

SEXUAL DIMORPHISM IN THE STRUCTURE OF THE HUMERUS AND FEMUR OF  
*MONACHOPSIS PONTICA* (PINNIPEDIA, PHOCIDAE)

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During the entire history of the study of present-day true seals, sexual dimorphism was researched only among the contemporary representatives of the subfamily exclusively on craniological material (Chapsky, 1952, 1967). Sexual dimorphism of the sacral bone of the Caspian seal was researched in recent years by Gadjiev (1892). Sexual dimorphism was not studied even among the Phocinae despite the classification need.

Fossil remains of pinnipeds are usually represented by uncoordinated limb bones, primarily the humerus and femur. In this work the most characteristic sexual differences are examined in the series of indicated bones that Eichwald (1850) attributed to *Phoca pontica* and which are also traceable to the representatives of the modern *Phoca*.

The species studied was related by Kretzoi (1941) to the new genus *Monachopsis* which until now does not have clear morphological characteristics. Therefore, before examining the established sexual differences we will present a brief description of the general morphology of the humerus and femur bones of *Monachopsis pontica*.

MATERIAL and METHODOLOGY. — The collection of the Institute of Zoology of the Uk. SSR Academy of Sciences was used to determine sexual dimorphism of fossil humerus and femur bones including 48 bones of females and 25 of males from the Kerch locality. For comparison material of contemporary representatives of the genus *Phoca* was used, i.e. 31 male femur and 25 of male humerus bones and 19 female femur and 20 female humerus bones from the Zoological Institute of the USSR Academy of Sciences, the Paleontological Institute of the USSR Academy of Sciences, and the Institute of Zoology of the Uk. SSR. The species *Phoca caspica*, *Phoca hispida*, and *Phoca sibirica* were selected by the author as typical representatives of the genus *Phoca*, and they were more accessible for research. During the research measurements were taken according to the chart recommended by Sergienko (1967).

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FEMUR.— In measurements the hip bones of *Monachopsis pontica* (fig. 1 a; table 1) came close to the modern *Phoca caspica*. The greater trochanter greatly exceeds in the height the femur head, and its proximal area is much narrower than the distal part. Its trochanter hollow is small and is situated across the axis of the bone. The femur head is turned markedly in the distal direction. The cervix is short. The smallest width of the diaphysis is at the proximal part of the bone. In the female the proximal epiphysis is considerably narrower than the distal part. Above the medial condyles is the plantar hollow whose measurements change from a barely perceptible indentation to a big hollow. The condyles are not large but they are widely spaced. The largest distance between them (when n = 21) is 47.9–58.9% along the length of the bone.

The absolute length of the bone of the male *Phoca* and *Monachopsis* is larger than the female's (diaphysis exceeds that of the males, table 1). Grigorescu (1976) presumes that the diaphysis of the female *Monachopsis pontica* femur is more compact than that of the male. However, our material indicated that it is the male who have a more compact diaphysis (figs. 2, 3). Sexual dimorphism in the structure of the diaphysis is related in various degrees to development of the vastus intermedius, quadriceps femoris, and biceps femoris muscles. As in modern true seals the cervix of the fossil femora is shorter and wider among the males. Together with the axis of the femur it forms nearly a right angle in the females and an obtuse angle in the males. In the males where the diaphysis is more compact, the head of the bone is larger. In that of the females it is just the opposite (fig. 4). Because the distal epiphysis is more developed in the males the average width of the diaphysis in both sexes is almost the same (fig. 5). The ratio of the transverse diameter of the upper epiphysis to the widest part of the lower epiphysis in *Monachopsis pontica* females is 88.84% (83.3–96.6) when n = 10, and it is 109.3% (102.9–113.4) when n = 5.

The greater trochanter is wider and longer among males than females except for *Phoca caspica* where the trochanter in both sexes is the same and the measurements of its length overlap (Table 1). The same situation can be noted among *Monachopsis pontica*, but the overlapping area in the modern species is somewhat smaller. The distal part of the greater trochanter in the females ends more sharply (Y-shaped), while that in the males it is frequently rounded – almost oval. The middle and small gluteal muscles (m. gluteus medius and m. gluteus minimis) are attached to the greater trochanter and are more developed in the males. Consequently, their trochanter is more powerful. In females the obturator externus which is

attached to the fossa trochanterica is better developed than in the males. As a result, m. obturator externus is much deeper and more closed. The plantar hollow above the medial condyle is wider and deeper in the females of the genus *Phoca*. It is edged with a very thin bone that is very well defined among the young and juveniles. It is barely noticeable among the males and is not bordered/edged by anything from the medial side. This is not a sexual indication among *Monachopsis pontica*. All the above listed indications (excepting the latter) are also characteristic of fossil bones, although they are not as clearly defined (fig. 1 b). The surface of the patella is higher in the males except for *Phoca caspica*. Its length overlaps in both sexes. The condyles are also relatively larger in the males.

HUMERUS. — The smaller tubercle (fig. 6 a; table 2) is extend across the bone axis and is located above the head on the same level with the proximal part of the deltoid crest. It is separated from the head by a wide but not deep hollow. The ratio of the length of the humerus head to its width is approximately 103.0%. The deltoid crest is powerful, smoothly descending to the condyles where it ends in a hollowed triangular shape, the base of which is bigger than the height. The entepicondyle foramen is narrow and long. The crest is poorly developed.

The absolute length of the bone in the males of both genera that were studied is larger in the males than the females and the head is larger and more spherical, whereas in the females it is more compact in the dorsoventral direction (fig. 7). The ratio of the widest part of the head to the widest part of the upper area in males of *Monachopsis pontica* is 65.83% and in females it is 75.75%. The length of the deltoid crest in *Monachopsis pontica* males is slightly greater than in the females. This ridge ends abruptly in the females and is bluntly rounded in the males, but the width of the crest in the middle part is larger than in the females. No structural differences are discernible in the structure of the distal part in the contemporary species of the genus *Phoca*.

The hollow located under the elbow line of the deltoid crest is deeper in the males. On the basis of fossil finds this sign is not as clearly defined, apparently, because of rolled and the of the bone material.

The humerus of *Monachopsis pontica* males are less curved than those of the females (fig. 6 a), which is probably also a sexual indication. However, modern seals do not have this distinction.

In spite of the smaller measurements of the deltoid crest, and the deltoid tubercle is more clearly defined in females. The m. subscapularis is located under the distal part of the tubercle

which, judging from the depth of the hollow, is developed in males. In females the medial subcondyle is compressed and its peripheral section is not curved backward, and the lateral subcondyle is shorter and narrower than in the males. However, the presence of the entepicondylar foramen is an individual sign. The shape of the olecranon foramen in the genus *Phoca* does not depend on the sex of the animal, but in females it is a bit deeper. The shape of the hollow in *Monachopsis pontica* males is practically triangular and in females it is rounded-triangular or semicircular (fig. 6 b). In general, sexual dimorphism in humerus and femur bones in fossil remains and modern individuals coincide.

The following indication may be used to determine the sex through humerus and femur bones: a) Femur bones – the anteroposterior thickness of the diaphysis, the length and thickness of the neck; the length and width of the greater trochanter; the anteroposterior diameter of the distal epiphysis; b) Humerus bones – the length of the deltoid crest and width of its middle part; the depth of the olecranon fossa; the depth of the subolecranon line of the deltoid crest. The most reliable way to determine the sex is by the degree of compactness of the diaphysis of the femora and the depression of the elbow line in the humeri.

The aforementioned indications are characteristic of adult animals. In juveniles and subadult they are not as clearly defined. Despite this, the established differences are sufficiently permanent and they enable the researcher to separate fossil extremities by sex.

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