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Proceedings of The Biological Society of Washington 112:503-509 (1999)
http://biostor.org/reference/74282

PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON
112(3):503–509. 1999.

A new species of pelican (Aves: Pelecanidae) from the Lower Pliocene of North Carolina and Florida

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Abstract.—A new species of pelican, *Pelecanus schreiberi,* is described from rare fossils from the Lower Pliocene Yorktown Formation of North Carolina. Additional material from the nearly contemporaneous Bone Valley Formation in Central Florida is tentatively referred to the same species, which was much larger than any existing New World pelican and so distinctive in some features that it appears to represent an extinct lineage with no living descendents. The holotype is the distal portion of a femur with dense medullary bone indicating a laying female, so the species presumably bred near the type locality.

Among the tens of thousands of bird fossils recovered from early Pliocene marine deposits excavated in a phosphate mining operation in North Carolina (Olson & Rasmussen 2000), are a few specimens belonging to an extremely large species of pelican (Pelecanidae: Pelecaniformes). These are so distinctive as to leave little doubt that they constitute a previously unrecognized element in the late Tertiary avifauna of North America. With the discovery of additional contemporaneous specimens from Florida that may represent the same species, it was decided that formal description was warranted, despite the paucity of material.

Order Pelecaniformes
Family Pelecanidae

The femora are referable to the Pelecanidae by the combination of the very long, broad anterior surface of the external condyle; the long, squared outline of the fibular condyle in posterior view; the very long, distinct scar for attachment of M. gastrocnemius lateralis; and the distinct, deep depression for the ligamentous loop of M. iliofibularis. The overall aspect of the distal end of the femur in anterior view is somewhat similar in the Cathartidae but the gastrocnemius scar is small and round, the depression for the loop of the iliofibularis is indistinct, and the external condyle is relatively shorter. The Pelagornithidae differ markedly in having the popliteal fossa indistinct (versus very deep), the shaft broader and not constricting above the condyles, and the external condyle much less posteriorly produced. From the illustrations of the femur of *Teratornis merriami* in Miller (1925, plate 4c, d), the Teratornithidae differ in having the popliteal fossa shallower, the fibular condyle much less produced laterally, the gastrocnemius scar smaller, and the intercondylar groove much shallower. Other taxa of large birds in the Lee Creek avifauna such as swans, storks, and cranes (Anatidae, Ciconiidae, and Gruidae) differ even more substantially from the Pelecanidae than the above families.

Pelecanus schreiberi, new species
(Figs. 1–2)

Holotype.—Distal third of right femur of an egg-laying adult female (lumen filled with dense medullary bone), paleontological collections of the National Museum of Natural History, Smithsonian Instution, UNSM 192077; collected about 1972 by

Gerard R. Case; collector's number NC 543.

Type locality.—Texasgulf Inc. Lee Creek Mine, south side of Pamlico River, near Aurora, Beaufort County, North Carolina (35°23′22″ N; 76°47′06″ W).

Horizon.—Basal part of the Yorktown Formation, Lower Pliocene. This determination was made from matrix removed from paratypical femur USNM 263567 and is based on the presence of secondary phosphate, abundant echinoid spines, and the foraminiferan *Nonionella labradorium* (Thomas G. Gibson, USGS, pers. comm., 1999). Most of the avian fossils recovered at Lee Creek are from the basal part of the Yorktown Formation and it is assumed that the other specimens cited here come from that unit as well.

Measurements (mm) of holotype.—Distal width 37.2, depth through external condyle 28.3, depth through internal condyle 22.3, length from proximal edge of scar for M. gastrocnemius lateralis to distal extent of external condyle 34.2, width and depth of shaft at proximal edge of scar of M. gastrocnemius lateralis 23.6 × 15.8.

Paratypes.—The following are topotypical paratypes from the Lee Creek Mine: distal fourth of left femur, USNM 263567; pedal phalanx 1 of digit III, USNM 446506; pedal phalanx 2 of digit III, USNM 421948.

Mainly on the basis of their very large size, the following specimens from the Bone Valley Formation in Polk County, central Florida, are also referred to *P. schreiberi:* right quadrate lacking orbital process, UF 125031 (Seminole phosphate mine); axis vertebra lacking dorsal spine, UF 65677 (Gardinier mine).

Measurements.—See Table 1.

Etymology.—To my late friend and colleague Ralph W. Schreiber (6 July 1942–29 March 1988), former curator of birds at the Natural History Museum of Los Angeles County, authority on and devoted student of pelicans, whose career was ended much too soon (see Woolfenden 1989).

Diagnosis.—Larger than all modern pelicans except the largest individuals of the two largest species (*Pelecanus crispus* Bruch and *P. onocrotalus* Linnaeus). Distal end of femur in distal view with rotular groove narrower and much deeper, anterior crest of external condyle extending anteriorly well beyond the level of that of the internal condyle; in posterior view fibular condyle much more expanded laterally. The pedal phalanges are much more robust than the comparable elements in modern pelicans.

Discussion.—This very large species exceeds in size either of the living North American pelicans (American White Pelican *P. erythrorhynchos* Gmelin and the smaller Brown Pelican *P. occidentalis* Linnaeus). Because medullary bone functions as a calcium reserve, forming 10 to 14 days prior to egg-laying and being quickly resorbed afterwards (see references cited in Ballmann 1979, Mourer-Chauviré et al. 1999), the holotype is certainly from a female. The paratypical femur is essentially the same size as the holotype and thus could be from a non-breeding female. This is turn suggests that males (the larger sex) of the fossil species may have exceeded in size any individuals of modern pelicans.

Pelecanus schreiberi must have been breeding somewhere near the site of fossil deposition in North Carolina, making it a previously unknown member of the resident avifauna of eastern North America, despite its apparent rarity. Size alone precludes its inclusion in any existing species of North American pelican and the qualitative differences in the femur are so great as almost to suggest generic distinction.

Pelican remains are also represented in the nearly contemporaneous Bone Valley Formation of central Florida (Becker 1987), but are likewise very scarce. A single axis vertebra (UF 65677) is too large for *Pelecanus erythrorhynchos* (Table 1) and is here tentatively referred to *P. schreiberi,* although otherwise I could detect no consistent differences from *P. erythrorhynchos* or Old World pelicans. Of three quadrates

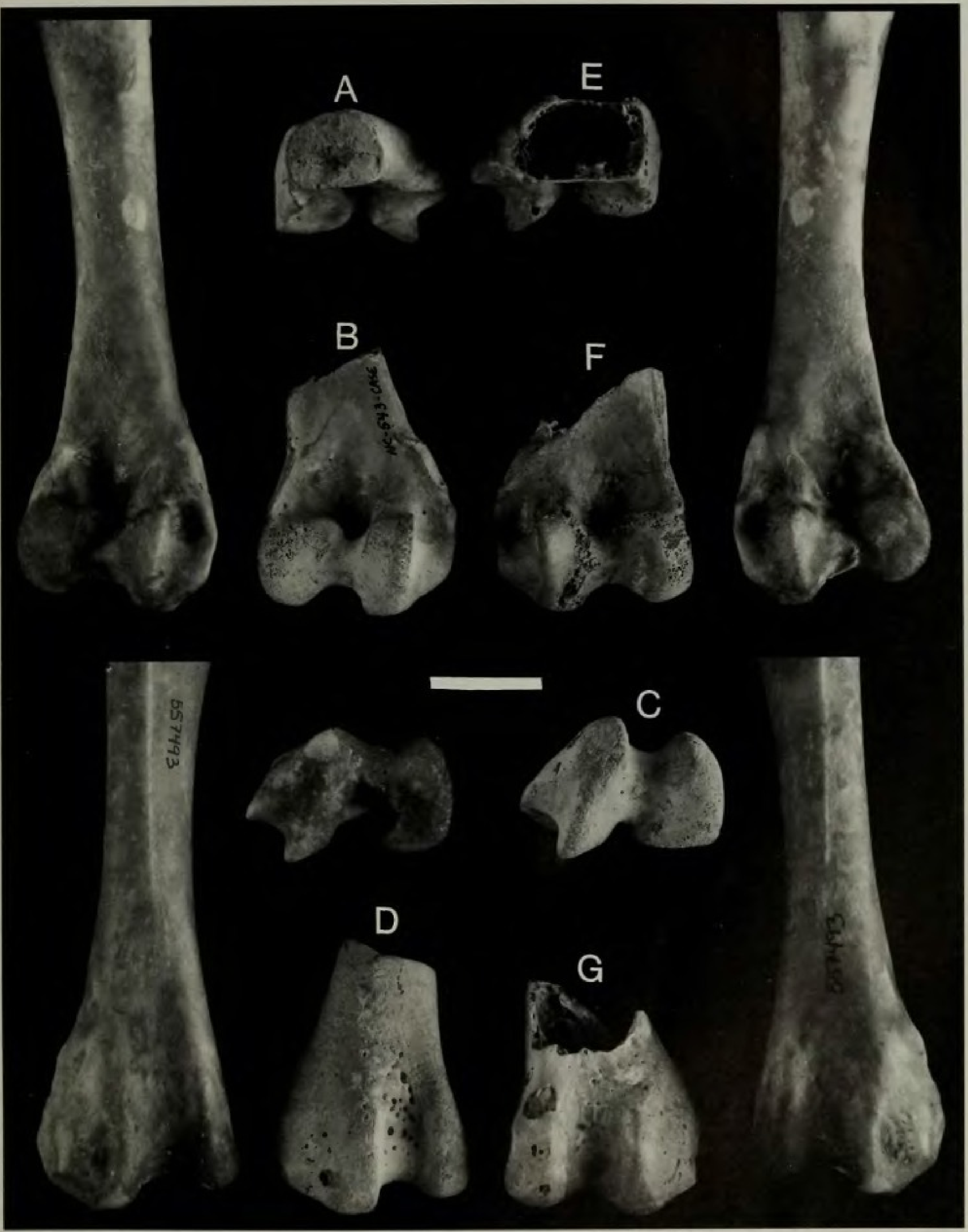

Fig. 1. Femora of *Pelecanus*. A–D, holotype of *Pelecanus schreiberi*, new species (USNM 192007): A, proximal view; B, posterior view; C, distal view; D, anterior view. E–G, paratype of *P. schreiberi*, new species (USNM 263567): E, proximal view; F, posterior view; G, anterior view. Unlettered elements are comparative views of the modern species *P. crispus* (USNM 557493). Note the dense medullary bone in the lumen of the femur of the holotype (A), indicating an egg-laying female, versus the hollow trabeculated lumen of the paratype (E). Scale bar = 2 cm.

Table 1.—Measurements of bones of *Pelecanus*. *P. schreiberi* $n = 1$ or 2; *P. crispus* $n = 2$ (1 unsexed, probably female; 1 male); *P. erythrorhynchos* all are males (the larger sex); $n = 8$ except quadrate and axis $n = 7$.

	P. schreiberi range	*P. crispus* range (mean)	*P. onocrotalus* range (mean)*n*	*P. erythrorhynchos* range (mean)
Quadrate				
Depth	33.0	34.8–37.0 (35.9)	30.4–33.6 (32.0) **2**	28.7–29.8 (29.2)
Length mandibular articulation	25.0	23.9–27.3 (25.6)	25.0–29.4 (27.8) **4**	23.0–23.9 (23.4)
Axis				
Length	38.5	34.5–39.9 (37.2)	35.8–43.7 (39.5) **7**	33.6–35.9 (35.0)
Posterior width	25.1	23.4–25.8 (24.6)	23.5–28.7 (26.2) **7**	21.1–23.3 (22.7)
Femur				
Distal width	37.2–38.2	35.3–37.4 (36.3)	33.5–37.6 (35.9) **7**	30.3–33.2 (31.8)
Depth external condyle	27.3–27.9	25.2–27.9 (26.5)	25.1–27.6 (26.7) **7**	21.5–24.0 (22.5)
Phalanx 1 Digit III				
Length	53.6	48.1–57.3 (52.7)	47.5–57.8 (53.5) **5**	40.7–46.5 (44.5)
Proximal width	13.2	10.5–11.9 (11.2)	10.6–12.6 (11.9) **5**	8.7–11.0 (10.1)
Distal width	8.2	7.1–8.9 (8.0)	7.6–9.5 (8.4) **5**	6.6–7.5 (7.1)
Phalanx 1 digit III				
Length	37.8	37.2–44.5 (40.8)	36.9–45.0 (41.4) **5**	30.1–35.9 (34.1)
Proximal width	9.6		8.4–10.1 (9.0) **5**	7.0–8.5 (7.9)
Distal width	7.3		6.0–8.3 (7.0) **5**	5.0–5.8 (5.6)

from the Bone Valley Formation, one (UF 65699) is smaller than in males of *P. erythrorhynchos* but probably within the range of females of the species, one (UF 125031) is larger than in *P. erythrorhynchos* in one measurement and within the range in another, whereas the third (UF 125030) exceeds that species in both measurements (Table 1) and is therefore referred to *P. schreiberi*. The measurements of three distal ends of tarsometatarsi from Bone Valley (UF 12344, UF 29738, UF 123868) all fall within the range of variation of *P. erythrorhynchos*. The quadrates and axis in the Brown Pelican (*P. occidentalis*) differ markedly in morphology from those of other pelicans, and are unlike those elements found at Bone Valley. If two species of pelican are represented there, one would be referred to *P. schreiberi* and the other would presumably be in the *P. erythrorhynchos* lineage.

The fossil record of Pelecanidae elsewhere in North America is also very meager. Miller (1944) tentatively assigned three poorly preserved fragments of femora from from the Pliocene of Oregon to *P. erythrorhynchos*. A new species, *P. halieus*, was erected by Wetmore (1933) for the proximal portion of a radius from the late Pliocene Hagerman deposits of Idaho said to be similar to *P. erythrorhynchos* but smaller. The radius is usually not considered a very diagnostic element, but when I re-examined the holotype of *P. halieus* (USNM 12233) I could find nothing that it resembled more than a pelican and it is indeed smaller than in *P. erythrorhynchos*. Becker (1986) assigned additional material from Idaho to this species.

Pelicans are much better represented in the fossil record of Europe, where *Pelecanus gracilis* Milne-Edwards is known from fairly abundant remains from the early Miocene of France. Cheneval (1984) made this the type of a new genus, *Miopelecanus*, and also suggested that *Pelecanus intermedius* Fraas, from the Middle Miocene of Germany might be conspecific with *Miopelecanus gracilis*, although he did not use the former in a new combination, contra Mlíkovsky (1992:435). These pelicans were

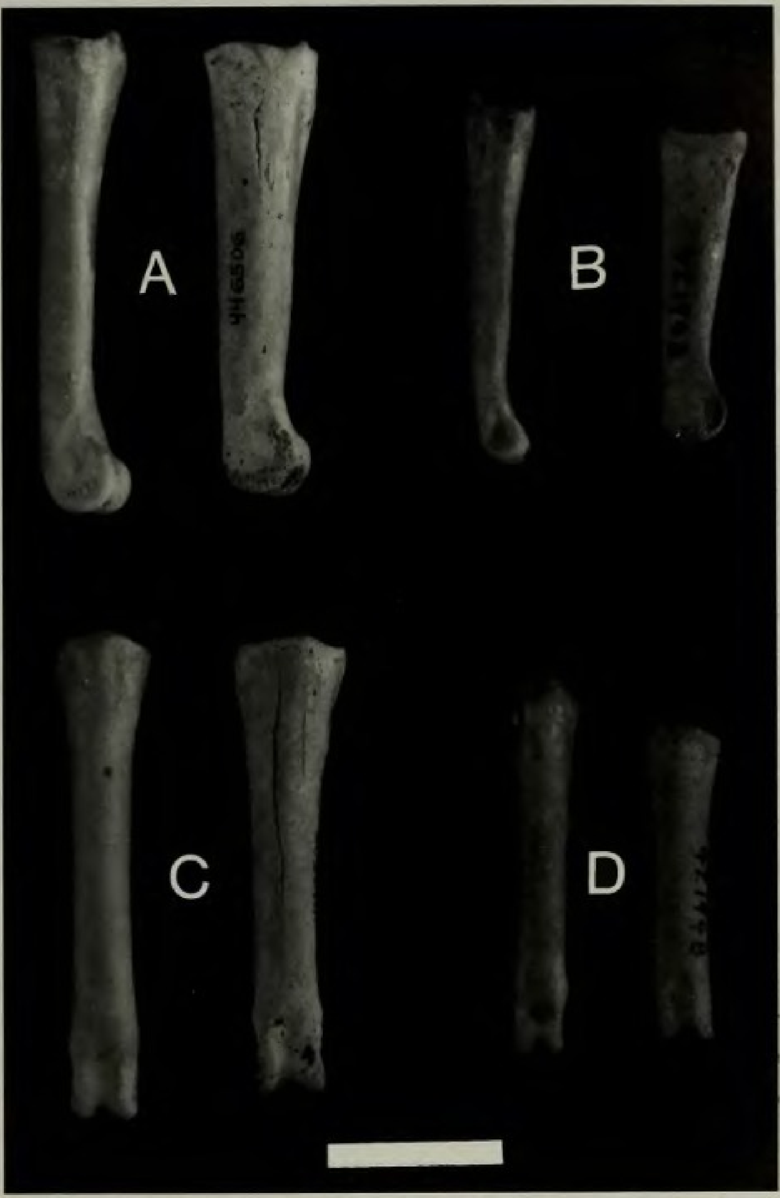

Fig. 2. Pedal phalanges of *Pelecanus crispus* (USNM 557493) on the left in each pair compared with paratypes of *Pelecanus schreiberi*, new species, on the right in each pair. A, pedal phalanx 1, digit III (USNM 446506), lateral view; C, same, dorsal view; B, pedal phalanx 2, digit III (USNM 421948), lateral view; D, same, dorsal view. Scale bar = 2 cm.

much smaller and more gracile than *P. schreiberi*, and the rotular groove of the femur is figured (Cheneval 1984: pl. 5-2) as quite broad, not narrow and deep as in *P. schreiberi*.

With one exception, discussed below, other named pelicans from Europe, Asia, and Africa would all have been smaller than *P. schreiberi* (see Lydekker 1891, Harrison & Walker 1976). The various fossil pelicans from Australasia, reviewed by Rich & van Tets (1981), likewise were smaller than *P. schreiberi*, with the exception of *Pelecanus conspicillatus novaezealandiae* Scarlett, which Rich & van Tets elevated to full species rank. The width of the femur in this species, from the late Holocene of New Zealand, was the size of that of *P. schreiberi*, although on temporal and geographic grounds it would be highly unlikely for the two to be closely related. Furthermore, Scarlett's (1966: fig. 4) illustration shows the rotular groove of the femur of the New Zealand bird to be very wide and shallow, unlike that of *P. schreiberi.*

Perhaps of greater potential relevancy in the present connection is the almost ethereal taxon *Pelecanus odessanus* Widhalm (1886), which was proposed in an obscure publication that seems to have eluded many researchers. Mlíkovsky (1996), for example, was unable to consult it, and one wonders if Brodkorb (1963) may have taken his information about it from Lambrecht (1933). Beginning at least with Lambrecht (1933), the author's name has most often been incorrectly rendered as "Wildhalm," when in fact it was Germanicized as J. Widhalm (from Ighnatii Martuinovich Vidghal'm).

Widhalm's paper treats a few fossils of waterbirds (the pelican, a toe bone of "*Colymbus,*" which at that time probably meant a loon [*Gavia*], and an assortment of bones of cormorants) from Tertiary deposits at Novaja Slobodka, near Odessa, Ukraine, previously assigned to the Lower Pliocene but now to the Upper Miocene (MN 11–13, Mlíkovsky 1996:749). This was for its time (or even now) an exemplary paper. In the case of the pelican, for example, Widhalm took into account recent views on the complexities of nomenclature of modern species, gave measurements of the fossil and the two relevant modern species, along with fairly detailed comparisons, and provided a superb lithographic plate.

The problem arises with what has been interpreted as Widhalm's apparent failure to conform to binomial nomenclature, but in my opinion this is an unfair appraisal probably arising from other authors' lack of access to the original publication. Brodkorb (1963), for example, considered Widhalm to be nonbinomial and therefore attributed the name *Pelecanus odessanus* to Lambrecht (1933). Mlíkovsky (1996) was of the opinion that Widhalm's apparent treatment of cormorants from the site called into question the validity of Widhalm's nomenclature. Widhalm's exact typography where the new pelican was proposed (p. 6) was as follows: "*Pelecanus odessanus.* fossilis *Widhalm.*". It is evident that Widhalm did not intend the term "fossilis" to be part of the scientific name, but merely an indication that his pelican was a fossil, as opposed to a modern taxon. The situation with cormorants is a little more complex but again I believe does not involve anything that can be considered formal nomenclature as on page 8 they are referred to as: "Haliaeus fossilis, var. Odessana major, medius, und minor. *Widhalm.*", which I interpret as simply a provisional way of saying that there were three sizes of fossil cormorants from Odessa (*Halieaus* Illiger, 1811, is a synonym of *Phalacrocorax* Brisson, 1760).

Regardless of its authorship, *Pelecanus odessanus* was a very large pelican, the length of the tarsometatarsus being given as 150 mm (that in the largest specimen of *P. crispus* that I examined was 131 mm, and in the two largest *P. onocrotalus* it was 138 and 145 mm). This species was temporally quite close to *P. schreiberi* and was probably of similar size. Unfortunately it is not known what became of Widhalm's specimens (Lambrecht 1933, Mlíkovsky 1996). Absent comparable elements it would not be possible to determine the distinctness of *P. odessanus* from *P. schreiberi* in any case.

Acknowledgments

I am grateful to Mark Frank and David W. Steadman, Florida Museum of Natural History, Gainesville, for information, arrangements, access to fossil and modern collections, and for lending specimens, and to Elizabeth Ann Schreiber for assistance and encouragement. Mark Florence assisted with USNM specimens. I am grateful for useful comments on the manuscript by Steven D. Emslie and Kenneth E. Campbell. The photographs are by John Steiner, Smithsonian Photographic Services.

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