

THE FOSSIL AVIFAUNA OF ITCHTUCKNEE RIVER, FLORIDA

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SINCE earliest discoveries of fossil avian remains at Vero on the east coast, the number of localities where such remains could be collected within the State has steadily grown. Today Florida ranks as the foremost eastern state for avian fossils. This paper is a report of certain paleontological researches conducted from 1956 through 1959.

INTRODUCTION

The Itchtucknee River is located in Columbia County, and flows southward into the Santa Fe River. The former stream is crossed by U.S. Highway 27 one mile east of Hildreth.

Together with its several spring-fed tributaries, the Itchtucknee River has proved to be a rich source of fossil remains. The first extensive collecting of fossil vertebrates in this area was done by the late J. Clarence Simpson of the Florida State Geological Survey. George Gaylord Simpson (1929, 1930) reported on the Pleistocene mammals of the area. Wetmore (1931) previously worked on fossil avian remains, from material supplied by the Florida State Geological Survey. This material was, in large part, reexamined and is included in this report.

The present study is also based on materials in the collections of Pierce Brodkorb, the Florida State Museum, the Museum of Comparative Zoology, and my own collections. A total of 390 elements was identified. Catalog numbers mentioned in the text are preceded by the letter V when referring to Florida Geological specimens, and PB when referring to the Brodkorb collection.

COLLECTING SITES

Although avian fossils were collected along the entire course of the Itchtucknee River, most were obtained from two localities in the W. $\frac{1}{2}$, Sec. 7, R. 16E, T. 6S, Columbia County.

Locality 1 is Jug Spring or Blue Spring located near the east bank of the river 0.3 miles downstream from the headspring. The surface elevation is about 70 feet above sea level. Numerous elements were collected along the short spring run of this spring, and, with the aid of underwater equipment, additional material was obtained at several levels ranging from 36 to 90 feet below the surface. Fossil elements were found strewn on the floor of this grotto, and were also taken from an extensive bed of soft, reddish clay at depths of about 40 to 60 feet.

Locality 2 is a small tributary of Jug Spring which heads about one-half mile north of the spring. An abundance of fossils along the bottom

of this tributary made this a particularly attractive collecting site. Elements were collected in this area by picking fossils from the bottom and by the washing of sediments.

The remaining fossils were found along Itchtucknee River as loose elements on the bottom. No attempt was made further to specify collecting sites, because of the random dispersal of the fossils and the considerable size of the collecting area.

Stratigraphic sections were taken along both the tributary and spring run of Jug Spring. Additional stratigraphic information was obtained from Dr. Walter Auffenberg concerning the cavern of this spring. These sections are given in Tables 1 through 3.

TABLE 1

SECTION AT THE MOUTH OF THE TRIBUTARY OF JUG SPRING: W. $\frac{1}{2}$, SEC. 7, R. 16E, T. 6S: SURFACE ELEVATION ABOUT 70 FEET

<i>Bed</i>	<i>Thickness in feet</i>	<i>Description</i>
1	$\frac{1}{2}$ -1	Very black organic soil.
2	1-2	Grayish clay of loose texture containing many fossils and much organic material.
3	?	Ocala limestone.

TABLE 2

SECTION AT THE TRIBUTARY OF JUG SPRING ABOUT 75 YARDS UPSTREAM

<i>Bed</i>	<i>Thickness in feet</i>	<i>Description</i>
1	$\frac{1}{2}$ -1	Very black organic soil.
2	1-2	Homogeneous grayish clay containing numerous vertebrate fossils.
3	?	Ocala limestone.

TABLE 3

SECTION ALONG JUG SPRING RUN

<i>Bed</i>	<i>Thickness in feet</i>	<i>Description</i>
1	1	Black organic soil near water level.
2	1	Light colored very soft clay lacking fossils.
3	$1\frac{1}{2}$	Sandy clay with recent vegetative material and <i>Goniobasis</i> shells.
4	2-7	Homogeneous gray clay with vertebrate fossils.
5	?	Ocala limestone.

FAUNAL LIST

Podilymbus podiceps

In all, 47 specimens: 6 right coracoids, 5 left coracoids, 10 right humeri, 7 left humeri, 5 right ulnae, 3 left ulnae, 3 right carpometacarpi, 1 left carpometacarpus, 4 right femora, 1 left femur, 2 right tibiotarsi. Localities 1 and 2 and Itchtucknee River. This grebe was the most abundant species represented in the Itchtucknee deposits.

Podilymbus magnus

Two specimens: two right tarsometatarsi. Locality 1. This species was synonymized with *Podilymbus podiceps* by Wetmore (1937), but has been revived recently by Brodkorb (1959), who listed the range in shaft width of tarsometatarsi as 2.7–3.0 mm. for *P. podiceps* and 3.0–3.5 mm. for *P. magnus*. Widths of the elements from Itchtucknee, PB 1854 and PB 1855, are more than 3.2 mm. and are therefore assigned to this species.

Podiceps auritus

One specimen: right humerus. Itchtucknee River.

Phalacrocorax auritus

In all, 21 specimens: rostrum, left coracoid, 4 right humeri, 2 left humeri, 4 right ulnae, 1 left ulna, synsacrum, 2 left femora, 1 right and 1 left tibiotarsus, 1 right and 1 left tarsometatarsus. Localities 1 and 2 and Itchtucknee River.

Anhinga anhinga

One specimen: left humerus. Locality 1.

Ardea herodias

In all, 8 specimens: 3 right humeri, left carpometacarpus, right tibiotarsus, 1 right and 2 left tarsometatarsi. Locality 1 and Itchtucknee River.

Casmerodius albus

One specimen: right femur. Locality 2.

Butorides virescens

One specimen: left tarsometatarsus. Itchtucknee River.

Nycticorax nycticorax

Two specimens: right ulna, left tibiotarsus. Locality 2. The tibiotarsus, PB 1885, can only be questionably assigned to this species due to abrasion.

Palaeophoyx new genus

Diagnosis. Referable to the subfamily Ardeinae due to greater rounding and internal projection of the internal surface of the coraco-humeral area than found in the Botaurinae. Coracoid readily separable from that of other genera of this subfamily by the following: the excavated area beneath the furcular facet and directly above the procoracoid process has an inclination of approximately 21 degrees to a horizontal reference plane with which the sternal end is at a right angle (inclination in other genera

approximates 32 to 38 degrees); shaft relatively narrow, with lower half bowed caudally and the area immediately above internal distal angle less rounded.

Type. *Palaeophoyx columbiana* new species.

Affinities. Generic relationships of this form are obscure, but it appears to be somewhat closer to *Nycticorax* and *Nyctanassa* than to the representatives of other genera examined.

Etymology. From Greek *palaeos*, old, and *phoyx*, a species of heron mentioned by Aristotle (c. 344 B.C., Book LX. 18).

***Palaeophoyx columbiana* new species**

Figure 1.

Holotype. Right coracoid lacking brachial tuberosity and area of the hyposternal process. No. PB 32, collection of Pierce Brodkorb; Itchtucknee River, Columbia County, Florida. Collected 23 August 1950, by P. Brodkorb, B. W. Cooper, and K. Beecher.

Diagnosis. As for the genus. In addition it differs in size from allied forms as follows: coracoid much shorter than in *Ardea herodias*, *Tigri-*

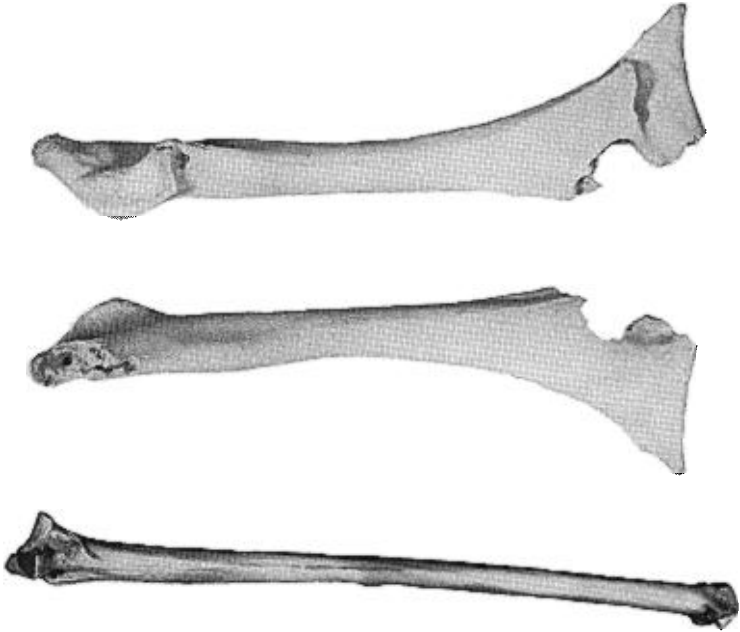


Figure 1. *Palaeophoyx columbiana*. From top: (a) holotype, right coracoid, internal view, No. PB 32, actual length, 47.0 mm; (b) external view of holotype; (c) left ulna, No. PB 1887, actual length, 110.6 mm.

soma lineatum, and *Tigrisoma cabanisi*; shorter than in *Casmerodius albus*, *Nycticorax nycticorax*, and *Nyctanassa violacea*; element much less robust than those of the above species. Larger than in *Hydranassa tricolor*, *Florida caerulea*, and *Leucophoyx thula* although comparable in shaft and head size. Much larger than in *Butorides virescens* and *Ixobrychus exilis*.

Measurements. Length of bone from head to internal distal angle, 47.0 millimeters; procoracoid to internal distal angle, 38.4; scapular facet to internal distal angle, 38.6; depth of shaft below scapular facet, 4.7; width of shaft below scapular facet, 4.0; head to scapular facet, 9.2; maximum width through glenoid facet, 6.3; length of sternal facet at internal distal angle, 5.8.

Paratype. Left coracoid lacking much of the region of the head and hyposternal area. No. PB 1886, collection of Pierce Brodkorb. Collected May, 1950, by K. Beecher.

This element was found to be nearly identical with the type specimen, the only difference being less indication of angularity in the area of the shaft immediately above the internal distal angle. The head of this specimen is more fragmentary than in the holotype and, unfortunately, the same areas are missing from both so that nothing new could be added to the diagnosis.

Measurements. Scapular facet to internal distal angle, 39.7 mm; depth of shaft below scapular facet, 4.0; maximum width through glenoid facet, 6.2; length of sternal facet at internal distal angle, 6.4.

Referred Material. One specimen: left complete ulna, PB 1887. Itchtucknee River.

The ulna is a complete, well-preserved element which suggests a bird intermediate in size between *Leucophoyx thula* and *Nyctanassa violacea*. This element was not assignable to modern herons because of the external cotyla being more narrow and projected.

Measurements. Length, 110.6 mm; depth through external cotyla, 10.0; maximum proximal width, 8.2; depth of external condyle, 7.5; width through condyles, 8.0.

Discussion. This heron is the first extinct genus and species of the family Ardeidae recorded from the Pleistocene of North America. Only two extinct genera and three extinct species have been previously reported from North America.

The referral of the ulna to this species may be regarded as somewhat questionable as ulnae at best have poor diagnostic value. I think, however, that the comparative material available is adequate for a good understanding of the range in variation shown by modern forms, so such assignment seems justified.

The pronounced differences shown by this form relative to modern genera are surprising. Such divergence may be indicative of a more primitive type, or of a Neotropical form present during the Pleistocene.

Etymology. This species is named for the county in which it was collected, Columbia County, Florida.

Ciconia malha

Two specimens: left carpometacarpus, right tarsometatarsus. Itchtucknee River.

Mycteria americana

One specimen: right humerus. Itchtucknee River. The Wood Ibis is here first reported as a fossil. An earlier report of this species from Rancho La Brea (Miller, 1912) is now considered to be *Mycteria wetmorei* (Howard, 1935).

Eudocimus albus

One specimen: left tibiotarsus. Itchtucknee River.

Olor columbianus

One specimen: left tarsometatarsus. Itchtucknee River.

Olor buccinator

In all, 15 specimens: right coracoid, 6 right humeri, 2 left humeri, right ulna, left ulna, right carpometacarpus, right femur, 2 right tarsometatarsi. Localities 1 and 2 and Itchtucknee River. The femur, PB 1871, and one of the humeri, PB 25, are tentatively assigned to this species.

Branta canadensis

In all, 22 specimens: 2 right ulnae, left ulna, 4 right radii, 3 left radii, 5 right carpometacarpi, 2 left carpometacarpi, 2 right tibiotarsi, left tibiotarsus, left tarsometatarsus. Localities 1 and 2 and Itchtucknee River. Shufeldt (1913) reported a pathological excrescence on some of the fossil elements of geese collected in Oregon. A similar condition was exhibited by two carpometacarpi, V-4910 and PB 1814. The radii are tentatively assigned to this species.

Branta canadensis hutchinsii

Two specimens: one right and one left ulna. Itchtucknee River. The right ulna, V-4742, was previously reported by Wetmore (1931), and the left ulna, PB 1876, is tentatively assigned to this subspecies. This ulna was found to be below the size of several Recent skeletons of *B. canadensis* with which it was compared, but having a length in excess of the two comparative skeletons of *B. c. hutchinsii*.

Anas platyrhynchos

In all, 9 specimens: right coracoid, 3 right humeri, 3 left humeri, right ulna, right radius. Localities 1 and 2 and Itchtucknee River. Wetmore (1931) reports two humeri from Itchtucknee River, but only one of these, V-4827, is from this locality. The other is from Hornsby Spring located two miles north of High Springs, Alachua County, Florida. An ulna, V-4802, and a radius, V-4912, are tentatively referred to this species, primarily on the basis of size.

Anas rubripes

Six specimens: two right coracoids, left ulna, left radius, two right carpometacarp. Itchtucknee River. Wetmore (1931) reports a humerus and a metatarsus from Itchtucknee River, the only previous report of this species as a fossil. The metatarsus, however, is from Hornsby Spring, Florida, and the humerus, V-4735, is here reassigned to the Canvasback, *Aythya valisineria*. The ulna, PB 5, and radius, PB 3, listed above are questionable.

Anas fulvigula

In all, 10 specimens: 2 right coracoids, right humerus, 3 left humeri, right ulna, right radius, 2 left radii. Itchtucknee River.

Anas acuta

In all, 6 specimens: right ulna, 2 left ulnae, left carpometacarpus, left tibiotarsus, right tarsometatarsus. Localities 1 and 2 and Itchtucknee River.

Anas discors

In all, 16 specimens: left coracoid, 3 right humeri, left humerus, left ulna, 6 right carpometacarp, 2 left carpometacarp, right tibiotarsus, left tarsometatarsus. Localities 1 and 2 and Itchtucknee River.

***Anas itchtucknee* new species**

Figure 2.

Holotype. Left coracoid, complete except for hyposternal process. PB 8500, collection of Pierce Brodkorb. Itchtucknee River, Columbia County, Florida. Collector and specific site unknown.

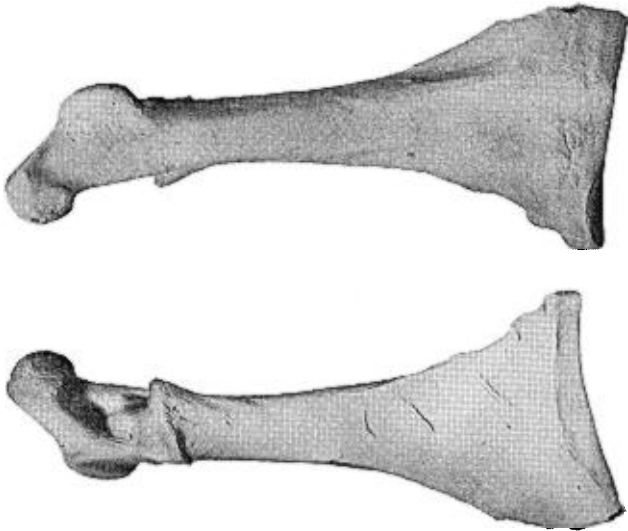


Figure 2. *Anas itchtucknee*. From top: (a) holotype, left coracoid, external view, No. PB 1850, actual length, 37.4 mm; (b) internal view of holotype.

TABLE 4
MEASUREMENT (mm.) OF CORACOID OF *ANAS*, *SPATULA*, AND *MARECA*

Species	A	B	C	D	E	F	G*
<i>Anas itchtucknee</i>	1	37.4	10.3	4.0	4.5	6.3	15.0
<i>A. discors</i>	8	32.8-37.0	8.4- 9.4	3.1-3.5	3.5-4.1	5.0-5.6	12.7-14.8
<i>A. carolinensis</i>	8	31.5-34.0	7.8- 8.7	3.1-3.5	3.2-3.7	4.7-5.6	12.6-13.9
<i>Spatula clypeata</i>	4	40.0-42.3	10.7-12.0	3.7-4.5	4.5-5.0	6.4-7.4	16.0-18.2
<i>Mareca americana</i>	3	39.2-44.1	11.6-12.0	4.1-4.6	5.1-5.5	6.7-7.3	16.1-19.2

* A, number of individuals. B, length from head to internal distal angle. C, length from head to procoracoid. D, depth below procoracoid. E, width below procoracoid. F, width through glenoid facet. G, width of sternal facet.

Diagnosis. Referable to the genus *Anas* (*sensu lato*) on the basis of the angle between the axis of the head and the horizontal plane parallel to the posterior surface being between 61-71 degrees.

Brachial tuberosity produced internally; furcular facet wide; head wide and nearly square; lip overhanging edge of glenoid facet and lower border of triosseal canal obsolete in lower portion.

Comparisons. Closest to *Anas discors*, but differs in having brachial tuberosity more produced internally; furcular facet wider, head wider and more nearly square, being larger. Similar to *Spatula clypeata* in general conformation of the humeral end, but differs in being shorter and less robust generally; lip overhanging edge of glenoid facet and lower border of triosseal canal obsolete in lower portion (lip continues along whole border in *Spatula*). Much smaller and less robust than *Mareca americana*, *Lophodytes cucullatus*, and *Aix sponsa*. Much larger than *Anas carolinensis*.

Measurements. A comparison of the type is made with *Anas discors*, *Anas carolinensis*, *Spatula clypeata*, and *Mareca americana* in Table 4.

Etymology. Named for the type locality, Itchtucknee River, Columbia County, Florida.

Anas carolinensis

Three specimens: right coracoid, left ulna, left carpometacarpus. Locality 1.

Anas strepera

In all, 4 specimens: right humerus, 2 left humeri, left ulna. Locality 1 and Itchtucknee River. This species has not been previously reported from Florida as a fossil. The humerus, V-4617, and ulna, V-4731, reported by Wetmore (1931) as belonging to *Anas fulvigula* and *Aythya affinis* respectively, are here reassigned.

Mareca americana

In all, 5 specimens: 4 right humeri, left carpometacarpus. Itchtucknee River. This species is here first recorded as a fossil from Florida.

Spatula clypeata

In all, 5 specimens: right humerus, left humerus, right carpometacarpus, 2 left carpometacarpi. Localities 1 and 2.

Aix sponsa

In all, 9 specimens: left coracoid, 3 right humeri, left humerus, 3 left ulnae, right tarsometatarsus. Localities 1 and 2 and Itchtucknee River.

Aythya affinis

In all, 16 specimens: 4 right coracoids, left coracoid, 4 right humeri, 3 left humeri, right ulna, right carpometacarpus, left carpometacarpus, right tibiotarsus. Localities 1 and 2 and Itchtucknee River.

Aythya collaris

In all, 24 specimens: 1 right and 2 left coracoids, 10 right humeri, 8 left humeri, 3 left ulnae. Localities 1 and 2 and Itchtucknee River. Remains of this species were more numerous than those of other ducks at Itchtucknee River, and were exceeded only by the Turkey, American Coot, and Pied-billed Grebe for all species represented in these deposits.

Aythya americana

Two specimens: right humerus, left ulna. Itchtucknee River. This duck has not been previously reported as a fossil in Florida.

Aythya valisineria

In all, 16 specimens: 2 right coracoids, 5 right humeri, 6 left humeri, 2 right ulnae, right carpometacarpus. Localities 1 and 2 and Itchtucknee River. A humerus, V-4618, previously reported by Wetmore (1931) as belonging to *Anas fulvigula* is here reassigned.

Bucephala albeola

One specimen: right humerus. Itchtucknee River.

Lophodytes cucullatus

In all, 4 specimens: right humerus, 2 left humeri, right carpometacarpus. Localities 1 and 2.

Mergus merganser

One specimen: right coracoid. Locality 2. The American Merganser has not been previously reported as a fossil from Florida.

Coragyps atratus

One specimen: left tarsometatarsus. Itchtucknee River.

Gymnogyps amplus

One specimen: right femur. Itchtucknee River.

Teratornis merriami

One specimen: left tibiotarsus. Locality 1.

Buteo jamaicensis

One specimen: right ulna. Itchtucknee River.

Pandion haliaetus

In all, 10 specimens: left carpometacarpus, right femur, right tibiotarsus, 3 left tibiotarsi, right tarsometatarsus, left tarsometatarsus, 2 claws. Localities 1 and 2 and Itchtucknee River.

Meleagris gallopavo

In all, 27 specimens: 2 left coracoids, 2 right ulnae, left ulna, right carpometacarpus, right femur, left femur, 9 right tibiotarsi, 4 left tibiotarsi, 5 right tarsometatarsi, left tarsometatarsus. Localities 1 and 2 and Itchtucknee River.

Grus americana

Three specimens: right carpometacarpus, left tarsometatarsus, right femur. Itchtucknee River.

Rallus elegans

Two specimens: right femur, left tibiotarsus. Locality 2 and Itchtucknee River.

Rallus limicola

One specimen: right tarsometatarsus. Itchtucknee River.

Porzana carolina

One specimen: right carpometacarpus. Itchtucknee River.

Gallinula chloropus

In all, 15 specimens: 2 right coracoids, 2 left coracoids, right humerus, 3 left humeri, right ulna, left carpometacarpus, 3 right tibiotarsi, 2 left tibiotarsi. Localities 1 and 2 and Itchtucknee River.

***Gallinula brodkorbi* new species**

Figure 3.

Holotype. Complete right humerus. No. PB 16, collection of Pierce Brodkorb. Locality 2, Columbia County, Florida. Collected 5 August 1950, by B. W. Cooper and E. McConkey.

Diagnosis. Referable to the genus *Gallinula* on the basis of bicipital crest extending to approximately one-half length of deltoid crest, rounding of internal condyle, and in having medial border of entepicondyle concave.

Brachial depression narrow, occupying less than half the width of distal end of shaft; muscle scar for brachialis well developed; capital groove six mm. in length.

Comparisons. Differs from *Fulica* in bicipital crest being shorter, extending distally to approximately one-half length of deltoid crest (in *Fulica* bicipital crest extends nearly to distal end of deltoid crest); differs from *Rallus*, *Aramides*, and *Pardivallus* in having internal condyle rounded rather than flattened, and entepicondyle with medial border strongly concave rather than straight; differs from *Porphyryula* in that deltoid crest is much more extensive, extending far beyond level of bicip-



Figure 3. *Gallinula brodkorbi*. From top: (a) holotype, right humerus, anconal view, No. PB 16, actual length, 59.0 mm; (b) palmar view of holotype; (c) left carpo-metacarpus, medial view, No. PB 1825, actual length, 34.7 mm; (d) left carpometacarpus, posterior view; (e) right ulna, No. PB 1807, actual length, 45.8 mm.

ital crest, and distal end of shaft is less bowed in lateral view; differs from *Porphyriops* in greater rounding of internal condyle, external condyle relatively larger and set more obliquely to vertical plane of the shaft, and shaft much less bowed laterally. Differs from *Gallinula chlo-*

ropus in having capital groove wider, deeper, and longer; brachial depression more extensive; entepicondyle more excavated; muscle scar for brachialis longer and deeper; size considerably larger and more robust.

Measurements. The measurements in millimeters of the fossil species are compared with a series of 7 Recent skeletons of *Gallinula chloropus*. The latter measurements are enclosed in parentheses.

Length 59.0 (48.6–54.6); width of proximal end 13.8 (10.6–12.2); width of distal end 8.4 (7.4–8.3); width of shaft at center 4.4 (3.6–4.1).

Referred material. Four specimens which, with the type, represent at least three individuals. Locality 2.

Humerus: right lacking areas of both the proximal and distal ends, PB 17, PB 1826.

Ulna: right complete, PB 1807.

Carpometacarpus: left complete except for metacarpal 1, PB 1825.

The referred humeri are both fragmentary, and are largely deficient in diagnostic area. However, both closely agree with the type in conformation and size of the entepicondyle and brachialis muscle scar, and are similar in size though somewhat smaller. Due to fragmentation, precise measurements are impossible except for shaft width (PB 17, 3.9 mm., PB 1826, 4.0 mm.).

The ulna is referred to this species on the basis of the larger size and greater projection of the olecranon than found in *Gallinula chloropus*. Length, 45.8 mm.; depth through external cotyla, 6.0; maximum proximal width, 5.3; depth of external condyle, 4.5; width through condyles, 5.3.

The carpometacarpus is distinct from that of *Gallinula chloropus* in being generally more robust, particularly metacarpal II; distal fusion of metacarpal III to metacarpal II extends over a greater length; pisiform process and pollical facet relatively larger. Length, 34.7 mm.; proximal width through pisiform process, 4.5; distal width, 3.8; depth at distal end above facet for digit II, 4.7; width at center, 2.8; depth at center through metacarpals II and III, 4.7; distal fusion of metacarpals II and III, 7.6.

Etymology. This gallinule is named for Dr. Pierce Brodkorb of the University of Florida whose contributions to the field of avian paleontology have been very numerous.

Discussion. The relatively long, robust wing elements and extensive brachialis muscle scar of *G. brodkorbi* suggest well-developed powers of flight. This is in contrast to the Florida Gallinule whose rather clumsy flight is reflected osteologically by shorter wing elements and shallow excavations for the attachment of flight muscles.

Fulica minor

One specimen: right tarsometatarsus. Locality 2. Shufeldt (1892) described this coot from the Pleistocene of Fossil Lake, Oregon. His description was based on several elements which indicated a species with shorter wings and longer legs than the living form. Howard (1946), in comparing a large series of Recent skeletons with *F. minor*, concluded that the latter was structurally too similar to *F. americana* to merit recognition of the extinct form as a separate species. More recently, Wetmore (1956) recognized *F. minor* as a separate species, and both Brodkorb (1957, 1959) and Woolfenden (1959) have assigned fossil elements from the Pleistocene of Florida to this species.

The fossil element listed above, PB 1921, measured 64.2 mm. in length. This is 2.4 mm. more than the maximum given by Howard (1946) for a series of 78 modern coots.

Fulica americana

In all, 37 specimens: 2 right coracoids, 2 left humeri, 2 right femora, 2 left femora, 11 right tibiotarsi, 10 left tibiotarsi, 2 right tarsometatarsi, 6 left tarsometatarsi. Localities 1 and 2 and Itchtucknee River.

Aramus guarauna

From the collection of the Florida State Geological Survey, Wetmore (1931) reported on parts of five metatarsi and a broken tibiotarsus from Itchtucknee River. These specimens were not available for the present study.

Colaptes auratus

One specimen: right carpometacarpus. Locality 1.

Agelaius phoeniceus

One specimen: right ulna. Locality 1.

Quiscalus quiscula

Two specimens: right humerus, right ulna. Locality 2.

PALEOECOLOGY

A listing of the specimens and individuals from the Itchtucknee River area is given in Table 5. The minimum number of individuals of each species was computed by counting the most numerous right or left element of that species. Extinct species are represented by an asterisk.

The homogeneous nature of the fossil avifauna of Itchtucknee readily lends itself to ecological interpretation. Species commonly found apart from aquatic situations are few and generally rare in numbers of specimens and individuals. The same may be said for forms generally limited to marine environments, seasonally or otherwise. Approximately 80 per cent of the species, representing 90 per cent of the total specimens, have moderate to pronounced affinities for fresh water, and of this group, most are birds which today are usually found about ponds and marshy situations. These are: *Podilymbus podiceps*, *Anhinga anhinga*, *Eudocimus albus*, *Olor buccinator*, *Anas platyrhynchos*, *A. fulvigula*, *A. acuta*, *A.*

TABLE 5
PLEISTOCENE BIRDS FROM ITCHTUCKNEE RIVER, FLORIDA

Species	Number of bones	Number of individuals	Species	Number of bones	Number of individuals
<i>Podilymbus podiceps</i>	58	4	<i>Spatula clypeata</i>	5	2
* <i>Podilymbus magnus</i>	2	2	<i>Aix sponsa</i>	9	3
<i>Podiceps auritus</i>	1	1	<i>Aythya affinis</i>	17	4
<i>Phalacrocorax auritus</i>	21	3	<i>Aythya collaris</i>	25	10
<i>Anhinga anhinga</i>	1	1	<i>Aythya americana</i>	2	1
<i>Ardea herodias</i>	8	2	<i>Aythya valisineria</i>	16	4
<i>Casmerodius albus</i>	1	1	<i>Bucephala albeola</i>	1	1
<i>Butorides virescens</i>	1	1	<i>Lophodytes cucullatus</i>	4	2
<i>Florida caerulea</i>	1	1	<i>Mergus merganser</i>	1	1
<i>Nycticorax nycticorax</i>	1	1	<i>Coragyps atratus</i>	1	1
* <i>Palaeophoxycolumbiana</i>	3	1	* <i>Gymnogyps amplus</i>	1	1
* <i>Ciconia malila</i>	2	1	* <i>Teratornis merriami</i>	1	1
<i>Mycteria americana</i>	1	1	<i>Buteo jamaicensis</i>	1	1
<i>Eudocimus albus</i>	1	1	<i>Pandion haliaetus</i>	10	3
<i>Olor buccinator</i>	15	5	<i>Meleagris gallopavo</i>	27	9
<i>Olor columbianus</i>	1	1	<i>Grus americana</i>	3	1
<i>Branta canadensis</i>			<i>Rallus elegans</i>	2	1
<i>hutchinsii</i>	2	1	<i>Rallus limicola</i>	1	1
<i>Branta canadensis</i> subsp.	22	4	<i>Porzana carolina</i>	1	1
<i>Anas platyrhynchos</i>	9	2	<i>Gallinula chloropus</i>	15	3
<i>Anas rubripes</i>	6	2	* <i>Gallinula brodkorbi</i>	5	3
<i>Anas fulvigula</i>	10	2	* <i>Fulica minor</i>	1	1
<i>Anas acuta</i>	6	2	<i>Fulica americana</i>	37	11
<i>Anas discors</i>	16	6	<i>Colaptes auratus</i>	1	1
* <i>Anas itchtucknee</i>	1	1	<i>Agelaius phoeniceus</i>	1	1
<i>Anas carolinensis</i>	3	1	<i>Quiscalus quiscula</i>	2	1
<i>Anas strepera</i>	4	1			
<i>Mareca americana</i>	5	4	TOTALS	392	122

* Extinct species.

discors, *A. carolinensis*, *A. strepera*, *Mareca americana*, *Spatula clypeata*, *Aix sponsa*, *Aythya collaris*, *Lophodytes cucullatus*, *Gallinula chloropus*, *Fulica americana*, and *Quiscalus quiscula*. Particularly significant is the presence in this group of *Podilymbus podiceps* and *Fulica americana* as they are the two most abundant species in the Itchtucknee deposits.

Extensive fresh water marsh conditions are lacking in the Itchtucknee drainage today, the land adjacent to the main stream and its tributaries being heavily timbered swamp or hammock. But evidence from the fossil avifauna seems rather conclusive that ponds and marshy conditions did exist at the time the bone beds were being laid down.

AGE OF THE DEPOSIT

The fossil remains of Pleistocene mammals, e.g., *Equus complicatus*, *Mastodon americanus*, *Nechoerus pinckneyi*, *Mytilodon harlani*, *Arctodus*, *Tapirus*, and *Parelephas*, reported by Simpson (1930) established the Itchtucknee River as an important Pleistocene locality. The admixture

of Pleistocene and Recent materials by stream action, however, complicates the dating of fossils. While such conditions are common in many stream deposits, major collecting sites were selected on the basis of least likelihood of admixture, and all specimens of doubtful age were eliminated.

As previously stated, a large majority of the fossils used in this study was obtained from Jug Spring and its tributary, i.e., Localities 1 and 2. The matrix along the upper reaches of the tributary is a homogeneous gray clay, largely lacking in detritus, which indicates a minimum reworking of the deposit. The excellent condition of the avian material at this site is further indication of such a lack of reworking, as muscle scars and processes are well preserved and show practically no abrasion. For these reasons, the avian fossils are believed to be contemporaneous with the deposit in this area. Teeth of *Equus* and one tooth of *Mastodon* were collected from this same deposit.

The cavern of Jug Spring presents a more complex picture than the tributary. Directly beneath the opening at a depth of about 35 feet were found numerous avian and mammalian fossils together with tree limbs, bits of glass, and a few scattered, unfossilized bones. There is no question that mixing has occurred in this area, but there were no such indications deeper in the cavern. It is doubtful that remains of Recent animals could be washed farther into the grotto as the force from the rate of flow is considerable. Fossils taken from deeper areas were heavily mineralized and perfectly preserved, and have evidently not been moved around very much as fairly complete remains of turtles and alligators have been found here. The scattered remains of the extinct mammal *Parelephas* sp. have been taken from depths near 85 feet.

Extensive mineralization of avian remains from the Itchtucknee area was found to be uniformly present. Two distinct color phases are represented among the fossils. Those taken from marl are a reddish brown while those on the bed of the stream are black. I think that these color variations are not indicative of differently aged bones, because elements, partially imbedded in marl, have been found in which both color phases are represented on the same specimen. Apparently, chemical action of the stream effects color transformation.

The main channel of the stream presents an interesting study in admixture, with Itchtucknee River flowing over Pleistocene beds and redepositing fossils upon younger material in the bed of the stream. Along the upper reaches of the river is found a variable amount of highly organic material containing twigs, skeletal elements of Recent animals, and numerous heavily mineralized bones. Near its mouth, this organic layer is almost completely absent, the stream flowing over bare lime-

stone. Fossils are relatively rare in this area, and of those collected identification was often made uncertain or impossible by extreme abrasion.

Primary deposits are Pleistocene in age, and from these, fossils are being freed by the eroding action of the stream. Both the tributary and spring run of Jug Spring, as well as its deeper cavern deposits, are believed to be principally of this type. Reworked deposits consist of younger materials, together with fossils which have been redeposited from Pleistocene beds. Such deposits are common in the main stream channel and near the mouth of tributaries.

Although the Itchtucknee River is today a swiftly flowing stream, scouring the bed of its relatively narrow channel, and freeing fossils from deposits along its banks, I think that at the time these fossil-bearing sediments were laid down, the river was broader and more sluggish. The principal bone beds of this area are composed of very fine, homogeneous clays which indicate that little current was present during their deposition. Also, along the upper reaches of the river, in the area known as the Flats, is found a well-developed, level flood plain. The Ocala limestone is exposed at higher elevations on either side of the flood plain so that it appears that a broader stream valley once existed in this area. While it is not known how present drainage patterns in Florida were affected by the alternate recession and encroachment of the sea during the Pleistocene, a raising of sea level could reduce the velocity of streams and favor development of ponded conditions. Such conditions would in turn be conducive to deposition of sediments, a situation contrary to that found in rapidly flowing bodies of water which erode and carry sediments to areas with lesser gradient. Temporary flooding of the Santa Fe River valley in recent years has caused extensive impoundment of water in the Itchtucknee area, and such conditions could be duplicated by a general rise in sea level such as occurred during the glacial recessions. The fresh water deposits of the Itchtucknee River indicate a more modest rise in sea level than would have occurred during interglacial times when inundation of this area occurred (MacNeil, 1950). As flooding during Pamlico (i.e., mid-Wisconsin) time was less extensive, the latter time designation for the Itchtucknee deposits seems more likely.

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SUMMARY

Fifty-two species of birds represented by 392 specimens are recorded from Pleistocene deposits of the Itchtucknee River, in Columbia County, Florida. Eight of these are extinct, and three species, *Palaeophox columbiana*, *Anas itchtucknee*, and *Gallinula brodkorbi*, are newly described.

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