

MORPHOLOGICAL PARTICULARITIES OF THE SKULL IN THE SOUTH AMERICAN SEA LION (*OTARIA FLAVESCENS* S. *OTARIA BYRONIA*) – CASE STUDY

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Abstract: The South American sea lion - *Otaria flavescens* (Shaw, 1800) or *Otaria byronia* (de Blainville, 1820), is part of the Family *Otariidae*, Order *Carnivora*, Genus *Otaria* (Péron, 1816). The international scientific community accepts both variants of the scientific name. Considering that the skull's morphology is important in the classification and differentiation of marine mammals, this study aimed to describe the morphological particularities of the skull of the South American sea lion, an exotic species for Europe found only in zoos and dolphinariums. Data in the scientific literature regarding the skull morphology of this species are limited. The study was conducted on one skull belonging to a female South American sea lion from the collection of the Anatomy discipline at the Faculty of Veterinary Medicine of Bucharest.

Introduction: In the specialized literature, from Romania, regarding the morphological particularities of the skull in carnivores, skulls of wild cats (jaguar, cheetah, puma, tiger, bear, wolf, fox, jackal) were described. In contrast, the skulls of aquatic mammals in the Family *Carnivora* have yet to be studied in detail. The anatomical studies in specialized literature carried out on the skulls of this species were focused on the changes produced during its phylogenetic evolution; for example, changes in the dentition, the orientation and arrangement of bones and bone formations (positioning of the maxillary tuberosity, length of the tympanic bone, individualization of the cochlear canal). Comparative morphometric studies were also carried out between different species of pinnipeds, as well as studies on the ontogeny and sexual dimorphism of the auditory region in *O. byronia*, in which it was observed that the average shape of the tympanic bulla in this species has a subtriangular outline, with variations between sexes and different ages. We can also cite some studies on the morphological particularities of the skull in seals, both within the same family and in relation to other carnivores, observing significant differences at the level of the palatine processes of the maxilla, the nasal processes, the zygomatic process of the frontal, tympanic bulla, condyloid process and lacrimal bone.

Material and method: This study used a skull of an adult female South American sea lion, *Otaria flavescens* s. *Otaria byronia*, from the Anatomy discipline's collection. The morphological characteristics of the skull bones were described, and the most exciting aspects were photographed. The description and identification followed *Nomina Anatomica Veterinaria* (N.A.V.) 2017.

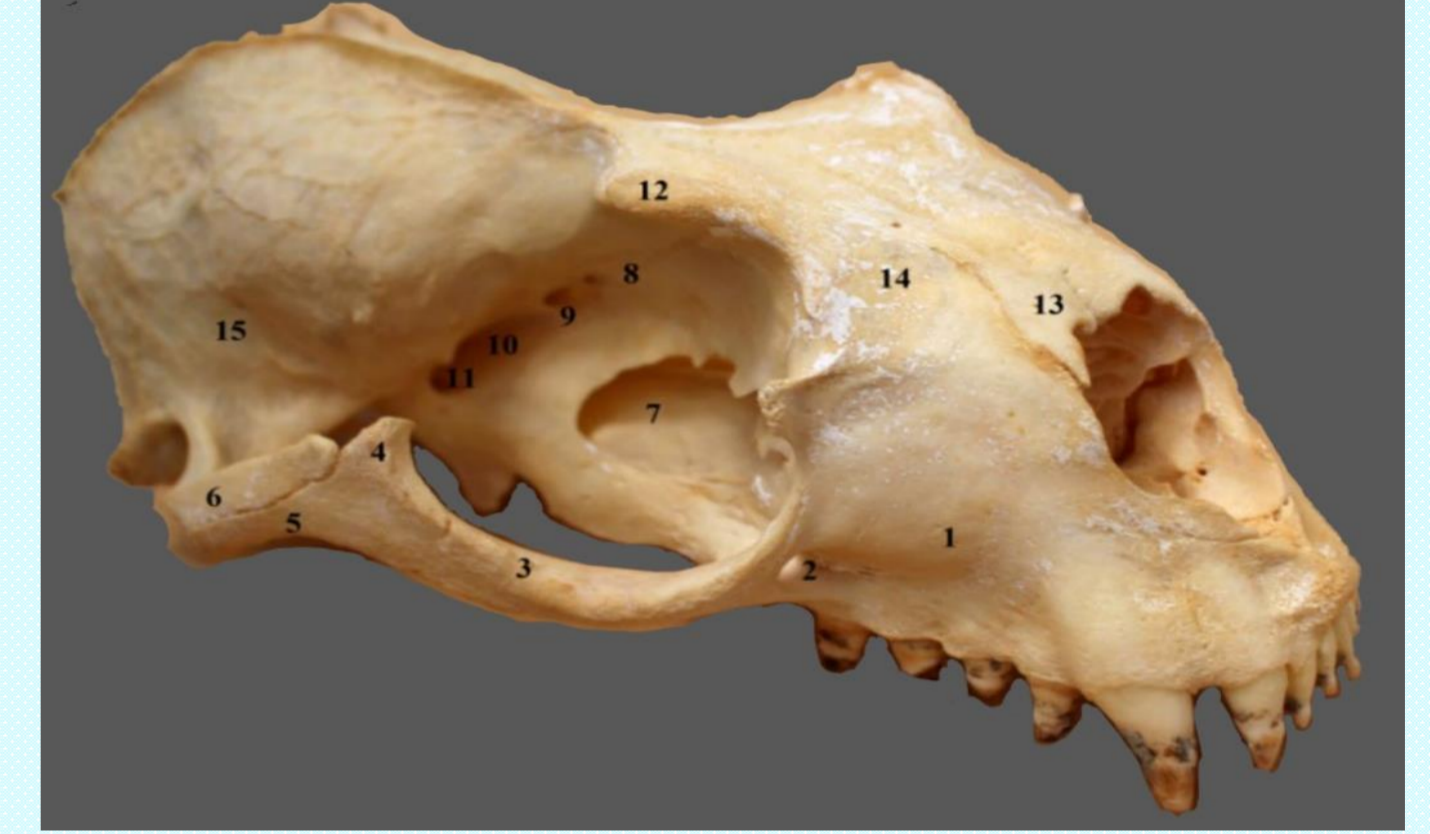
Results and discussions: The sea lion's skull appears elongated, with the viscerocranium more developed than the neurocranium. The dorsal face of the neurocranium is crossed in the median plane by a rectilinear, high external sagittal crest with a thin and sharp edge. In the aboral extremity of the frontal, the external sagittal crest divides into two unequal temporal lines. The temporal lines are well highlighted in the aboral extremity, gradually fading towards the zygomatic process of the frontal. The external occipital protuberance is lower in height than the nuchal crests and appears chamfered. The rostral extremity of the frontal is bifid. Between the two extensions, the aboral extremity of the nasal penetrates deeply to form the frontonasal suture. The preorbital apophysis has the appearance of a rough ridge, wider at the base and narrower in the dorsal plane (Fig. 1) The incisive has a narrow nasal process. Above the first incisors, at the suture site between the two incisive bones, is a nipple-like tuberosity. The vomer, located inside the viscerocranium, has a wide and deep groove in which the ventral edge of the nasal septum is fixed. The parietal bones are convex from one side to the other, and the zygomatic processes detach from the lateral face of the temporal bone in a lateral-rostral direction. This zygomatic process has a relatively triangular appearance in the aboro-lateral portion, and the lateral-dorsal-rostral portion is elongated but flattened latero-medially. The aboral face of the zygomatic process presents a prominent spine on the ventral edge, directed ventromedial. The zygomatic process of the temporal shows a well-defined temporal line on its dorsal surface. The zygomatic bone ends bifid aborally and presents a reduced dorsal process, called the postorbital process, and a ventral, elongated latero-ventro-aboral process, called the temporal process. The infraorbital canal can be observed at the base of the zygomatic bone, very short, delimited rostrally by the infraorbital foramen and aborally by the maxillary foramen. The posterior palatine foramen is halfway up the upper border of the perpendicular process of the palatine. In the orbital hiatus open: the ethmoid foramen, the optic canal, the orbitotundum foramen, and the anterior alar foramen. The anterior alar foramen communicates through a long alar canal with the posterior alar foramen. The temporal fossa is deep and elongated. In the aboral extremity, on the sides of the viscerocranium, is a vast space, delimited by the frontal, sphenoid, palatine, and maxillary bones, that allows communication with the nasal cavities. This space constitutes the foramen of the medial face of the orbit.



South American sea lion skull (*Otaria flavescens* s. *Otaria byronia*) – dorsal face
1. External occipital protuberance; 2. Nuchal crest; 3. Parietal; 4. External sagittal crest; 5. Temporal lines; 6. Zygomatic process of the frontal; 7. Maxilla; 8. Nasal; 9. Incisive; 10. Zygomatic; 11. The zygomatic process of the temporal; 12. Preorbital apophysis.



South American sea lion skull (*Otaria flavescens* s. *Otaria byronia*) – dorsolateral face
1. Parietal; 2. Nuchal crest; 3. External occipital protuberance; 4. External sagittal crest; 5. Zygomatic process of the frontal; 6. Frontal; 7. Nasal processes of the frontal; 7. Preorbital apophysis; 8. Nasal; 9. Maxilla; 10. Incisive tuberosity; 11. Vomer; 12. Ventral nasal horn; 13. Anterior alar foramen.



South American sea lion skull (*Otaria flavescens* s. *Otaria byronia*) laterodorsal face
1. Maxilla; 2. Infraorbital foramen; 3. Zygomatic; 4. The dorsal (postorbital) process of the zygomatic; 5. Ventral (temporal) process of the zygomatic; 6. The zygomatic process of the temporal; 7. Foramen of the medial face of the orbit; 8. Ethmoid foramen; 9. Optic foramen; 10. Orbitotundum foramen; 11. Anterior alar foramen; 12. Zygomatic process of the frontal; 13. Nasal; 14. Frontal process of the maxilla; 15. Temporal.



South American sea lion skull (*Otaria flavescens* s. *Otaria byronia*) – ventral face
1. Aboral alar foramen; 2. Oval foramen; 3. Spinous foramen; 4. Tympanic bulla; 5. External acoustic meatus; 6. Stenomastoid foramen; 7. Mastoid process; 8,10. Jugular foramen; 9. Hypoglossal foramen; 11. Pharyngeal tubercle; 12. Vascular foramen; 13. Pterygoid grooves.



South American sea lion skull (*Otaria flavescens*, s. *Otaria byronia*) – nuchal face
1. External occipital protuberance; 2. Nuchal crests; 3. External occipital crest; 4. Rugosities of muscle insertion; 5. Foramen magnum; 6. The entrance foramen in the canal of the hypoglossal nerve; 7. Occipital condyles



South American sea lion mandible (*Otaria flavescens*, s. *Otaria byronia*) – lateral face
1. Masseterine fossa; 2. The coronoid process; 3. The condylar process; 4. Angular process; 5. The ventral edge of the horizontal branch of the mandible; 6. Corono-condylar incision; 7. Accessory mental foramina; 8. Mental foramen; 9. Mental foramen of the rostral extremity of the mandible.

Behind the base of the zygomatic process of the temporal, the external acoustic meatus can be observed, reduced with the appearance of an oval-shaped foramen. A tympanic notch can be seen above the external acoustic meatus and an prominent mastoid process behind it. The basioccipital is short and wide, with a rectangular appearance. On the aboral part is the opening of the hypoglossal nerve canal, represented by the hypoglossal foramen. In the middle part of the basioccipital, there is an obvious pharyngeal tubercle, which continues to the rostral edge of the basioccipital with a thin, sharp, and high ridge. On each side of the ridge, two wide pharyngeal fossae are evident, arranged obliquely, and flanked rostrally by a prominent muscular tubercle. At the base of the mastoid process is the stenomastoid foramen. The tympanic bullae are evident, elongated, and widened medially. The posterior carotid foramen can be seen on the medial and aboral sides of the tympanic bulla. The posterior carotid foramen communicates rostrally, through a long carotid canal, with the anterior carotid foramen located in the rostro-latero-ventral extremity of the tympanic bulla. A thin bony plate separates the anterior carotid foramen from the spinous foramen, which is located medially from the first one. The oval foramen is present on the ventral side of the sphenoid, rostro-lateral to the anterior carotid foramen. The paracondylar processes are very small, and at their base is the jugular foramen. On the nuchal face, the external occipital crest descends from the level of the external occipital protuberance towards the occipital foramen. This crest is extremely developed in the middle third, reduced in the upper third, and absent in the lower third. The occipital condyles, biconvex, located at the ventral extremity of the nuchal face, are positioned slightly obliquely latero-medially, delimiting a wide, circular occipital foramen, foramen magnum. The endocranial opening of the hypoglossal nerve canal can be observed on the condyles' inner face. Above each condyle is an elongated and slightly oblique dorsal condylar fossa. The paracondylar processes are significantly reduced. The vertical branch of the mandible is oblique, the coronoid process is drawn far aborally, and its rostral edge is oblique, increasing in height oro-aborally, looking like a thin and sharp blade. The angular process detaches from the aboral extremity of the mandible's caudal edge of the recurved branch, with the appearance of a medio-aboral drawn blade located at a distance from the mandibular angle. The condylar process appears like a slightly excavated blade on the dorsal side towards the lateral side and is drawn in an aboral direction. The coronoid process has a rounded upper edge and is drawn aborally. The masseterine fossa is excavated and extends to the level of the coronoid process. The smaller pterygoid fossa is excavated in the middle and distal third. On the rostral face of the body of each mandible, there is a rostral mental foramen. On the lateral side of the body of the mandible, under the first premolar, there is the aboral mental foramen, and behind it are two accessory mental foramen.

Conclusions: The external sagittal ridge is high, rectilinear, and in the aboral part of the frontal, it divides into two unequal temporal lines. The zygomatic process of the frontal, ends with a spine-like aboro-ventral extension and does not present the supraorbital foramen.

- >The rostral extremity of the frontal is bifid, and the medial part represents the nasal process of the frontal. The orbit, in the rostral plane, presents a preorbital apophysis with the appearance of a rough ridge, wider at the base and narrow in the dorsal plane.
- >The entrance to the nasal cavities is wide, the dorsal and ventral nasal turbinates are visible. The lacrimal bone is missing.
- >At the aboral extremity, the zygomatic bone ends bifid, with a reduced dorsal process, the postorbital process, and an elongated latero-ventro-aboral ventral process, the temporal process.
- >The ethmoid foramen, the optic canal, the orbitotundum foramen and the anterior alar foramen open in the orbital hiatus. The anterior alar foramen communicates through a long alar canal with the posterior alar foramen.
- >On the sides of the viscerocranium, there is a wide space delimited by the frontal, sphenoid, palatine, and maxillary bones, allowing communication with the nasal cavities and forming the foramen of the medial face of the orbit.
- >The pharyngeal tubercle continues to the rostral edge of the basioccipital with a thin, sharp, and high ridge.
- >An external occipital ridge, highly developed in the middle third, can be observed on the nuchal face. Above each condyle is an elongated and slightly oblique dorsal condylar fossa.
- >An elongated aboral tuberosity is present at the level of the recurved angle of the mandible. The angular process has a blade-like appearance, drawn medio-aborally. A rostral mental foramen is at the extremity of each mandible's body.