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THE HARP SEAL, *Pagophilus groenlandicus*, (ERXLEBEN, 1777): XVI EPIPHYSEAL FUSION

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Abstract: The epiphyseal fusion of the manus and the fusion of the pelvic bones during the first year of life of four harp seal pups are reported and compared with the bones of two older animals of 2½ years and 24 years of age. In the period under observation in the pups the only physes to fuse were those of the third phalanx and the pelvis.

One of the first published reports of the use of radiography to study the fusion of epiphyses in animals concerned work on dogs in the Egyptian Armand breed.³ Other longitudinal data in dogs has been published.^{1,4,5}

An attempt was made by one of us⁴ to establish a calendar of fusion of the bones of the appendicular skeleton of the dog by examining radiographically the epiphyses of animals of known age.

This study resulted in the opinion that the criterion of fusion was, at best, only a crude indication of the age of a puppy.

The opportunity occurred of radiographing pups and adult harp seals (*Pagophilus groenlandicus*) and it was decided to apply the same technique as used in the previous work on the dog, as the data might be of benefit in forming a rough estimate of the age of future specimens. If it proved possible to establish a table of epiphyseal fusion times, during skeletal maturation, the data might then be used to obtain an estimate of the ages of the skeletal remains of seal herds.

The work reported herein concerns the durability of the thoraco-lumbar junction, the pelvis, the metacarpals, the metatarsals, and the proximal epiphyses of the femur. The period of observation ranges over the first 6 months of the pup's life.

MATERIALS AND METHODS

Four seal pups were caught on the ice in March 1969, and on arrival at the laboratory their age was estimated at 4 to 5 weeks. They were radiographed initially every 2 weeks and later every month. In addition, one 2½ year old seal and a dead 24 year old specimen were radiographed on one occasion in order to determine the state of the epiphysis being studied in an adolescent and an adult. The age of the 24 year old specimen was determined by D. E. Sergeant, Fisheries Research Board of Canada, St. Anne de Bellevue, Quebec, after the sectioning of a canine tooth.

The seals were restrained on a board by four bands passing over the neck and trunk. The value of each animal to other research projects precluded the use of anesthesia, since this aspect of the physiology of *P. groenlandicus* is in an early stage of investigation.² In an attempt to minimize distress, the animals were examined only in sternal recumbency. Consequently, in examining the vertebrae at the thoraco-lumbar junction considerable magnification resulted and it was not possible to measure the linear growth of the bones. For the same reasons it was also not possible to obtain good lateral films of the proximal bones of the appendicular skeleton. Good radiographs of the manus were obtained as well as

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satisfactory films of the pelvis and proximal epiphysis of the femur. In addition, occasional films of the pes were made.

OBSERVATIONS

During the first 33 weeks of life that are covered in this report, two main facts emerge.

As far as could be ascertained, all centers of ossification throughout the body were present at birth. In the following 33 weeks, the only epiphyses to fuse were those of the distal phalanx of the manus and those of the acetabulum. In the distal phalanx the epiphyseal plate is situated at the proximal end of the bone. Initial fusion took place over a relatively short period of 2 weeks and was completed in another 4-6 weeks. There did not appear to be a common sequence of fusion of the distal phalanges of the digits of the manus between the three animals but they did not all fuse at once (Table 1)

(Figs. 1 to 3). The period from the first sign of fusion to completion, ranged from 6 weeks to 26 weeks. The corresponding epiphyses of the pes had not commenced to unite in a 2½ year old seal (Fig. 4).

Each os coxae consists of the ilium, ischium, pubis and acetabular bone. Apparently the two halves of the pelvis never fuse at the pelvic symphysis and through life are only united by cartilage which takes on a resting state in adulthood. In the three animals examined the acetabular bone fused to the ilium and ischium at 6 weeks. It was not possible to observe the fusion of the pubis to the rest of the pelvis.

The skeleton of the 2½ year old seal that was radiographed did not exhibit fusion of any further epiphyses than in the young pups. A radiographic examination of the skeleton of the 24 year old animal revealed that at that age all epiphyses had united.

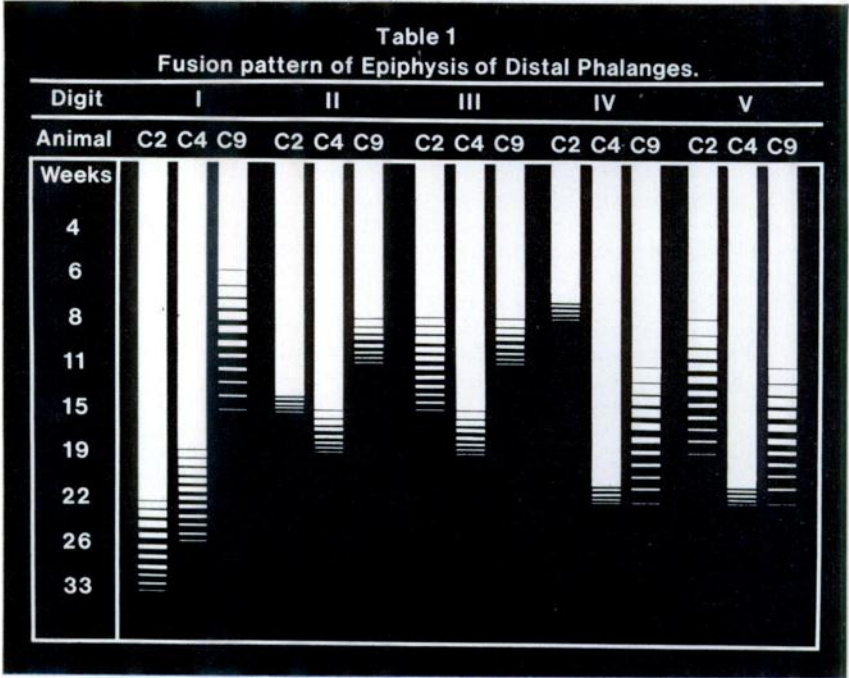




FIGURE 1. Radiograph of manus of 4 weeks old pup.

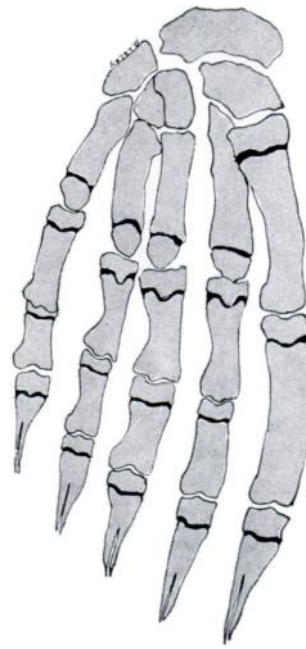


FIGURE 2. For the sake of clarity, diagram made from the original radiograph seen in Fig. 1. The epiphyseal growth plates are shown by the dense black lines. At this stage there is no fusion of the epiphyses to the metaphyses.

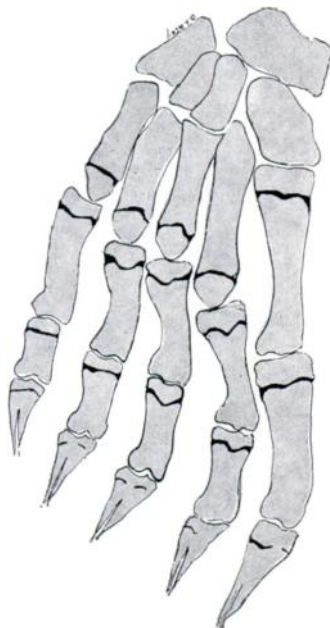


FIGURE 3. Diagram of a radiograph of the manus of 15 weeks old pup. Closure of the epiphyseal plates of 4 of the distal phalanges.



FIGURE 4. Diagram of the pes and epiphyseal plates of a 2 1/2 year old adolescent seal. Fusion of epiphyses has not yet commenced.

DISCUSSION

At the commencement of this study it was hoped that it would be possible to assemble data indicating both the fusion pattern and period of all the epiphyses. Unfortunately the same seals were used in a number of different cytological and psychological studies and only one pup and the adult used in this study now remain alive. The small number studied makes any statistical analysis of data concerning epiphyseal fusion impossible, but the paucity of literature on the skeleton of the harp seal makes any contribution of some value. In addition, the fact that the animals do not mature until 5-7 years makes a prolonged study necessary. The difficulty in carrying out linear studies of epiphyseal fusion on *P. groenlandicus* are therefore readily apparent, so few having lived in captivity for any period of time.

The epiphyses of the third phalanx of the manus appear to commence fusion between 6 and 26 weeks. They are totally fused between 8 and 26 weeks. It is suggested that this wide range of time may be due to the known delayed implantation of harp seal, or combined with an apparent ability of the female to delay parturition until favourable wea-

ther conditions exist. Presumably skeletal development of the unborn would not be stationary during this phase. The epiphyses on the different digits do not all fuse at once and there appears to be no specific chronological order of fusion, though digits II, III and IV appear to be slightly more precocious than the remaining two. The most interesting fact concerning the epiphyses of the third phalanx is that the corresponding epiphyses in the pes did not show any signs of fusion in the one 2½ year old individual that was radiographed. It is assumed that the epiphyses in the forelimbs fuse early because of the pup's need to drag itself over the ice within the first few weeks of life. It would not be able to do so if the phalanges were not completely united, since there would be no firm point of insertion for the tendons of the *m. flexor digitorum profundus*. The digits of the hind limb are never used for propulsion on land. They serve to spread the web of the pes and aid in propulsion in the water.

The early fusion of the bones involved in the acetabulum is in keeping with the findings in the dog.⁴

It is hoped to report later development and epiphyseal fusions as more individuals become available and the length of life in captivity is extended.

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