

A New Pliocene Grebe from the Lee Creek Deposits

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ABSTRACT

A new species of *Podiceps* (Aves: Podicipedidae) is described from the early Pliocene Lee Creek marine deposits in North Carolina. The holotype is a femur. Referred material includes entire or partial femora (7), tarsometatarsi (5), coracoid (1), humeri (7), and ulna (1).

Introduction

Among the thousands of bird bones found in the Neogene marine deposits at Lee Creek Mine, near Aurora, Beaufort County, North Carolina, are 22 bones or parts of bones belonging to a small species of grebe. Different bones representing the same element of the skeleton vary considerably in overall size and in the positions of the muscle scars on them; however, comparable differences may be found within series of a single recent species (e.g., in a series of skeletons of the Horned Grebe, *Podiceps auritus* (Linnaeus)), and there is no reason to believe that they represent more than a single species. According to the characteristics listed by Murray (1967:278) for the appropriate elements, the Lee Creek Mine grebe is referable to the recent genus *Podiceps*. Comparisons with skeletons of living grebes in the University of Michigan Museum of Zoology (UMMZ) confirm this placement. The fossil form is about the size of *P. auritus* but differs in several respects that warrant describing it as a new species.

ACKNOWLEDGMENTS.—I am grateful to the curators of the National Museum of Natural History (which includes collections of the former United States National Museum (USNM)), Smithsonian Institution, and the University of Kansas Museum of Natural History (KUVP) for permission to borrow the fossils described herein, to L. Delle Cave (Musèò Geologia e Paleontologia, Università di Firenze) for providing a cast of the holotype of *Podiceps pisanus* (Portis), and to the curators of the University of Michigan Museum of Paleontology (UMMP) for

permission to study comparative material. Clayton E. Ray, Storrs L. Olson, and T.J. Cohn offered valuable comments on the manuscript; Karna Steelquist and Jennifer Emry prepared the figure. Tom and Pat Burns, Raymond Douglas, Frank and Becky Hyne, Peter J. Harmatuk, and Clyde Swindell collected many of the Lee Creek Mine specimens used in this study.

Podiceps howardae, new species

FIGURE 1

HOLOTYPE.—Complete right femur, vertebrate paleontological collections of the National Museum of Natural History, Smithsonian Institution, USNM 252314.

PARATYPES.—Seven other femora (KUVP 21240, USNM 177918, 178151, 206413, 215453, 215649, 460785) probably represent this species. Their measurements are shown in Table I.

TYPE LOCALITY.—Lee Creek Mine, near Aurora, Beaufort County, North Carolina (35°18'N, 76°48'W), collected in 1977 by Peter J. Harmatuk.

HORIZON AND AGE.—Yorktown Formation, early Pliocene.

ETYMOLOGY.—Named in honor of Hildegard Howard in recognition of her many important contributions to the study of fossil birds.

DIAGNOSIS.—*Podiceps howardae* was a small grebe, approximately the size of the recent *P. auritus*, and had similar leg proportions. It differed from the recent species in conformation of the known skeletal elements as noted below. It was smaller than the fossil species *Podiceps oligoceanus* (Shufeldt), *P. subparvus* (L. Miller and Bowman), *P. parvus* (Shufeldt), and *P. dixi* Brodkorb and was larger than *P. pisanus*, *P. discors* Murray, and *Pliolymbus baryosteus* Murray.

MEASUREMENTS OF HOLOTYPE.—Overall length 32.5 mm, width at head 8.6 mm, width at distal end 8.7 mm, least width of shaft 3.6 mm.

DESCRIPTION OF HOLOTYPE.—The specimen is similar in size to femora of *Podiceps auritus*, but it is considerably narrower across the distal end and has a much narrower external condyle. The latter is difficult to measure, but the differences are readily seen when the bones are viewed from the anterior or distal aspects.

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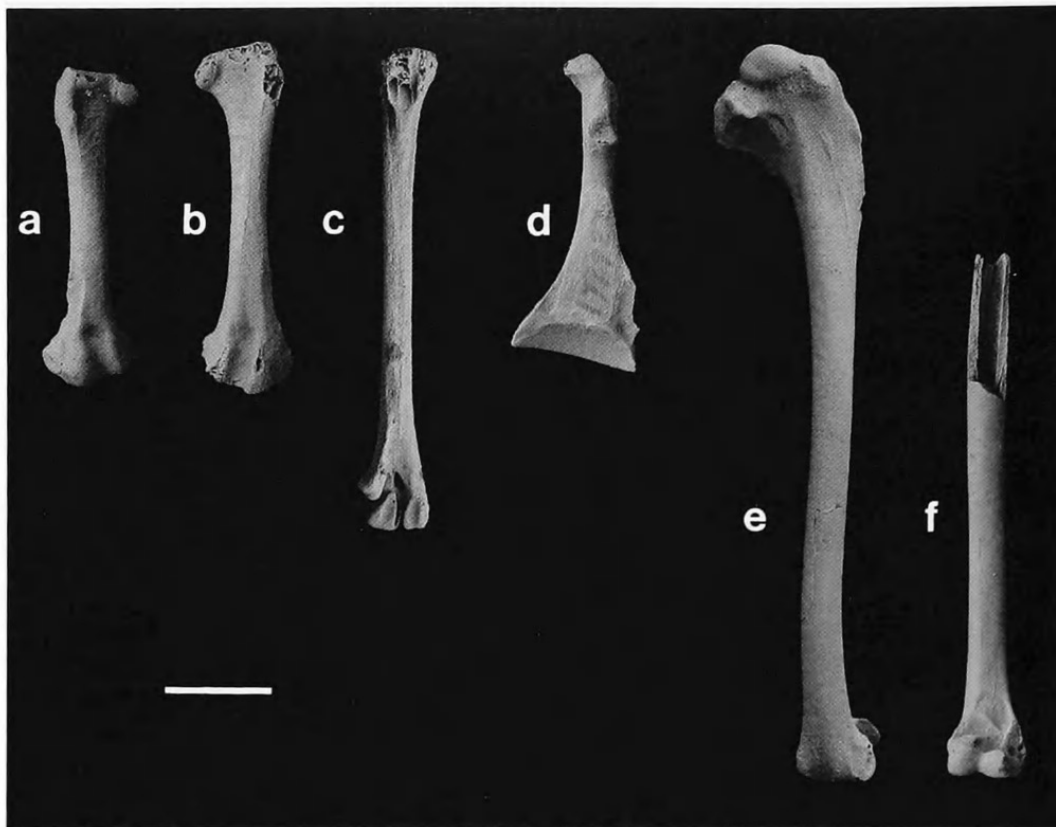


FIGURE 1.—Specimens of *Podiceps howardae*: a, holotype femur USNM 252314; b, paratype femur USNM 177918; c, tarsometatarsus KUVV 21239; d, coracoid USNM 177927; e, humerus USNM 243764; f, distal portion of humerus USNM 215034. (Scale bar=17.5 mm.)

ADDITIONAL SPECIMENS.—A nearly complete tarsometatarsus (KUVV 21239) is approximately the length of that of the largest available male of *Podiceps auritus* and, in general, it is similarly shaped. The foramen between the trochleae for digits three and four is longer in the fossil, and the trochlea for digit four is less offset and does not extend distally as far as that of digit three (in 27 out of 31 *P. auritus*, the trochlea for digit four is the longer). The proximal half of a tarsometatarsus (USNM 250773) is as wide as that of a large example of *P. auritus*, whereas the distal portion of another (USNM 210531) is noticeably more slender, differing to the same degree as tarsometatarsi of males and females of recent *P. auritus*. Two other fragmentary tarsometatarsi, a proximal portion (USNM 193175) and a distal portion (USNM 206326), are more similar in size to the smaller one. Unfortunately, the trochlea for digit four has been lost in each of the distal pieces.

The nearly complete tarsometatarsus measures 48.8 mm (if it were complete, it would measure approximately 50 mm.) Assuming that this bone and the largest femur (USNM 177918, paratype) belong to the same sex of the same species, the ratio of femoral length to tarsometatarsal length would be about 0.72. The comparable ratios of four specimens each of *P. auritus* and *P. grisegena* (Boddaert) are 0.73 and 0.76, respectively, whereas those of *Aechmophorus occidentalis* (Lawrence) and *Podilymbus podiceps* (Linnaeus) are 0.60 and 1.02, respective-

ly. Thus, the new bird presumably had similar hind-limb proportions to those of *P. auritus*.

The proximal two-thirds of a tarsometatarsus (USNM 250773) has a nearly complete articular portion and resembles that of a large male *P. auritus* in size and in width of the proximal end. This is in contrast with the relatively narrow distal end of the femur.

A nearly complete coracoid (USNM 177927) resembles coracoids of *P. auritus* in size and form but has a relatively deeper sternal facet. The bone is 30.5 mm long, 12.4 mm wide at the base, 3.0 mm in least width of shaft, and 4.0 mm in maximum depth of the external facet. In the shape of the head it differs markedly from that illustrated for the holotype of *Pliodytes lanquisti* Brodkorb (1953:954) of the Bone Valley Formation.

A nearly complete humerus (USNM 243764) measures 75.4 mm in length and thus is within the range of measurements of females of *P. auritus*.

Five partial humeri, consisting of a proximal portion (USNM 183430) and four distal portions (USNM 193242, 215034, 368557, 430524), also fall within the range of *P. auritus*. A fifth distal portion (USNM 407798) is somewhat larger and heavier (Table 2) than the extreme of *P. auritus* and probably is from a large male of *P. howardae*. The shaft of the humerus is somewhat wider and flatter in the fossil than it is in the living

form, but not enough to suggest an adaptation for using the wings under water.

The distal portion of an ulna (KUVV 21292) is slightly heavier than it is in males of *P. auritus* and measures 5.8 mm in maximum width at the distal end, which is near the maximum for males of *P. auritus*.

COMPARISONS.—According to Brodkorb (1963b:227), the earliest fossil species of *Podiceps*, and the earliest record of the Podicipedidae, is *P. oligoceanus* from the early Miocene of Oregon. The holotype femur, as figured by Wetmore (1937:197), is considerably heavier and somewhat longer than that of *P. howardae*. Storrs Olson (in litt., 1986) reported that according to Jane Gray (in litt.) the provenance, and likewise the age, of the type of *P. oligoceanus* are in doubt. He added that “it is a typical modern grebe and could as well be Pleistocene as early Miocene.”

Podiceps pisanus, from the middle Pliocene of Italy, is known from the distal portion of a humerus. According to Regalia (1902:233–234, pl. 27[1]: figs. 21, 22), *P. pisanus* was somewhat larger than *P. auritus*, and the holotype is characterized by the shape of the scar for the attachment of *M. brachialis anticus* near the distal end of the bone. A cast of the holotype was compared with four humeri of *P. howardae* (USNM 193242, 215034, 368557, 407798) and with a series of skeletons of recent *P. auritus* in the UMMZ (Table 2). In size it is at

or near the lower limits of females of *P. auritus* (from this, it appears that Regalia’s comparisons were made with the smaller species, *P. nigricollis* Brehm, which for many years was called “*auritus*”). In its shorter, wider, more transverse scar for the attachment of *M. brachialis anticus*, *P. pisanus* differs from *P. auritus* (and also from *P. howardae*) as described by Regalia.

Podiceps subparvus, described by Miller and Bowman (1958:6–7) from the middle Pliocene of San Diego, California, was somewhat larger than *P. howardae* and was wider across the distal end of the femur.

Podiceps discors, described by Murray (1967:279–282) from the late Pliocene Rexroad Formation of Kansas, appears to have been a slightly smaller species than *P. howardae*. The type, a well-preserved tarsometatarsus (UMMP 52465), is smaller and more slender than the tarsometatarsi referred to *P. howardae*. The latter specimens also differ from *P. discors* and resemble *P. auritus* and *P. nigricollis* in having the support of the internal condyle more flared internally.

Murray (1967:281–282) referred several specimens from the Hagerman local fauna of Idaho to *P. discors*. One of these, a femur (UMMP 52423), is within the range of *P. howardae* and is proportionally too narrow at the distal end for *P. auritus*. It differs from the holotype of *P. howardae* in having facets for the insertion of *M. obturator internus* and *M. ischiofemorialis*

TABLE 1.—Measurements (in mm) of femora of *Podiceps howardae* and *P. auritus*. Data for *P. auritus* are the ranges of 12 individuals, six of each sex, in the collection of the UMMZ.

Specimen	Total length	Width at head	Least width of shaft	Width at distal end	Width at distal end/total length
<i>Podiceps howardae</i>					
Holotype					
USNM 252314	32.5	8.6	3.6	8.7	0.27
Paratypes					
USNM 177918	35.8	9.5±	3.5	9.5±	0.27±
USNM 178151	—	9.9	3.8	—	—
USNM 206413	—	10.0	4.0	—	—
USNM 215453	32.5	8.7±	3.6	—	—
USNM 215649	35.0	9.0	3.3	9.0±	0.26±
USNM 460785	32.4	9.9	3.8	9.3	0.29
KUVV 21240	—	—	3.7	—	—
<i>Podiceps auritus</i>	31.3–35.7	8.7–10.3	3.4–3.9	9.3–10.9	0.27–0.31

TABLE 2.—Measurements (in mm) of the distal portions of humeri of *Podiceps auritus* (UMMZ), *P. howardae*, and *P. pisanus* (UMMP). Data for *P. auritus* are range and mean standard deviation for 10 individuals of each sex.

Specimen	Width at distal end	Least width of shaft	Height of shaft
<i>Podiceps auritus</i>	7.2–8.1 7.69±0.26	3.3–3.95 3.62±0.19	2.75–3.5 3.08±0.16
<i>Podiceps howardae</i>			
USNM 193242	7.5	4.0	3.4
USNM 215034	7.5	3.8	3.15
USNM 368557	7.9	4.1	3.35
USNM 407798	8.3	4.4	3.75
USNM 243764	7.3	4.0	3.25
USNM 430524	8.0	—	—
<i>Podiceps pisanus</i> (cast of holotype)	7.2	3.75	2.95

lying more on the lateral plane of the bone than in *P. howardae*, *P. auritus*, or *P. nigricollis*, and in having a larger, deeper depression for the insertion of *M. obturator externus*. Two of the three coracoids assigned to *P. discors* by Murray (UMMP 52277, 49590) have considerably shallower external sternal facets than in *P. howardae*.

Pliolymbus baryosteus, also described by Murray (1967:278–279) from late Pliocene deposits in Kansas, was placed in a new genus on the basis of characters in the sternum, an element that so far is unknown in *Podiceps howardae*. The other skeletal elements of *Pliolymbus* are much smaller than the corresponding ones of *P. howardae*.

The holotype of *Podiceps parvus* has been discussed and figured by Wetmore (1937:195–197, 200–201) and reviewed by Miller and Bowman (1958:4–5). This was a larger species than *P. howardae* and has been stated to range from the early middle Pliocene to the middle Pleistocene.

Podiceps dixi, from middle Pleistocene beds in Florida, is known from the proximal part of the carpometacarpus, an element as yet unknown for *P. howardae*. Measurements given in the original description (Brodkorb, 1963a:54) indicate that it was a larger bird than *P. auritus*, and hence, than *P. howardae*. Steadman (1984:49), after reviewing the literature on fossil grebes, pointed out the “unsatisfactory nature” of this species and preferred to regard it “as a synonym of *P. auritus*.”

Podiceps gadowi, described from Quaternary deposits on Mauritius (Hachisuka, 1953:124–125), is known from a single right ulna (205k) in the Cambridge University Museum of Zoology. This was examined by S.L. Olson (pers. comm.) in August 1985, who found that it had been annotated by Graham Cowles of the British Museum (Natural History) (now The Natural History Museum, London) as being from a whimbrel (*Numenius phaeopus*, Scolopacidae). According to Olson, the specimen measures 81.8 mm in length and is definitely not a grebe.

The fossil *Thiornis sociata* Navás from the middle Miocene of Spain has been recognized as a grebe and was redescribed by Olson (1995:131–140), who placed it tentatively in the genus *Podiceps*, although “in its general morphology, particularly the pelvis and hind limb, *Thiornis sociata* is decidedly more similar to *Tachybaptus* than to modern species of *Podiceps*.” Because comparisons with skeletons of recent grebes show that *P. howardae* clearly belongs in the genus *Podiceps*, comparison with *Thiornis* was not attempted.

REMARKS.—*Podiceps howardae* was a small grebe; it averaged slightly larger in size than the recent Horned Grebe, *Podiceps auritus*, but it was similar in proportions. The known specimens all come from offshore marine deposits; however, because the floating nests of all living grebes are subject to damage or loss by wave action and fluctuations in water level,

these birds do not nest near large expanses of open water or in tidal situations. Assuming that *P. howardae* had similar nesting requirements, it probably nested inland on fresh water and wintered on salt water. Thus, specimens of this Pliocene species may well be expected in inland localities. Such a pattern of distribution is already known for the fossil species *Podiceps parvus* (Miller and Bowman, 1958:5).

In spite of the similarities in size and proportions between *P. howardae* and *P. auritus*, whether the former was ancestral to the latter is unclear. Fjeldså (1983) has provided convincing evidence for character displacement in the bill length of grebes, and character displacement also is evident in the overall size of the Red-necked Grebe (*Podiceps grisegena*), which is considerably smaller in Europe, where it is sympatric with the larger Great Crested Grebe (*P. cristatus* (Linnaeus)), than it is in North America, where no larger congener occurs (Palmer, 1962:63–87). Even greater geographic variation in size is found in the White-tufted Grebe (*Rollandia rolland* (Quoy and Gaimard)), in which tarsometatarsal length of study skins varies from 51.7 mm in a male of the race on the Falkland Islands (Islas Malvinas) to 31.0 mm in a small female from northern Argentina (Storer, unpublished data). Smaller, but significant, differences in size in this species occur between lakes Junín and Titicaca, where *R. rolland* is found with different assemblages of grebes. There is no reason to doubt that geographic variation occurred in the past as it does today, and this should be taken into consideration in any analysis of fossils (Storer, 1992:419–422).

It is thus evident that size in grebes is not necessarily an indication of close relationships. It is therefore to be expected that as faunas change with the disappearance of some forms and the appearance of others, shifts in the size of at least some of the species can be expected. This being the case, other characteristics, especially the conformation of bones, should be more useful in assessing relationships among closely related species of grebes.

Differences in proportions can arise from more than one source. In birds using similar types of locomotion, wings must increase more rapidly than overall size in order for a bird to maintain the ability to fly. This explains most, if not all, of the differences in the ratios of humeral length to tarsometatarsal length mentioned above. Other proportional differences, such as those in the toes, are more likely to reflect differences in the way the foot is used and are presumably more significant in phylogenetic studies.

Compared with other pre-Pleistocene grebes, *Podiceps howardae* is represented by a fair number of specimens. Until other species become known from more adequate material, little can be shown about the relationships among them and recent species.

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