

A REVIEW OF THE PLIOCENE LOONS

By PIERCE BRODKORB

Three nominal species of loons have been described from Pliocene deposits in North America and Europe. From Italy, *Gavia portisi* (Regalia, 1902) is known from a cervical vertebra nearly as large as that of modern *Gavia immer*. From California, Wetmore (1940) named *Gavia concinna* on the basis of a fragmentary ulna somewhat smaller than that of *immer*. Unfortunately the possible identity of *portisi* and *concinna* cannot be investigated at the present time, since they are represented by different elements. The third named Pliocene species is *Gavia palaeodytes* Wetmore (1943), based on a coracoid from Florida.

Study of recently collected material from the Pliocene of Florida and examination of the specimens from San Diego recorded by Howard (1949) enables me to elucidate further the American species and to describe an additional one.

Thanks are due to Dr. Hildegard Howard of the Los Angeles County Museum, for the loan of specimens, and to Mr. Stanley J. Olsen of the Museum of Comparative Zoology, for a cast of the type of *palaeodytes*. The drawings were made by Miss Esther Coogle.

Gavia concinna Wetmore

Gavia concinna Wetmore, 1940a:25, figs. 1-4 (Lower Pliocene: Sweetwater Canyon, east of King City, California; type proximal portion of ulna, U.S.N.M.); Wetmore, 1940b:6 (Sweetwater Canyon); Miller and DeMay, 1942:55, 71 (Sweetwater Canyon); Howard, 1945:17 (King City); Howard, 1949:185, part, pl. 3, figs. 6, 6a (Pliocene: San Diego; desc. cranium, upper and lower mandibles).

Cranium.—L. A. Mus. no. 2109, incomplete right frontal, right and portion of left parietals, and small portion of supraoccipital; San Diego Pliocene. In size between *immer* and the two smaller species, *stellata* and *pacifica*. Cranium much more vaulted than in either *immer* or *stellata*, thus resembling *pacifica*; some of the vaulting may have resulted from inaccuracy of repair of the specimen. Frontoparietal suture resembles that of *immer* and *stellata* in taking a wavy diagonal forward course, from the midline to the side of the cranium, instead of making a right angle to the axis of the skull and then bending forward at about 45 degrees, as in *pacifica*. Length of parietal and frontal about 23.5 mm.; diagonal anterior width of parietal, 18.2; length of parietal, 11.0; maximum width of supraorbital groove and flange, 7.1.

Rostrum.—L. A. Mus. no. 2109, fragmentary premaxilla; no. 2110, fairly complete premaxilla, lacking the tip; both from the San Diego Pliocene. Near *pacifica* in having the tip of the culmen slightly upturned, but not so much as in *stellata*. Groove on palatal side of premaxilla resembles that of *pacifica* in width and in position of its margins. Size between *immer* and the two smaller living species. Howard believed that the rostrum resembled most closely that of *stellata*. Its proportions, though close to those of *stellata*, seem to be even closer to *pacifica*. For example, the width of the premaxillary groove is 24 per cent of the width of the bone in *concinna*, 25 per cent in *pacifica*, and only 22 per cent in *stellata*. Again, the width of the nasal process in *concinna* and *pacifica* is 76 per cent of the depth of the premaxilla, but 78 per cent in *stellata*. Width of premaxilla at anterior end of nares, 7.1 mm.; depth at same point, 5.4; width of nasal process at same point, 4.9; width of premaxillary groove at same point, 1.7.

Mandible.—L. A. Mus. no. 2109, consisting of three fragments, the tip and portions of right and left rami; San Diego Pliocene. Resembles *stellata* and *immer* in being deeper than wide, the mandible of *pacifica* being wider than deep. Size between *immer* and *stellata*. Depth of gonys, 3.7 mm.; width of gonys, 3.3; depth of ramus at posterior end of dentary foramen, 5.8.

Humerus.—L. A. Mus. nos. 2142, 2144, fragments of proximal portion of left humeri; San Diego Pliocene. No. 2144 resembles *immer* in configuration but is smaller, except for the length of the capital groove. No. 2142 is too fragmentary for exact reference. It appears to be from a smaller individual and possibly may not belong to the present species.

Brodkorb Coll., nos. 90, 297, distal portions of left humeri, from one and one-half miles southeast,

and one and one-half miles south of Brewster, Polk County, Florida. Referred here through their approach in size to the humerus of *immer* (see table 1).

Ulna.—The proximal portion of the type ulna has already been described by Wetmore.

Brodkorb Coll., no. 89, distal portion of right ulna, from one and one-half miles southeast of Brewster, Florida. This specimen is likewise referred to *concinna* because it approaches *immer* in size. Least width of shaft, 5.3 mm.; least depth of shaft, 7.6; width through condyles, 8.0; height through condyles, 16.6.

Femur.—Brodkorb no. 298, complete left femur, from south of Brewster, Florida. In shape resembles *arctica* in that it is relatively straight, less bowed compared to *immer*, and much less bowed compared to *stellata*. However, it is a large, massive bone, approaching that of *immer* in stoutness. Length, 42.7 mm.; width through head, 15.8; narrowest width of shaft, 6.6; greatest depth of shaft, 9.0; width through condyles, 16.8.

Gavia palaeodytes Wetmore

Gavia palaeodytes Wetmore, 1943:64, figs. 1-2 (Middle Pliocene: Pierce, Polk County, Florida; type coracoid, Mus. Comp. Zool.).

All my material was collected by Mr. George C. Elmore, south and southeast of Brewster, Florida. The type is from a few miles farther north, in the same formation.

Coracoid.—Cast of type, Mus. Comp. Zool. no. 2329, left coracoid, lacking the head, procoracoid, lateral half of sternal facet, and hyosternal process.

Brodkorb no. 132, right coracoid, nearly complete. Size similar to that of modern *stellata*. Coracoidal fenestra well bridged as in *immer* and *pacifica*; in my two specimens of *stellata* there is a coracoidal notch instead of a fenestra, possibly because of immaturity. Head less swollen, and brachial tuberosity less overhanging than in the case of the three modern species. Sternal margin nearly straight as in *pacifica*, rather than bowed as in *stellata* or *immer*. The differences claimed in the original description of less angularity of the sternal facet and less well developed anterior intermuscular line do not hold when compared with one of my specimens of *stellata*; they may be age differences. Head to internal angle of sternal facet, 45.2 mm.; coracoidal fenestra to sternal margin, 24.4–26.5; width of sternal facet, 23.3; width of shaft below procoracoid, 5.3–6.6; least depth of shaft, 3.6–3.7; width of neck, 3.7; depth of neck, 7.7; glenoid facet to head, 20.7; width through glenoid facet, 7.9.

Humerus.—Brodkorb no. 88, distal half of right humerus; no. 306, proximal two-thirds of right humerus. Size larger than *stellata*, smaller than *concinna*. The proximal portion differs from *stellata* and *arctica* in having the external tuberosity less produced proximally; deltoid crest straighter, less excavated; attachment for infrapinatus less prominent and therefore forming a shallower excavation in the margin of the bone distal to the attachment. Distal end very similar in configuration to that of *stellata*, but condyles more robust, with ectepicondylar prominence protruding more from shaft, and attachments for articular ligament and pronator brevis more pronounced.

Femur.—Brodkorb no. 133, complete right femur. Compared with *stellata* and *pacifica*, the femur is longer, narrower, less strongly bowed, and with somewhat less sculpturing on its posterior surface. It is a strikingly more delicate bone than the same element of *concinna*, although agreeing with that species in its straightness. Length, 39.2 mm.; width through head, 12.7; narrowest width of shaft, 5.0; greatest depth of shaft, 6.4; width through condyles, 13.1.

Gavia howardae, new species

Gavia concinna? Howard, 1949:185, part, pl. 3, fig. 5 (Pliocene: San Diego).

Type.—L. A. Mus. no. 2111, distal portion of left humerus, with a segment of about an inch missing between distal fourth and shaft. Middle Pliocene of San Diego, California; Locality 1071 (Curlew Street at Ostego Drive), collected by Clifford Kennel, May 11, 1947.

Description.—Shaft convex on anconal surface; external and internal tricipital grooves separate and well marked for about distal 10 mm., the ridge between them not forming a prominent distal projection; olecranal fossa short and only about two mm. in depth; entepicondyle extends distally beyond other prominences; internal condyle shorter than entepicondyle, but longer than external condyle; ectepicondyle reduced. Internal surface of shaft almost flat. Palmer surface with shaft somewhat concave; brachial depression extends about 11 mm. proximally, occupying nearly entire width of shaft, and divided distally by a slight ridge, which is almost perpendicular to shaft; condyles rela-

tively small and close together; entepicondyle extends farthest distally, its lateral outline sweeping gently from outline of shaft; internal condyle roughly circular in outline and extended distally beyond external condyle; ectepicondylar prominence forms a flange, rounded in lateral outline, and extending farther laterally than external condyle; internal margin of attachment for anterior articular ligament nearly straight, without pronounced lateral indentation. Color dark gray, mottled with white.

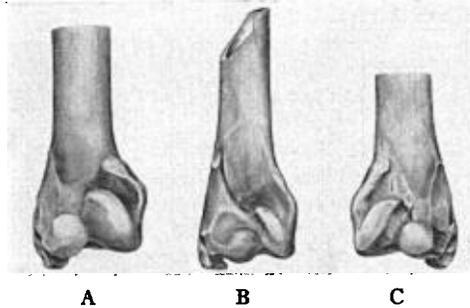


Fig. 1. Distal portions of humeri. A, *Gavia concinna*, P. B. no. 90; B, *Gavia howardae*, L. A. Mus., no. 2111; C, *Gavia palaeodytes*, P. B. no. 88. All natural size.

Referred material.—Distal portions of left and right humeri, L. A. Mus. nos. 2175 (published as 2131) and 2133, same formation, but from Locality 1080, Washington Boulevard Freeway, San Diego.

Comparisons.—Distal portion of humerus closest to that of *Gavia palaeodytes* among fossil loons, from which it differs in smaller size (see table 1); attachment for anterior articular ligament slightly longer; distal end more compressed; tricipital grooves narrower; ectepicondylar prominence forms a more extensive flange; brachial depression relatively larger; inner side of shaft near brachial depression more nearly flat; entepicondyle straighter, less bent.

Gavia concinna is even larger, and its attachment for the anterior articular ligament is about the same size as in *howardae*, thus being only relatively shorter.

Howardae differs from modern *Gavia arctica pacifica* in having the attachment for the anterior articular ligament longer, entepicondyle slightly straighter, internal and external condyles smaller, and inner surface of shaft flatter.

Table 1

Measurements of Humerus in *Gavia* in Millimeters

	<i>howardae</i>	<i>palaeodytes</i>	<i>concinna</i>
Breadth through epicondyles	12.0-14.4	14.3	15.5-16.7
Breadth through condyles	9.2-10.2	11.7	12.5-13.1
Depth through internal condyle	8.8-9.3	10.1	10.5-11.6
Depth through external condyle	7.8-8.4	9.2	9.7-10.4
Depth through brachial depression	4.2-4.7	5.1	6.0-6.1
Depth above brachial depression	4.7-5.2	6.1	6.5-7.0
Width above brachial depression	6.2-6.8	7.1	8.4-8.8
Length of attachment for anterior ligament	9.5-10.2	8.7	10.2-10.7
Length of internal condyle	4.3-4.8	5.4	5.4-5.5
Diagonal length of external condyle	6.8-7.4	8.8	9.2-10.5
External tuberosity to capital groove	.....	16.6	18.5
External tuberosity to internal tuberosity	.....	19.3	22.0
Maximum depth of head	.....	9.5	10.2
Depth through internal tuberosity	.....	6.4	7.6
Length of capital groove	.....	8.6	9.4

Except for the length of the attachment for the anterior articular ligament, the same differences appear in more marked degree when the humeri of *howardae* are compared with those of modern *Gavia stellata* and *immer*. In addition those two species are still larger.

Discussion.—Following is a list of species of loons which have been recorded in a fossil state.

Gavia immer (Brünnich). Modern species reported from Pleistocene of Europe. A loon near *immer* also occurs in the Pleistocene of California and Florida.

Gavia stellata (Pontoppidan). Modern species reported from Pleistocene of Europe.

Gavia portisi (Regalia). Upper Pliocene of Italy.

Gavia concinna Wetmore. Middle and Lower Pliocene of California; Middle Pliocene of Florida.

Possibly synonymous with *portisi*.

Gavia palaeodytes Wetmore. Middle Pliocene of Florida.

Gavia howardae Brodkorb. Middle Pliocene of California.

Gavia sp. Miocene of Maryland. Smaller than *immer* (see Wetmore, 1944).

Gaviella pusilla (Shufeldt). Oligocene (?) of Wyoming.

Colymboides minutus Milne-Edwards. Upper Oligocene of France.

Colymboides anglicus Lydekker. Upper Eocene of England.

The American Pliocene loons fall into three size classes. *Gavia concinna* is a bird with size between that of the living *immer* on the one hand and that of *stellata* and *pacifica* on the other. In three characters it resembles modern *pacifica*, namely, the vaulted cranium, the slightly upturned tip of the premaxilla, and the shape of the groove on the underside of the premaxilla. In its relatively long capital groove of the humerus it resembles both *pacifica* and *stellata*. In the diagonal course of the frontoparietal suture and in the deep mandible it resembles both *immer* and *stellata*.

Gavia palaeodytes is slightly larger than the living *stellata*. It resembles *pacifica* in the nearly straight sternal margin of the coracoid and both *immer* and *pacifica* in the bridged coracoidal fenestra, but its closest relationships appear to be with *stellata*.

Gavia howardae is slightly smaller than *pacifica* or *stellata*. As indicated by the distal end of the humerus, its relationships are closest to *pacifica*.

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