Developmental changes in bacular size and shape, illustrated by representative specimens from northern fur seals* (Callorhinus ursinus)*, ranging in age from newborn (left) to 8 years of age (right). Specimens are shown in right lateral view, with bacular apex at the top. Scale is in centimeters. From V. B. Scheffer (1950;* Journal of Mammalogy **31**, *384–394).*

seals, *Pusa caspica*), and aggressive social interactions (e.g., fights in adult male sea otters). Healed fractured bacula have been documented for several species. Bacula likely serve several functions: as a mechanical aid in copulation (especially in the absence of full erection), or maintenance of intromission, in aquatic copulations; and to initiate or engage neural or endocrinological responses in females. Bacular size may be limited by adverse effects on females: a female sea otter and a harbor seal (*Phoca vitulina*) pup died from perforation of the vagina during forced copulations with male sea otters. Bacular form and diversity reflect multiple functions, and hence likely have multiple adaptive explanations within and across species.

In Carnivora, bacula grow throughout life in thickness and mass (particularly at the proximal or basal end), but not in length (Fig. 4). Bacular growth is most rapid around puberty. Differential growth occurs in different parts of the baculum (e.g., bacular apex, shaft, and base, in Steller's sea lion, *Eumetopias jubatus*; Miller *et al*., 2000).

The baculum is anatomically complex and species-specific in many groups, so has been used extensively in mammalian systematics. In addition, bacular growth has been investigated in furbearers and game animals, because it can be informative about age and time of puberty. More recently, the baculum has been studied in the context of mate-choice and sexual-selection theories. In Alaska, the

Figure 5 *Genitals of African fur seal* (Arctocephalus p. pusillus) *drying under a work table at a seal processing facility in Luderitz, South Africa (1994). Photo: ©International Fund for Animal Welfare.*

Figure 6 *Cooked seal genitals prepared as a meal in the Guolizhuang Penis Restaurant, Beijing, China (September 7, 2007). These were advertised as Canadian seal, so probably were from a harp seal* (Pagophilus groenlandicus), *and killed in the commercial hunt in Quebec or Newfoundland and Labrador. Photo: Feng Li/Gettyimages.*

U.S. Fish & Wildlife Service requires that hunters leave the baculum attached to the hide of sea otters and polar bears, to confirm sex. The seal baculum forms most of the mass of the male genitals that are taken illegally and legally [e.g., in commercial hunts of African fur seals (*Arctocephalus p. pusillus*) in Namibia, and harp seals in Canada], and are usually dried, then sold (mainly in Asia) whole or ground, for use as supposed aphrodisiacs or in traditional medicine (Fig. 5); they are also exported frozen, and served as putatively aphrodisiac-containing food (Fig. 6). Sexual maturation and reproduction may be affected by pollutants, so bacular size and form also may be informative in studies on pollution biology.

See Also the Following Articles

Male Reproductive Systems ■ Mating Systems

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B

Baiji
Lipotes vexillifer

Kaiya Zhou

I. Characteristics and Taxonomy

The baiji or Yangtze river dolphin is endemic to the middle and lower reaches of the Yangtze River in China. It is a relict species and the only living representative of a whole family of mammals. It was described early in the ancient dictionary, *Erh Ya*, published as long ago as 200 BC.

The baiji is a graceful animal with a very long, narrow and slightly upturned beak. It can be easily identified by the rounded melon, longitudinally oval blow hole, very small eyes, low triangular dorsal fin, and broad rounded flippers (Fig. 1). The color is generally bluish gray or gray above and white or ashy white below. Females are larger than males. Maximum recorded length for females is 253 cm and for males is 229 cm (Zhou, 1989). Significant differences between the sexes in external proportions were demonstrated in nine characters, and the skull size is also sexually dimorphic (Gao and Zhou, 1992a, b). The mouth is lined with 31–36 teeth in each tooth row. The crown of the tooth is conspicuously inclined labially and is slightly compressed antero-posteriorly. Its upper half recurves interiorly. The lower half of the lingual side of the crown is a broad, rounded cingulum. The enamel of the entire crown is ornamented with irregular vertical striae and ridges which present a reticular appearance. The lower end of the root widens to form slight anterior and posterior projections (Zhou *et al.*, 1979a). The structure of the stomach is unique in cetaceans. The forestomach is lacking, and the main stomach is divided into three compartments. The connecting channel between the main stomach and the pyloric stomach is absent (Zhou *et al.*, 1979b). The skull is characterized in having an extremely long slender rostrum and mandible (Fig. 2). The rostrum length exceeds two thirds of the condylobasal length. The rostrum bows slightly upward, bends left at the anterior end and is constricted transversely posterior to the end of the tooth row. The total number of vertebrae ranges from 41 to 45. The seven cervical vertebrae are unfused. The costal facets of the second to fifth thoracic vertebrae are located on the posterior edge of the centrum. The facet on the posterior edge of the sixth thoracic disappears or is vestigial, and that of the seventh thoracic sits on the anterior edge of the vertebral body (Fig. 3). The position of the costal facet on the thoracic vertebrae in baiji is unique and is opposite to that in the boto, *Inia geoffrensis*. This feature is one of the morphological bases for favoring rejection of close relationship between the two taxa.

The largest brain weighed was 590 g (Chen, 1979). The largest cranial capacity measured was 590 cm (Zhou *et al.*, 1979a). Comparing brain weight with that in delphinids of similar body size, the former is only about half of the latter. The cerebral hemispheres are short, wide, and highly convoluted. No trace of olfactory bulbs, tracts, or olfactory nerves has been found. The Yangtze River is turbid. The visibility from the surface downward is about 25–35 cm in April and 12 cm in August. A corresponding regression has taken