AN EARLY IRVINGTONIAN AVIFAUNA FROM LEISEY SHELL PIT, FLORIDA

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ABSTRACT

A new early Irvingtonian avifauna is reported from Leisey Shell Pit, Hillsborough County, Florida. Bones of at least 30 extant and 15 extinct taxa are identified, including new species of spoonbill (*Ajaia chione*) and ibis (*Eudocimus leiseyi*). The avifauna is composed primarily of aquatic and wading species, with the earliest fossil occurrence of trumpeter swan (*Cygnus buccinator*), spoonbill, extinct flamingo (*Phoenicopterus copei*), eagle (*Amplibuteo* sp.) and the teratorn (*Teratornis merriami*), and the latest occurrence of an extinct loon (*Gavia concinna*). The flamingo, eagle, a large teratorn (*Teratornis* cf. *T. incredibilis*), and an extinct goose (*Branta dickeyi*) are also the first records of these taxa in the eastern U. S. The avifauna is indicative of a paleoenvironment of a coastal tidal marsh or wetland with nearby mud flats and sandy shores. This habitat is common along the Gulf Coast of Florida today, but lacks the diversity of avian species that was present in the early Pleistocene.

RESUMEN

Se reporta una nueva avifauna Irvingtoniana proveniente de los depósitos de conchuelas de Leisey, en el condado de Hillsborough, Florida. Se identificaron huesos pertenecientes a 30 especies actualmente existentes y a 15 especies extinguidas, incluyendo una nueva especie de espátula (*Ajaia chione*) y un nuevo ibis (*Eudocimus leiseyi*). La avifauna se compone primariamente de aves acuáticas y zancudas, con el fósil más antiguo de cisne trompetero (*Cygnus buccinator*), espátula, flamenco extincto (*Phoenicopterus copei*), águila (*Amplibuteo* sp.), de teratorn (*Teratornis merriami*), y además, la más reciente ocurrencia de un somorgujo extincto (*Gavia concinna*). El flamenco, águila, un gran teratorn *Teratornis* cf. *T. incredibilis*), y un ganso extincto (*Branta dickeyi*) representan también los primeros registros de estos taxones para el este de los Estados Unidos. Esta fauna es indicativa de un paleoambiente caracterizado por un humedal costero con influencia de mareas, o por un humedal con planicies lodosas y costas arenosas. Actualmente, este habitat es común a lo largo de la costa oeste de Florida, aunque no posee la diversidad de especies de aves que existía en el Pleistoceno temprano.

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INTRODUCTION

Excavations at Leisey Shell Pit, Hillsborough County, Florida, have produced over 280 bird bones of at least 45 taxa. Most of the avifauna was recovered from one level in the pit, designated Leisey Shell Pit 1A, where thousands of bones of terrestrial mammals and aquatic vertebrates were located and excavated by amateur paleontologists and personnel from the Florida Museum of Natural History (FLMNH), Gainesville. This portion of the shell pit has been dated to the late early Irvingtonian (1.5-1.0 Ma) based on associated vertebrate and invertebrate faunas, reversed paleomagnetism and strontium stratigraphy (Hulbert and Morgan 1989; Webb et. al 1989).

In December 1986, two additional bone beds were uncovered in the shell pit 0.5 km west of Leisey 1A. One of these beds, Leisey 3A, produced hundreds of bones of camel (*Hemiauchenia*), a rich microfauna, and 25 bones and 11 taxa of birds. The second bed, Leisey 3B, contained a small collection of vertebrates including 10 bones and 5 taxa of bird. Leisey 3A and 3B also date to the late early Irvingtonian and are nearly comtemporaneous with Leisey 1A (Morgan and Hulbert this volume). These three sites, as well as Leisey 1, 1B and 3, together comprise the Leisey Shell Pit local fauna (Hulbert and Morgan 1989). Leisey 1 and 3 refer to bones from the same quarry as Leisey 1A or 1B and 3A or 3B, respectively, but with unknown provenience within the Irvingtonian Bermont Formation. Leisey 1B is located stratigraphically below Leisey 1A, but within the Bermont Formation.

The avifaunas of the Leisey Shell Pit LF together represent a unified avifauna (Table 1). An additional 10 bird bones were collected from Leisey Shell Pit 2 by amateur paleontologists and the exact provenience and age of these bones within the pit is unknown. These bones include three taxa not known from the Leisey Shell Pit LF (Tables 1 and 2). Their age could be either late early Irvingtonian or Rancholabrean.

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METHODS

Comparisons and measurements of skeletal material of Recent and fossil birds were completed at FLMNH and in the collections of Pierce Brodkorb (also housed at FLMNH), Los Angeles County Museum of Natural History (LACM) and George C. Page Museum, Los Angeles, University of California Museum of Paleontology (UCMP) and Museum of Vertebrate Zoology (UCMVZ), Berkeley, National Museum of Natural History, Smithsonian Institution (USNM), Washington, D. C., American Museum of Natural History (AMNH), New York, Museum of Northern Arizona (MNA), Flagstaff. All measurements were taken with Vernier calipers to the nearest 0.1 mm. Terminology follows that of Howard (1927). All fossils are deposited at FLMNH and are catalogued with University of Florida (UF) numbers.

Minimum numbers of individuals were calculated for each taxon by counting the most common element of the same side. MNI's were determined separately for taxa from Leisey Shell Pit 1, 1A, 1B, 3, 3A and 3B and summed in Table 1. Table 2 provides MNI's for taxa from Leisey 2.

LEISEY SHELL PIT LOCAL FAUNA

SYSTEMATIC PALEONTOLOGY

Class AVES
Order GAVIIFORMES
Family GAVIIDAE
Gavia concinna Wetmore 1940

Referred Material.– Leisey 1A: distal left humerus, UF 63518; shaft left humerus, UF 86126; distal left tarsometatarsus, UF 82968.

Description.– These specimens are from a small loon, slightly smaller than the smallest living loon, *Gavia stellata* (Table 3). The humerus, UF 63518 and 86126, differs from *G. stellata* in having a shallower impression of brachialis anticus and deeper facets on lateral ectepicondyle; *G. immer* has a relatively larger ectepicondylar prominence. The tarsometatarsus, UF 82968, differs from *G. stellata*, *G. arctica*, *G. adamsii* and *G. immer* by its relatively smaller distal foramen, and the posterior proximal border of the middle trochlea which extends farther proximally in the fossil specimen.

Three fossil species of loons are known from the Pliocene of North America (Brodkorb 1963) and were compared to these specimens. The humerus of *Gavia palaeodytes* and *G. howardae* are smaller than UF 63518 and 86126, especially in the shaft (Table 3). Specimens of *G. concinna* from the Bone Valley Formation, Florida, agree with these specimens in size and characters, particularly with the extension of the border of the middle trochlea of the tarsometatarsus as described above.

Table 1. Early Irvingtonian avifauna of Leisey Shell Pit LF with total number of bones and minimum number of individuals (MNI) for each taxon. MNI's were calculated separately at each locality and summed below.

Taxon	No. Bones	MNI
*Gavia concinna**	3	2
Gavia immer	2	1
Podilymbus podiceps	27	8
Podiceps sp.	4	2
Pelecanus cf. *P. erythrorhynchos*	1	1
Phalacrocorax sp. or spp.	8	4
Anhinga anhinga	2	1
Anhinga sp.	1	1
Ardea sp.	2	1
Casmerodius albus	3	1
Egretta cf. *E. tricolor*	1	1
Egretta sp.	3	-
*Eudocimus leiseyi**	1	1
Threskiornithinae, gen. et sp. indet.	1	-
*Ajaia chione**	4	2
Ciconia sp.*	1	1
*Ciconia maltha**	9	2
Teratornis cf. *T. incredibilis**	1	1
*Teratornis merriami**	8	1
*Gymnogyps kofordi**	6	1
Gymnogyps sp.	1	-
Cygnus buccinator	5	1
Cygnus sp.	1	-
Branta canadensis	3	1
*Branta dickeyi**	2	1
*Anabernicula gracilenta**	4	2
Anas crecca	5	3
A. crecca or *A. discors*	13	-
A. platyrhynchos	2	1
A. americana	1	1
Anas sp.	9	-
Aythya americana	6	3
A. marila	2	1
A. americana or *A. marila*	3	-
A. affinis	9	3
A. collaris	2	1
A. affinis or *A. collaris*	9	-
Aythya sp.	8	-
Somateria cf. *S. spectabilis*	1	1
Bucephala albeola	5	3
Mergus serrator	1	1
Mergus sp.	1	-
Anatidae	17	-
Buteo sp.	1	-
Buteo cf. *B. lineatus*	1	1

Table 1 Continued.

Taxon	No. Bones	MNI
Aquila sp.	1	1
Amplibuteo sp.*	6	1
Accipitridae	1	-
*Meleagris leopoldi/anza**	5	2
Colinus sp.	1	1
Rallus sp.	2	2
Fulica americana	19	5
Grus canadensis	7	2
Grus sp.*	2	2
Recurvirostra sp.*	2	1
Limosa cf. *L. fedoa*	1	1
Alcidae, gen. et sp. indet.	2	1
Phoenicopterus ruber	2	1
*P. copei**	2	1
Bubo virginianus	2	1
Corvus sp.	1	1
Aves, indet.	18	-
Total	281	80

*extinct taxon

Table 2. Irvingtonian or Rancholabrean avifauna of Leisey Shell Pit 2 with total number of bones and minimum number of individuals (MNI) for each taxon.

Taxon	No. bones	MNI
Podilymbus podiceps	1	1
Phalacrocorax sp.	1	1
Anhinga anhinga	1	1
*Ciconia maltha**	2	1
Buteo sp.	1	1
Grus americana	1	1
Jacana spinosa	1	1
cf. Icterinae	1	1
Aves, indet.	1	-
Total	10	8

*extinct taxon

Discussion.-- The referral of these specimens to the extinct loon *Gavia concinna* extends the geologic range of this species by 2-3 million years. Prior to now, *G. concinna* was known only from the Pliocene Bone Valley Formation and the Etchegoin Formation, California (Brodkorb 1963a). Chandler (1990) considers previously referred material from the San Diego Formation, California, to represent an undescribed species. After identifying these specimens, another specimen was found in the collections at FLMNH from Port Charlotte, Charlotte County, Florida. This bone, a distal left humerus (UF 22594), is from deposits dated to the Irvingtonian and has characters of *G. concinna*, including size (Table 3).

Gavia immer (Brünnich 1764)

Referred Material.-- Leisey 1: distal right humerus, UF 93272. Leisey 3: distal right tarsometatarsus, UF 124566.

Table 3. Comparative measurements (in mm) of fossil and Recent loon (*Gavia*) humeri to specimens from Leisey Shell Pit 1A and Port Charlotte, Florida. For each set of numbers the top row = mean ± s.d, bottom row = range, m = male, f = female.

Species	Least Breadth Shaft	Least Depth Shaft	Distal Breadth	Distal Depth
G. arctica (3m, 2f, 1?)	7.3 ± .2 7.0-7.8	5.8 ± .3 5.5-6.2	14.3 ± .5 13.7-15.1	9.7 ± .5 9.0-10.3
G. stellata (5m, 9f, 1?)	7.0 ± .5 5.8-7.7	5.8 ± .5 5.1-6.6	13.7 ± .7 12.5-14.7	9.4 ± .7 8.6-11.1
G. adamsii (1m, 1f)	10.8 10.8	8.7 8.5-8.8	20.4 20.0-20.8	14.3 13.7-14.8
G. immer (10m, 10f)	9.5 ± 1.0 8.3-11.4	7.9 ± .8 6.6-9.5	19.0 ± 1.8 16.9-22.4	13.5 ± 1.2 12.1-15.7
G. palaeodytes[1] (N=4)	7.7 ± .3 7.3-8.0	5.9 ± .4 5.4-6.3	14.1 ± 1.0 13.0-15.1	9.7 ± .3 9.4-10.0
G. howardae[2] Range (N=3)	-	-	12.0-14.4	8.8-9.3
G. concinna[1] (N=4)	8.3 ± .3 8.0-8.6	6.4 ± .5 5.9-7.0	15.1 ± .7 14.3-15.7	10.5 ± .7 10.0-11.5
UF 63518 (Leisey 1A)	8.5	6.6	15.8	11.0
UF 86126 (Leisey 1A)	8.1	6.8	-	-
UF 22595 (Port Charlotte)	7.8	6.4	15.9	11.2

[1]Specimens from Bone Valley, Florida (early Pliocene).
[2]Data from Brodkorb (1955).

Order PODICIPEDIFORMES
Family PODICIPEDIDAE
Podilymbus podiceps (Linnaeus 1758)

Referred Material.– Leisey 1A: 3 right coracoids, UF 69647, 80417, 80440; 6 left coracoids, UF 80418-80419, 80421, 84003, 85010, 87234; sternal end of left coracoid, UF 85179; 3 distal left humeri, UF 69644, 80441, 85011; proximal left ulna, UF 69400; distal left ulna, UF 85002; 2 left femora, UF 65812, 80415; distal right femur, UF 69637; right femur missing distal end, UF 80416; distal left tibiotarsus, UF 69640; distal right tibiotarsus, UF 80439. **Leisey 3A**: left coracoid, UF 95949; distal right humerus, UF 95950; left femur, UF 95888; proximal left tibiotarsus, UF 95898; distal left tibiotarsus, UF 95893; distal right tarsometatarsus, UF 95894.

Podiceps sp.

Referred Material.– Leisey 1A: left coracoid with ends damaged, UF 80422; humeral end of left coracoid, UF 85134; left tibiotarsus, UF 80420. **Leisey 3**: proximal left tarsometatarsus, UF 129066.

Description.– These specimens are intermediate in size between large individuals of *Podiceps auritus* and small individuals of *P. grisegena* and cannot be satisfactorily assigned to either species. Fossil grebes of this genus include *P. oligoceanus* from the early Miocene of Oregon, *P. pisanus* from the middle Pliocene of Italy, *P. subparvus* from the middle Pliocene of California, *P. discors* from the late Pliocene of Kansas, *P. parvus* from the early to middle Pleistocene of California and Oregon, *P. dixi* from the late Pleistocene of Florida, and *P. arndti* from the late Pliocene of California (Brodkorb 1963b; Murray 1967; Chandler 1990).

Specimens of *Podiceps subparvus* and *P. parvus* were examined at LACM. *P. subparvus* (LACM 5754) is approximately equal in size but not in relative proportions to UF 80420 (Table 4). The proximal articular surface appears relatively broader in UF 80420, and the distal shaft and condyles are more robust in LACM 5754. *P. parvus* (LACM 2546, 2220, 6923) compares most closely to UF 80420 except for a more robust shaft in the former (Table 4). *P. arndti* is smaller than *P. grisegena* (Chandler 1990) and has a relatively more robust tibiotarsus than UF 80420 and 86276. *P. discors* is known by only a single tarsometatarsus and is near the size of *P. nigricollis* or female *P. auritus* (Murray 1967). *P. dixi* is an extinct grebe, larger than *P. auritus*, described by Brodkorb (1963b) from the late Pleistocene of Florida based on a proximal carpometacarpus. Steadman (1984) regards *P. dixi* to be a synonym of *P. auritus* because of a lack of diagnostic material. The specimens here, however, indicate Brodkorb (1963b) was correct in recognizing that a grebe larger than *P. auritus* occurred in the

Pleistocene of Florida, but whether this grebe represents a distinct species or a large form of *P. auritus* cannot be determined.

Order PELECANIFORMES
Family PELECANIDAE
Pelecanus cf. *P. erythrorhynchos* Gmelin 1789

Referred Material.– Leisey 1A: head of right humerus, UF 81721. **Leisey 3**: distal right humerus, UF 124571; distal left tibiotarsus, UF 124572.

Description.– These specimens are tentatively referred to species by their large size, equal to that of *Pelecanus erythrorhynchos* and much greater than that of *P. occidentalis*. *P. halieus*, an extinct species from the late Pliocene of Hagerman, Idaho, is known by only a proximal radius and is smaller than *P. occidentalis* (Wetmore 1933).

Discussion.– These specimens are the first fossil occurrence of an extant species of pelican in Florida. *Pelecanus erythrorhynchos* has been identified from late Pleistocene localities in California, Nevada and Kansas (Lundelius et al. 1983).

Table 4. Comparative measurements (mm) of grebe (*Podiceps*) tibiotarsi.

Specimen	Length without Cnemial Crest	Proximal Breadth	Proximal Depth	Least Breadth Shaft	Least Depth Shaft	Distal Breadth	Distal Depth
Podiceps sp.							
UF 80420	90.5	8.4	9.1	4.0	2.7	8.2	8.2
P. subparvus							
LACM 5754	97.3	8.3	6.6	4.6	3.3	8.8	8.4
P. parvus							
LACM 2546	-	8.5	8.0	-	-	-	
LACM 2220	-	9.5	9.3	5.1	3.5	-	-
LACM 6923	-	-	-	-	-	9.7	9.2

Family PHALACROCORACIDAE
Phalacrocorax sp. or spp.

Referred Material.– **Leisey 1A**: distal right tarsometatarsus, UF 125199. **Leisey 3**: upper mandible, UF 124567; proximal left humerus, UF 129068; proximal left ulna, UF 102549; right carpometacarpus, UF 124568; distal right tarsometatarsus, UF 102545; distal left tarsometatarsus, UF 102544. **Leisey 3B**: complete right tibiotarsus, UF 116097.

Description.– UF 124567 measures length, 51.6 mm; depth and breadth at anterior nares (closed), 6.1 and 8.8 mm. UF 124568 measures length, 68.2; proximal breadth and depth, 6.7 and 14.7 mm; distal breadth and depth, 7.4 and 8.0 mm; least breadth and depth of shaft, 5.3 and 3.8 mm. UF 116097 measures length, 117.4 mm; proximal breadth and depth, 12.8 and 16.2 mm; least breadth and depth of shaft, 7.7 and 5.4 mm; distal breadth and depth, 13.5 and 12.7 mm.

All specimens except UF 124567 are from a large cormorant, near the size of male *Phalacrocorax auritus* or *P. penicillatus*. UF 124567 is from a small cormorant, similar in size and characters to *P. brasilianus*, and may represent that species.

Family ANHINGIDAE
Anhinga anhinga (Linnaeus 1766)

Referred Material.– **Leisey 1**: distal right ulna, UF 95621. **Leisey 3A**: right coracoid with ends damaged, UF 95896.

Anhinga sp.

Referred Material.– **Leisey 3A**: right tibiotarsus, UF 95948.

Description.– This specimen is from a short-legged, robust individual compared to *A. anhinga* (Table 5), suggesting that two species are represented in the avifauna, but additional material is needed to verify the taxa.

Discussion.– The fossil history of Anhingidae is reviewed by Olson (1985) and Becker (1986). Becker (1986) reports additional localities for *Anhinga grandis* from the late Miocene of Florida, and an indeterminate large species from the early Pliocene (Bone Valley District) and late Pleistocene (Coleman 3; Ritchie 1980). The specimen from Coleman 3 is a distal ulna (UF 16664) and is not comparable

Table 5. Comparative measurements (mm) of anhinga (*Anhinga*) tibiotarsi.

Specimen	Length without Cnemial Crest	Proximal Breadth	Proximal Depth	Least Breadth Shaft	Least Depth Shaft	Distal Breadth	Distal Depth
Anhinga anhinga (6m, 6f, 1?)							
mean ± s.d.	84.5±2.4	10.2±0.3	15.4±0.7	5.2±0.3	4.2±0.1	10.3±0.4	9.1±0.3
Range	79.4-88.3	9.5-10.9	14.3-17.1	4.6-5.7	4.0-4.4	9.6-10.8	8.5-9.8
Leisey 3A UF 95948	82.7	11.0	15.6	6.3	5.3	10.6	10.0

to the Leisey specimen. In addition, an unreported distal left humerus (UF 102203) and distal left tibiotarsus (UF 102204) from the late Pleistocene Cutler Fossil Site, Dade Co., Florida, are also from a large anhinga. These records suggest that two lineages of anhinga are present in the fossil record of Florida. One lineage of large anhingas, beginning with *A. grandis* in the late Miocene, existed until the end of the Pleistocene. A second lineage of smaller anhingas is represented by the living species. Additional specimens are needed to determine systematic relationships of these taxa.

Order CICONIIFORMES
Family ARDEIDAE
Ardea sp.

Referred Material.– Leisey 3: left carpometacarpus lacking distal end, UF 123875; distal right tibiotarsus, UF 129061.

Description.– UF 123875 is similar to *Ardea herodias* (n=7, UCMVZ) except that it is slightly more robust, and the anterior distal margins of the carpal trochlea extend relatively farther distally, with a longer and deeper depression between the margins than in the living species. It measures proximal breadth and depth, 9.0 and 21.2 mm; least breadth and depth of shaft, 7.3 and 5.6 mm. UF 129061 is from a heron most similar to *Ardea*, but much larger and probably

represents an extinct species. It measures distal breadth and depth, 16.9 and 20.5 mm.

Casmerodius albus (Linnaeus 1758)

Referred Material.– Leisey 1A: distal right femur, UF 65811; distal right tibiotarsus, UF 125198; phalanx, UF 69646.

Egretta cf. *E. tricolor* (Muller 1776)

Referred Material.– Leisey 1A: distal right tarsometatarsus missing internal and middle trochleae, UF 82999.

Description.– Compared to *Egretta thula*, *E. caeurlea*, and *E. tricolor*, this specimen is most similar to this last species in the position of the distal foramen and the relative size and position of the metatarsal facet.

Egretta sp.

Referred Material..– Leisey 1A: right coracoid, UF 82965; sternal end of right coracoid, UF 85180; distal right tarsometatarsus, UF 80427.

Description.– These elements are equal in size to *Egretta tricolor*, *E. thula*, and *E. caerulea* and probably represent one of these species.

Family THRESKIORNITHIDAE
Subfamily THRESKIORNITHINAE
***Eudocimus leiseyi* n. sp.**

Holotype.– Complete left tarsometatarsus, UF 80426 (Fig. 1). Collected August 1984.

Type Locality.– Leisey Shell Pit 1A, NW 1/4, SE 1/4, SW 1/4 Sec. 15, T. 32 S., R. 18 E., Ruskin 7.5' Quadrangle; Hillsborough County, Florida. Bermont Formation.

Range and Distribution.– Late Blancan to late early Irvingtonian. This new species also is known from Macasphalt Shell Pit, Sarasota County, Florida (Emslie 1992).

Diagnosis.-- Recognized as *Eudocimus* by (1) single opening for proximal intertrochlear foramen and vascular foramen (these foramina are separate in *Plegadis*, also see Olson 1981), and (2) uneven borders of anterior metatarsal groove in sagittal plane (borders parallel in *Plegadis*).

Differs from *Eudocimus albus*, *E. ruber* and *E. peruvianus* by: (1) distinctly smaller size and slender shaft (Table 6), (2) hypotarsus with single, centrally-placed tendinal opening entirely enclosed by bone (this opening is laterally-placed and is open posteriorly in other species of *Eudocimus*), (3) prominence lateral to external rim of external cotyla greatly reduced (this prominence is large in other species of *Eudocimus* and reduced in *Plegadis*). In all other features and proportions the specimen is similar to *Eudocimus*.

Etymology.-- Named for Mr. Bud Leisey, owner of Leisey Shell Pit, who generously delayed mining operations for over a year in the portion of the shell pit where the bone bed was located so that paleontologists could excavate the fossils.

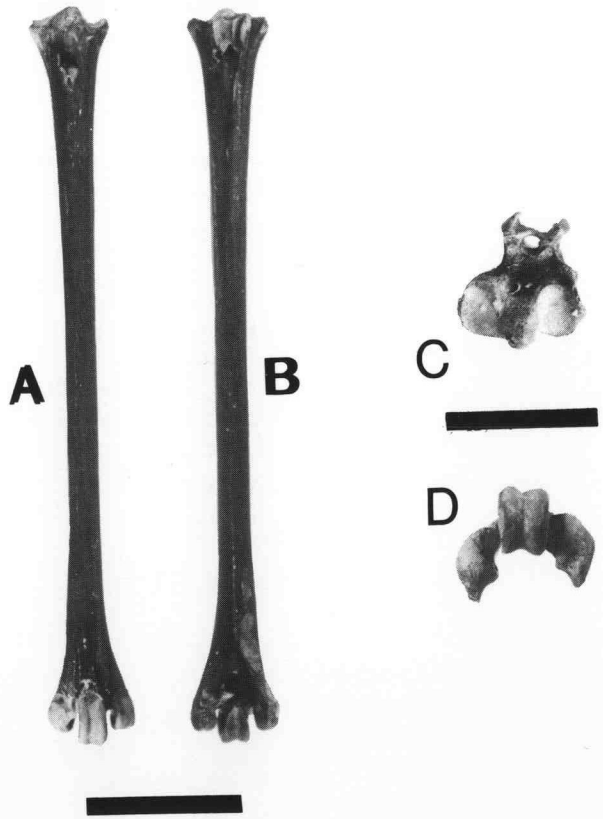

Figure 1. Holotype left tarsometatarsus (UF 80426) of *Eudocimus leiseyi* n. sp. from Leisey 1A (A) anterior view, (B) posterior view (1X, bar=2 cm), and (C) proximal view, (D) distal view (2X, bar=1 cm).

Table 6. Comparative measurements of ibis tarsometatarsi to *Eudocimus leiseyi* n. sp. from Leisey Shell Pit 1A.

Specimen	Length	Proximal Breadth	Proximal Depth	Shaft Least Breadth	Shaft Least Depth	Distal Breadth	Trochleae Internal Breadth	Trochleae Internal Depth	Trochleae Middle Breadth	Trochleae Middle Depth	Trochleae External Breadth	Trochleae External Depth
Eudocimus albus (7Á, 13Â, 9?)												
Ø±s.d.	92.0±8.0	11.5±0.9	11.7±0.8	4.6±0.3	3.4±0.2	11.8±0.8	3.3±0.3	6.4±0.5	4.5±0.3	6.0±0.4	3.3±0.3	6.7±0.5
Range	79.1-105.0	10.0-13.6	10.7-13.3	4.0-5.2	3.0-3.9	10.4-13.5	2.7-4.1	5.5-7.2	4.0-5.2	5.2-6.8	2.6-4.0	5.8-7.8
E. ruber (4Á, 5?)												
Ø±s.d.	83.4±6.1	11.0±0.7	11.3±0.7	4.6±0.3	3.2±0.2	11.4±0.7	3.2±0.2	6.0±0.6	4.3±0.2	5.7±0.3	3.2±0.2	6.5±0.6
Range	76.1-95.5	10.1-12.1	10.6-12.4	4.3-5.1	2.8-3.6	10.5-12.6	3.0-3.6	4.6-6.7	4.1-4.8	5.3-6.3	3.0-3.6	6.0-7.8
Phimosus infuscatus (USNM 190315, ?)	57.4	9.5	10.1	4.0	2.5	9.7	2.7	5.1	3.5	4.9	2.3	5.6
Mesembrinibis cayennensis (USNM 345762, Á)	64.1	10.9	10.7	4.5	3.6	11.0	3.2	5.6	4.1	5.4	2.9	6.1
Theristicus melanopsis (UCMVZ 125155, Á)	72.5	13.8	12.6	5.1	3.5	13.4	4.9	4.9	5.1	6.5	3.1	6.3
T. caudatus (UCMVZ 94065, Á)	79.4	14.2	13.1	5.7	4.3	13.7	4.3	5.7	5.0	6.8	3.6	5.7
E. leiseyi UF 80426	77.9	8.8	9.5	3.6	2.7	9.6	2.6	4.6	3.5	4.5	2.9	4.8
Plegadis gracilis UCMP 45088	-	8.0	-	3.4	-	-	-	-	-	-	-	-

Discussion.– Three fossil ibis have been described from the New World: *Theristicus wetmorei* and *Eudocimus peruvianus* from the late Pleistocene of Peru (Campbell 1979) and *Plegadis gracilis* [=*P. pharangites* (Olson 1981)] from the late Pliocene of Texas (A. H. Miller and Bowman 1956). Three other bones from the early Pliocene Bone Valley Formation of Florida, and a distal tibiotarsus from the early Pliocene Lee Creek, North Carolina, have been referred to *Eudocimus* sp. (Brodkorb 1972; Olson 1981). These bones are as large or larger than *E. albus* and are not comparable to UF 80426.

Eudocimus leiseyi is the smallest species known for this genus and is smaller than *Plegadis falcinellus* or *P. chihi*. Only the fossil species *P. pharangites* approaches the size of *E. leiseyi*. The former is known by a proximal tarsometatarsus, carpometacarpus, and distal ulna from Cita Canyon, Texas (Miller and Bowman 1956), and by two distal tibiotarsi and a coracoid from Rexroad, Kansas (Collins 1964). It is recognized as *Plegadis* by characters given by Collins (1964), and differs from *E. leiseyi* and is most similar to Recent *Eudocimus* and *Plegadis* by characters of the proximal tarsometatarsus given above.

THRESKIORNITHINAE, indet. gen. et sp.

Referred Material.– Leisey 3: proximal right tibiotarsus, UF 123999.

Description.– This specimen is from an ibis similar in size to *Plegadis chihi*, but is too fragmentary for generic or specific identification.

Subfamily PLATALEINAE
Ajaia chione n. sp.

Type Specimens.– Holotype, distal right tibiotarsus, UF 82996 (Fig. 2). Paratypes, distal right tibiotarsus, UF 82967; proximal left tarsometatarsus, UF 82997; distal left tarsometatarsus lacking external and part of middle trochleae, UF 69645.

Type Locality.– Leisey Shell Pit 1A, NW 1/4, SE 1/4, SW 1/4 Sec. 15, T. 32 S., R. 18 E., Ruskin 7.5' Quadrangle; Hillsborough County, Florida. Bermont Formation.

Range.– Known only from the type locality, late early Irvingtonian.

Diagnosis.– Recognized as *Ajaia* and differs from *Platalea* by (1) smaller size (Table 7), (2) tarsometatarsus in posterior view with internal trochlea angled less posterior-externally, (3) tibiotarsus with narrower intercondylar fossa, and (4)

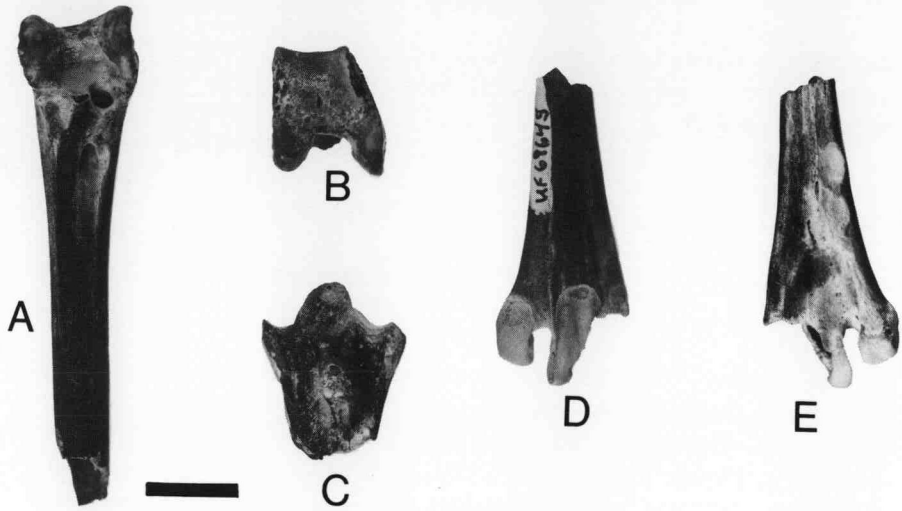

Figure 2. Holotype distal right tibiotarsus (UF 82996) of *Ajaia chione* n. sp. from Leisey 1A; (A) anterior view, (B) distal view. Paratypes, proximal left tarsometatarsus (UF 82997); (C, anterior), and distal left tarsometatarsus (UF 69645) in anterior (D) and posterior (E) views (1.5X, bar=1 cm).

Table 7. Comparative measurements of spoonbill (*Platalea* and *Ajaia*) tarsometatarsi to *A. chione* n. sp. from Leisey Shell Pit 1A.

Specimen	Proximal Breadth	Shaft Least Breadth	Shaft Least Depth	Distal Trochleae Internal Breadth	Distal Trochleae Internal Depth	Distal Trochleae Middle Depth
P. leucorodia (USNM 491329)	16.0	6.2	5.5	4.4	9.3	8.3
P. alba (USNM 558417)	16.0	6.0	5.4	4.4	9.6	8.6
A. ajaja (5m, 7?)						
mean±s.d.	14.5±0.6	5.8±0.3	4.5±0.3	4.1±0.1	8.2±0.4	7.8±0.4
Range	13.6-15.5	5.5-6.5	4.1-5.0	3.9-4.3	7.7-9.1	7.3-8.6
A. chione						
UF 82997	16.1	-	-	-	-	-
UF 69645	-	6.8	5.1	4.2	7.8	8.0

internal medial border of shaft of tibiotarsus more steeply angled proximally from the anterior proximal edge of the internal condyle to the shaft.

Differs from *Ajaia ajaja* by tibiotarsus with (1) relatively larger and rounder distal foramen, (2) external condyle less robust, (3) intercondylar fossa relatively

broader (but not as broad as in *Platalea*), and (4) proximal tendinal foramen located more medial with relatively more distinct medial border extending proximally on shaft.

Tarsometatarsus with (1) larger distal foramen in posterior view, (2) distal foramen angled more dorso-ventrally than proximo-distally so that the opening is more visible in anterior view, (3) metatarsal facets relatively larger.

Etymology.– From *Chione*, the most common genus of mollusk in the bone bed deposit at Leisey Shell Pit 1A.

Discussion.– This material represents the first fossil spoonbill to be described from North America, and the only fossil material known prior to the late Pleistocene. Bones of *Ajaia ajaja* have been reported from late Pleistocene deposits in Florida (Woolfenden 1959), California (Howard 1930), and Peru (Campbell 1979), and it is possible that *A. chione* is the direct ancestor of the living species.

Family CICONIIDAE

Ciconia sp.

Referred Material.– Leisey 3: humeral end of left coracoid, UF 123869.

Description.– The breadth and depth of the coraco-humeral surface measures 11.0 and 19.4 mm; the internal border of this surface is steeply angled in *Mycteria americana* (N=3, UCMVZ), *Leptoptilos*, *Anastomus* and *Ephippiorhynchus*. This specimen is similar in this and other characters to *Ciconia ciconia*, and is much smaller than the large, extinct *C. maltha*.

Discussion.– This specimen represents the first Pleistocene record of a small stork of this genus in the New World. Becker (1985) identified at least three species of *Ciconia* from the Love Bone Bed (late Miocene) of Florida of which one was similar in size to the living *C. ciconia*. It is possible that the specimen from Leisey represents an extension of this lineage, but additional material is needed.

Ciconia maltha L. Miller 1910

Referred Material.– Leisey 1A: shaft right radius, UF 80432; anterior carina of sternum, UF 84001; cervical vertebra, UF 63522; distal right tibiotarsus, UF 65806 (Fig. 3); distal right tibiotarsus missing internal condyle, UF 80428; proximal right tarsometatarsus, UF 65805 (Fig. 3); distal right tarsometatarsus, UF 80433 (Fig. 4); two proximal phalanges, UF 80435 and 85009.

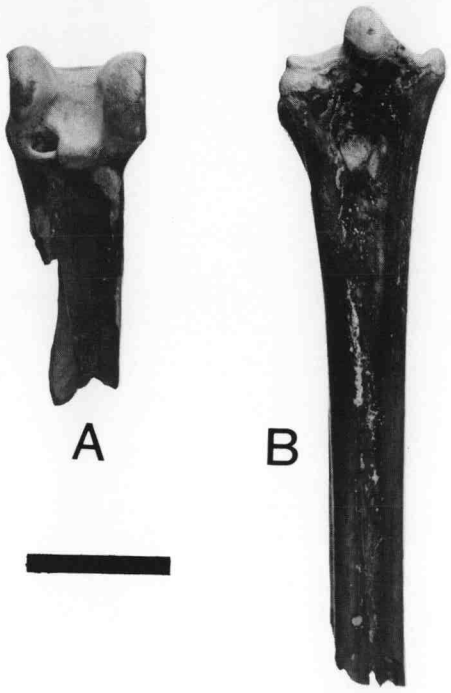

Figure 3. (A) distal right tibiotarsus (UF 65806) and (B) proximal right tarsometatarsus (UF 65805) of *Ciconia maltha* from Leisey 1A (1X, bar=2cm).

Description.-- UF 65806 measures distal breadth and depth, 19.0 and 23.3 mm. UF 65805 measures proximal breadth and depth, 22.7 and 24.1 mm. UF 80433 measures least breadth and depth of shaft, 9.3 and 7.1 mm; distal breadth, 24.6 mm; breadth and depth and internal trochlea, 7.6 and 12.2 mm; breadth and depth of middle trochlea, 8.8 and 12.2 mm; breadth and depth of external trochlea, 6.6 and 12.0 mm (see also Figs. 3-4).

Discussion.-- This large, extinct stork is well known from numerous fossil sites in western North America and Florida ranging in age from Blancan through Rancholabrean (Brodkorb 1963a; Feduccia 1967). The material here compares well with fossil specimens from the Rancholabrean of Florida.

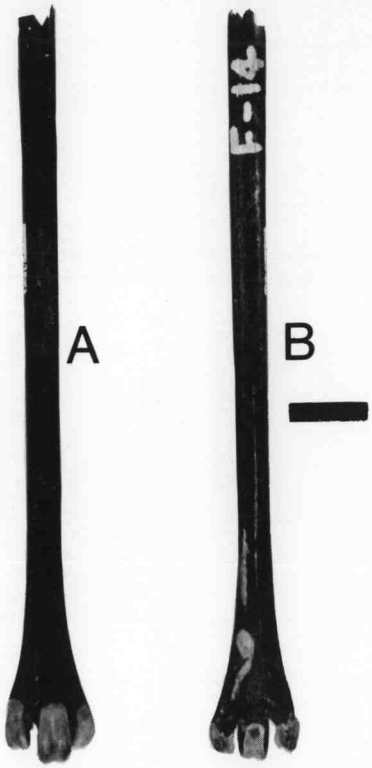

Figure 4. Distal right tarsometatarsus (UF 80433) of *Ciconia maltha* from Leisey 1A. (A) posterior view, (B) anterior view (0.5X, bar=2 cm).

Family TERATORNITHIDAE

Teratornis cf. *T. incredibilis* Howard 1952

Referred Material.-- Leisey 3: proximal end of right carpometacarpus, UF 123874 (Fig. 5).

Description.-- This specimen measures proximal breadth of carpal trochlea, 26.7 mm; it is identical in characters to *Teratornis merriami*, but is approximately 40% larger. These characters distinguish *T. incredibilis* from *T. merriami* and the specimen is tentatively identified to that species.

Discussion.-- This specimen represents the first record of this taxon in the eastern U. S., and only the fourth record for the species. It is known by only three other bones from three localities of discrepant ages: a cuneiform from the late Rancholabrean Smith Creek Cave, Nevada, a distal radius from the Irvingtonian Vallecito Creek and upper mandible from the late Blancan Fish Creek, California

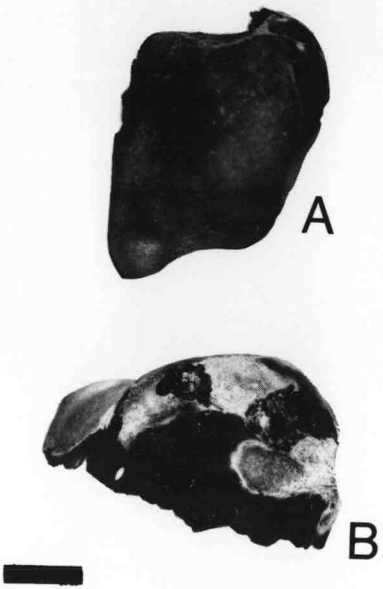

Figure 5. Proximal right carpometacarpus (UF 123874) of *Teratornis* cf. *T. incredibilis*. (A) proximal view, (B) lateral view (1.7X, bar=1 cm).

(Howard 1952, 1963, 1972). The fossil record of this taxon is too sparse to determine whether or not a single species is represented by these bones.

Teratornis merriami L. Miller 1909

Referred Material.-- Leisey 1A: shaft left coracoid, UF 65807; proximal left scapula, UF 82984; proximal left humerus, UF 63508 (Fig. 6); proximal right ulna, UF 63510; partial left ulnar, UF 69399; distal right carpometacarpus, UF 63515; midsection of sacrum, UF 63511; distal right tarsometatarsus, UF 63509 (Fig. 6).

Description.-- All specimens (excluding UF 69399 and 82984) were found within a small area (< 1 sq. m) of the bone bed deposit and are probably from the same individual. Except for their generally smaller size, these specimens compare well to *Teratornis merriami* from Rancho La Brea, California, particularly in the relative height and position of the distal trochleae of the tarsometatarsus (Fig. 6). Although 7 elements are represented, most are too fragmentary for comparative

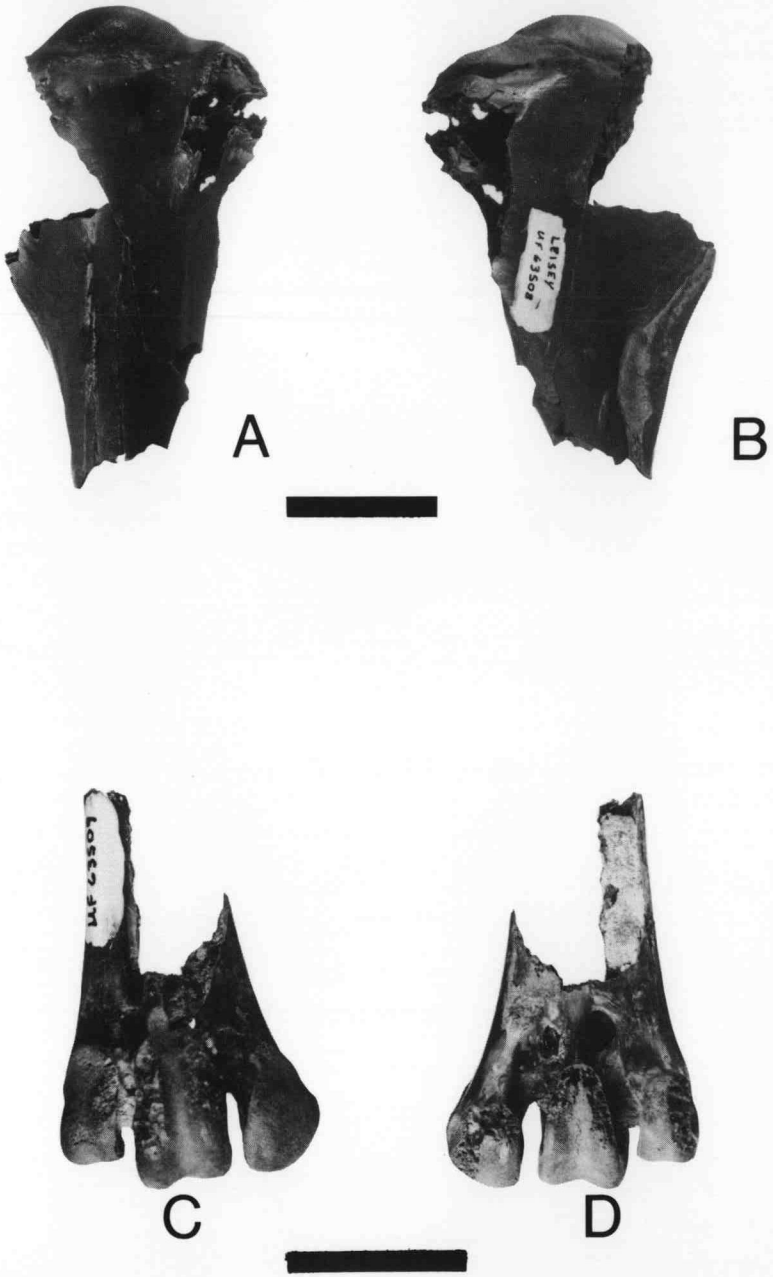

Figure 6. (A) anconal and (B) palmar views of the proximal left humerus (UF 63508; 0.55X, bar=3 cm), and (C) anterior and (D) posterior views of the distal right tarsometatarsus (UF 63509; 1X, bar=2 cm) of *Teratornis merriami* from Leisey 1A.

Table 8. Comparative measurements (mm) of the proximal ulna of *Teratornis merriami* from Rancho La Brea, California, and Leisey Shell Pit 1A.

Specimen	Proximal Breadth	Proximal Depth
Rancho La Brea		
N	15	15
mean±s.d.	39.2±1.3	30.9±1.7
Range	36.5-42.2	28.0-34.8
Leisey 1A		
UF 63510	35.8	28.7

Table 9. Comparative measurements (mm) of the distal tarsometatarsus of *Teratornis merriami* from Rancho La Brea, California, and Leisey Shell Pit 1A.

Specimen	Breadth	Internal Breadth	Internal Depth	Trochleae Middle Breadth	Trochleae Middle Depth	External Breadth	External Depth
Rancho La Brea							
N	26	28	28	33	32	27	28
mean±s.d.	32.3±1.4	10.4±0.5	16.1±0.7	12.4±0.6	19.4±0.6	7.7±0.4	15.5±0.8
Range	29.8-34.4	9.5-11.3	14.8-17.8	11.7-13.5	17.6-20.7	6.8-8.3	14.2-17.2
Leisey 1A							
UF 63509	29.5	10.0	14.3	10.9	17.9	7.0	13.0

measurements except the proximal ulna, UF 63510 (Table 8), and the distal tarsometatarsus, UF 63509 (Table 9). These measurements indicate a smaller proximal breadth of the ulna, and a smaller breadth and depth of the distal trochleae of the tarsometatarsus, from Leisey 1A compared to *T. merriami*. The smaller size of the Leisey 1A material may be due to geographical or temporal variation within the species.

Discussion.— These specimens extend the geologic range of *Teratornis merriami* into the early Pleistocene and are the earliest record of this species now known. It has been reported from the Rancholabrean of western North America and Florida (Brodkorb 1964) and only one other species in this genus, *T. incredibilis*, has been described from North America (Howard 1972). The earliest record of the family is from the late Miocene of Argentina, suggesting that this

group evolved in South America (Campbell and Tonni 1980. It now appears that the teratorns first arrived in North America in the late Pliocene or early Pleistocene during the Great American Interchange.

Family VULTURIDAE

Gymnogyps kofordi Emslie 1988

Referred Material.– Leisey 1A: partial cranium, UF 63517; upper mandible, UF 87232; left carpometacarpus, UF 63514; distal right ulna, UF 63516; left femur, UF 63513; right tarsometatarsus, UF 63512.

Description.– This material is the basis of a new species described elsewhere (Emslie 1988). It is known also from 34 elements of two individuals from Haile 16A, Alachua Co., Florida, which is slightly older in age than Leisey Shell Pit 1A.

Discussion.– This new species shares a common ancestor to the living California condor, *Gymnogyps californianus*. A phylogenetic comparsion of living and fossil condors is provided by Emslie (1988).

Gymnogyps sp.

Referred Material.– Leisey 1: cervical vertebrae, UF 93818.

Description.– Vertebrae of *Gymnogyps kofordi* from Leisey Shell Pit 1A and *G. californianus* are indistinguishable (Emslie 1988) and this specimen cannot be assigned to species.

Order ANSERIFORMES

Family ANATIDAE

Cygnus buccinator Richardson 1832

Referred Material.– Leisey 1A: proximal right humerus, UF 82964; distal right humerus, UF 63519; proximal right ulna, UF 85008; distal left ulna, UF 86367; fragment of sternum, UF 85013.

Description.– Only one fossil species in this genus has been described from North America: *Cygnus paloregonus* (Howard 1946) from Fossil Lake, Oregon. Characters of the distal humerus provided by Howard (1946), however, do not agree with UF 63519; other characters for this extinct species are on elements not present in this fragmentary material.

Discussion.– This swan has been reported in abundance from Rancholabrean deposits at Ichetucknee River, Florida (Campbell 1980). The material here represents the earliest reported fossil occurrence of this species in North America.

Cygnus sp.

Referred Material.– **Leisey 1A**: shaft left tibiotarsus, UF 86394. **Leisey 3**: shaft of right humerus, UF 124553.

Description.– Too fragmentary for positive identification, these specimens probably represent *Cygnus buccinator*.

Branta canadensis (Linnaeus 1758)

Referred Material.– **Leisey 1A**: right scapula, UF 82985; proximal right radius, UF 65808. **Leisey 3**: humeral end of right coracoid, UF 129062.

Branta dickeyi L. Miller 1924

Referred Material.– **Leisey 1A**: manubrium of sternum, UF 82966; right carpometacarpus, UF 87235 (Fig. 7). **Leisey 3**: right carpometacarpus, UF 124570.

Description.– These specimens were compared to *Cygnus*, *Anser*, *Chen*, and *Branta* and found to compare most closely in characters to the last genus. In particular, *Cygnus* has a sternum with a large ventral manubrial spine and reduced or no dorsal manubrial spine while *Branta* and UF 82966 have a smaller ventral spine and distinct dorsal spine. The carpometacarpus of *Branta* and UF 87235 (Fig. 7) and 124570 have a rounded proximal external border of the carpal trochlea (high and pointed in *Cygnus*), a deep dorsal fossa distal to the carpal trochlea (shallow in *Cygnus*), and relatively shorter proximal and distal symphyses (long in *Cygnus*). UF 87235 and 124570 are larger than *B. canadensis*, including 4 specimens of *B. c. canadensis* (Table 10), and equal the size of *Cygnus*.

Miller (1924) described the giant goose *Branta dickeyi* from a distal tibiotarsus from McKittrick, California, that is as large as *Cygnus columbianus* but retains characteristics of *Branta*. Later, Miller (1944) assigned five additional bones to this species from the Owyhee Pliocene, Oregon, including a manubrium of a sternum (CIT/LACM 62/3235) and a proximal end of a carpometacarpus

Table 10. Comparative measurements (mm) of carpometacarpi of *Branta canadensis* and *B. dickeyi* from Leisey Shell Pit 1A and Dry Creek, Oregon.

Specimen	Length	Proximal Breadth	Proximal Depth	Shaft Least Breadth	Shaft Least Depth	Distal Breadth	Distal Depth
B. canadensis							
N	12	12	12	12	12	12	12
mean±s.d.	101.6±3.8	9.7±0.4	23.7±1.4	7.2±0.4	5.4±0.3	10.4±0.3	12.1±0.5
Range	94.8-106.3	8.8-10.2	21.8-25.8	6.3-7.6	5.0-5.9	10.0-11.0	11.3-12.9
B. dickeyi							
UF 87235	115.1	11.5	28.7	9.5	6.6	12.6	14.5
LACM 62/3234	-	11.5	28.7	-	-	-	-

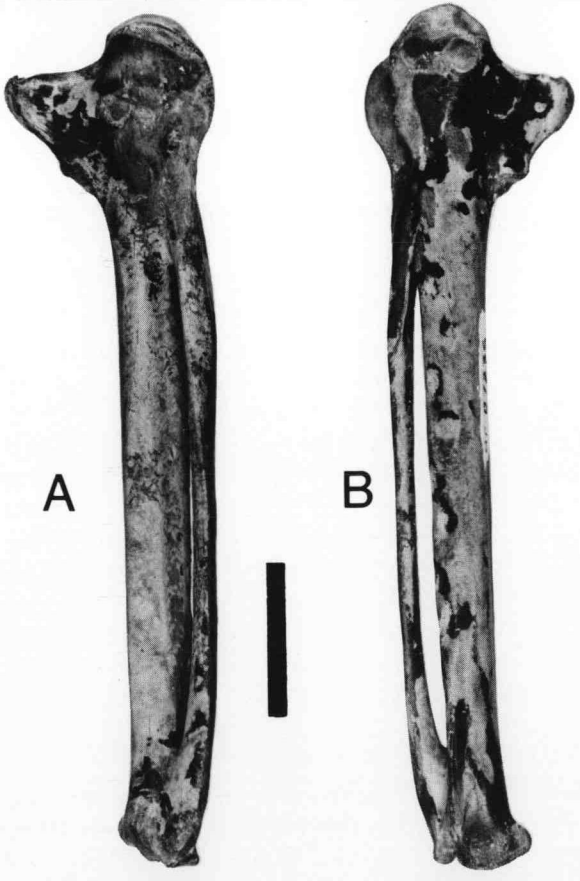

Figure 7. Right carpometacarpus (UF 87235) of *Branta dickeyi* from Leisey 1A. (A) internal view, (B) external view (1X, bar = 2 cm).

(CIT/LACM 62/3234). These specimens compare well in size to UF 82966 and 87235, but differ in other characters. Specifically, the coracoidal sulcus of the sternum is relatively broader, and the dorsal lip curves farther proximally in UF 82966, and a distinct dorsal manubrial spine is present in UF 82966 but absent in LACM 3235. The carpometacarpus (UF 87235 and 124570) has a less robust process of metacarpal I but is otherwise identical in size and characters to LACM 62/3234 (Table 10). These differences may be due to a high amount of osteological variation, as seen in Recent *Branta*, but additional material is needed.

Discussion.– These specimens are the first record of this extinct goose from the early Pleistocene and from eastern North America, and include the only complete bones (UF 87235 and 124570) now known for the species. Three other fossil species of *Branta* are *B. esmeralda* and *B. howardae* from the Blancan of Nevada and California, respectively, and *B. propinqua* from Fossil Lake, Oregon (Brodkorb 1964). All these species, however, are as small as, or smaller than *B. canadensis*.

Anabernicula gracilenta Ross 1935

Referred Material.– **Leisey 1A**: distal right humerus, UF 66795; two proximal left carpometacarpi, UF 66791 and 82998; distal right tibiotarsus missing internal condyle, UF 65809.

Description.– UF 66795 measures distal breadth, 14.8 mm; distal depth through external condyle, 9.0 mm; least breadth and depth of shaft, 7.6 and 6.9 mm. UF 66791 and 82998 measure proximal breadth through carpal trochlea, 5.8 and 7.0 mm respectively. UF 65809 measures distal depth through external condyle, 9.3 mm; least breadth and depth of shaft, 4.6 and 3.8 mm. This material compares well to the shelduck *Tadorna tadorna* but most closely approximates the characters for *Anabernicula gracilenta* as given by Howard (1964) in separating these genera. In particular, the proximal carpometacarpus has an attenuated and prominent process of metacarpal I in UF 66791 and 82998, with exostosis at the tip in the latter specimen, and a rugose external surface in both specimens as in *A. gracilenta*, and the distal tibiotarsus has a deeply inset supratendinal bridge that is angled slightly more horizontally in UF 65809 and in *A. gracilenta* than in *T. tadorna*. The proximal breadth of UF 82998, however, is larger than the largest (6.6 mm) measurement of this element from Rancho La Brea given by Howard (1964).

Three other species of *Anabernicula* have been described from North America: *A. minuscula* from the late Pliocene of Arizona (Wetmore 1924), *A. oregonensis* from Fossil Lake, Oregon (Howard 1964), and *A. robustus* from the middle Pleistocene of Nebraska (Short 1970). *Brantadorna downsi*, another tadornid described by Howard (1963) from Vallecito Creek, California, is smaller

than *Anabernicula* and differs by generic characters given by Howard (1963). *A. minuscula* is known only by a proximal humerus and coracoid and is distinguished from *A. gracilenta* and *A. oregonensis* by characters of the coracoid (Howard 1964). *A. oregonensis* is better known and differs from *A. gracilenta* in that the latter species has a slightly less prominent lobe at the distal edge of the external trochlear crest in the carpometacarpus, and the humerus is proportionally larger than in *A. oregonensis* (Howard 1964).

Specimens of *Anabernicula oregonensis* were examined at AMNH. AMNH 3546C and D, and 18244, are carpometacarpi with a lobe at the external trochlear crest about equal to UF 82998 but the internal ligamental fossa is deeper and the process of metacarpal I smaller than UF 82998. AMNH 3548, 3521, 18233-18234, and 18241-18243 are humeri similar in size to UF 66795 but have the anterior articular ligament longer than wide (round in UF 66795) and a relatively greater depth of the internal distal condyle. *A. robustus* is known by only one bone, a complete humerus, that is slightly larger and more robust than other species of *Anabernicula* (Short 1970). A comparison of the characters of these species with the specimens here indicate that, while comparable material is not available for all species, the close similarity of this material to that of *A. gracilenta* allows referal to this species.

Discussion.– These specimens are the second record of *Anabernicula gracilenta* in Florida. Speaker Carr (1981) referred two bones, a quadrate and a tarsometatarsus, from the very early Irvingtonian Inglis 1A fauna, Citrus County, to *A. gracilenta*. Shelducks are not found in North or South America today but have a widespread distribution throughout Asia and Europe. The fossil record indicates this tribe had been in the New World at least since the middle Miocene. Alvarez and Olson (1978) reported a proximal ulna from the Calvert Formation of Maryland, and Becker (1985) identified a proximal humerus from the Pliocene Bone Valley Formation of Florida. Neither of these records was assigned to a genus or species. Bickart (1990) tentatively identified 47 bones to this genus from the late Miocene/early Pliocene Big Sandy Formation, Arizona.

Anas crecca Linnaeus 1758

Referred Material.– Leisey 1A: left coracoid, UF 69638; right coracoid, UF 81720; right humerus, UF 80403. **Leisey 3A**: right coracoid, UF 95936; distal right ulna, UF 95938.

Anas crecca Linnaeus 1758 or *A. discors* Linnaeus 1766

Referred Material.– Leisey 1A: 4 right coracoids, UF 66793, 80401-80402, 82961; shaft left coracoid, UF 65813; proximal right humerus, UF 116090; 2

proximal left humeri, UF 66798, 82983; distal left humerus, UF 80404; distal left ulna, UF 82982; proximal right carpometacarpus, UF 69639. **Leisey 3**: right coracoid, UF 124617; right ulna, UF 129063.

Anas platyrhynchos Linnaeus 1758

Referred Material.– Leisey 1A: humeral end right coracoid, UF 80405; proximal right scapula, UF 82960.

Anas americana Gmelin 1789

Referred Material.– Leisey 1A: proximal right humerus, UF 83000.

Anas sp.

Referred Material.– Leisey 1A: shaft left coracoid, UF 69398; humeral end right coracoid, UF 80406; proximal right scapula, UF 82987; proximal left radius, UF 82954; proximal right carpometacarpus, UF 66792; distal left carpometacarpus, UF 82956. **Leisey 3**: proximal right humerus, UF 129067. **Leisey 3A**: humeral end right coracoid, UF 95889; distal left ulna, UF 95887.

Description.– Specimens UF 69398, 82954, 66792, 82956, 95887, 95889 and 129067 are from a duck near the size of *Anas clypeata*; UF 80406 and 82987 are near the size of *A. platyrhynchos* and *A. acuta*, respectively. The elements are too fragmentary for positive identification.

Aythya americana (Eyton 1838)

Referred Material.– Leisey 1A: three right coracoids, UF 65818, 80411, 81719; left coracoid, UF 66797; proximal left humerus, UF 69394; distal left humerus, UF 66800.

Aythya marila (Linnaeus 1761)

Referred Material.– Leisey 1A: right coracoid, UF 82953; left carpometacarpus, UF 82976.

Aythya americana (Eyton 1838) or *A. marila* (Linnaeus 1761)

Referred Material.– Leisey 1A: shaft right humerus, UF 82952; left carpometacarpus, UF 85014; proximal right tarsometatarsus, UF 82955.

Aythya affinis (Eyton 1838)

Referred Material..– Leisey 1A: 2 left coracoids, UF 69396, 80413; proximal left humerus, UF 80414; distal right humerus, UF 82980; shaft right humerus, UF 82979; proximal right ulna, UF 66794; right carpometacarpus, UF 80429; distal left tibiotarsus; UF 65815. **Leisey 3A**: distal right humerus, UF 95779.

Aythya collaris (Donovan 1809)

Referred Material.– Leisey 1A: humeral end right coracoid, UF 82977; proximal left humerus, UF 80412.

Aythya affinis (Eyton 1838) or *A. collaris* (Donovan 1809)

Referred Material.– Leisey 1A: 2 right coracoids, UF 69395, 69642; shaft left coracoid, UF 80409; distal right ulna, UF 65817; anterior carina of sternum, UF 65814; 2 distal left femora, UF 80407-80408; proximal left tarsometatarsus, UF 63520. **Leisey 1B**: left humerus lacking proximal end, UF 95646.

Aythya sp.

Referred Material.– Leisey 1A: left coracoid, UF 85016; shaft left coracoid, UF 80410; shaft right humerus, UF 85006; proximal right carpometacarpus, UF 69643; sacrum, UF 82971; phalanx, UF 82973. **Leisey 3**: right coracoid, UF 129065. **Leisey 3A**: proximal right scapula, UF 95890.

Description.– Specimens UF 80410, 82971 and 82973 are from a duck near the size of *Aythya americana*; UF 85006, 69643, 95890 and 129065 are near the size of *A. collaris*. UF 85016 is from a small scaup; it was compared to *Oxyura*, *Bucephala*, *Histrionicus*, *Melanitta*, *Anas* and *Lophodytes* but conforms most closely to characters of *Aythya* (see Woolfenden 1961) and may represent an undescribed species.

Somateria cf. *S. spectabilis* (Linnaeus 1758)

Referred Material.-- Leisey 1A: proximal left tarsometatarsus, UF 82978.

Description.-- This specimen is easily identified to genus by its broadly flared proximal end, and the external curvature of the shaft (see Woolfenden 1961). It compares most closely in size to *Somateria spectabilis*.

Discussion.-- This specimen is the first fossil occurrence of this genus in Florida.

Bucephala albeola (Linnaeus 1758)

Referred Material.-- Leisey 1A: 2 right coracoids, UF 80430, 82958; left coracoid, UF 82951; proximal left humerus, UF 116091. **Leisey 3**: proximal right humerus, UF 123872. **Leisey 3A**: left femur, UF 95937.

Mergus serrator Linnaeus 1758

Referred Material.-- Leisey 1: right coracoid, UF 95620.

Mergus sp.

Referred Material.-- Leisey 1A: proximal left tibiotarsus, UF 125200.

ANATIDAE, indet. gen. et sp.

Referred Material.-- Leisey 1A: left coracoid, UF 82981; right coracoid, UF 86977; 4 shafts left coracoids, UF 82986, 85005, 87233, 88450; sternal end left coracoid, UF 85003; sternal end right coracoid, UF 80442; proximal left scapula, UF 82959; 2 shafts right humeri, UF 66799, 69397; phalanx 1 digit 2, UF 82972; right margin of sternum, UF 85004; shaft right tibiotarsus, UF 82962; proximal left tibiotarsus, UF 69648; phalanx, UF 82995. **Leisey 3A**: sternal end left coracoid, UF 95892; medial fragment of furculum, UF 102526. **Leisey 3B**: distal right tarsometatarsus, UF 116096.

Order ACCIPITRIFORMES
Family ACCIPITRIDAE

Buteo sp.

Referred Material.– Leisey 1A: proximal right femur, UF 82990.

Description.– This specimen is near the size of *Buteo swainsoni* but is too fragmentary for positive identification.

Buteo cf. *B. lineatus* (Gmelin 1788)

Referred Material.– Leisey 3A: distal right tarsometatarsus missing external trochlea, UF 95897.

Aquila sp.

Referred Material.– Leisey 1A: proximal end of ungual phalanx, UF 82989.

Amplibuteo sp.

Referred Material.– Leisey 3B: proximal left humerus, distal and proximal left radius, right and left carpometacarpi lacking metacarpal III (Fig. 8A and B), distal left tarsometatarsus (Fig. 8C and D), UF 102550.

Description.– The radius measures proximal breadth and depth, 11.4 and 7.2 mm; distal breadth and depth, 12.9 and 6.6 mm. Measurements of the carpometacarpi are given in Table 11. All specimens were found associated and probably are from the same individual.

All elements of this associated skeleton except the carpometacarpus compare well in size and characters to the fossil species *Amplibuteo woodwardi* from Rancho La Brea, California. The carpometacarpus (UF 102550) was compared to five specimens of *A. woodwardi* and differs from this species by its shorter length (Table 11), shorter and blunter process of metacarpal I, broader distal symphysis and lower height of facet for digit 3. These differences suggest that an undescribed species is represented from Leisey Shell Pit.

Discussion.– *Amplibuteo woodwardi* is known from three fossil localities in Florida. Two distal tarsometatarsi, UF 22560 from Ichetucknee River, Columbia County, and USNM 209535 from Aucilla River, Jefferson County, were reported as Accipitridae, indet. by Campbell (1980). Though Campbell did not consider these specimens to represent *Amplibuteo*, they were compared to 17 tarsometatarsi of *A.*

Table 11. Comparative measurements (mm) of carpometacarpi of *Amplibuteo woodwardi* from Rancho La Brea, California, and *Amplibuteo* sp. from Leisey Shell Pit 3B, Florida.

Specimen	Length	Proximal Breadth	Proximal Depth	Shaft Least Breadth	Shaft Least Depth	Distal Breadth	Distal Depth
A. woodwardi							
N	5	5	5	5	5	4	4
mean±s.d.	115.3±10.9	10.8±0.8	25.5±2.6	8.4±0.5	6.3±0.6	13.4±1.0	15.3±1.3
Range	106.1-130.2	9.5-11.5	23.0-29.2	8.0-9.2	5.7-7.3	12.6-14.7	14.5-17.3
Amplibuteo sp.							
UF 102550							
right	97.2	10.8	22.7	8.2	5.6	12.5	14.3
left	97.6	10.8	23.2	8.1	5.7	12.6	14.3

woodwardi from Rancho La Brea and found to fall within the size and variation of this species.

Ten uncatalogued elements of *Amplibuteo woodwardi* at AMNH from the middle Irvingtonian McLeod Limerock Mine, Levy County, include a proximal right carpometacarpus and distal right and left tarsometatarsi of at least two individuals. The tarsometatarsi compare well with UF 22560, 102550 and specimens from Rancho La Brea; the carpometacarpus has a long process of metacarpal I that curves upward at its end, as in *A. woodwardi* and unlike that of 102550. Consequently, if UF 102550 does represent an undescribed species of *Amplibuteo*, then at least two species of this long-legged eagle existed in the Irvingtonian of Florida.

Campbell (1979) described *Amplibuteo hibbardi* from late Pleistocene deposits in Peru. A cast of the holotype left tarsometatarsus (Royal Ontario Museum 16905), available at LACM, was compared to the distal tarsometatarsi from McLeod and to UF 22560. *A. hibbardi* differs by its larger size and more robust shaft, and large distal foramen, but agrees in all other characters.

ACCIPITRIDAE, indet. gen. et sp.

Referred Material.– Leisey 3: shaft of left ulna, UF 129064.

Description.– This specimen is from an eagle similar to *Aquila* or *Haliaeetus*, but is too fragmentary for positive identification.

Order GALLIFORMES
Family PHASIANIDAE

Meleagris leopoldi (A. H. Miller and Bowman 1956) or *M. anza* (Howard 1963)

Referred Material.– Leisey 1: distal right tibiotarsus, UF 124616. **Leisey 1A**: distal right femur, UF 85001; right tarsometatarsus missing distal end and portion of hypotarsus, UF 82991 (Fig. 9). **Leisey 3**: distal right tibiotarsus, UF 124565; distal left tarsometatarsus, UF 129059.

Description.– UF 82991 is from a male turkey as denoted by the presence of a bony spur. It compares well in size and characters to early Irvingtonian specimens of *Meleagris leopoldi/anza* from Inglis 1A, Citrus County, Florida (Steadman 1980), except for a slightly longer outer calcaneal ridge and smaller intercotylar prominence (Fig 9). It is smaller than specimens of *Meleagris* sp. from the late Irvingtonian Coleman 2A fauna, Sumter Co., Florida, which Steadman (1980) recognized as representing an intermediate link between the Inglis turkeys and *M. gallopavo*.

Colinus sp.

Referred Material.– Leisey 3: distal right humerus, UF 124576.

Order GRUIFORMES
Family RALLIDAE

Rallus sp.

Referred Material.– Leisey 1A: distal left tibiotarsus, UF 69636. **Leisey 3A**: distal left tibiotarsus, UF 95899.

Description.– UF 69636 measures distal breadth and depth, 6.7 and 6.9 mm. It compares well in size and characters with Recent *Rallus elegans* and *R. longirostris*, but is too fragmentary for positive identification. UF 95899 is from a rail intermediate in size between the living *R. limicola* and *R. longirostris*. Extinct rails of this size include *R. prenticei* from the late Pliocene of Kansas and Idaho, and *R. phillipsi* from the late Pliocene of Arizona. Tibiotarsi of *R. prenticei* are similar in size to UF 95899 (see Feduccia 1968); no tibiotarsi of *R. phillipsi* are known but this species may represent a temporal form of *R. longirostris* (Olson 1977).

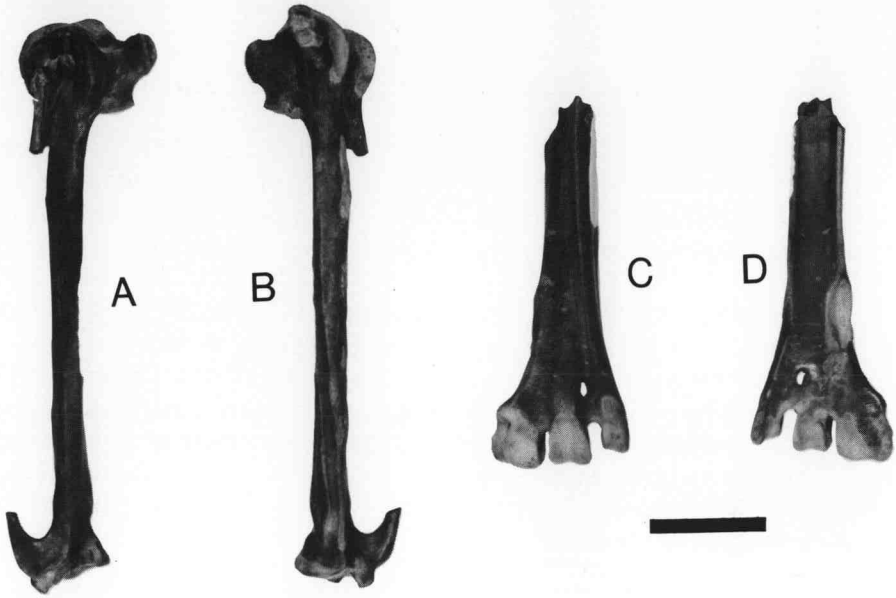

Figure 8. UF 102550, left carpometacarpus in (A) internal and (B) external views; UF 102550, distal left tarsometatarsus in (C) anterior and (D) posterior views of *Amplibuteo* sp., Leisey 3B (1X, bar=2 cm).

Fulica americana Gmelin 1789

Referred Material.-- Leisey 1A: 3 right coracoids, UF 65820, 69393, 69641; right scapula, UF 80425; proximal right humerus, UF 65819; distal left humerus, UF 63521; proximal left ulna, UF 85007; distal left ulna, UF 80424;distal right radius, UF 65816; distal left femur, UF 80423; distal right femur, UF 82957; distal right tibiotarsus, UF 82988. **Leisey 3**: left coracoid, UF 124569; proximal right tarsometatarsus, UF 123870. **Leisey 3A**: left coracoid, UF 95891; manubrium of sternum, UF 95939; distal left tibiotarsus, UF 95884; distal right tibiotarsus, UF 95883; 2 proximal right tarsometatarsi, UF 95885 and 95895; distal right tarsometatarsus, UF 95886.

Family GRUIDAE

Grus canadensis (Linnaeus 1758)

Referred Material.-- Leisey 1: proximal left femur, UF 95619. **Leisey 3**: humeral end of right coracoid, UF 123876; sternal end of left coracoid, UF 123877; fragmentary manubrium of sternum, UF 123878; left carpometacarpus lacking

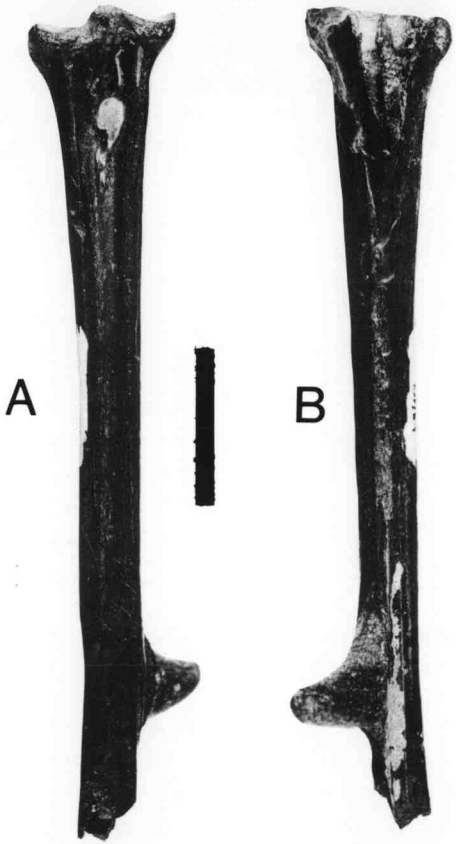

Figure 9. Right tarsometatarsus (UF 82991) of *Meleagris leopoldi/anza* from Leisey 1A. (A) anterior view, (B) posterior view (1X, bar=2 cm).

distal end, UF 102548; proximal right carpometacarpus, UF 102546. **Leisey 3B**: proximal right humerus, UF 116094.

Description.-- These specimens are from a large crane approximately equal in size to *Grus canadensis tabida*.

Grus sp.

Referred Material.– Leisey 3: distal right ulna, UF 129060. **Leisey 3B**: distal right tarsometatarsus lacking internal trochlea, UF 116095.

Description.– UF 129060 measures distal breadth and depth, 20.0 and 15.2 mm. It is from a crane within the size range of *G. americana*. UF 116095 measures breadth and depth of middle trochlea, 11.0 and 13.7 mm; breadth and depth of external trochlea, 9.7 and 13.6 mm. It is from a large crane, much larger than male *G. canadensis tabida* and *G. americana*, and near the size of male *G. antigone* (N=2, USNM). It probably represents an undescribed species but is too poorly known for systematic description.

Discussion.– One other bone of a large crane, a distal left tibiotarsus (UF 91223) from the Irvingtonian Shell Materials Pit, Hillsborough County, is known from Florida. This specimen, which measures distal breadth and depth 26.8 and 27.2 mm, is also as large as *Grus antigone* (N=6, USNM; range of distal breadth and depth, 24.3-28.8 and 23.3-27.2). These specimens indicate that at least two species of crane, including *G. canadensis*, occurred in the Irvingtonian of Florida.

A large species of crane, *Grus cubensis*, was described from over 450 bones from the late Pleistocene Pio Domingo Cave, Cuba (Fischer and Stephan 1971). Measurements of the tibiotarsus indicate overlap in size with UF 91223 (N=25; range of distal breadth and depth, 27.0-32.0 and 25.6-31.0 mm; Fischer and Stephen 1971, table 19, p. 590). This species was considered by the authors to have been flightless. It is possible that UF 116095 and 91223 represent this species, but comparative material was not available.

Order CHARADRIIFORMES
Family RECURVIROSTRIDAE

Recurvirostra sp.

Referred Material.– Leisey 1A: proximal left humerus, UF 80434 (Fig. 10A); distal right humerus, UF 65810 (Fig. 10B).

Description.– Recognizable as *Recurvirostra* by a reduced pectoral attachment and reduced entepicondylar prominence compared to other Charadriiformes, these specimens are smaller than Recent *R. americana* (Table 12). UF 80434 also differs by its smaller pectoral attachment, and UF 65810 has an attachment of the anterior articular surface angled more medially than in *R. americana* (Fig. 10B). Other characters of these specimens, including the angle and length of the median crest and the relative size and depth of the impression of brachialis anticus, are within the variation observed in a series of *R. americana*.

Discussion.– This material may represent a new species of *Recurvirostra*, but more diagnostic specimens are needed before it can be described. The fossil record of avocets is sparse. Mourer-Chauvire (1978) described *Recurvirostra sanctaeneboulae* from the late Eocene/early Oligocene of France, and Miller (1961) referred one bone to *Recurvirostra* sp. from the Miocene of California (Olson 1985). Rogers et al. (1985) reported a humerus of *R. americana* from the early Pleistocene of Colorado.

Family SCOLOPACIDAE

Limosa cf. *L. fedoa* (Linnaeus 1758)

Referred Material.– Leisey 3: distal left tarsometatarsus, UF 123871.

Description.– This specimen measures distal breadth, 7.9 mm; least breadth and depth of shaft, 3.5 and 2.7 mm. It is similar in characters to *Limosa*, and is tentatively identified as *L. fedoa* by its larger size compared to *L. limosa*, *L. haemastica* and *L. lapponica*.

Family ALCIDAE

indet. gen. et sp.

Referred Material.– Leisey 3: sternal end of right coracoid, UF 123998; distal right humerus, UF 123997.

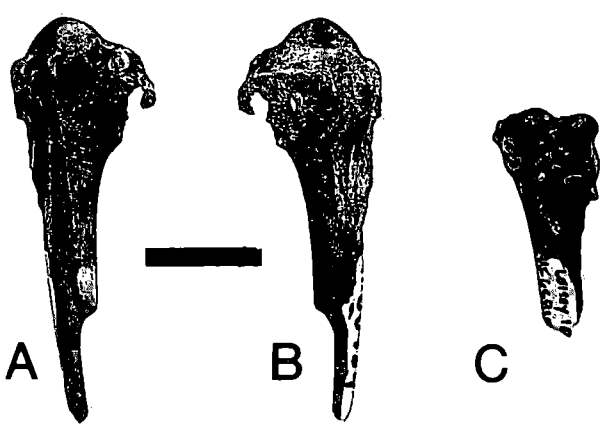

Figure 10. (A) anconal view and (B) palmar view of the proximal left humerus (UF 80434) and (C) palmar view of the distal right humerus (UF 65810) of *Recurvirostra* sp. from Leisey 1A (1.5X, bar=1 cm).

Table 12. Comparative measurements (mm) of Recent avocet (*Recurvirostra americana*) to specimens of *Recurvirostra* sp. from Leisey Shell Pit 1A.

Specimen	Proximal Breadth	Proximal Depth	Distal Breadth	Distal Depth
R. americana (8m, 5f, 2?)				
mean ± s.d.	14.8±0.4	4.3±0.2	10.3±0.3	6.3±0.2
Range	14.2-15.6	4.0-4.8	9.8-10.7	6.0-6.6
UF 80434	13.3	3.8	-	-
UF 65810	-	-	9.7	5.5

Description.– These specimens are from an alcid similar in size to the living *Cerorhinca monocerata*, but are too fragmentary for generic or specific identification.

Family PHOENICOPTERIDAE

Phoenicopterus ruber Linnaeus 1758

Referred Material.– Leisey 1A: distal left humerus with internal side damaged, UF 82974; head of left femur, UF 66796.

Description.– UF 82974 measures distal depth through external condyle, 13.8 mm; least breadth and depth of shaft, 10.5 and 9.1 mm. These specimens compare well in size and characters to *Phoenicopterus ruber*.

Four fossil species of flamingo have been described from North America: *Phoenicopterus floridanus* and *P. stocki* from the Pliocene of Florida and Mexico respectively, *P. copei* from the middle to late Pleistocene of Oregon and California, and *P. minutus* from the late Pleistocene of California (Brodkorb 1963a). Of these, *P. stocki* and *P. minutus* are much smaller than *P. ruber*, *P. copei* is much larger than *P. ruber*, and *P. floridanus* is known only by two distal tibiotarsi and two distal tarsometatarsi but is generally more robust than *P. ruber* (Brodkorb 1953).

Phoenicopterus copei Shulfeldt 1891

Referred Material.– Leisey 1A: distal right tibiotarsus, UF 81718 (Fig. 11A); proximal right tarsometatarsus, UF 81717 (Fig. 11B).

Description.– UF 81718 measures least breadth and depth of shaft, 8.0 and 7.7 mm; distal breadth, 17.8 mm; distal depth through external condyle, 19.7 mm.

UF 81717 measures proximal breadth and depth, 21.2 and 19.3 mm; breadth and height of intercondylar tubercle, 11.6 and 6.5 mm; least breadth and depth of shaft, 8.7 and 9.4 mm. These specimens were found within a 4 m^2 area of the site, articulate precisely, and undoubtedly are from the same individual. *Phoenicopterus copei* has been reported from Fossil Lake, Oregon (type locality), and Manix Lake, California (Howard 1946, 1955; Jefferson 1985). It is distinguished from most living species of flamingo by its greater size, greater breadth of the intercotylar area of the distal tibiotarsus and corresponding greater

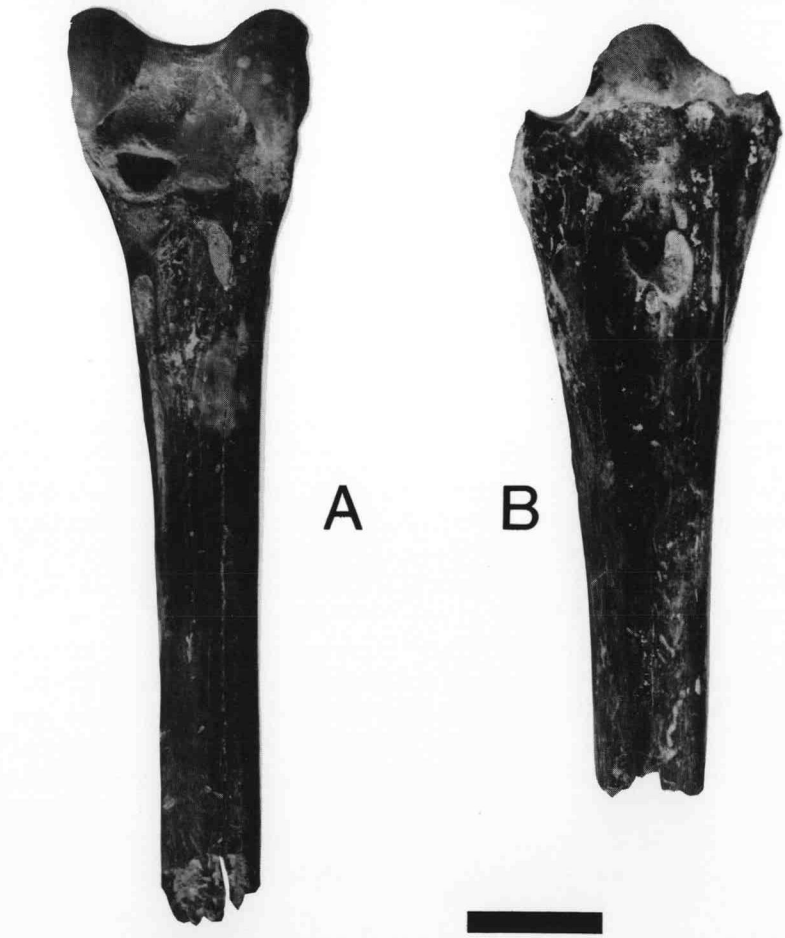

Figure 11. Anterior view of (A) distal right tibiotarsus (UF 81718) and (B) proximal right tarsometatarsus (UF 81717) of *Phoenicopterus copei* from Leisey 1A (1.5X, bar=1 cm).

breadth and height of the intercotylar tubercle of the proximal tarsometatarsus (Fig. 11). It most closely approximates Recent *P. ruber roseus* in size (see comparative measurements of *P. ruber*, *P. chilensis*, and *P.* "*antiquorum*" [=*P. ruber roseus*] to *P. copei* in Howard 1946, 1955). A proximal tarsometatarsus (LACM 2448) from an immature individual from Manix Lake compares well with UF 81717, particularly in size and proportions of the cotylae and intercotylar prominence.

Discussion.– These specimens are the first record of *Phoenicopterus copei* in the eastern U. S. and the earliest reported occurrence of the species. The presence of two species of flamingo, one large (*P. copei*) and one small (*P. ruber*), in the same deposits is not unusual. Both *P. copei* and *P. minutus* are reported from Manix Lake, California (Howard 1955; Jefferson 1985), and Becker (1987) recognized at least two species of *Phoenicopterus* from the Clarendonian Love Bone Bed fauna, Florida. Moreover, the greater and lesser flamingo occur sympatrically in South Africa today (Broekhuysen 1975), and three species (*P. chilensis*, *P. jamesi* and *Phoenicoparrus andinus*) of different sizes are found on the Arica altiplano, Chile (McFarlane 1975).

Order STRIGIFORMES
Family STRIGIDAE
Bubo virginianus (Gmelin 1788)

Referred Material.– **Leisey 1A**: proximal left scapula, UF 82969; proximal half of digit 2, phalanx 1, UF 86272.

Order PASSERIFORMES
Family CORVIDAE
Corvus sp.

Referred Material.– **Leisey 3**: distal right tarsometatarsus, UF 124552.

Description.– This specimen is similar in size and characters to *Corvus ossifragus*.

Class AVES, indet.

Referred Material.– **Leisey 1A**: shaft radius, UF 82970; proximal left ulna, UF 95940; distal left ulna, UF 123878; shaft femur, UF 80431; 5 cervical vertebrae, UF 80436, 82975, 82993-82994, 85012; synsacrum, UF 82992; 4 phalanges, UF 80437-80438, 85015, 85178. **Leisey 3**: cervical vertebra, UF

124574; distal left ulna, UF 123878; wing phalanx 1, digit 2, UF 124573; 3 pedal phalanges, UF 124575.

LEISEY SHELL PIT 2
(indet. stratigraphic horizon)

Order PODICIPEDIFORMES
Family PODICIPEDIDAE
Podilymbus podiceps (Linnaeus 1758)

Referred Material.– Proximal left humerus, UF 63506.

Order PELECANIFORMES
Family PHALACROCORACIDAE
Phalacrocorax sp.

Referred Material.– Proximal left coracoid, UF 63507.

Family ANHINGIDAE
Anhinga anhinga (Linnaeus 1766)

Referred Material– Distal right humerus, UF 63503.

Order CICONIIFORMES
Family CICONIIDAE
Ciconia maltha L. Miller 1910

Referred Material.– Distal left humerus, UF 63502; proximal left tarsometatarsus, UF 63501.

Description.– UF 63501 measures proximal breadth and depth, 22.6 and 21.9 mm.

Order ACCIPITRIFORMES
Family ACCIPITRIDAE
Buteo sp.

Referred Material.– Phalanx, UF 93815.

Order GRUIFORMES
Family GRUIDAE
Grus americana (Linnaeus 1758)

Referred Material.– Distal right tibiotarsus, UF 63505.

Order CHARADRIIFORMES
Family JACANIDAE
Jacana spinosa (Linnaeus 1758)

Referred Material.– Proximal right humerus, UF 63504.

Description.– This specimen measures proximal breadth, 9.2 mm; depth through head, 2.9 mm. It compares well in size and characters to Recent *Jacana spinosa*; *J. jacana* interbreeds with *J. spinosa* and may be synonymous with the latter species (A. O. U. Checklist 1983). Olson (1976) described *J. farrandi* from a distal tarsometatarsus and coracoid from the late Miocene of Florida; Becker (1985) referred additional material to this extinct species from the Clarendonian Love Bone Bed fauna of Florida. This species differs from *J. spinosa* by its distinctly larger size, and characters given by Olson (1976). An unreported distal right tibiotarsus (UF 101534) of *J. spinosa* also is known from the Rancholabrean Lecanto 2A Site, Citrus County, Florida.

Discussion.– This specimen represents the first Pleistocene record of *Jacana spinosa* from North America; Winge (1888) reports a record of this species from the late Pleistocene of Brazil. It apparently occurred in Florida throughout the Pleistocene.

Order PASSERIFORMES
Family EMBERIZIDAE
cf. ICTERINAE, indet. gen. et sp.

Referred Material.– Manubrium of sternum, UF 93816.

CLASS AVES, indet.

Referred Material.– Thoracic vertebra, UF 93817.

DISCUSSION

The avifauna from the Leisey Shell Pit LF consists of at least 30 Recent and 15 extinct taxa and is the most diverse aquatic avifauna known from the Irvingtonian of North America. Other fossil avifaunas in Florida are diverse in terrestrial species, including the very early Irvingtonian Inglis 1A fauna (Speaker Carr 1981), the early Irvingtonian Haile 16A fauna, and the late Irvingtonian Coleman 2A fauna (Ritchie 1980). In addition, Steadman (1984) reported a late early Irvingtonian avifauna from Payne Creek, Florida. Other comparable Irvingtonian collections outside of Florida include those from Vallecito Creek, California (Howard 1963), and the Rushville Quarries, Nebraska (Short 1970).

Of the extant taxa represented in the Leisey Shell Pit LF, almost all currently occur in Florida. The trumpeter swan (*Cygnus buccinator*) has not been reported from Florida historically, but is known from numerous bones from the late Pleistocene Ichetucknee River (Campbell 1980). This species was once widespread in North America and has only recently been reduced to its current northerly range (A.O.U. Checklist 1983). The king eider (*Somateria spectabilis*) also occurs in more northerly latitudes, but is found along the eastern coast of the U. S. in winter and as far south as Florida (A.O.U. Checklist 1983). The fossil occurrence of these species at Leisey suggests they were more common in Florida in the early Pleistocene.

The extinct taxa at Leisey include three newly described species and at least one undescribed species (*Recurvirostra* n. sp.). The condor (*Gymnogyps kofordi*), described in detail elsewhere (Emslie 1988), is the earliest species of this genus now known from North America. The spoonbill (*Ajaia chione*) and avocet (*Recurvirostra* n. sp.) are most similar to and may be direct ancestors of the living species, *A. ajaja* and *R. americana*, respectively. The small ibis, *Eudocimus leiseyi*, has no living counterpart; however, another small ibis, *Plegadis pharangites*, is known from the Blancan of Texas and Kansas (Olson 1981). Apparently, small forms of these closely related genera of ibis were present in the Plio-Pleistocene but disappeared by the end of the Irvingtonian.

The remaining taxa from Leisey include first occurrences in the Irvingtonian of species that were known previously only from geologically older deposits (*Gavia concinna*, *Ciconia* sp.) or younger deposits (*Teratornis merriami*, *Amplibuteo* sp., *Phoenicopterus copei*). *Branta dickeyi* and *Amplibuteo* sp. are reported from the Irvingtonian for the first time here, but are known from Blancan and Rancholabrean localities in Oregon and California (Miller 1924, 1944), and Rancholabrean localities in California (Brodkorb 1964) and Peru (Campbell 1979), respectively. These fossil taxa, with *P. copei* and *Teratornis* cf. *T. incredibilis*, from the Leisey Shell Pit LF are the first records from the eastern U. S. and add to a growing list of fossil fauna (birds and mammals) with a disjunct distribution between eastern and western North America (see Webb 1974).

The avifauna from Vallecito Creek is diverse; Howard (1963) reported 28 species, including 10 extinct species of which 6 were described from this locality. This avifauna consists of a mixture of terrestrial (teratorn, eagle, vulture, quail, turkey and owl) and aquatic (grebes, ducks, rails and shore birds) taxa but does not approach the diversity of aquatic species known from the Leisey Shell Pit LF.

By far the most diverse collection of Irvingtonian birds is from Inglis 1A, Citrus County, Florida (Speaker Carr 1981). Over 2700 bones of non-passerines have been identified to at least 47 species, including 6 undescribed species (ibid.); hundreds of bones of passerines are also known from the site. This avifauna is dominated by terrestrial taxa, but of the 20 aquatic and wading species, only 5 are shared with Leisey 1A (*Podilymbus podiceps*, *Anabernicula gracilenta*, *Anas platyrhynchos*, *A. discors*, and *Aythya americana*).

PALEOECOLOGY

The habitat now used by the majority of the extant species identified from the Leisey Shell Pit LF consists of shallow bays and inlets, or tidal freshwater marshes with emergent and floating vegetation. Coots and numerous species of ducks congregate in these areas along the Gulf Coast of Florida today, particularly in the winter months (Sprunt 1954). Surface-feeding ducks (*Anas* spp.) prefer shallow ponds, bays and estuaries in the winter and feed on emergent vegetation. Diving ducks (*Aythya*, *Somateria*, *Bucephala*), as well as grebes and coots, do not require water deeper than 2-7 m. These species feed on vegetation (*A. americana*, *A. collaris*), or on mollusks and crustaceans (*A. marila*, *A. affinis*, *S. spectabilis*, *B. albeola*).

Other aquatic species at Leisey are principally shore birds or wading species that feed on invertebrates and small vertebrates in shallow water and mud. Extinct taxa from the site can also be associated with this habitat, especially the ibis (*Eudocimus leiseyi*), spoonbill (*Ajaia chione*), and avocet (*Recurvirostra* sp.).

The ecological conditions reflected by the avifauna at Leisey are compatible with the remainder of the fauna from the site, and agree with paleoecological interpretations of Hulbert and Morgan (1989). Those groups known to be in their primary site of deposition in the bone bed, in particular the fish and invertebrate faunas (see Hulbert and Morgan 1989 and Pratt and Hulbert this volume, for discussions of the taphonomy of the bone bed deposit), are characteristic of Florida Gulf Coast habitats today. These habitats include fresh and saltwater marshes, shallow bays and mangrove swamps. Accordingly, most of the avian remains of wetland species at Leisey also are probably in their primary site of deposition in the bone bed, or were transported only a short distance.

Bones of terrestrial species of birds at the site are rare, probably because they could not survive transport to the area of deposition, or were carried away by stream currents. Bones of small mammals are also scarce (Hulbert and Morgan

1989, Morgan and White this volume). The teratorn, condor and extinct eagle, however, are terrestrial species whose bones were located in a restricted area of the site and probably represent associated elements from one individual of each species. Because these were large birds, their carcasses may have survived transport to the site where they were deposited with the many mammalian remains there. Equally possible is that these species were adapted to a coastal or shoreline habitat and, like the shore birds, are in their primary site of deposition. The living California Condor shows coastal adaptations as it has been observed foraging along the coast of California and feeding on carcasses of seals, whales and fish; also, mollusk shells have been found in their nests (Koford 1953).

The avifauna from Leisey Shell Pit 2 is reported here separately from the local fauna as its age cannot be determined. Bone deposits ranging in age from early to late Pleistocene can be found in the extensive shell deposits and exact location is needed to substatiate the age of a fossil. The ten bones of unknown age represent 8 taxa, 3 of which (*Grus americana*, *Jacana spinosa*, cf. Icterinae) are absent from the larger avifauna from the Leisey Shell Pit LF. This discrepancy may be due to sampling from deposits of different ages and/or different paleoecological situations.

The avifauna from the Leisey Shell Pit LF adds substantially to the species known to have existed in North America during the early Pleistocene. The fossil record in Florida is particularly rich in avifaunas of this age, although most of these are composed primarily of terrestrial species. The aquatic avifauna was also very diverse, as shown by that from Leisey, and was probably supported by rich wetland habitats along the Gulf Coast. These habitats must have continually shifted with or were destroyed by fluctuations in sea level throughout the Plio-Pleistocene periods. With an increased knowledge of the composition of avifaunas living in these habitats, it will be possible to evaluate the effects of these fluctuations on the evolution and development of modern avian communities in Florida, and on avian extinctions in the Plio-Pleistocene (Emslie 1992).

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