AN EARLY PLEISTOCENE AVIFAUNA
FROM INGLIS, FLORIDA

BY

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Abstract of Dissertation Presented to the Graduate Council of
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By

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Inglis IA in Citrus County, Florida, is a fossiliferous early Pleistocene (Irvingtonian) sinkhole deposit in the Inglis member of the late Eocene Ocala Limestone. The non-passerine species of the paleoavifauna consists of over 2,710 specimens representing a minimum of 258 individuals of 12 orders, 18 families, 41 genera, and 47 species. Thirty-four percent of the species are extinct. Five new species are described. The families represented and the number of identified species in each family are: Gaviidae, 1; Podicipedidae, 3; Ardeidae, 3; Plataleidae, 1; Anatidae, 6; Vulturidae, 3; Accipitridae, 5; Falconidae, 2; Phasianidae, 2; Rallidae, 3; Gruidae, 1; Phorusrhacidae, 1; Scolopacidae, 2; Columbidae, 1; Cuculidae, 1; Strigidae, 7;; Tytonidae, 1; Picidae, 4.

Inglis IA represents a community from a late glacial (Kansan) habitat of high pine, xeric hammock, and savanna. The composition of this avifauna is similar to that of a younger Irvingtonian site from Coleman, Florida.

INTRODUCTION

Florida's wealth of fossil material has kept workers in avian paleontology busy for many years. A list of only the major publications on fossil avifaunas from this state includes Wetmore (1931 and 1943c), Brodkorb (1953b, 1955, 1959a, 1963d), McCoy (1963), Ligon (1965), Ritchie (1980), and Campbell (1980). These studies cover localities ranging in age from late Miocene to late Pleistocene.

The oldest Pleistocene localities in Florida from which avian fossils have been studied are: one Blancan site, Santa Fe River I (Brodkorb, 1963c); and three Irvingtonian sites, Inglis IA (this paper) and the younger Coleman IIA and III (Ritchie, 1976 and 1980). Therefore, the Inglis IA collection represents the earliest Florida Pleistocene avifauna known.

Inglis IA is located in Section 8, R. 16 E., T. 17 S., in Citrus County, Florida. The site was discovered at sea level on the north bank of the Cross Florida Barge Canal by Jean Klein and Robert Martin in 1967. The Florida State Museum collected fossils there between 1967 and 1974.

Inglis IA is a sinkhole deposit in the Inglis member of the late Eocene Ocala Limestone. Klein (1971) and Meylan (1980) provide extensive discussions of the geology of the deposit. The sediment filling the sinkhole consisted of six layers. The lowest level which covered

the floor of the sink was the basal conglomerate composed of sand, limestone, and bone fragments. Above this was the lower clay layer, followed by the lower sand layer, upper clay layer, and then the upper sand layer. The thin clay layers, less than 5 cm. deep, indicate periods of reduced energy of deposition which allowed the fine clay particles to accumulate during periods of high water level in the sink. The sandy levels varied between one and two meters in thickness, and housed most of the fossils. The highest layer of the deposit was composed of cemented sandstone plugging the neck of the sinkhole.

These alternating levels of sand and clay are indications of fluctuations in the water table. Klein (1971) believes the time span represented by this series of layers to be a short one based on the following geological evidence: (1) the small size of the chamber; (2) no collapse within the chamber; and (3) the small diameter of the opening to the surface. Klein (1971) concludes that the Inglis IA population sample is isochronous.

The ferungulates of Inglis IA were studied by Klein (1971), the turkeys by Steadman (1975 and 1980), the quails by Ritchie (1976 and 1980), and the squamate reptiles by Meylan (1980). Webb (1974) lists the mammals from Inglis IA.

The non-passerine avifauna from Inglis IA contains representatives of 12 orders, 18 families, 41 genera, and 47 species. This includes one extinct family, 4 extinct genera, and 16 extinct species. Thirty-four percent of the non-passerine avifauna is extinct. Five new species are described. There are 2,710 elements and a minimum number of 258 individuals. Table 1 lists the non-passerine birds identified from Inglis IA.

Table 1. List of the 47 non-passerine species from Inglis 1A, with number of elements (Elem) and minimum number of individuals (Ind). Extinct species are marked with an asterisk (*).

	<u>Elem</u>	<u>Ind</u>
Gaviiformes		
Gaviidae		
<u>Gavia artica</u>	1	1
Podicipediformes		
Podicipedidae		
<u>Podilymus podiceps</u>	6	2
<u>Podiceps dominicus</u>	1	1
* <u>Podiceps dixi</u>	3	1
Ardeiformes		
Ardeidae		
<u>Ardea</u> sp.	1	1
<u>Botaurus lentiginosus</u>	1	1
<u>Ixobrychus</u> n. sp.	2	1
Plataleidae		
<u>Eudocimus albus</u>	1	1
Anseriformes		
Anatidae		
* <u>Anabernicula gracilenta</u>	2	1
<u>Aix sponsa</u>	5	1
<u>Anas platyrhynchos</u>	2	1
<u>Anas strepera</u>	4	1
<u>Anas discors</u>	5	2
<u>Aythya americana</u>	1	1
Accipitriformes		
Vulturidae		
<u>Coragyps atratus</u>	17	2
<u>Cathartes aura</u>	2	1
cf. <u>Gymnogyps californianus</u>	1	1
Accipitridae		
<u>Buteo</u> n. sp.	12	2
<u>Aquila</u> n. sp.	34	2
* <u>Buteogallus fragilis</u>	1	1
* <u>Neophrontops slaughteri</u>	7	1
<u>Accipiter cooperii</u>	6	2
Falconidae		
<u>Falco columbarius</u>	2	1
<u>Falco sparverius</u>	14	2
Galliformes		
Phasianidae		
* <u>Colinus suillum</u>	1100	115
* <u>Meleagris anza</u>	1230	50

(Continued)

Table 1. Continued.

	<u>Elem</u>	<u>Ind</u>
Ralliformes		
Rallidae		
<u>Rallus longirostris</u>	11	3
<u>Rallus elegans</u>	2	2
<u>Porzana carolina</u>	4	3
Gruidae		
<u>Grus americana</u>	1	1
Phorusrhacidae		
<u>*Titanis walleri</u>	11	2
Charadriiformes		
Scolopacidae		
<u>Capella galinago</u>	10	4
<u>Philohela minor</u>	12	2
Columbiformes		
Columbidae		
<u>Zenaidura macroura</u>	40	
Cuculiformes		
Cuculidae		
<u>Coccyzus americanus</u>	25	
Strigiformes		
Strigidae		
<u>Bubo virginianus</u>	10	
<u>Otus asio</u>	44	
<u>*Speotyto megalopeza</u>	6	
<u>Glaucidium n. sp. 1</u>	12	3
<u>Glaucidium n. sp. 2</u>	3	2
<u>*Asio priscus</u>	3	1
<u>Strix varia</u>	4	
Tytonidae		
<u>Tyto alba</u>	1	
Piciformes		
Picidae		
<u>*Campephilus dalquesti</u>	1	1
<u>Colaptes auratus</u>	10	3
<u>Melanerpes erythrocephalus</u>	38	7
<u>cf. Sphyrapicus varius</u>	1	1
Totals	2,710	258

Twenty-three species are represented by 5 or more specimens, 17 by 10 or more specimens, and 7 by 15 or more specimens. Twelve species are represented by only one specimen. The extinct turkey, Meleagris anza, is the best represented species, having 1,230 fossils from a minimum number of 50 individuals. Another extinct gallinaceous bird, the quail Colinus suilium, is a close second with 1,100 elements from a minimum number of 115 individuals.

The habitat requirements of the avifauna range from aquatic conditions to drier forested areas and open savanna country. Species requiring aquatic or marsh habitats include the loon, grebes (three species), herons (three species), ibis, ducks (six species), and rails (three species). The woodpeckers (four species) are abundant, as is the cuckoo. Species with terrestrial requirements include the quail, turkey, crane, phorusrhacid, and dove.

The ten species of diurnal raptors include three vulturids, five accipitrids, and two falconids. The owls are represented by eight species, including two new species of Glaucidium, the pygmy-owls.

The fossil birds from Inglis IA are housed in the Florida State Museum at the University of Florida in Gainesville.

Most of the modern skeletons examined in this study were on loan from the collection of Pierce Brodkorb. Several skeletons were borrowed from the Florida State Museum and the Smithsonian Institution.

Avian osteological terms are those of Howard (1929). Osteological measurements were taken following those of Steadman (1975) and Ritchie (1976).

All measurements are given in millimeters, with range (R), mean (M), and number of specimens (N).

LIST OF SPECIES

Asterisks denote extinct taxa. Classification follows that of Brodkorb (1963a, 1964a, 1967, 1971a).

Order Gaviiformes Wetmore and W. D. Miller

Family Gaviidae Allen

Subfamily Gavinae (Allen)

Genus Gavia Forster

Gavia arctica (Linnaeus)

Arctic Loon

Material: Proximal end of 1 left ulna.

Characters: Gavia arctica is distinguished from G. immer and G. adamsii by having a smaller size, and from G. stellata by Wetmore's (1940) characters.

Remarks: Two species of Gavia are described from the Miocene. Gavia portisi (Regàlia, 1902) of the Middle Miocene of Italy is known only from a cervical vertebra nearly as large as that of Recent G. immer. Howard (1978) describes the small G. brodkorbi based on an ulna from the late Miocene of California. Measurements of this ulna are listed in Table 2 along with those of some other species of Gavia.

Gavia concinna Wetmore (1940) of the Middle Pliocene of California and the Upper Pliocene of Florida is known by the ulna and by several

Table 2. Measurements of the ulna of Late Miocene Gavia brodkorbi (Howard, 1978), Recent G. stellata, Recent G. arctica pacifica, Inglis G. artica, Late Pliocene G. concinna, Recent G. immer, and Recent G. adamsii.

		<u>G. brodkorbi</u>	<u>G. stellata</u>	<u>G. arc. pacifica</u>
<u>Ulna</u>				
Total	R	81.0	100.4-114.1	104.6-121.2
Length	M	-		113.30
	N	1	11	7
Proximal	R	9.4	9.3-11.2	9.4-11.9
Width	M	-		10.76
	N	1	11	7
Midshaft	R	4.9	4.4-5.5	4.7-5.6
Width	M	-		5.11
	N	1	11	7
Midshaft	R		5.4-6.2	5.6-7.3
Depth	M			6.39
	N		11	7
Distal	R	7.3	11.7-12.5	11.4-16.2
Depth	M	-		13.83
	N		11	7

Table 2. Extended.

<u>Inglis</u> <u>G. arctica</u>	<u>G. concinna</u>	<u>G. immer</u>	<u>G. adamsii</u>
		131.3-159.5	163.7
		29	1
12.6	11.6	13.2-15.0	16.7
-	-		-
1	1	29	1
5.8	5.3	6.8-7.4	7.8
-	-		-
1	1	29	1
7.3	7.6	8.1-10.1	10.7
-	-		-
1	1	29	1
	16.6	17.8-21.7	23.3
	-		-
	1	29	1

other elements. The ulna of this loon is intermediate in size between those of Recent G. stellata and G. immer, and overlaps that of G. artica pacifica (Table 2). The ulna of the Inglis Gavia is slightly closer in measurements to that of G. concinna, but in the characters listed by Wetmore (1940), it resembles that of Recent G. arctica pacifica.

Wetmore's (1943c) Gavia palaeodytes from the Middle Pliocene of Florida is not known for the ulna. However, other elements show it to be a bird close in size to Recent G. stellata.

Gavia howardae Brodkorb (1953b) is recorded from the Middle Pliocene of California, is not known for the ulna, and is smaller than G. stellata, G. palaeodytes, and G. concinna.

Gavia arctica is known from Pleistocene deposits in Denmark (H. Winge, 1903) and California (Howard, 1949). This is the first fossil record of this species in Florida. In recent times G. arctica has been recorded in Florida four times (Hopkins and Woolfenden, 1977).

Order Podicipediformes (Fürbringer)

Family Podicipedidae (Bonaparte)

Genus Podiceps Latham

Podiceps *dixi Brodkorb

Material: Distal portion of 1 right humerus, distal end of 1 left ulna, one anterior sternal fragment. The 3 specimens represent a minimum number of 1 individual.

Characters: Podiceps and Podilymbus are separated using characters listed by Murray (1967).

The sternum of Podiceps differs from that of Podilymbus in having medial area of coracoidal sulcus smooth (ventral lip projecting anteriorly beyond dorsal lip in Podilymbus).

Remarks: Brodkorb (1963b) describes Podiceps dixi based on the proximal end of a carpometacarpus from the Middle Pleistocene of Reddick, Florida. Brodkorb's (1963b) measurements show Podiceps dixi to be larger than living P. auritus, and smaller than living P. cristatus, P. grisegena, and P. parvus (Shufeldt) from the Lower and Middle Pleistocene of California and Oregon. Podiceps pisanus (Portis) of Italy and P. subparvus (L. Miller and Bowman) of California, both from the Middle Pliocene, are smaller than P. dixi (Brodkorb, 1963b).

Podiceps dixi is larger than Pliolymbus baryosteus Murray from the Upper Pliocene, which Murray (1967) describes as a small robust grebe. An ulna referred by Murray (1967) to Pliolymbus baryosteus is shorter than that of Podiceps nigricollis, which is much smaller than the Inglis ulna of P. dixi.

Podiceps dixi is also larger than P. discors Murray of the Upper Pliocene of Kansas and Idaho. Podiceps discors may have had a size range similar to that of P. auritus (Murray, 1967).

Pliodytes lanquisti Brodkorb (1953a) is based on a coracoid from the Lower Pliocene of the Bone Valley Formation. The coracoid is longer than that of Podiceps auritus, shorter than that of Podiceps parvus (Shufeldt), and close in size to that of Podilymbus podiceps.

Measurements of the Inglis Podiceps dixi are given in Table 3.

Table 3. Measurements of the humerus and ulna of Recent Podiceps auritus (2♂, 4♀, 4?) and Inglis P. dixi.

		<u>P. auritus</u>	<u>P. dixi</u>
<u>Humerus</u>			
Midshaft	R	3.9-4.6	4.3
Width	M	4.16	-
	N	8	1
Midshaft	R	3.1-3.7	3.7
Depth	M	3.40	-
	N	8	1
<u>Ulna</u>			
Distal	R	3.8-4.5	4.8
Depth	M	4.15	-
	N	10	1

Podiceps dominicus (Linnaeus)

Least Grebe

Material: One complete left ulna.

Characters: The ulna of the Inglis Podiceps dominicus differs from that of Recent P. dominicus in having (1) internal cotylar area flatter (more excavated in modern form); (2) shaft more robust; and (3) external condylar ridge concave at junction with shaft (convex in modern form).

Measurements of the fossil ulna are compared to those of Recent P. dominicus in Table 4.

Remarks: Podiceps dominicus is known from the Pleistocene of Brazil (O. Winge, 1887). This is the first fossil record of the Least Grebe for Florida.

Genus Podilymbus LessonPodilymbus podiceps (Linnaeus)

Pied-billed Grebe

Material: One complete left humerus, proximal end of 1 left ulna, distal end of 1 left ulna, proximal end of 1 right tibiotarsus, distal ends of 2 right tibiotarsi. The 6 specimens represent a minimum number of 2 individuals.

Characters: The humerus of Podilymbus differs from that of Podiceps in having (1) larger bicipital crest; (2) deltoid crest extending farther down shaft; and (3) brachial depression deeper.

The ulna in having (1) olecranon process broad; (2) intercotylar region smooth (sharp ridge in Podiceps); (3) in internal view, edge of internal cotyla smooth (notch at junction with olecranon in Podiceps);

Table 4. Measurements of the ulna of Recent Podiceps dominicus (1♂, 3♀) and Inglis P. dominicus.

<u>Ulna</u>		<u>Podiceps</u> <u>dominicus</u>	<u>Inglis</u> <u>P. dominicus</u>
Total	R	45.5-48.8	45.5
Length	M	47.33	-
	N	4	1
Proximal	R	4.0-4.1	4.2
Width	M	4.07	-
	N	3	1
Midshaft	R	1.7-2.1	2.0
Width	M	1.85	-
	N	4	1
Midshaft	R	2.2-2.6	2.5
Depth	M	2.40	-
	N	4	1
Distal	R	2.7-3.0	2.9
Depth	M	2.83	-
	N	4	1

(4) tendinal groove smaller; and (5) carpal tuberosity short and blunt (long and sharp Podiceps).

The tibiotarsus in having (1) in external view, outer cnemial crest forming a sharp angle on anterior side (curving in Podiceps); (2) condyles much larger; and (3) distal width greater.

Remarks: Shufeldt (1913) describes Podilymbus magnus from the Pleistocene of Fossil Lake, Oregon, as larger than P. podiceps. However, Wetmore (1937c) synonymizes P. magnus Shufeldt with P. podiceps. Later, Brodkorb (1959a) revives P. magnus after measuring grebe fossils from Arredondo, Florida. Measurements of Pleistocene grebes labelled Podilymbus magnus from the Santa Fe River (in the Brodkorb Collection) all fall within Storer's (1976) ranges for Recent P. podiceps. Finally, Brodkorb (1963a, p.230) comments on Pleistocene Podilymbus podiceps,

Specimens from Fossil Lake and some of the Floridian localities average large and are perhaps recognizable as a temporal subspecies, P. podiceps magnus Shufeldt.

Storer (1976) compares measurements for 39 modern skeletons and 220 Late Pleistocene fossils of P. podiceps, and shows that there is no significant size differences between the two groups. Measurements of the Inglis fossils fit well with Storer's (1976) Pied-billed Grebe measurements (Table 5).

Podilymbus majusculus Murray (1967) and P. parvus (Shufeldt, 1913), both from the Upper Pliocene, are larger than P. podiceps. The Pleistocene P. wetmorei Storer (1976) has thicker bones than the Pied-billed Grebe. (Brodkorb, pers. com., suspects that P. wetmorei really ought to be called P. podiceps magnus.) There appears to have been a decrease in size in this genus since the Upper Pliocene.

Table 5. Measurements of the humerus, ulna, and tibiotarsus of Recent Podilymbus podiceps (from Storer 1976; 23♂ for humerus and tibiotarsus; 16♀ for ulna) and Inglis P. podiceps.

		<u>Podilymbus</u> <u>podiceps</u>	Inglis <u>P. podiceps</u>
<u>Humerus</u>			
Total	R	74.3-81.2	75.2
Length	M	77.63	-
	N	23	1
Proximal	R	13.0-14.8	13.6
Width	M	13.97	-
	N	23	1
Least	R	2.9-3.3	3.2
Width of Shaft	M	3.09	-
	N	23	1
Distal	R	6.6-7.5	7.3
Width	M	7.20	-
	N	23	1
<u>Ulna</u>			
Distal	R	3.5-4.1	3.8
Depth	M	3.80	-
	N	16	1
<u>Tibiotarsus</u>			
Distal	R	6.9-8.0	7.7
Width	M	7.56	-
	N	23	1

Order Ardeiformes (Wagler)

Suborder Plataleae Newton

Family Plataleidae Bonaparte

Subfamily Threskiornithinae (Richmond)

Genus Eudocimus Wagler

Eudocimus albus (Linnaeus)

White Ibis

Material: Proximal end of 1 left humerus.

Characters: The humerus of Eudocimus albus differs from that of Ajaia ajaja in having (1) smaller size; (2) deltoid crest more rounded; and (3) bicipital crest more rounded.

The Inglis humerus is greatly abraded, making the usual osteological measurements impossible. A few measurements are given in Table 6.

Remarks: Brodkorb (1963a) lists several Pleistocene sites in Florida yielding E. albus fossils.

Xenicibis xympthecus Olson and Steadman (1977), a flightless ibis from a Late Quarternary cave deposit on Jamaica, has a relatively small humerus.

Suborder Ardeae Wagler

Family Ardeidae Vigors

Genus Ardea Linnaeus

Ardea sp.

Material: Anterior fragment of 1 sternum.

Characters: The sternum of Ardea n. sp. differs from those of A. herodias and A. occidentalis in having (1) anterior crinal margin with long, deep grooves on either side of midline ridge; (2) right

Table 6. Measurements of the humerus of Recent Eudocimus albus (2 ♂, 4 ♀) and Inglis E. albus. Shaft measurements taken just distal to deltoid crest.

		<u>Eudocimus</u> <u>albus</u>	<u>Inglis</u> <u>E. albus</u>
<u>Humerus</u>			
Head	R	15.0-17.1	15.9
Length	M	15.82	-
	N	6	1
Head Width	R	6.2-7.1	6.5
	M	6.62	-
	N	6	1
Shaft Width	R	7.5-9.2	8.5
	M	8.62	-
	N	6	1
Shaft Depth	R	6.0-7.0	6.3
	M	6.43	-
	N	6	1

corner of left coracoidal sulcus flat and without encircling ridge (area depressed and ridge present in A. herodias and A. occidentalis); and (3) carinal apex higher.

Measurements of the sternal fragment are given in Table 7.

Remarks: Ardea herodias has been recorded from several Pleistocene sites in Florida (Brodkorb, 1963a).

Howard (1946) synonymized Ardea paloccidentalis Shufeldt with Botaurus lentiginosus. Ardea polkensis Brodkorb (1955) of Lower Pliocene was similar to, but smaller than, A. herodias.

Genus Ixobrychus Billberg

Ixobrychus n. sp.

Material: Distal end of 1 left tibiotarsus; distal end of 1 left tarsometatarsus. The 2 specimens represent a minimum number of 1 individual. Both specimens are too worn for measurements.

Characters: Tibiotarsus having (1) size similar to that of Ixobrychus involucris and I. sinensis (I. exilis smaller; I. minutus slightly larger; I. cinnamomeus and I. sturmi much larger); (2) internal ligamental prominence very flat, as in I. exilis (high and distinct in I. involucris, I. sinensis and I. minutus); (3) tendinal bridge width as in I. sinensis and I. exilis (bridge wider in I. minutus and I. involucris); and (4) openings on either side of tendinal bridge large and rounded, as in I. exilis and I. minutus (openings small and narrow in I. sinensis and I. involucris).

The tarsometatarsus (with trochleae crushed or lost) is slightly larger than that of I. exilis (those of I. sinensis, I. involucris and I. minutus all larger than the Inglis fossil). Ixobrychus cinnamomeus

Table 7. Measurements of the sternum of Recent Ardea herodias (1♂, 5♀) and Inglis Ardea sp.

		<u>Ardea</u> <u>herodias</u>	Inglis <u>Ardea</u> sp.
<u>Sternum</u>			
Length of right	R	21.8-24.5	23.0
Coracoidal sulcus	M	23.85	-
	N	6	1
Width of dorsal	R	3.0-4.1	3.0
Lip of right	M	3.72	-
Coracoidal sulcus	N	6	1
Distance between	R	3.9-7.0	3.8
Dorsal lips of	M	5.73	-
Coracoidal sulcus	N	6	1

and I. sturmi tarsometatarsi are much larger than the Inglis tarsometatarsus.

Remarks: Ritchie (1976) reports an Ixobrychus tibiotalaris from Coleman IIA of the mid-Pleistocene of Florida, which is probably a new species intermediate in size between I. exilis and Butorides virescens. The Inglis tibiotalaris is the same size as the Coleman fossil and conforms with the characters given by Ritchie (1976, 1980). The tarsometatarsus is also a bit larger than that of I. exilis, and most likely belongs to the same Ixobrychus species as the tibiotalaris.

Wetmore (1928a) reports I. exilis from the Pleistocene Ciego Montero deposit of Cuba.

The Recent Least Bittern, I. exilis, ranges from southern Canada to southern Peru (Blake, 1977), inhabiting fresh-water marshes with tall grasses (Wetmore, 1965).

Genus Botaurus Stephens

Botaurus lentiginosus (Rackett)

American Bittern

Material: One left carpometacarpus, missing metacarpal III.

Remarks: Botaurus lentiginosus is known from several Pleistocene localities in Florida (Brodtkorb, 1963a).

The Upper Pleistocene Palaeophox columbiana McCoy (1963) from the Itchtucknee River, Florida, was restudied by Olson (1974a), who synonymized it with Botaurus lentiginosus. Olson (1974a) comments that the Pleistocene B. lentiginosus may have been a bit smaller than the modern form.

Measurements of the Inglis fossil are compared with those of Recent B. lentiginosus in Table 8.

Table 8. Measurements of the carpometacarpus of Recent Botaurus lentiginosus (6 ♂, 5 ♀) and Inglis B. lentiginosus.

		<u>Botaurus</u> <u>lentiginosus</u>	<u>Inglis</u> <u>B. lent.</u>
<u>Carpometacarpus</u>			
Total	R	55.7-69.2	58.8
Length	M	63.33	-
	N	11	1
Proximal	R	9.9-12.0	11.0
Depth	M	10.99	-
	N	11	1
Length of Metacarpal I	R	6.9-8.6	7.9
	M	7.99	-
	N	11	1
Midshaft	R	2.4-3.5	3.0
Depth of Metacarpal I	M	2.99	-
	N	11	1
Midshaft	R	3.4-4.3	3.8
Width of Metacarpal I	M	3.90	-
	N	11	1
Distal	R	6.5-8.2	7.2
Depth	M	7.39	-
	N	11	1

Order Anseriformes (Wagler)

Suborder Anseres Wagler

Family Anatidae Vigors

Subfamily Anatinae (Vigors)

Genus Aix BoieAix sponsa (Linnaeus)

Wood Duck

Material: Proximal end of 1 right scapula, shaft of 1 right coracoid, one furcula, 1 complete right humerus, distal end of 1 left carpometacarpus. The 5 specimens represent a minimum number of 1 individual.

Characters: The humerus agrees with those characters listed by Ligon (1965) for distinguishing Aix from Spatula. Measurements of the humerus of Aix sponsa appear in Table 9.

Remarks: No extinct species of Aix have been described.

Aix sponsa has been recorded for a number of Pleistocene localities in Florida (Brodkorb, 1964a).

Genus Anas LinnaeusAnas platyrhynchos Linnaeus

Mallard

Material: Proximal end of 1 left humerus, fragment of 1 sternum.

Characters: Specimen agrees with characters of the humerus listed by Woolfenden (1961) for Anas. Following Ligon (1965), A. rubripes and A. fulvigula are combined with A. platyrhynchos. The Inglis A. platyrhynchos differs from A. pachyscelus following the characters in Wetmore's (1960) description.

Table 9. Measurements of the humerus of Aix sponsa (8 ♂, 5 ♀) and Inglis A. sponsa.

		<u>Aix</u> <u>sponsa</u> males	<u>Aix</u> <u>sponsa</u> females	<u>Inglis</u> <u>Aix</u> <u>sponsa</u>
<u>Humerus</u>				
Total	R	67.0-73.2	69.0-73.9	70.8
Length	M	70.86	70.76	-
	N	8	5	1
Proximal	R	15.6-17.5	15.7-16.6	
Width	M	16.60	15.92	
	N	8	5	
Midshaft	R	5.5-6.0	5.5-5.9	6.0
Width	M	5.81	5.68	-
	N	8	5	1
Midshaft	R	4.7-5.4	4.6-5.2	5.1
Depth	M	5.07	4.96	-
	N	8	5	1
Distal	R	11.3-12.2	11.5-12.7	
Width	M	11.80	11.86	
	N	8	5	

Anas itchtucknee McCoy (1963) from the Upper Pleistocene of Florida is slightly larger than Recent A. discors, and is therefore much smaller than the Inglis A. platyrhynchos.

Jánossy (1978) describes two species of Anas from the Lower Pleistocene of the Carpathian Basin of Poland, Czechoslovakia, and Austria. Anas submajor is the size of A. platyrhynchos, but differs in the proportions of some long bones. Anas albae is a very small duck, with a carpometacarpus shorter than that of A. crecca.

Campbell (1979) describes three species of Anas from the late Pleistocene of the Talará Tar Seeps, northwestern Peru. Anas talaráe, A. amotape, and A. sanctaehelenae are all small ducks, which Campbell compares with the four smallest living species of Anas: A. leucophrys, A. brasiliensis, A. crecca, and A. cyanoptera.

Anas strepera Linnaeus

Gadwall

Material: Shaft of 1 right humerus, proximal end of 1 left ulna, distal end of 1 right ulna, fragment of 1 left femur, distal end. The 4 specimens represent a minimum number of 1 individual.

Characters: The medium-sized Anas strepera is distinguished from A. acuta based on the characters of the ulna listed by Ligon (1965).

Remarks: Anas strepera is reported from the Itchtucknee River, Florida (McCoy, 1963).

Anas discors (Linnaeus)

Blue-winged Teal

Material: One complete left humerus, distal shaft of 1 left

humerus, 1 complete left ulna, 1 right and 1 left carpopmetacarpus (both lacking metacarpal III). The 5 specimens represent a minimum number of 2 individuals.

Characters: Anas discors is distinguished from A. itchtucknee based on the characters listed by McCoy (1963).

Measurements of the humerus, ulna, and carpopmetacarpus are given in Table 10.

Remarks: The carpopmetacarpus of Anas albae Jánosy (1978) has a total length of 33.7 mm, which is smaller than the minimum length of the carpopmetacarpus for A. discors (Table 10).

Campbell's (1979) Anas talarae and A. sanctaehelenae are smaller than A. discors, and his A. amotape is about the same size. However, the Inglis A. discors differs from the A. amotape following Campbell's list of characters (1978).

Subfamily Aythyinae (Delacour and Mayr)

Genus Aythya Boie

Aythya americana (Eyton)

Redhead

Material: One complete left ulna.

Characters: The ulna of Aythya americana is larger than those of A. collaris, A. affinis, and A. fuligula, and is distinguished from those of A. marila and A. valisineria by having (1) cotylae smaller; (2) impression of brachialis anticus shallower; (3) carpal tuberosity smaller; and (4) external condyle smaller.

Measurements of the fossil are compared with several species of Aythya in Table 11.

Table 10. Measurements of the humerus, ulna, and carpometacarpus of Anas discors (3♂, 3♀) and Inglis A. discors.

		<u>Anas</u> <u>discors</u>	Inglis <u>Anas</u> <u>discors</u>
<u>Humerus</u>			
Total	R	61.5-64.1	61.8
Length	M	63.34	-
	N	5	1
Proximal	R	13.2-13.9	13.8
Width	M	13.55	-
	N	6	1
Distal	R	9.3-10.4	9.8
Width	M	9.83	-
	N	6	1
<u>Ulna</u>			
Total	R	51.0-54.1	
Length	M	52.96	
	N	6	
Proximal	R	6.0-6.8	6.3
Width	M	6.45	-
	N	6	1
Distal	R	5.3-5.8	5.4
Depth	M	5.51	-
	N	6	1
<u>Carpometacarpus</u>			
Total	R	36.7-39.5	37.9-38.3
Length	M	37.88	38.10
	N	6	2
Proximal	R	8.6-9.2	9.2
Width	M	8.93	-
	N	6	1

Table 11. Measurements of the ulna of Aythya collaris (7♂, 2♀), A. affinis (4♂, 4♀), A. fuligula (4♂, 1♀), A. marila (5♂, 6♀), Inglis A. americana, A. americana (3♂, 10♀), and A. valisineria (2♂, 6♀).

<u>Ulna</u>		<u>Aythya collaris</u>	<u>Aythya affinis</u>	<u>Aythya fuligula</u>	<u>Aythya marila</u>	<u>Inglis Aythya americana</u>	<u>Aythya ameri.</u>	<u>Aythya valisi.</u>
Total Length	R	63.4-68.0	66.3-71.3	69.1-72.9	69.5-79.5	78.5	76.2-83.9	79.0-84.1
	M	65.62	68.75	70.68	76.46	-	79.17	81.90
	N	9	8	5	11	1	13	8
Proximal Width	R	7.2-7.6	7.2-7.8	7.5-7.8	7.6-8.7	7.7	8.0-8.7	8.3-9.0
	M	7.41	7.48	7.64	8.26	-	8.33	8.67
	N	9	8	5	11	1	13	8
Distal Depth	R	5.9-6.5	5.8-6.3	6.0-6.1	6.1-7.1	5.9	6.4-7.5	6.8-7.5
	M	6.11	6.06	6.04	6.61	-	6.90	7.11
	N	9	8	5	11	1	13	8

Remarks: The five known extinct species of Aythya are recorded from the Upper Pleistocene of Australia (A. robusta, A. reclusa, and A. effodiata) and the Upper Pliocene of Italy (A. aretina and A. sepulta).

Subfamily Tadorninae Reichenbach

Genus *Anabernicula RossAnabernicula gracilenta Ross

Material: One right quadrate, 1 left tarsometatarsus (lacking hypotarsus and inner trochlea). The 2 specimens represent a minimum number of 1 individual.

Characters: Howard (1964a) lists characters of the tarsometatarsus used to separate Anabernicula from Tadorna. Anabernicula gracilenta is distinguished from A. oregonensis by having a slightly smaller size. See Table 12.

Remarks: Four species of Anabernicula are known. Anabernicula minuscula (Wetmore, 1924) from the lower Pleistocene of Arizona is known only by the proximal half of the humerus. Anabernicula oregonensis Howard (1964a) is recorded from the late Pleistocene of Oregon, and is a slightly heavier bird than A. gracilenta. Anabernicula gracilenta is recorded from the late Pleistocene of California, Nevada, and New Mexico. Short (1970a) describes the stocky A. robusta from the middle Pleistocene of Nebraska based on a humerus.

Howard (1963) describes another extinct genus of the subfamily Tadorninae, Brantadorna downsi from the middle Pleistocene of California. Brantadorna is distinguished from Anabernicula based on characters of the humerus showing it to be more gooselike than Anabernicula.

Table 12. Measurements of the tarsometatarsus of Rancho La Brea Anabernicula gracilenta (Howard, 1964). Inglis A. gracilenta, A. oregonensis Howard, (1964), and Recent Tadorna ferruginea (4 females).

		<u>A. grac.</u>	Inglis <u>A. grac.</u>	<u>A. oreg.</u>	<u>Tadorna</u> <u>ferruginea</u>
<u>Tarsometatarsus</u>					
Total	R	56.0-63.3	61.6		59.2-62.8
Length	M	58.9	-		61.12
	N	5	1		4
Proximal	R	9.9-11.7		11.7	11.2-12.0
Width	M	10.7		-	11.62
	N	9		1	4
Midshaft	R		5.2		4.7-5.6
Width	M		-		5.05
	N		1		4
Midshaft	R		4.9		4.3-5.2
Depth	M		-		4.65
	N		1		4
Width of	R	4.5-5.3		5.7	
Internal	M	4.8		-	
Condyle	N	7		1	
Depth of	R	5.4-6.2		6.5	
Internal	M	5.7		-	
Condyle	N	7		1	
Width	R				11.3-13.0
Through	M				12.25
Trochleae	N				4

Order Accipitriformes (Viellot)

Suborder Sarcoramphi (Ridgway)

Family Vulturidae (Illiger)

Subfamily Vulturinae (Illiger)

Genus Gymnogyps Lesson

cf. Gymnogyps californianus (Shaw)

California Condor

Material: Proximal end of one left tibiotarsus.

Characters: The cnemial crests of this fossil are worn, making application of Fisher's (1945) characters for separating Gymnogyps and Teratornis useless. Table 13 shows considerable overlap in the proximal width of the Gymnogyps and Teratornis tibiotarsi. Howard's (1974) detailed comparison of Breagyps, Vultur, and Gymnogyps likewise cannot be used to identify this fossil, and she gives no proximal width measurements for tibiotarsi. However, these genera can be eliminated on the basis of their generally larger size with respect to Gymnogyps. Modern Sarcoramphus papa is much smaller than the fossil (Table 13).

Measurements in Table 13 show the Inglis bone to be at the minimum size for Recent G. californianus. Measurements of the proximal end of G. amplus have not been published. However, Fisher's (1947) tibiotarsus measurements of total length, distal width, and fibular crest length show the two species to be inseparable in size.

Remarks: The specimen is referred to the extant species Gymnogyps californianus rather than to the extinct G. amplus L. Miller. Fisher (1944) considers G. amplus to be the ancestral form of G. californianus, and lumped all Pleistocene Gymnogyps into the species G. amplus. Loye

Table 13. Proximal width of the tibiotarsus of modern Sarcoramphus papa, Inglis cf. Gymnogyps californianus, Recent G. californianus (Fisher, 1947), Pleistocene Teratornis merriami (Fisher, 1945), and Pleistocene Vultur (Campbell, 1973).

	<u>Sarcoramphus</u>	<u>Gymnogyps</u> Inglis	<u>Gymnogyps</u> Recent	<u>Teratornis</u>	<u>Vultur</u>
R	18.8-19.8	26.2	26.2-29.4	26.6-31.2	30.0-31.1
M	19.3	-	27.3	29.0	30.6
N	2	1	8	15	2

Miller (1957) does not agree with this move. Fisher's (1947) study of Recent and fossil Gymnogyps reveals no qualitative or quantitative differences in postcranial G. amplus or G. californianus bones (see Table 14). Howard's (1974) skeletal measurements of G. californianus show even more overlap in their size ranges than Fisher's (1947) paper did. The only differences between these species are the characters of the skull listed by Fisher (1944), but Wetmore (1959, p.12) remarks, "even here the distinction is not clear-cut." Brodkorb (1964a) suggests that G. amplus is a temporal subspecies of G. californianus. It seems appropriate to here synonymize G. amplus with G. californianus.

Three species of condor are known from the Florida Pleistocene. Gymnogyps amplus is recorded for the middle Pleistocene of Reddick by Brodkorb (1957), and for the Upper Pleistocene of the Itchtucknee River by McCoy (1963). Wetmore (1931) lists G. californianus for the Upper Pleistocene of Sarasota. Teratornis merriami is known from the Upper Pleistocene of Seminole Field and Manatee County (Wetmore, 1931b).

The tibiotarsus is not represented for several fossil vulture species. Pliogyps fisheri Tordoff (1959) of the Upper Pliocene of Kansas is known only from the tarsometatarsus, and is smaller than Vultur, Breagyps, and Gymnogyps. The Pliocene Vultur patruus (Lönnberg, 1902) of Bolivia is also known solely from the tarsometatarsus, as is the long and slender Cathartornis gracilis L. Miller (1910) of the Upper Pleistocene of Rancho La Brea. Only the humerus is known of Sarco-ramphus kernense (L. Miller, 1931) from California's middle Pliocene. Antillovultur varonai Arredondo (1971 and 1976) from Cuba's late Pleistocene is known from the tarsometatarsus and humerus, and is equal in size to the Andean Condor, Vultur gryphus. The Antillovultur tarsometatarsus is longer and more robust than that of Gymnogyps.

Table 14. Measurements of the tarsometatarsus of mid-Pleistocene Gymnogyps amplus from Reddick, late Pleistocene G. amplus from Rancho La Brea (Fisher, 1947 and L. Miller, 1910), and Recent G. californianus (Fisher, 1947).

		<u>G. amplus</u> Reddick	<u>G. amplus</u> Rancho La Brea (Fisher)	<u>G. amplus</u> Rancho La Brea (Miller)	<u>G. calif.</u> Recent
<u>Tarsometatarsus</u>					
Total	R	126.9	113.0-134.0	120.0-131.4	113-117
Length	M	-	123.00	123.70	114
	N	1	100	14	6
Proximal	R	29.3	26.5-31.7	26.5-30.1	25.5-28.0
Width	M	-	28.50	28.01	26.6
	N	1	86	14	6
Width	R	30.8	29.5-34.5	30.7-33.2	28.3-30.2
Through	M	-	32.3	32.09	29.40
Trochleae	N	1	97	14	6

Genus Coragyps GeoffroyCoragyps atratus (Bechstein)

Black Vulture

Material: One axis, proximal end of 1 left scapula, proximal end of 1 left coracoid, 2 complete right coracoids, distal ends of 1 left and 1 right humeri, proximal ends of 2 left and 1 right ulnae, distal ends of 2 left ulnae, 1 right ulnare, 1 right radiale, proximal end of 1 left carpometacarpus, distal end of 1 right tibiotarsus, proximal end of 1 left tarsometatarsus. The 17 specimens represent a minimum number of 2 individuals.

Characters: The tibiotarsus and tarsometatarsus conform to Cracraft and Rich's (1972) diagnosis of the "Cathartidae" (Vulturidae). Coragyps atratus is easy to distinguish from Cathartes aura, the Turkey Vulture, in most elements by many characters.

The carpometacarpus (proximal end) of Coragyps differs from that of Cathartes in having (1) proximal process of metacarpal I narrow and pointed (wide and rounded in Cathartes); (2) area between distal end of tendinal groove and proximal edge of internal condyle narrow (wide in Cathartes); and (3) prominence exterior to tendinal bridge low and blunt (prominence sharp in Cathartes).

The tarsometatarsus (proximal end) in having; (1) in proximal view, posterior edge of hypotarsus straight (curved in Cathartes); and (2) in anterior view, lacks prominence distal to external condyle.

Measurements are given in Table 15 comparing the Inglis fossils with Coragyps occidentalis (L. Miller) from Reddick, C. occidentalis occidentalis from Rancho La Brea (Howard, 1968), C. occidentalis mexicanus from San Josecito Cave (Howard, 1968), Recent C. atratus atratus

Table 15. Measurements (mm.) of the coracoid, humerus, ulna, and tibiotarsus of early Pleistocene Coragyps atratus from Inglis, middle Pleistocene C. occidentalis from Reddick, late Pleistocene C. o. occidentalis from Rancho La Brea (Howard, 1968), late Pleistocene C. o. mexicanus from San Josecito Cave, Mexico (Howard, 1968), Recent C. atratus atratus from Florida and California (Howard, 1968) and Recent C. atratus brasiliensis from Panama. *-surface worn. R-range, M-mean, N-number.

		<u>Coragyps atratus</u> Inglis	<u>C. occidentalis</u> Reddick	<u>C. o. occi.</u> RLB
<u>Coracoid</u>				
Length to int.	R	59.2	64.4-65.4	60.3-69.4
Sternal facet	M	-	64.90	64.5
	N	1	2	70
Length to ext.	R	65.5		
Sternal facet	M	1		
	N	1		
Head to	R	25.3-26.3	27.9-29.9	
Scapular facet	M	25.80	28.77	
	N	2	3	
Midshaft	R	7.4-8.3		
Width	M	7.85		
	N	2		
Midshaft	R	6.0-6.3		
Depth	M	6.15		
	N	2		
<u>Humerus</u>				
Midshaft	R	10.5		
Width	M	-		
	N	1		
Midshaft	R	8.8		
Depth	M	-		
	N	1		
Distal	R	23.7-24.2		26.1-29.1
Width	M	23.95		27.4
	N	2		50

Table 15. Extended.

<u>C. o. mexicanus</u>	<u>C. atratus</u>	<u>atratus</u>	<u>C. a. brasiliensis</u>
San Josecito Cave	Florida	California	Panama
58.5-65.3	57.9-64.0	56.6-62.6	56.6-59.7
62.0	61.71	59.87	58.80
38	9	6	4
	63.1-68.7		65.0-65.5
	66.51		65.25
	9		2
	24.4-26.8		23.1-25.1
	25.66		24.45
	9		4
	7.0-7.9		7.0-8.3
	7.59		7.65
	9		2
	5.4-6.4		5.7-6.0
	6.09		5.85
	9		2
	10.2-11.4		9.9-10.4
	10.87		10.15
	9		2
	8.9-9.5		8.9-8.9
	9.21		8.9
	9		2
24.9-28.1	24.4-25.9	22.5-25.7	22.5-24.4
26.4	25.07	24.2	23.58
15	9	6	4

Table 15. Continued.

		<u>Coragyps atratus</u>	<u>C. occidentalis</u>	<u>C. o. occi.</u>
		Inglis	Reddick	RLB
<u>Ulna</u>				
Proximal	R	*15.8-*16.1		16.0-18.2
Width	M	15.95		17.0
	N	2		58
Distal	R	12.3-13.0		
Depth	M	12.65		
	N	2		
<u>Tibiotarsus</u>				
Depth of	R	12.1	12.6-13.0	
External	M	-	12.73	
Condyle	N	1	3	
Depth of	R	12.7	13.2-14.0	
Internal	M	-	13.73	
Condyle	N	1	3	
Distal	R	12.2	14.3	13.4-15.9
Width	M	-	-	14.4
	N	1	1	65

Table 15. Extended.

<u>C. o. mexicanus</u>	<u>C. atratus atratus</u>		<u>C. a. brasiliensis</u>
San Josecito Cave	Florida	California	Panama
15.6-17.7	15.8-16.1	14.2-17.0	14.2-17.0
16.6	17.86	15.8	15.70
20	9	6	4
	12.2-13.8		11.8-13.7
	13.07		12.75
	9		2
	12.5-13.5		12.2-12.5
	13.04		12.35
	9		2
	13.4-14.6		13.5-13.9
	13.99		13.70
	9		2
12.9-14.1	12.4-13.3	12.4-13.2	12.3-12.8
13.5	12.76	12.7	12.53
17	9	6	4

from Florida and from Howard's (1968) paper (from the United States, Mexico, and Guatemala), and Recent C. atratus brasiliensis from Panama, (including Oaxaca, Mexico, and Guatemala specimens from Howard, pers. com.). These measurements show an increase and then a decrease in average size from early Pleistocene to Recent. However, there are greatly overlapping ranges in the coracoid, humerus, ulna, and tibiotarsus measurements.

Remarks: In Florida, C. occidentalis is listed for Reddick (Brodkorb, 1957) and Haile (Ligon, 1965). Coragyps occidentalis is a supposedly heavier-boned species than C. atratus, but Howard's (1968, p.116) "Limb measurements of the extinct vulture, Coragyps occidentalis" states:

Qualitative distinctions from bones of the living C. atratus are not evident in the fossil limb bones; both species exhibit considerable variation. Differences lie in over-all size and proportions of the elements.

However, Ligon's (1965) tibiotarsus measurements of C. occidentalis are within the range of modern C. atratus.

Geographical variation in Recent Coragyps atratus has been discussed by Brodkorb (1944) and Wetmore (1962). The three subspecies include the large C. atratus atratus, of the North American temperate region, the small C. atratus brasiliensis of the tropical region, and the large C. atratus foetens of the South American temperate region.

According to Howard (1968), there was a similar pattern of variation in the late Pleistocene. Coragyps o. occidentalis was the larger North American form, and C. o. mexicanus was the smaller tropical subspecies.

There appears to have been a gradual increase, then decrease, in Coragyps' size from early Pleistocene to Recent, plus geographical variation in size at least in late Pleistocene to Recent. The size fluctuation indicates climatic changes from warmer to cooler and back to warm again in Recent times.

In view of the lack of qualitative characters to separate C. occidentalis and C. atratus, and the broad overlap in measurements, it seems appropriate to synonymize C. occidentalis with C. atratus.

The Inglis bones are the oldest known for this genus.

Genus Cathartes Illiger

Cathartes aura (Linnaeus)

Turkey Vulture

Material: One left quadrate, proximal end of 1 left tarsometatarsus. The 2 specimens represent a minimum number of 1 individual.

Characters: The identification of the tarsometatarsus is based on the characters listed under the section on Coragyps atratus.

Measurements given in Table 16 compare these fossil elements with those of nine modern specimens of Cathartes aura.

Remarks: Cathartes aura is known from many Pleistocene sites in Florida (Brodkorb, 1964a). Inglis is the oldest fossil locality for this genus and species.

Table 16. Measurements of the quadrate and tarsometatarsus of Inglis Cathartes aura and Recent, C. aura (4 males, 5 females).

		<u>C. aura</u> <u>Inglis</u>	<u>C. aura</u> <u>Recent</u>
<u>Quadrate</u>			
Length (horizontal)	R	18.7	16.0-18.0
	M	-	17.14
	N	1	9
Depth	R	12.3	11.0-12.2
	M	-	11.51
	N	1	9
<u>Tarsometatarsus</u>			
Proximal Width	R	15.7	13.2-15.5
	M	-	14.29
	N	1	9
Midshaft Width	R	7.0	7.3-8.2
	M	-	7.86
	N	1	9
Midshaft Depth	R	5.0	4.3-5.2
	M	-	4.90
	N	1	9

Suborder Accipitres (Vieillot)

Family Accipitridae (Vieillot)

Subfamily Buteoninae (Vigors)

Genus Buteo Lacépède

Buteo n. sp.

Holotype: One complete left carpometacarpus.

Paratypes: Proximal end of 1 left ulna, proximal end of 1 left carpometacarpus, distal end of 1 left tibiotarsus, proximal end of 1 left tarsometatarsus, distal end of 1 left tarsometatarsus.

Referred material: One left digit II of phalanx of manus, 2 left acetabular fragments, proximal end of 1 left tarsometatarsus, 1 phalanx I of digit I, 1 ungual phalanx each of digits I, II, III and IV.

The 14 specimens represent a minimum number of 2 individuals.

Locality and age: Inglis IA, Citrus County, Florida. Early Pleistocene.

Diagnosis: Carpometacarpus agrees with Buteo in the characters listed by Campbell (1973, p. 98). It is larger than those of B. magnirostris, B. platypterus, B. nitidus, B. lineatus, B. lagopus, and B. swainsoni, and is slightly smaller than B. regalis. It agrees in size with that of B. jamaicensis (Table 17).

The carpometacarpus differs from those of Buteo jamaicensis and B. regalis in having (1) distal edge of pollical facet forming a broad U-shape; (2) ridge between metacarpal I and external trochlea longer and thinner; (3) internal ligamental fossa deeper; (4) internal carpal trochlea shorter; (5) depression between pisiform process and metacarpal I deeper; (6) tendinal groove wider; (7) in internal view, wide area at distal end of metacarpal II more depressed.

Table 17. Measurements (mm) of the carpometacarpus of Buteo magnirostris, B. platypterus, B. nitidus, B. lineatus, B. logopus, B. swainsoni, B. jamaicensis, Inglis Buteo n. sp., and B. regalis.

		<u>B.</u> <u>magnirostris</u> (2 males, 2 females, 2 ?)	<u>B.</u> <u>platypterus</u> (1 male, 3 females)	<u>B.</u> <u>nitidus</u> (1 male, 4 females)	<u>B.</u> <u>lineatus</u> (6 males, 11 females)
Total	R	37.5-42.2	44.5-46.5	43.2-49.6	47.0-55.2
Length	M	39.78	45.6	47.40	51.31
	N	6	4	5	17
Proximal	R	9.2-10.3	10.8-11.3	10.7-12.8	10.8-13.7
Height	M	9.68	10.95	11.94	11.85
	N	6	4	5	17
Height	R	5.5-5.9	6.7-7.0	6.5-8.0	6.5-8.2
of Meta-	M	5.70	6.83	7.46	7.34
carpal I	N	6	4	5	17
Distal	R	6.6-7.5	7.2-8.0	7.2-9.1	8.0-9.7
Width	M	7.10	7.63	8.20	8.79
	N	6	4	5	17

Table 17. Extended.

<u>B.</u> <u>lagopus</u> (1 male, 1 females)	<u>B.</u> <u>swainsoni</u> (2 males, 1 female)	<u>B.</u> <u>jamaicensis</u> (6 males, 6 females, 2 ?)	<u>B.</u> <u>n. sp.</u>	<u>B.</u> <u>regalis</u> (1 male, 2 females)
62.9-64.6 63.75 2	60.8-66.4 63.20 3	61.2-72.7 65.52 14	69.3 - 1	72.4-79.4 75.90 2
14.3-14.4 14.35 2	13.5-15.2 14.27 3	14.7-17.8 16.08 14	16.9-18.4 17.65 2	16.1-18.6 17.35 2
7.2-9.2 8.20 2	8.6-10.5 9.27 3	9.2-11.9 10.56 14	10.4-10.6 10.50 2	11.1-12.1 11.60 2
10.5-10.6 10.55 2	9.9-11.3 10.53 3	10.9-13.2 11.81 14	13.3 - 1	12.2-13.8 13.00 2

Characters: The proximal end (76.8 mm. long) of the ulna differs from those of Buteo jamaicensis and B. regalis in having (1) olecranon process higher; (2) depression of internal side of olecranon deeper; (3) intercotylar ridge higher; (4) tricipital attachment wider; (5) bicipital attachment forming one elongated scar (forms 2 short scars in B. jamaicensis and B. regalis); (6) impression of brachialis anticus bordered on internal side by a sharp ridge; (7) nutrient foramen much larger. The proximal width of the Inglis Buteo n. sp. ulna is 16.9 mm.

The tibiotarsus differs from those of B. jamaicensis and B. regalis in having (1) tendinal groove more medial (closer to external condyle in B. jamaicensis and B. regalis); (2) anterior intercondylar fossa shallower; (3) distal edge of supratendinal bridge convex (straight in B. jamaicensis and B. regalis). Measurements of the tibiotarsus (Table 18) show it to be larger than those of B. jamaicensis and B. regalis.

The tarsometatarsus in having (1) inner proximal foramen larger; (2) in anterior view of proximal end, external edge of shaft nearly straight (curves inward in B. jamaicensis and B. regalis); (3) area proximal to tubercle for tibialis anticus relatively shallow, as in B. regalis; (4) internal edge of shaft thicker proximally; (5) facet for metatarsal I much larger and wider; (6) condyles larger (sternal condyle missing in fossil). Tarsometatarsus measurements of several Buteo are shown in Table 18. The referred piece of a tarsometatarsus agrees with all the above characters except for number (4).

The carpometacarpus of Buteo n. sp. is closer in size to that of B. jamaicensis than to that of B. regalis, while the tibiotarsus and tarsometatarsus are slightly larger than those of B. regalis (Tables 17 and 18).

Table 18. Measurements (mm) of the tibiotarsus and tarsometatarsus of Buteo lagopus, B. swainsoni, B. jamaicensis, Inglis Buteo n. sp., and B. regalis. Tibiotarsus measurements are taken just proximal to the tendinal bridge. *(6 ♂, 6 ♀, 2??)

		<u>B.</u> <u>lagopus</u> (1♂, 1♀)	<u>B.</u> <u>swainsoni</u> (2 ♂, 1♀)	<u>B.</u> <u>jamaicensis</u> (5 ♂, 6 ♀, 2??)	<u>B.</u> <u>n. sp.</u>	<u>B.</u> <u>regalis</u> (1♂, 1♀)
<u>Tibiotarsus</u>						
Width of	R	7.6-8.2	8.1-8.5	9.4-11.8	13.4	10.1-11.4
Shaft	M	7.90	8.30	10.52	-	10.70
	N	2	3	13	1	2
Depth of	R	4.1-4.3	4.1-4.5	4.5-6.3	6.7	5.0-6.0
Shaft	M	4.20	4.27	5.54	-	5.50
	N	2	3	13	1	2
<u>Tarsometatarsus</u>						
Proximal	R	11.8-11.9	10.9-12.4	13.5-17.1	15.5	14.1-16.6
Width	M	11.85	11.43	14.84	-	15.35
	N	2	3	*14	1	2
Head to	R	13.7-15.2	13.2-15.3	16.2-19.3	9.5-20.0	15.9-20.9
Middle of	M	14.45	14.33	17.70	19.75	18.40
Tibialis	N	2	3	*14	2	2
Anticus						
Tubercle						

The Inglis Buteo n. sp. is perhaps ancestral to B. jamaicensis, as it shows more resemblance to that species in the characters listed above.

Measurements of the phalanges are shown in Table 19.

Remarks: Buteo typhoius Wetmore of the Upper and Lower Miocene of Nebraska is known from the distal part of a tarsometatarsus and the distal part of a tibiotarsus (Wetmore, 1923 and 1928b). The tibiotarsus B. typhoius (from a juvenile individual) differs from that of Buteo n. sp. in having (1) slightly smaller size, and (2) considerably different shape and orientation of the tendinal bridge. The tarsometatarsus of B. typhoius is larger than that of B. jamaicensis and Buteo n. sp.

The tarsometatarsus of Buteo contortus (Wetmore) from Nebraska's Upper Miocene is much larger than that of Buteo n. sp., as is readily seen from Wetmore's (1923) drawings and measurements.

The Lower Pliocene hawk from Nebraska, Buteo dananus (Marsh), was described from the distal end of a tibiotarsus as being "nearly as large as the Golden Eagle" (Marsh, 1871). Wetmore (1923) gives its width across the condyles as just over 16 mm. The tibiotarsus of Buteo n. sp. is distinguished from that of B. dananus, based on the photograph of the type (Shufeldt, 1915), by having (1) proximal edge of supratendinal bridge parallel with the long axis of the tibiotarsus (edge makes an acute angle in B. dananus); (2) distal edge of supratendinal bridge at a 45° angle to the long axis of the bone (edge is almost perpendicular to long axis in B. dananus); and (3) distal opening of tendinal groove triangular in shape (opening is nearly spherical in B. dananus).

Table 19. Measurements of phalanx I of digit I and the ungual phalanges of digits I, II, III, and IV of 1 Recent Buteo jamaicensis (2 ♂, 2 ♀) and Inglis Buteo n. sp.

<u>Phalanx I of digit I</u>		<u>B. jamaicensis</u>	<u>Buteo n. sp.</u>
Total	R	22.2-27.1	24.7
Length	M	24.13	-
	N	4	1
Proximal	R	10.9-12.7	11.8
Width	M	11.68	-
	N	4	1
Distal	R	5.4-6.3	6.0
Width	M	5.78	-
	N	4	1
<u>Ungual phalanx of digit I</u>			
Proximal	R	6.5-8.2	7.7-8.0
Width	M	7.20	7.85
	N	4	2
Proximal	R	12.0-14.0	14.1-14.6
Depth	M	12.95	14.35
	N	4	2
<u>Ungual phalanx of digit II</u>			
Proximal	R	6.0-7.3	6.3
Width	M	6.45	-
	N	4	1
Proximal	R	11.1-13.2	11.6
Depth	M	12.10	-
	N	4	1
<u>Ungual phalanx of digit III</u>			
Proximal	R	4.9-5.7	6.5
Width	M	5.15	-
	N	4	1
Proximal	R	8.1-9.9	10.0
Depth	M	8.95	-
	N	4	1
<u>Ungual phalanx of digit IV</u>			
Proximal	R	4.0-4.7	4.7
Width	M	4.28	-
	N	4	1
Proximal	R	7.5-9.0	8.5
Depth	M	8.15	-
	N	4	1

Buteo conterminus (Wetmore), also of Nebraska's Lower Pliocene, is even more massive than B. contortus in the size of the tarsometatarsus (Wetmore, 1923), and is clearly not the same species as Buteo n. sp.

Two new genera of Pleistocene hawks from South America, Miraquila terrestris Campbell and Amplibuteo hibbardi Campbell (1979) are gigantic in comparison to Buteo n. sp. Campbell's (1979) Buteo sp. 1 and Buteo sp. 2 (not illustrated in his paper) are both smaller and differ qualitatively from the Inglis Buteo n. sp.

Genus Aquila Brisson

Aquila n. sp.

Holotype: Complete right carpometacarpus.

Paratypes: Proximal end of 1 left humerus, proximal end of 2 left ulnae, distal end of 1 left ulnae, proximal ends of 2 right and 1 left radii, distal end of 1 left carpometacarpus, 1 right and 1 left pollex, 1 left digit III of manus, 1 complete left femur, proximal end of 1 right femur, 1 complete right tibiotarsus, proximal end of 1 right fibula, 1 right metatarsal, 1 subterminal phalanx of digit I, 1 ungual phalanx of digit I, 1 phalanx II of digit II, 1 phalanx I of digit III, 1 phalanx III of digit III, 1 phalanx I of digit IV, and 1 ungual phalanx of digit IV.

Referred material: Anterior end of 2 mandibles, posterior end of 1 left mandible, proximal end of 1 sternum, proximal end of 2 left scapulae, midsection of 1 left coracoid, distal fragment of 1 right humerus, distal end of 1 left radius, proximal fragment of 1 right femur, and distal fragment of 1 right femur.

The 34 specimens represent a minimum number of 4 individuals.

Generic characters: Carpometacarpus agrees with that of Aquila in having (1) in ventral view, carpal trochleae set far apart, with depression for ulnare relatively flat, as in Spizaetus and Parabuteo (trochleae closer together and depression for ulnare a rounded pit in Haliaeetus, Heterospizias, and Buteo; very far apart in Accipiter; very close in Buteogallus); (2) ligamental attachment of pisiform process distinct, broad, and forming a deep pit anterior to pisiform process, as in Accipiter, Spizaetus, and Heterospizias (smaller, less distinct, and a shallow pit in Haliaeetus and Buteo; no pit in Buteogallus and Parabuteo); (3) in internal view, tendinal groove short and broad, and extending proximally from proximal end of intermetacarpal space (groove long and narrow, coming to a distinct point at proximal end in Haliaeetus and Accipiter; indistinct in Buteogallus, Buteo, Spizaetus, Heterospizias, and Parabuteo); (4) proximal fused area between metacarpal II and metacarpal III of medium length, as in Accipiter, Buteogallus, Spizaetus, and Parabuteo (long in Haliaeetus; very short in Buteo and Heterospizias); (5) tendinal groove strongly curved around edge of shaft towards metacarpal I, as in Accipiter, Buteogallus, Buteo, Spizaetus, Heterospizias, and Parabuteo (groove more nearly parallel to shaft in Haliaeetus); distal end of intermetacarpal space a broad U-shaped region, as in Buteo (narrow U-shape in Haliaeetus, Buteogallus, Spizaetus, Heterospizias, and Parabuteo; V-shape in Accipiter).

Humerus agrees with that of Aquila in having attachment of infraspinatus forming a long, deep groove (attachment flat and oval-shaped with no such groove in Haliaeetus; short groove in Accipiter, Buteogallus, Buteo, Spizaetus, Heterospizias, and Parabuteo).

Ulna agrees with that of Aquila in having (1) ridge separating internal and external cotylae high (very low ridge in Haliaeetus and Heterospizias; sharp prominence in Accipiter and Spizaetus; low ridge in Buteogallus, Buteo, and Parabuteo); (2) bicipital scar more distally placed than in Haliaeetus, Accipiter, Buteogallus, Buteo, Spizaetus, Heterospizias, and Parabuteo.

Femur agrees with that of Aquila in having (1) anterior intermuscular line extending much farther proximally than proximal foramen, as in Accipiter, Buteogallus, Buteo, Spizaetus, Heterospizias and Parabuteo (line stops at about level of foramen in Haliaeetus); (2) posterior intermuscular line extending much farther proximally than nutrient foramen, as in Accipiter, Buteo, Spizaetus ornatus, and Heterospizias (stops at about level of foramen in Haliaeetus, Buteogallus, Spizaetus tyrannus, and Parabuteo); (3) medial edge of internal condyle rounded, as in Accipiter, Buteogallus, Buteo, Spizaetus, Heterospizias, and Parabuteo (tapered in Haliaeetus); external wing of fibular condyle thrust laterally, as in Accipiter, Spizaetus, and Heterospizias (more compressed in Haliaeetus, Buteogallus, Buteo, and Parabuteo); (5) external condyle large and rounded, as in Accipiter, Buteogallus, Spizaetus, Heterospizias, and Parabuteo (smaller and squared-off on proximal edge in Haliaeetus and Buteo); (6) anterior view, ridges formed by internal and external condyles extending proximad to same level, as in Buteogallus and Spizaetus (ridge of external condyle extends much farther proximally than ridge of internal condyle in Haliaeetus, Accipiter, Buteo, Heterospizias, and Parabuteo).

Tibiotarsus agrees with that of Aquila in having (1) region between proximal edge of supratendinal bridge and external condyle wide, as in Spizaetus (narrow region in Haliaeetus, Accipiter, and Buteo; area of medium width in Buteogallus, Heterospizias, and Parabuteo); (2) in anterior view, proximal end of internal condyle rounded, as in Accipiter, Buteogallus, Buteo, Heterospizias, Parabuteo, and Spizaetus (proximal end forms a point directed toward supratendinal bridge in Haliaeetus); (3) in posterior view, internal condyle longer and its internal ridge parallel with long axis of bone, as in Accipiter, Buteogallus, Buteo, Heterospizias, Parabuteo, and Spizaetus (internal condyle shorter and ridge angled toward center of bone in Haliaeetus); (4) internal ligamental prominence low, as in Spizaetus (high in Haliaeetus, Accipiter, Buteogallus, Buteo, Heterospizias, and Parabuteo).

Tarsometatarsus characters separating Aquila and Haliaeetus are listed by L. Miller (1911).

Diagnosis: Carpometacarpus differs from that of Aquila chrysaetos in having (1) anterior carpal fossa deeper; (2) large foramen at external base of pollical facet (not present in A. chrysaetos); (3) proximal, internal edge of metacarpal III has distinct muscle scar that curved towards internal carpal trochlea (scar less distinct and straighter in A. chrysaetos); (4) distal end of scar described above comes to a prominence (smooth scar in A. chrysaetos).

Specific characters: Aquila n. sp. differs from Recent Aquila chrysaetos canadensis in having humerus with (1) much larger

tricipital fossa; (2) median crest forming a broad U-shaped curve proximally (narrow curve in A. chrysaetos).

Ulna with (1) proximal radial depression deeper and broader; (2) small prominence present just proximal to tendinal pit (not present in A. chrysaetos).

Radius with (1) shaft heavier; (2) bicipital tubercle set farther distally; (3) proximal width 13.3-13.8 mm. ($\bar{x}$ = 13.53, N = 3); (4) proximal depth 9.3-9.7 mm. ($\bar{x}$ = 9.53, N = 3).

Femur with (1) in anterior view, two small, proximal foramina and one large distal foramen to trochanteric ridge (only one large distal foramen in A. chrysaetos); (2) large foramen internal to trochanteric ridge elongated (more rounded in A. chrysaetos); (3) popliteal area deeply depressed (flat in A. chrysaetos); (4) two foramina in center of popliteal area (set at distal end of popliteal area in A. chrysaetos).

Tibiotarsus with (1) in anterior view, ridge of inner cnemial crest does not extend as far down shaft; (2) intermuscular line nearly absent (very prominent in A. chrysaetos).

Measurements of the scapula, metatarsal I, and some of the phalanges are given in Table 20 for the Inglis Aquila n. sp. and for Recent A. chrysaetos. Table 21 lists measurements of the carpometacarpus and femur of these species from several localities. These measurements show the Inglis bird to be larger than any known Golden Eagles of past or present.

Remarks: Wetmore (1937b) described two new genera of eagles from the Pleistocene of Great Exuma Island in the Bahamas: Calohierax

Table 20. Measurements (mm.) of the scapula, tibiotarsus, metatarsal I, phalanx I of digit I, and ungual phalanx of digit I, phalanx II of digit II, phalanx I of digit III, phalanx III of digit III, phalanx I of digit IV, and ungual phalanx of digit IV, from Recent Aquila chrysaetos (3 ♂, 1 ♀, 1?) and Inglis Aquila n. sp.

<u>Scapula</u>		<u>A. chrysaetos</u>	<u>Aquila</u> n. sp.
Proximal Width	R	23.7-27.1	32.3-32.9
	M	25.85	32.60
	N	4	2
Length of Articular surface	R	14.3-17.3	18.7-20.7
	M	15.72	19.70
	N	5	2
<u>Tibiotarsus</u>			
Length from head	R	151.7-168.2	181.2
	M	161.77	-
	N	3	1
Midshaft width	R	10.2-12.0	11.8
	M	11.33	-
	N	3	1
Midshaft depth	R	8.8-9.7	9.8
	M	9.37	-
	N	3	1
<u>Metatarsal I</u>			
Length	R	22.5-27.6	26.0
	M	25.10	-
	N	3	1
Width of Digital condyle	R	13.1-15.7	17.0
	M	14.83	-
	N	3	1
<u>Phalanx I</u>			
Length	R	35.5-41.0	40.0
	M	38.83	-
	N	3	1
Proximal width	R	16.0-19.1	17.7
	M	17.97	-
	N	3	1
<u>Ungual phalanx of digit I</u>			
Proximal width	R	9.8-11.8	11.3
	M	10.93	-
	N	3	1
Proximal depth	R	16.8-21.0	20.5
	M	19.10	-
	N	3	1

Table 20. Continued.

<u>Phalanx II of digit II</u>		<u>A. chrysaetos</u>	<u>Aquila n. sp.</u>
Total	R	29.2-34.5	33.3
Length	M	32.30	-
	N	3	1
Proximal	R	10.5-12.1	10.8
Width	M	11.46	-
	N	3	1
Distal	R	8.3-10.2	9.1
Width	M	9.46	-
	N	3	1
<u>Phalanx I of digit III</u>			
Total	R	24.1-27.8	32.0
Length	M	26.30	-
	N	3	1
Proximal	R	9.6-12.0	14.3
Width	M	11.07	-
	N	3	1
Distal width	R	7.2-8.2	9.2
Width	M	7.73	-
	N	3	1
<u>Phalanx III of digit III</u>			
Total	R	24.3-28.0	28.2
Length	M	26.73	-
	N	3	1
Proximal width	R	7.7-8.2	7.9
Width	M	8.03	-
	N	3	1
Distal	R	6.4-7.5	7.1
Width	M	7.10	-
	N	3	1

Table 20. Continued.

<u>Phalanx I of digit IV</u>		<u>A. chrysaetos</u>	<u>Aquila n. sp.</u>
Total	R	12.9-15.2	18.3
Length	M	14.30	-
	N	3	1
Proximal	R	7.5-9.3	9.8
Width	M	8.36	-
	N	3	1
Distal	R	5.7-7.1	8.9
Width	M	6.40	-
	N	3	1
<u>Ungual phalanx of digit IV</u>			
Proximal	R	6.6-7.3	6.7
Width	M	6.60	-
	N	3	1
Proximal	R	10.0-12.2	12.9
Depth	M	11.26	-
	N	3	1

Table 21. Measurements of the carpometacarpus and femur from early Pleistocene A. chrysaetos bonifaci from Saint-Estève, France (Mourer-Chauviré, 1975), late Pleistocene A. chrysaetos from Rancho LaBrea (Howard, 1932), and Recent A. chrysaetos from North America (Brodkorb Collection and Howard, 1932), and from Europe (Mourer-Chauviré, 1975).

		<u>Aquila n. sp.</u> Inglis	<u>A. c. bonifaci</u> France	<u>A. chrysaetos</u> Rancho La Brea
<u>Carpometacarpus</u>				
Total	R	120.0	-	92.5-112.9
Length	M	-	102.10	-
	N	1	2	-
Proximal	R	30.2	-	
Width	M	-	26.46	
	N	1	3	
Height of	R	19.3		
Metacarpal I	M	-		
	M	1		
Midshaft	R	7.7		
Width of	M	-		
	N	1		
Metacarpal II	R	11.1		
Depth of	M	-		
	N	1		
Distal	R	23.2		
Width	M	-		
	N	1		
<u>Femur</u>				
Total	R	139.8	-	114.0-135.8
Length	M	-	123.54	-
	N	1	5	-
Proximal	R	30.1	-	
Width	M	-	26.30	
	N	1	6	
Head	R	12.0		
Width	M	-		
	N	1		
Midshaft	R	14.1	-	
Width	M	-	12.30	
	N	1	4	

Table 21. Extended.

Recent <u>Aquila chrysaetos</u>		
North America		France
Brodkorb	Howard	
94.2-113.2	96.6-105.5	-
105.00	102.20	14
3	3	14
24.5		-
26.43		25.77
3		14
15.0-17.5		
16.57		
3		
6.0		
6.90		
3		
8.0		
8.77		
3		
18.6-21.5		
20.43		
3		
118.7-133.8	118.6-129.2	-
128.73	123.46	127.55
3	3	20
26.7-33.0		-
30.47		27.98
3		20
10.1-12.0		
11.33		
3		
12.0-14.0		-
13.10		12.82
3		20

Table 21. Continued.

		<u>Aquila n. sp.</u>	<u>A. c. bonifacti</u>	<u>A. chrysaetos</u>
		Inglis	France	Rancho La Brea
<u>Femur</u>				
Midshaft	R	14.5		
Depth	M	-		
	N	1		
Distal	R	30.8	-	
Width	M	-	20.92	
	N	1	4	
Depth of	R			
Internal	M			
Condyle	N			
Depth of	R	23.1		
External	M	-		
Condyle	N	1		

Table 21. Extended.

Recent <u>Aquila chrysaetos</u>		
North America		France
Brodkorb	Howard	
12.0-14.0		
13.27		
3		
26.5-32.3		-
30.20		28.75
3		20
17.9-23.4		
21.33		
3		
20.0-24.6		
22.97		
3		

resembles Buteo in some characters and in size; the gigantic Titanohierax resembles Recent Buteogallus urubitinga, but is nearly twice as large. The Inglis Aquila n. sp. carpometacarpus appears to be about 30% larger than the natural-size photograph of the Titanohierax carpometacarpus. Wetmoregyps daggetti (L. Miller) from the Upper Pleistocene of California and Mexico also bears a resemblance to the genus Buteogallus (L. Miller, 1928).

Aquila borrasii Arredondo of Cuba's late Pleistocene is known from the tarsometatarsus, femur, and the ungual and subterminal phalanges.

Table 22 gives femur measurements of A. borrasii and the Inglis Aquila n. sp., which show A. borrasii to be a much larger species of eagle. Visual comparison with the photograph in Arredondo's paper (1970) confirms this. Aquila n. sp. more closely resembles A. chrysaetos and differs from A. borrasii based on Arredondo's (1976) characters of the femur for separating these two species.

Other fossil species of Aquila are known from the Upper Miocene of France (A. delphinensis Gaillard and A. pennatoides Gaillard). Fossil A. chrysaetos are known from many localities in Europe and North America (Brodkorb, 1964a).

Mourer-Chauviré (1975) described Aquila chrysaetos bonifacti from the Middle Pleistocene of Saint-Estève, France, which she considers to be the primitive form of today's Golden Eagle. No morphological differences are found between these two forms, although statistical analyses show allometric difference in the proportions of certain bones. Also, the Saint-Estève bird is almost always smaller than the Recent A. chrysaetos. Mourer-Chauviré (1975) concludes that there was

Table 22. Femur measurements (mm.) of Aquila borrasii (Arredondo, 1976) and Aquila n. sp. * - length as preserved is 140.0 mm.

	<u>A. borrasii</u>	<u>Aquila n. sp.</u>
Total length	*155.	139.8
Proximal width	45.4	30.1
Head width	16.3	12.0
Maximum width of pneumatic foramen	8.0	3.3
Length of pneumatic foramen	14.0	7.9
Least width of shaft	19.8	13.7

an increase in size of Golden Eagles throughout the course of the Pleistocene in France.

Loye Miller (1911) remarks that the Rancho La Brea A. chrysaetos has remained nearly unchanged to this day. Howard's (1947) study of Rancho La Brea A. chrysaetos measurements indicate that Pleistocene humeri and ulnae averaged longer, while tarsometatarsi averaged shorter than Recent forms, although no proportional or structural differences are evident.

Genus Buteogallus Lesson

Buteogallus *fragilis (L. Miller)

Extinct Fragile Eagle

Material: Proximal two-thirds of 1 left tarsometatarsus.

Characters: The fossil is placed in the genus Buteogallus and separated from Geranoaetus, Harpyhaliatus, Spizaetus, Aquila, Buteo, and Heterospizias based on characters number 3, 5, and (page 96) of Campbell (1973).

Tarsometatarsus larger, but resembling living Buteogallus urubitinga in having (1) posterior metatarsal groove very deep for most of the bone's length, and bordered by high ridges on internal and external sides; (2) anterior proximal foramina set in a scooped-out depression; (3) in posterior view, anterior end is cocked slightly towards external side, with a "corner" formed on internal side at level of attachment for tibialis anticus; (4) edge of shaft external to posterior metatarsal groove a distinct ridge, greatly flared externally. Agrees with Buteogallus fragilis in characters and

measurements listed by L. Miller (1911). The type specimen measurements are (1) proximal width 18.0 mm, (17.7 for Inglis fossil); (2) length to center of papilla of tibialis anticus 18.6 mm (18.2 for Inglis fossil).

Remarks: This is the oldest fossil for the genus Buteogallus which was previously known from the Upper Pleistocene of California and Mexico (Howard and A. Miller, 1933).

Wetmore (1931a) records three fragmentary eagle ulnae from the late Pleistocene of Seminole Field, Florida which he called Geranoaetus sp. In his discussion section Wetmore mentions Pleistocene G. fragilis (now Buteogallus fragilis), Pleistocene G. grinelli, and Recent G. melanoleucas, the Black-chested Buzzard-Eagle of South America. No characters or measurements are given. However, Wetmore states that these ulnae agree in size with G. melanoleucas.

The elongated, narrow tarsometatarsus with attachment of the tibialis anticus placed high on the bone indicated a relatively weak-legged predator with poor lifting power.

The related Great Black Hawk of South America, Buteogallus urubitinga, is described by Blake (1953, p.86) as, ". . . decidedly sluggish . . . soars at length . . . more abundant in the hot lowlands, especially near water." Amadon (1949) also notes B. urubitinga living near water, and remarks that it usually feeds upon reptiles, amphibians, or crabs. Blake (1977) lists southern Mexico through northern Argentina for this species' range.

Subfamily Gypaetinae (Vieillot)

Genus *Neophrontops L. MillerNeophrontops slaughteri Feduccia

Material: Left side of 1 mandible (without mandibular symphysis), 1 left coracoid, distal end of 1 right ulna; proximal end of 1 left radius; distal end of 1 left radius; 1 right femur, proximal half of 1 left tibiotarsus, distal half of 1 right tibiotarsus, proximal half of 1 right tarsometatarsus, distal half of 1 right tarsometatarsus.

Referred material: Shaft of 1 right radius.

The 11 specimens represent a minimum number of 2 individuals.

Characters: The mandible differs from those of recent Neophron percnopterus ginglymianus and Necrosyrtes monachus monachus in having (1) larger size; (2) internal, posterior and exterior articular processes relatively longer; (3) ramus longer and wider; (4) medial lip of articular surface protruding with a broad, curved edge; (5) internal articular process projecting more laterally (projects dorsally in Neophron and Necrosyrtes).

Measurements of the mandible of several members of the subfamily Gypaetinae are listed in Table 23. The mandible of Neogyps errans L. Miller of the Upper Pleistocene resembles those of Neophron and Necrosyrtes in characters (2) and (4) listed above, and is larger than the Inglis bone. The fragment of mandible of Palaeoborus umbrosus is larger and more robust than that of the Inglis Neophrontops slaughteri, while the mandible of Neophrontops americanus L. Miller is slightly

Table 23. Measurements of the mandible and femur of Neophron percnopterus (2 ♀). Necrosyrtes monachus (sex ?), Neophrontops americanus (Howard 1932), Palaeoborus umbrosus (Cope, 1877), Inglis Neophrontops slaughteri, and Neogyps errans (Howard, 1932). * - measured from photograph in Howard (1932).

<u>MANDIBLE</u>		<u>Neophron</u> <u>percnopt.</u>	<u>Necros</u> <u>monachus</u>	<u>Neophrontops</u> <u>americanus</u>	<u>Palaeo</u> <u>umbrosus</u>	<u>Inglis</u>	<u>Neogyps</u> <u>errans</u>
Width, int. to	R	14.8-15.0	15.2			18.6	*22.3
ext. articular	M	14.90	-			-	-
process	N	2	1			1	1
Depth of ramus	R	7.7-8.2	8.7			10.1	
through suran-	M	7.95	-			-	
gular process	N	2	1			1	
<u>FEMUR</u>							
Total length	R	67.3-75.5	80.3	71.7-83.4		93.5	103.4-113.4
	M	71.40	-	79.80		-	107.58
	N	2	1	5		1	4
Proximal	R	18.0-19.9	20.8	14.8-15.8	21.0		18.5-20.8
width	M	18.95	-	15.48	-		19.20
	N	2	1	4	1		4
Width of Head	R	7.0-7.6	7.8			8.6	
	M	7.30	-			-	
	N	2	1			1	

Table 23. Continued.

Midshaft width	R	7.8-8.3	10.3		
	M	8.05	-		9.8
	N	2	1		1
Midshaft depth	R	7.5-8.2	9.8		9.6
	M	7.85	-		-
	N	2	1		1
Distal width	R	17.3-18.3	19.2	22.0	23.6
	M	17.80	-	-	-
	N	2	1	1	1
Depth of internal condyle	R	11.0-13.0	12.3	14.0	14.9
	M	12.00	-	-	-
	N	2	1	1	1
Depth of external condyle	R	12.8-13.8	14.2	20.0	18.5
	M	13.30	-	-	-
	N	2	1	1	1

smaller than it. Neophrontops americanus is in close agreement with N. slaughteri in characters (2) and (4) above, based on Howard's (1932) photograph.

The left coracoid lacks the head, tip of procoracoid process, and the sterno-coracoidal process. Howard's (1932) coracoid lengths for 112 N. americanus range from 49.5 to 56.2 mm. Howard divided the distance from the sternal facet to the procoracoid by the total length of the bone to get an average ratio of 65.7% for N. americanus (56.8% for Neophron percnopterus). The distance from the sternal facet to the procoracoid of the Inglis Neophrontops slaughteri is 40.3 mm. The total length could not be measured. However, a rough calculation gives a total length of about 59.8 mm (40.3 divided by 65.7%).

The coracoid agrees with the characters listed by Brodkorb (1961) for Neophrontops. Depth of sternal facet is 7.4 mm. (6.3 for N. dakotensis); width of shaft at upper end of corracobrachial scar is 10.2 mm. (8.3 for N. dakotensis).

The ulna differs from that of Neophron percnopterus in having (1) external condyle larger, and less rounded; (2) in internal view, depression at proximal end of external condyle deeper; (3) carpal; tuberosity less pronounced and blunter. Distal depth of ulna, 12.1 mm.

The radius has the bicipital tubercle larger, more elongated, and set farther distally on shaft than in N. percnopterus. Distal width of radius, 11.7 mm.

The femur of the Inglis Neophrontops slaughteri differs from that of the living Necrosyrtes monachus and Neophron percnopterus in having (1) much greater length; (2) trochanteric ridge long, as in Neophron; (3) posterior intermuscular line running nearly entire length of shaft

and set closer to internal edge of shaft; (4) internal condyle thrust farther posteriorly; (5) ridge proximal to popliteal area absent; (6) popliteal depression deeper distally; (7) pit above fibular condyle deeply excavated; (8) proximal edge of fibular condyle with expanded prominence.

The Inglis femur differs from that of Palaeoborus umbrosus in having (1) head rounder and set farther out from shaft; (2) popliteal depression extending distally; (3) fibular condyle extending farther distally.

The femur differs from that of Neogyps errans in having (1) trochanteric ridge longer; (2) anterior intermuscular line more medial in position; (3) fibular condyle extending farther externally.

The Inglis femur resembles that of Neophrontops americanus, but differs in having greater length and condyles set farther apart (Table 23).

The tibiotarsus is distinguished from other accipitrid subfamilies and agrees with Gypaetinae in the shape of the inner cnemial crest (Howard, 1932). Of the New World Gypaetinae, the proximal end of the tibiotarsus is known only for Palaeoborus umbrosus (Cope), Neogyps errans L. Miller, and Neophrontops americanus L. Miller.

The proximal piece of the tibiotarsus is distinguished at once from that of the Lower Pliocene Palaeoborus umbrosus Cope by its large, squared inner cnemial crest. Also, the Inglis tibiotarsus in proximal view has a straight ridge over the cnemial crest as opposed to a curved ridge for P. umbrosus as figured by Cope (1877).

Table 24. Measurements (mm.) of the tibiotarsus of Neophron percnopterus (2♀), Necrosyrtes monachus (sex?), Arikarornis macdonaldi (Howard, 1966), Neophrontops americanus (Feduccia, 1969), Palaeoborus umbrosus (Cope, 1877), and Neogyps errans (Howard, 1932).

		<u>Neophron</u> <u>percnopt.</u>	<u>Necros.</u> <u>monachus</u>	<u>Arikar.</u> <u>macdon</u>	<u>Neophrontops</u> <u>americanus</u>
<u>Tibiotarsus</u>					
Proximal	R	13.3-14.3	15.4		13.3-15.2
Width	M	13.80	-		14.42
	N	2	1		5
Proximal	R	18.3-18.5	20.0		17.0-18.6
Depth	M	18.40	-		17.90
	N	2	1		5
Distal	R	14.0-14.4	15.1	13.2	13.2-15.0
Width	M	14.20	-	-	14.30
	N	2	1	1	6
Depth of	R	9.7-10.5	12.3	9.3	10.2-11.3
Internal	M	10.10	-	-	11.00
Condyle	N	2	1	1	6
Depth of	R	9.6-10.8	11.7	9.2	
External	M	10.20	-	-	
Condyle	N	2	1	1	

Table 24. Extended.

<u>Neophrontops</u> <u>slaughteri</u>	<u>Inglis N.</u> <u>slaughteri</u>	<u>Palaeoborus</u> <u>umbrosus</u>	<u>Neogyps</u> <u>errans</u>
	16.1	20.0	18.8-21.2
	-	-	20.34
	1	1	7
	19.3	17.0	22.5-24.2
	-	-	23.43
	1	1	7
15.0	15.7	16.0	18.0-20.8
-	-	-	19.40
1	1	1	3
11.4	12.1	13.0	12.8-14.5
-	-	-	13.67
1	1	1	3
	11.2	12.0	11.8-13.4
	-	-	12.63
	1	1	3

The Inglis tibiotarsus differs from that of Neogyps errans in its smaller size and its much more prominent inner cnemial crest.

The proximal end of the Inglis tibiotarsus closely resembles that of Neophrontops americanus as figured by Howard (1932), but differs in having (1) in internal view, inner cnemial crest with squared-off corners both proximally and distally (in N. americanus corners are pointed proximally and rounded distally); (2) in anterior view, outermost edge of outer cnemial crest projecting distally; (3) shaft more robust.

Measurements of the tibiotarsus are summarized in Table 24.

The distal piece of tibiotarsus agrees with the following characters listed by Howard (1966) for the Gypaetinae: (1) short, broad supratendinal bridge, less vertical in position than in Aquila or Buteo; (2) tendinal groove centrally placed on shaft above bridge; (3) attachment of oblique ligament on slope of internal face of groove; (4) anterior face of shaft external to groove well rounded.

The tibiotarsus is distinguished from the Lower Miocene Arikarornis macdonaldi (Howard, 1966) in the unequal depth of the internal and external condyles, the excentral position of the internal ligamentary prominence, and the more mediad posterior border of the internal condyle.

Palaeoborus rosatus and P. howardae are not known from the tibiotarsus, however other skeletal elements of these species are about the same size as those of Neogyps errans, which is larger than the Inglis bird (Table 24).

The tibiotarsus differs from that of the late Pliocene Palaeoborus umbrosus as figured by Cope (1877, pl.68) in having the tendinal groove narrower, the proximal edge of the supratendinal bridge more vertical in position, and the internal condyle projecting farther laterally.

The tibiotarsus differs from that of the Upper Pleistocene Neogyps errans as figured by Howard (1932) in having (1) tendinal groove narrower; (2) supratendinal bridge forming a 45° angle with the long axis of the shaft (30° in Neogyps); (3) distal edge of supratendinal bridge straighter; (4) opening below supratendinal bridge less rounded; (5) internal condyle projecting farther laterally.

Five species of the extinct genus Neophrontops have been described, but only N. slaughteri Feduccia of the Upper Pliocene and N. americanus L. Miller of the Upper Pleistocene are known from the distal end of the tibiotarsus (Table 24).

The Inglis tibiotarsus agrees with Neophrontops slaughteri in the following characters listed by Feduccia (1974) which distinguish it from N. americanus: (1) tendinal groove broader; (2) internal ligamental prominence more pronounced; (3) shaft more robust; (4) external condyle notched at junction with shaft.

The tarsometatarsus differs from Recent Neophron percnopterus ginianus, the Egyptian Vulture, by having (1) larger size; (2) prominence between cotylae higher; (3) inner foramen much larger (enlarged proximal foramina may indicate an immature individual); (4) tubercle for tibialis anticus placed farther distally; (5) anterior metatarsal groove deeper; (6) internal edge of shaft rounded at level of anterior metatarsal groove; (7) in posterior view, outer proximal

foramen opens a bit farther distally than inner foramen (foramina open at same level in Neophron); (8) posterior metatarsal groove deeper, wider; (9) calcaneal ridges of hypotarsus much closer together.

Measurements of the proximal piece of a tarsometatarsus are as follows (those of two female Neophron percnopterus in parentheses): proximal width, 17.5 (13.9-14.2); length to middle of tubercle for tibialis anticus, 15.5 (12.6 for both); width at level of tubercle for tibialis anticus, 5.8 (4.7-5.1).

Distal half of right tarsometatarsus differs from N. percnopterus in having (1) internal ridge along posterior metatarsal groove terminating before reaching metatarsal facet; (2) metatarsal facet rounded proximally, with a narrow ridge projecting distally; (3) distal foramen large and oval. The trochleae for digits II and IV are damaged in this fossil. Table 25 gives measurements for the distal end of the tarsometatarsus of several species of the family Gypaetinae.

Remarks: Neophrontops slaughteri was previously known only from the late Pliocene Hagerman local fauna in Idaho, which is dated at 3.5 million years B.P. and is older than the Inglis site.

Table 26 summarizes the New World fossil Gypaetinae.

Table 25. Measurements of the tarsometatarsus of Neophron percnopterus (2 ♀), Necrosyrtes monachus (sex?), Neophrontops americanus (Howard, 1963), Neophrontops vallecitoensis (Howard, 1963), Inglis, Neophrontops slaughteri, and Neogyps errans (Howard, 1966).

		<u>Neophron</u> <u>percnopt.</u>	<u>Necros.</u> <u>monach.</u>	<u>Neophr.</u> <u>americ.</u>	<u>Neophr.</u> <u>vallec.</u>	<u>Inglis</u> <u>Neophr.</u> <u>slaugh.</u>	<u>Neogyps</u> <u>errans</u>
Distal	R	14.9-16.8	18.1	17.5	19.6	17.4	21.4-24.1
width	M	15.80	-	-	-	-	22.55
	N	3	1	1	1	1	4
Depth of	R	7.7-8.7	7.8	8.3	10.1		11.1-12.6
internal	M	8.13	-	-	-		12.03
trochlea	N	3	1	1	1		4
Depth of	R	6.6-7.4	8.2	7.6		8.0	9.0-9.6
middle	M	6.93	-	-		-	9.33
trochlea	N	3	1	1		1	4
Depth of	R	7.5-8.5	8.2	8.8	9.8		10.5-11.5
external	M	8.05	-	-	-		11.13
trochlea	N	3	1	1	1		4

Table 26. The fossil Gypaetinae of the New World (revised from Feduccia, 1974).

Species	Age	Skeletal elements known
<u>Arikarornis macdonaldi</u> Howard 1966	Lower Miocene	Tibiotarsus, distal end
<u>Palaeoborus rosatus</u> A. H. Miller	Lower Miocene	Ulna, distal end
<u>Palaeoborus howardae</u> Wetmore 1936	Middle Miocene	Tarsometatarsus, distal end
<u>Palaeoborus umbrosus</u> (Cope 1874)	Lower Miocene	Broken pieces of most elements
<u>Neophrontops vetustus</u> Wetmore 1943	Middle Miocene	Humerus, distal end
<u>Neophrontops dakotensis</u> Compton 1935	Lower & Middle Pliocene	Coracoid and humerus, distal ends
<u>Neophrontops slaughteri</u> Feduccia 1974	Upper Pliocene	Tibiotarsus, distal end
<u>Neophrontops vallecitoensis</u> Howard 1963	Middle Pleistocene	Tarsometatarsus, distal end
<u>Neophrontops americanus</u> L. Miller 1916	Upper Pleistocene	All principal elements
<u>Neogyps errans</u> L. Miller 1916	Upper Pleistocene	All principal elements

Subfamily Accipitrinae (Vieillot)

Genus Accipiter BrissonAccipiter cooperii (Bonaparte)

Cooper's Hawk

Material: One complete right ulna, distal ends of 1 right and 1 left ulnae, proximal ends of 1 right and 1 left tibiotarsi, distal end of 1 right tibiotarsus. The 6 specimens represent a minimum number of 2 individuals.

Characters: Accipiter cooperii is distinguished from A. gentilis and A. striatus on the basis of size. Measurements of the fossils are compared to those of Recent A. cooperii in Table 27.

Remarks: Accipiter cooperii has been recorded at the Reddick, Arredondo, and Haile sites in Florida (Brodkorb, 1964a).

Family Falconidae Vigors

Subfamily Falconinae (Vigors)

Genus Falco LinnaeusFalco sparverius Linnaeus

Sparrow Hawk

Material: Fragment of 1 premaxillary, proximal end of 1 left coracoid, distal half of 1 right coracoid, proximal ends of 2 left scapulae, 1 left humerus (lacking head), distal ends of 2 left humeri, proximal half of 1 right ulna, posterior fragment of synsacral vertebrae, 1 right femur, distal end of 1 left femur, proximal end of 1 left tibiotarsus, proximal end of 1 right tarsometatarsus. The 15 specimens represent a minimum number of 2 individuals.

Referred material: Shaft of 1 right ulna.

Table 27. Measurements of the ulna and tibiotarsus of Recent Accipiter cooperii (3♂, 3♀) and Inglis A. cooperii.

		<u>Accipiter</u> <u>cooperii</u>	Inglis <u>A. cooperii</u>
<u>Ulna</u>			
Distal	R	6.2-7.2	6.2-7.1
Depth	M	6.75	6.60
	N	6	3
<u>Tibiotarsus</u>			
Width of	R	8.0-9.6	8.8
Head	M	8.78	-
	N	6	1

Characters: These elements of Falco sparverius are distinguished from those of Accipiter striatus as follows: (1) premaxillary having ventral notch; (2) coracoid lacking dorsal lip bordering sternal lip; (3) scapula having coracoidal articulation next to glenoid facet enlarged; (4) humerus having brachial depression wider, groove between ectepicondylar prominence and external condyle semi-circular, distal end narrower, and attachment of anterior articular ligament larger; (5) ulna having internal cotyla smaller and prominence for anterior articular ligament set more distally on shaft; (6) femur having anterior foramen set closer to proximal end and fibular condyle less prominent; (7) tibiotarsus having inner cnemial crest shorter, supratendinal bridge with 3 openings (Brodkorb, 1960b), and internal ligamental prominence low; (8) tarsometatarsus having shaft short and broad, tubercle for tibialis anticus set towards internal side of bone (centered on anterior side in Accipiter), hypotarsal ridge extending far down shaft between proximal foramina (ridge absent in Accipiter), and external trochlea much shorter than other two.

Falco sparverius is distinguished from other Recent species of the genus Falco on the basis of size.

Remarks: Falco swarthi L. Miller (1927) from the Pleistocene of McKittrick, California was a large species, exceeding F. peregrinus and F. mexicanus in the size of the tarsometatarsus. From the Pleistocene of Oregon, Howard (1946) described Falco oregonus based on a carpometacarpus the same size as those of F. peregrinus and F. mexicanus. Brodkorb's (1959a) Pleistocene Falco readei from Arredondo, Florida has been restudied by Campbell (1979), who places it in the genus Milvago.

Falco columbarius Linnaeus

Pigeon Hawk

Material: Anterior fragment of 1 mandible, distal end of 1 right femur. The 2 specimens represent a minimum number of 1 individual.

Characters: The mandible of Falco columbarius differs from that of F. sparverius in having a larger size.

The femur in having (1) in posterior view, prominence proximal to internal condyle projecting farther internally; (2) prominence proximal to popliteal region central on posterior side of shaft (shifted externally in F. sparverius); and (3) in external view, depression on fibular condyle crescent-shaped (roundish in F. sparverius). The distal width of the fossil femur is 6.8 mm.

Remarks: Campbell's (1979) Falco sp. is between F. peregrinus and F. femoralis, and is therefore, much larger than the Inglis F. columbarius.

Order Galliformes (Temminck)

Family Phasianidae Vigors

Subfamily Odontophorinae Gould

Genus Colinus Goldfuss

Colinus *suilium Brodkorb

Material: Nine skull parts, 16 fused thoracic vertebrae, 49 synsacra, 58 sternums, 16 furcula, 75 right and 97 left coracoids, 46 right and 48 left scapulae, 124 right and 98 left humeri, 33 right and 22 left ulnae, 19 radii, 5 ulnares, 29 right and 15 left carpometacarpal, 5 digital phalanges, 17 pelvic fragments, 70 right and 61 left femora, 59 right and 56 left tibiotarsi, 1 fibula, 21 right and 36 left

tarsometatarsi, and 15 pedal phalanges. The 1100 specimens represent a minimum of 115 individuals.

Remarks: Ritchie (1976) includes a detailed osteological comparison between Colinus suilium from Inglis IA and from Coleman IIA (a late Illinoian glacial stage site from Sumpter County, Florida). Ritchie (1976) also compared measurements of the Colinus material from those sites with those from 6 late Pleistocene sites and demonstrated that C. suilium gradually increased in size throughout the Pleistocene.

Subfamily Meleagrinae G. R. Gray

Genus Meleagris Linnaeus

Meleagris *anza (Howard)

Material: Steadman (1975) lists the Florida State Museum's catalogue numbers for the Inglis Meleagris anza material in his Appendix. The 1230 specimens represent a minimum number of 50 individuals.

Remarks: Steadman's (1975) dissertation on the Plio-Pleistocene evolution of turkeys was based heavily on his study of the huge collection of Inglis Meleagris. Steadman simplified meleagrid taxonomy by synonymizing (1) Proagriocharis Martin and Tate, Agriocharis Chapman, and Parapavo L. Miller with Meleagris Linnaeus; and (2) M. alta Marsh and M. tridens Wetmore with M. gallopavo. His proposed phylogeny shows an increase in size from Late Pliocene to Recent in Meleagris: M. kimballensis (Martin and Tate) M. progenes (Brodkorb) M. leopoldi A. Miller and Bowman M. anza (Howard) M. gallopavo Linnaeus.

Order Ralliformes (Reichenbach)

Suborder Ralli (Reichenbach)

Family Rallidae Vigors

Subfamily Rallinae (Vigors)

Genus Rallus LinnaeusRallus longirostris Boddaert

Clapper Rail

Material: Proximal end of 1 right coracoid, distal end of 1 right coracoid, proximal end of 1 right ulna, 1 complete left carpometacarpus, anterior fragment of 1 sternum, distal end of 1 left tibiotarsus, shaft of 1 left tibiotarsus, proximal end of 1 left tarsometatarsus, distal ends of 1 right and 2 left tarsometatarsi. The 11 specimens represent a minimum number of 3 individuals.

Characters: Ligon (1965) lists characters useful in separating Rallus, Gallinula, and Fulica. Rallus longirostris is distinguished from R. limicola and R. elegans on the basis of its intermediate size.

Measurements of the carpometacarpus and tarsometatarsus of R. longirostris are compared with those of some other species of rails in Table 28.

Remarks: Rallus prenticei Wetmore (1944) of the Upper Pliocene of Kansas is slightly larger than the Virginia Rail, R. prenticei, but still smaller than R. longirostris.

In his study of the Pliocene rails of North America, Feduccia (1968) places Porzana lacustris Brodkorb (1958) in the genus Rallus, and compares it with the Recent R. sanguinolentus of South America. Rallus lacustris (Brodkorb) is a little smaller than R. longirostris.

Table 28. Measurements of the carpometacarpus and tarsometatarsus of Rallus limicola (5♂,4♀), Inglis R. longirostris, R. longirostris waynei (1♂,6♀), Inglis R. elegans (tarsus only), R. elegans elegans (2♂,2♀), Fulica americana (2♂,2♀), Gallinula chloropus cachinnana (5♂,4♀), and Porphyryla martinica (3♂,3♀).

		<u>Rallus</u> <u>limicola</u>	<u>Inglis</u> <u>Rallus</u> <u>longi.</u>	<u>Rallus</u> <u>longi.</u> <u>waynei</u>	<u>Inglis</u> <u>Rallus</u> <u>elegans</u>
<u>Tarsometatarsus</u>					
Total	R	32.1-37.6		46.2-49.1	50.3-52.4
Length	M	34.95		47.63	51.35
	N	8		7	2
Proximal	R	4.1-4.7	6.0	6.0-6.6	6.2-6.7
Width	M	4.36	-	6.34	6.45
	N	8	1	7	2
Midshaft	R	2.0-2.4		2.7-3.2	3.3-3.5
Width	M	2.16		2.91	3.40
	N	8		7	2
Midshaft	R	1.9-2.2		2.6-3.0	3.1-3.5
Depth	M	2.08		2.77	3.30
	N	8		7	2
Width	R	4.4-4.9	6.2-6.6	6.3-7.1	7.0
Through	M	4.60	6.43	6.71	7.00
Trochleae	N	8	3	7	2
<u>Carpometacarpus</u>					
Total	R	18.4-20.8	27.4	26.5-28.4	
Length	M	19.41	-	27.41	
	N	9	1	7	
Proximal	R	3.9-4.3	5.6	5.7-6.1	
Width	M	4.07	-	5.92	
	N	9	1	7	
Distal	R	2.5-2.9	4.0	3.8-4.4	
Width	M	2.69	-	4.02	
	N	9	1	7	

Table 28. Extended.

<u>Rallus</u> <u>elegans</u> <u>elegans</u>	<u>Fulica</u> <u>americana</u> <u>americana</u>	<u>Gallinula</u> <u>chloropus</u> <u>cachinnans</u>	<u>Porphyryla</u> <u>martinica</u> <u>martinica</u>
53.1-63.8 59.27 4	50.5-61.7 54.07 8	52.9-62.6 55.82 9	58.8-64.3 60.78 5
6.5-7.6 7.17 4	7.8-8.9 8.27 8	6.9-8.2 7.56 9	6.8-7.5 7.13 6
3.1-3.6 3.37 4	3.3-4.4 3.66 8	3.4-4.6 3.75 9	4.1-4.9 4.54 5
3.0-3.7 3.37 4	2.9-4.2 3.48 8	3.1-3.7 3.44 9	3.0-3.7 3.44 5
6.7-8.2 7.50 4	7.6-9.1 8.40 8	7.3-8.7 7.95 9	6.9-7.5 7.25 6
30.4-35.4 32.72 4	37.6-41.7 38.82 8	31.0-36.0 33.72 9	29.1-31.3 30.48 6
6.0-7.5 6.87 4	7.0-7.6 7.27 8	6.8-7.5 7.14 9	6.3-6.6 6.50 6
4.1-5.0 4.42 4	4.7-5.3 5.02 8	4.5-5.3 4.83 9	4.2-4.7 4.55 6

Rallus elegans Audubon

King Rail

Material: One complete right and 1 complete left tarsometatarsi. The 2 specimens represent a minimum number of 2 individuals (due to a difference in size).

Characters: Rallus elegans is distinguished from R. limicola, R. longirostris, and the extinct species of Rallus on the basis of its superior size.

Measurements are given in Table 28.

Remarks: All three Recent species of North American Rallus have been recorded previously from Pleistocene sites in Florida (Brodkorb, 1967).

Genus Porzana VieillotPorzana carolina (Linnaeus)

Sora

Material: One complete left carpometacarpus, distal ends of 2 right tibiotarsi, shaft of 1 right tibiotarsus. The 4 specimens represent a minimum number of 3 individuals.

Characters: The genus Porzana is distinguished from Rallus based on characters listed by Ligon (1965).

Measurements are given in Table 29.

Remarks: The Upper Pliocene Porzana insignis (Feduccia 1968) and P. avita (Feduccia 1968) are smaller than P. carolina.

The Lower Pleistocene Porzana lacustris Brodkorb (1958) is transferred to the genus Rallus (Feduccia 1968).

Porzana auffenbergi Brodkorb (1954) is larger than P. carolina, and P. guti (Brodkorb, 1952) is smaller. Both are from the Middle Pleistocene of Florida.

Table 29. Measurements of the carpometacarpus and tibiotarsus of Rallus limicola (5 males, 4 females), Porzana carolina (7 males, 4 females, 1 ?), and Inglis P. carolina.

		<u>Rallus</u> <u>limicola</u>	<u>Porzana</u> <u>carolina</u>	<u>Inglis</u> <u>Porzana</u> <u>carolina</u>
<u>Carpometacarpus</u>				
Total	R	18.4-20.8	18.6-21.3	21.4
Length	M	19.41	20.22	-
	N	9	12	1
Proximal	R	3.9-4.3	3.9-4.4	4.5
Width	M	4.07	4.22	-
	N	9	12	1
Distal	R	2.5-2.9	2.4-2.8	2.8
Width	M	2.69	2.68	-
	N	9	12	1
<u>Tibiotarsus</u>				
Distal	R	3.9-4.4	3.5-4.3	4.4-4.6
Width	M	4.17	4.08	4.50
	N	9	12	2
Depth of	R	4.2-4.7	4.0-4.7	4.4-4.9
Internal	M	4.47	4.35	4.65
Condyle	N	9	12	2
Depth of	R	4.0-4.6	3.8-4.5	4.4-4.8
External	M	4.33	4.23	4.60
Condyle	N	9	12	2

Suborder Grues Bonapartes

Family Gruidae Vigors

Subfamily Gruinae (Vigors)

Genus Grus Pallas

Grus americana (Linnaeus)

Whooping Crane

Material: Proximal end of 1 right ulna, olecranon process missing.

Characters: The ulna of Grus differs from that of Balearica in having: (1) proximal radial depression deeper; (2) ridge internal to impression of brachialis anticus more prominent; (3) prominence for anterior articular ligament extending farther distally; and (4) tricipital attachment extending distally past edge of external cotyla.

The ulna of Grus americana differs from that of Recent G. canadensis in having: (1) condyles larger; (2) impression of brachialis anticus deeper; and (3) shaft heavier.

The proximal end of the ulna of the Inglis Grus americana differs from that of Grus grus in having: (1) impression of brachialis anticus deeper with prominence for anterior articular ligament overhanging; (2) impression for brachialis anticus narrower; (3) ridge from bicipital attachment extending just slightly posteriorly; (4) in internal view, scar for anterior articular ligament wider proximally; (5) proximal radial depression deeper; and (6) diameter of internal cotyla greater.

Measurements of the ulna of the Inglis Grus americana are compared with those of several Recent species of cranes in Table 30.

Table 30. Measurements of the ulna of Anthropoides virgo (1 male, 1 female), Balearica pavonina (1 male, 2 females, 1 ?), Grus grus grus (1 ?), Grus g. lilfordi (2 females), Grus canadensis rowani (2 males, 1 female), Grus c. tabida (3 males, 4 females), Grus c. pratensis (4 males, 2 females), Grus americana (1 ?), and Inglis Grus americana.

		<u>A. virgo</u>	<u>B. pavonina</u>	<u>Grus g. grus</u>	<u>G. g. lilfordi</u>	
<u>Ulna</u>						
Proximal	R	17.7-18.4	17.7-20.7	24.1	20.5-20.8	
Width	M	18.05	18.68	-	20.65	
	N	2	4	1	2	
Width at	R	15.1-15.9	15.3-18.3	21.0	17.9-18.2	
Bicipital	M	15.50	16.25	-	18.05	
Scar	N	2	4	1	2	
Depth at	R	12.5-13.2	11.0-14.3	15.0	12.3-13.0	
Bicipital	M	12.85	12.65	-	12.65	
Scar	N	2	4	1	2	
		<u>G. c. row.</u>	<u>G. c. tab.</u>	<u>G. c. pra.</u>	<u>G. amer.</u>	<u>Inglis</u>
<u>Ulna</u>						<u>G. amer.</u>
Proximal	R	19.3-21.6	19.4-21.0	19.0-21.3	21.0	23.1
Width	M	20.57	20.26	20.05	-	-
	N	3	7	6	1	1
Width at	R	17.5-18.3	15.4-18.1	16.3-17.8	17.3	19.2
Bicipital	M	17.90	17.33	17.20	-	-
Scar	N	3	7	6	1	1
Depth at	R	12.3-13.5	12.2-13.7	12.1-13.5	14.0	14.0
Bicipital	M	13.10	13.13	12.65	-	-
Scar	N	3	7	6	1	1

Remarks: Probalearica crataegensis Brodkorb of Florida's Lower Miocene resembles the living Balearica pavonina and was described from a distal end of a tibiotarsus. This bird is much smaller than the living Sandhill Crane.

Pliogrus germanicus Lambrecht and Pliogrus pentelici (Gaudry) are recorded from the Lower Pliocene of Europe. Cracraft (1973) notes a close similarity between Pliogrus and Grus, and suggests that the genus Pliogrus may be poorly defined. The ulna of P. pentelici was mentioned by Brodkorb (1967) but was not examined by Cracraft (1973).

Baeopteryx latipes Wetmore from the Lower Pleistocene of Bermuda is known from several skeletal elements. The ulna of B. latipes is smaller and apparently weaker than that of Grus canadensis.

Grus conferta A.H. Miller and Sibley (1942) is described from a distal piece of tarsometatarsus from California's Upper Lower Pliocene, and was in size similar to G. americana.

Grus nannodes Wetmore and Martin (1930) of the Middle Pliocene of Kansas is based on a carpometacarpus lacking the proximal end. This bird was small, being less than two-thirds the size of G. canadensis.

Two neospecies of Grus, G. canadensis (Linnaeus), the Sandhill Crane, and G. americana, the Whooping Crane, are known from the Pleistocene of North America, including several sites in Florida (Brodkorb, 1967).

Suborder Cariamae Furbringer

Family *Phorusrhacidae (Ameghino)

Subfamily *Phorusrhacinae (Ameghino)

Genus *Titanis BrodkorbTitanis walleri Brodkorb

Material: One complete carpometacarpus, 2 complete cervical vertebrae (C2 and C3), 1 vertebral fragment, distal shaft of 1 right tibiotarsus, 1 metatarsal I fragment, 1 left phalanx I of digit III, 1 left phalanx II of digit III, 1 left phalanx III of digit III, 1 right and 1 left phalanges I of digit IV. The 11 specimens represent a minimum number of 2 individuals.

Characters: The second cervical vertebra (axis) differs from that of Andalgalornis ferox Patterson and Kraglievich (1960, as drawn in dorsal view on p. 42) in having: (1) prezygapophyses greatly reduced to small prominences; (2) anterior end of neural spine narrower and posterior end rounder; (3) anapophyses enlarged and rounded dorsally; and (4) anapophyses thinner and projecting farther laterally.

The third cervical vertebra differs in having: (1) edge of centrum more deeply curved; (2) prezygapophyses rounded; (3) neural spine set farther back posteriorly; and (4) anapophyses larger and projecting farther laterally.

The following are measurements of C2 with those of C3 in parentheses: anterior width of centrum, 44.2; anterior depth of centrum, 31.2; diameter of neural canal, 8.2 (8.0); width through diapophyses, 126.8 (138.7); width through hypapophysis, 33.0 (32.3); length of centrum, 69.3 (65.1); height from hypapophysis through neural spine, 105.0 (109.2). All measurements above are in millimeters.

Characters of the carpometacarpus are: (1) internal and external carpal trochleae fused into one enlarged and flattened surface; (2) carpal trochlear surface rounded on its edge closest to metacarpal III, but heart-shaped nearest metacarpal I, and does not extend onto internal or external surfaces of carpometacarpus; (3) carpal trochlear surface extending 8.6 mm from anterior end towards metacarpal III, and 13.4 mm towards metacarpal I; (4) anterior carpal fossa small and shallow; (5) metacarpal I greatly developed with edge bluntly rounded; (6) metacarpal I with a large, deep depression on both internal and external sides of the bone just distal to carpal fossa at junction of metacarpal I and metacarpal II; (7) pollical facet greatly enlarged, knoblike, and projectly distally; (8) long fused region at proximal end where metacarpal II and metacarpal III join deeply excavated; (9) ligamental attachment of pisiform process absent; (10) at proximal base of metacarpal II, greatly enlarged elongated prominence pointing posteriorly; (11) metacarpal III broad and flattened and narrowing distally; (12) intermetacarpal space long, narrow, and rounded at both ends; (13) metacarpal II heavy and squarish in cross-section; (14) distal metacarpal symphysis long (13.9 mm), with a narrow longitudinal groove at its distal end (in external view); and (15) facet for digit III extending beyond facet for digit II.

The carpometacarpus of Titanis walleri differs from that of Palaeociconia cristata Moreno and Mercerat (Phorusrhacos inflatus) Ameghino, as drawn in Andrews, 1899, plate 17) in having (1) metacarpal III not bowed, and nearly parallel to metacarpal II; (2) tuberosity at base of metacarpal III much larger; and (3) anterior end relatively much larger, being nearly one-half of the length of the bone.

Measurements of the carpometacarpus are: total length, 95.7; proximal depth through trochleae, 27.5; proximal width through trochleae, 19.4; maximum proximal width through metacarpal I, 40.2; length of metacarpal I, 27.4; width of metacarpal II, 9.6; depth of metacarpal II, 11.3; maximum width of intermetacarpal space, 6.9; length of intermetacarpal space, 30.2; maximum width of metacarpal III, 7.0; distal width, 20.6; distal depth, 14.5.

The fragment of tibiotarsus has a length of 111.0, and a greatest width of 75.6 mm.

The metatarsal I fragment has a length of 43.6, and a depth of 24.9 mm on the articular surface.

Measurements of the Titanis walleri phalanges are given in Table 31.

Drawings of the cervical vertebrae appear in Figures 1 and 2 for comparison with the vertebrae of Andalgalornis ferox, as drawn in Patterson and Kraglievich (1960). Photographs of the vertebrae and the carpometacarpus appear in Figures 3, 4, and 5.

Remarks: The genus and species Titanis walleri is described by Brodkorb (1963c) from the distal end of a tarsometatarsus and a phalanx I of digit III from the late Pleistocene of the Santa Fe River, Florida. This was the first record of a phorusrhacid from North America and the most recent, the group being previously known only from Argentina and Uruguay and ranging in time from the Oligocene to the early Pleistocene. Brodkorb (1963c, p.111) describes this species as,

. . . a bird of tremendous size, larger than the African ostrich and more than twice the size of the South American rhea.

Table 31. Measurements of the phalanges of the Inglis Titanis walleri.

	Digit III Phalanx I <u>left</u>	D III P II <u>left</u>	D III P III <u>left</u>	D IV P I <u>right</u>	D IV P I <u>left</u>
Dorsal length	99.9	61.6	43.5	53.4	53.4
Plantar length	102.1	63.1	47.3	53.0	53.5
Proximal width		40.9	35.4	24.4	22.6
Proximal depth	47.0	36.0	30.8	33.7	33.4
Distal width	40.6	34.8	34.3	22.7	22.8
Distal depth	28.6	20.9	18.0	26.2	26.5
Least width of shaft	34.6	34.6	32.0	19.7	20.2

Order Charadriiformes (Huxley)

Suborder Charadrii (Huxley)

Family Scolopacidae Vigors

Subfamily Scolopacinae (Vigors)

Genus Capella Frenzel

Capella gallinago (Linnaeus)

Common Snipe

Material: One complete right humerus, proximal ends of 3 right humeri, distal ends of 2 left humeri, 2 left carpometacarpi, 1 complete right tarsometatarsus, distal end of 1 left tarsometatarsus. The 10 specimens represent a minimum number of 4 individuals.

Characters: Capella is separated from Philohela, Limnodromus, and Totanus using Ligon's (1965) characters for the coracoid, humerus, ulna, carpometacarpus, and tarsometatarsus. Olson (1976b) lists generic characters for separating Capella and Scolopax. Measurements of C. gallinago appear in Table 32.

Remarks: With the removal of Capella anthonyi (Wetmore, 1920) to the genus Scolopax by Olson (1976b), there are now no extinct species of Capella known for the New World. Jánosy (1978) describes Gallinago (Capella) veterior based on a coracoid from the Upper Pliocene of the Carpathian Basin of eastern Europe.

Table 32. Measurements of the humerus, carpometacarpus, and tarsometatarsus of Recent Capella gallinago delicata (1 male, 3 females, 1 ?) and Inglis C. gallinago.

		<u>Capella gallinago</u>	<u>Inglis C. gallinago</u>
<u>Humerus</u>			
Total	R	35.9-38.8	39.6
Length	M	37.28	-
	N	5	1
Proximal Width	R	8.3-9.4	9.0
	M	8.88	-
	N	5	1
Distal Width	R	6.2-6.4	6.6
	M	6.28	-
	N	5	1
<u>Carpometacarpus</u>			
Total	R	24.2-26.1	24.1
Length	M	25.24	-
	N	5	1
Proximal Depth	R	5.5-6.1	5.5
	M	5.88	-
	N	5	1
Distal Width	R	2.7-3.2	3.3
	M	2.92	-
	N	5	1
<u>Tarsometatarsus</u>			
Total	R	29.9-33.9	31.4
Length	M	31.78	-
	N	5	1
Proximal Width	R	4.6-4.9	4.5
	M	4.76	-
	N	5	1
Width Through Trochleae	R	4.6-5.0	4.2
	M	4.78	-
	N	5	1

Genus Philohela GrayPhilohela minor (Gmelin)

Woodcock

Material: One complete right coracoid, proximal end of 1 right coracoid, proximal end of 1 right scapula, distal fragment of 1 left humerus, proximal end of 1 right ulna, one synsacrum, distal end of 1 right femur, distal ends of 2 right tibiotarsi, 1 right and 1 left tarsometatarsi, proximal end of 1 right tarsometatarsus. The 12 specimens represent a minimum number of 2 individuals.

Characters: Olson (1976b) contains a list of characters of Philohela minor distinguishing it from Scolopax anthonyi (Wetmore) and S. rusticola.

Measurements of P. minor and S. rusticola appear in Table 33.

Remarks: Jánosy (1978) describes Scolopax baranensis from a slender carpometacarpus of Hungary's Upper Pliocene.

Table 33. Measurements of the coracoid and tarsometatarsus of Recent Philohela minor (6 males, 8 females), Inglis P. minor, and Recent Scolopax rusticola (1 male, 1 ?).

		<u>Philohela</u> <u>minor</u> males	<u>Philohela</u> <u>minor</u> females	<u>Inglis</u> <u>P. minor</u>	<u>Scolopax</u> <u>rusticola</u>
<u>Coracoid</u>					
Length to	R	23.1-25.2	24.9-26.8	27.7	28.5-29.0
External	M	24.26	25.81	-	28.55
Facet	N	6	8	1	2
Distal width	R	5.6-6.8	6.2-7.0	7.2	7.7-8.5
Through	M	6.31	6.57	-	8.10
Sternal facet	N	6	8	1	2
<u>Tarsometatarsus</u>					
Total	R	29.9-31.5	33.3-35.7	35.9-36.0	35.8-37.1
Length	M	31.08	34.07	35.95	36.45
	N	5	8	2	2
Proximal	R	4.9-5.5	5.1-6.0	6.5-6.6	6.8-7.5
Width	M	5.26	5.56	6.55	7.15
	N	5	8	2	2
Width	R	5.4-6.0	5.4-6.2	5.9-6.5	6.6-7.2
Through	M	5.66	6.00	6.20	6.90
Trochleae	N	5	8	2	2

Order Columbiformes (Latham)

Suborder Columbae Latham

Family Columbidae (Illiger)

Subfamily Columbinae (Illiger)

Genus Zenaidura Nonaparte

Zenaidura macroura (Linnaeus)

Mourning Dove

Material: Proximal ends of 1 right and 1 left scapulae, 1 complete left coracoid, proximal ends of 3 left coracoids, distal ends of 1 right and 2 left coracoids, 6 anterior sternal fragments, 1 complete left humerus, proximal ends of 1 right and 1 left humeri, distal ends of 5 right and 1 left humeri, shaft of 1 left humerus, 1 complete left ulna, proximal ends of 1 right and 1 left ulnae, distal ends of 2 right and 1 left ulnae, proximal end of 1 left radius, 1 complete left ulnare, proximal end of 1 right carpometacarpus, proximal end of 1 left tibiotarsus, distal ends of 3 left tibiotarsi, 1 complete right tarsometatarsus, shaft of 1 right tarsometatarsus. The 40 specimens represent a minimum of 6 individuals.

Characters: Zenaidura macroura is easily distinguished by size from other North American species of doves. The following measurements are in millimeters.

Coracoid: total length - 23.3

Humerus: total length - 31.3; proximal width - 9.6; midshaft width - 3.7; midshaft depth - 2.9; distal width - 7.5.

Ulna: total length - 38.7; proximal width - 4.8; midshaft width - 2.7; midshaft depth - 3.1; distal depth - 4.5.

Tarsometatarsus: total length - 22.2; proximal width - 4.5; midshaft width - 2.3; midshaft depth - 1.6; width trochleae 4.8.

Remarks: Brodkorb (1969) described an ancestral mourning dove, Zenaidura prior from the Upper Pliocene of the Rexroad formation of Kansas. The humerus of the Inglis Zenaidura agrees with the characters he listed for Z. macroura.

Order Cuculiformes (Wagler)

Suborder Cuculi Wagler

Family Cuculidae Vigors

Subfamily Coccyginae (Swainson)

Genus Coccyzus Vieillot

Coccyzus americanus (Linnaeus)

Yellow-billed Cuckoo

Material: Three left mandibular fragments, proximal end of left scapula, proximal end of 1 left coracoid, proximal ends of 2 right and 1 left humeri, distal ends of 3 right humeri, shaft of 1 right humerus, 1 complete left ulna, proximal end of 1 right ulna, shaft of 1 left ulna, 1 right carpometa carpus (without metacarpal III), proximal end of 1 right tibiotarsus, distal ends of 2 right and 3 left tibiotarsi, 1 complete right tarsometatarsus, proximal ends of 1 right and 1 left tarsometatarsi. The 25 specimens represent a minimum of 6 individuals.

Characters: Coccyzus americanus is distinguished from C. erythrophthalmus by having slightly larger size. See Table 34.

The humerus of C. americanus differs from that of C. minor in

Table 34. Measurements of the ulna and tarsometatarsus of Recent Coccyzus erythrophthalmus (1♂, 1♀), C. minor (1♀, 1?), C. americanus (4♂, 1♀), and Inglis C. americanus.

		<u>C. eryth.</u>	<u>C. minor</u>	<u>C. amer.</u>	Inglis <u>C. amer.</u>
<u>Ulna</u>					
Total	R	27.2-27.7	27.8	28.1-30.4	28.8
Length	M	27.45	-	29.34	-
	N	2	1	5	1
Proximal	R	3.7-3.8	4.0	4.0-4.4	4.2
Width	M	3.75	-	4.16	-
	N	2	1	5	1
Distal	R	2.9-3.0	3.0	3.0-3.3	3.2
Depth	M	2.95	-	3.14	-
	N	2	1	5	1
<u>Tarsometatarsus</u>					
Total	R	25.1-26.2	28.5-29.1	24.9-26.9	25.3
length	M	25.65	28.80	26.44	-
	N	2	2	5	1
Proximal	R	3.7-3.8	4.4	3.9-4.3	4.0
Width	M	3.75	4.40	4.06	-
	N	2	2	5	1
Width	R	3.8-4.1	4.2-4.4	4.1-4.3	4.4
Through	M	3.95	4.30	4.14	-
Trochleae	N	2	2	5	1

having (1) bicipital crest larger; (2) external tuberosity larger; (3) in anconal view, prominence at distal end of capital groove larger; and (4) ectepicondylar prominence larger.

The ulna in having (1) impression of brachialis anticus deeper; and (2) carpal tuberosity larger and more pointed.

The carpometacarpus in having (1) process of metacarpal I longer; and (2) ligamental attachment of pisiform process larger.

The tibiotarsus in having (1) condyles smaller and closer together and (2) anterior intercondylar fossa deeper.

The tarsometatarsus in having smaller size.

Order Strigiformes (Wagler)

Family Strigidae Vigors

Subfamily Buboninae (Vigors)

Genus Bubo Duméril

Bubo virginianus (Gmelin)

Great Horned Owl

Material: Proximal end and distal end of 1 right humerus, one complete right ulna, one complete left ulnare, proximal end of 1 right femur, distal ends of 1 right and 2 left radius.

Referred material: Distal end of 1 left radius, fragment of 1 right acetabulum. The 10 specimens represent a minimum of 2 individuals.

Characters: The humerus of Bubo virginianus is distinguished from those of Strix varia, Tyto alba, and Asio flammeus by its much greater size, and from that of Nyctea scandiaca in having (1) in proximal view,

distance between capital groove and ligamental furrow narrower; (2) line of latissimus dorsi anterioris extending farther distally; (3) in palmar view, scar extending medially above ectepicondylar prominence deeper and longer; (4) ectepicondylar prominence smaller; (5) in external view, two pits proximal to ectepicondyle smaller; and (6) tricipital groove shallower.

The ulna of Bubo virginianus differs from that of Nyctea scandiaca in having (1) in proximal view, internal cotyla narrower and its palmar edge forming a narrower point (wider and more rounded in N. scandiaca); (2) prominence for the anterior articular ligament set closer to proximal end; (3) prominence for bicipital attachment thin and elongated (thick and squarish in N. scandiaca); (4) carpal tuberosity smaller; (5) ridge from carpal tuberosity extending farther up shaft; and (6) external condyle smaller and narrower. Measurements of the ulna and ulnare are listed in Table 35.

The femur of Bubo virginianus is distinguished from that of Nyctea scandiaca by having (1) head smaller; (2) neck narrower; and (3) proximal end of anterior intermuscular line set closer to trochanteric ridge, and from that of Strix varia in having (1) neck deeper; (2) in anterior view, anterior intermuscular line separated from trochanteric ridge curving. See Table 36.

The tibiotarsus of Bubo virginianus differs from that of Nyctea scandiaca in having (1) in anterior view, ligamental prominence above tendinal groove set farther away from distal end of bone; and (2) tendinal groove undercutting anterior intercondylar fossa.

Table 35. Measurements of the ulna and ulnare of Tyto alba (3♂, 2♀), Strix varia (1♂, 3♀, 3?), Inglis Bubo virginianus, Bubo v. virginianus (6♂, 9♀), and Nyctea scandiaca (1♂).

	<u>Tyto</u> <u>alba</u>	<u>Strix</u> <u>varia</u>	<u>Inglis</u> <u>B. virg.</u>	<u>Bubo v.</u> <u>virg.</u> Males	<u>Bubo v.</u> <u>virg.</u> Females	<u>Nyctea</u> <u>scandiaca</u>
<u>Ulna</u>						
<u>Total</u>	R 111.9-119.6	111.2-120.4	141.5	141.7-157.0	147.8-158.0	163.2
<u>Length</u>	M 117.38	114.93	-	147.20	153.61	-
	N 4	6	1	6	8	1
<u>Proximal</u>	R 9.6-10.2	10.4-11.2	13.5	13.2-14.2	13.8-15.7	15.8
<u>Width</u>	M 9.90	10.74	-	13.85	14.87	-
	N 5	7	1	6	9	1
<u>Midshaft</u>	R 3.9-4.4	4.4-5.0	6.1	6.1-6.7	6.0-7.8	6.6
<u>Width</u>	M 4.13	4.58	-	6.47	7.00	-
	N 4	6	1	6	8	1
<u>Midshaft</u>	R 4.3-4.8	4.9-5.5	6.6	5.3-6.0	5.6-7.5	7.6
<u>Depth</u>	M 4.50	5.17	-	5.60	6.28	-
	N 4	6	1	6	8	1
<u>Distal</u>	R 7.1-7.9	8.0-8.9	9.9	10.0-11.2	10.5-11.7	12.1
<u>Depth</u>	M 7.46	8.40	-	10.57	11.13	-
	N 5	7	1	6	9	1
<u>Ulnare</u>						
<u>Length</u>	R 8.4-8.7	8.2-9.2	11.3	10.1-11.0	10.1-12.0	11.6
	M 8.53	8.57	-	10.53	11.27	-
	N 4	7	1	6	9	1
<u>Width</u>	R 6.5-6.9	6.5-7.1	8.8	7.8-8.5	8.6-9.7	11.4
	M 6.75	6.84	-	8.27	9.23	-
	N 4	7	1	6	9	1

Table 36. Measurements of the femur of Strix varia, (1 ♂, 2 ♀, 2?) Inglis Bubo virginianus, and Bubo v. virginianus. (6 ♂, 8 ♀).

		<u>Strix</u> <u>varia</u>	<u>Inglis</u> <u>B. virg.</u>	<u>Bubo v.</u> <u>virg.</u>	<u>Bubo v.</u> <u>virg.</u>
				Males	Females
Proximal	R	12.5-13.2	14.9	14.9-16.1	14.9-17.3
Width	M	12.86	-	15.58	16.58
	N	5	1	6	8
Depth of	R	5.3-6.0	6.5	6.2-7.0	6.5-7.7
Head	M	5.62	-	6.58	7.52
	N	5	1	6	8

Remarks: Loe Miller (1911) describes the Upper Pleistocene Bubo sinclairi of California as larger than Recent Nyctea scandiaca and Strix nebulosa, which makes it much larger than Bubo virginianus.

Genus Otus Pennant

Otus Asio (Linnaeus)

Screech Owl

Material: Proximal ends of 2 right scapulae, 1 complete right and 1 complete left coracoids, humeral end of 1 right coracoid, sternal end of 1 left coracoid, proximal ends of 1 right and 3 left humeri, distal end of 1 left ulna, shafts of 1 right and 1 left ulnae, proximal end of 1 right radius, distal ends of 2 right radii, 1 right and 1 left carpometacarpus (both lacking metacarpal III), distal end of 1 left carpometacarpus, 1 complete right femur, proximal ends of 2 right femora, distal ends of 2 right femora, proximal end of 1 right tibiotarsus, distal ends of 4 right and 1 left tibiotarsi, 1 complete right and 2 complete left tarsometatarsi, distal ends of 1 right and 1 left tarsometatarsi, one phalanx 1 of digit 2. The 44 specimens represent a minimum number of 6 individuals.

Characters: Otus asio is distinguished from Aegolius funereus and Speotyto cunicularia by the following characters.

Scapula having (1) no pneumatic foramina on proximal end; (2) in ventral view, area below furcular articulation smooth (knobby in Aegolius and Speotyto).

Coracoidal characters separating Otus, Aegolius and Speotyto are listed by Ford (1966). In addition, coracoid having (1) ventral view,

presence of a knob on brachial tuberosity which points towards the procoracoid (no knob in Aegolius and Speotyto); (2) sterno-coracoidal process shorter (does not extend as far up the shaft as in Aegolius and Speotyto). Characters that distinguish the coracoids of Otus and Glaucidium are found in Brodkorb (1959b).

Humerus having (1) pneumatic fossa smaller; (2) bicipital crest smaller; (3) entepicondyle lower; (4) ectepicondylar prominence closer to distal end.

Ulna having (1) prominence for anterior articular ligament larger; (2) olecranon square in palmer view; (3) groove between condyles broader; (4) in anconal view, external condyle relatively larger.

Radius having ligamental prominence elongated (rounded in Aegolius and Speotyto).

Carpometacarpus having (1) in internal view, proximal end of metacarpal III gently curved toward metacarpal II (abruptly angled towards metacarpal II in Aegolius and Speotyto); (2) knob on internal edge of metacarpal III set more distally.

Femur having (1) neck more constricted; (2) anterior intermuscular line angled toward external side of bone and in line with trochanteric ridge (line parallel to and offset from ridge in Aegolius and Speotyto); (3) popliteal depression deeper; (4) in posterior view, external condyle rotated slightly towards external side; (5) lacks prominence above popliteal area.

Tibiotarsus having (1) in proximal view, no prominence at union of inner cnemial crest and inner articular area of head; (2) flexor

attachment ridgelike rather than knoblike; (3) tendinal groove longer and deeper; (4) in internal view, shaft constricted above internal condyle.

Tarsometatarsus having (1) outer proximal foramen large; (2) inner calcaneal ridge of hypotarsus long; (3) distal foramen smaller; (4) trochlea for digit IV larger. These three species are easily distinguished on total length of the tarsometatarsus: Aegolius funereus is shorter and Speotyto cunicularia is longer than Otus asio. Characters of the tarsometatarsus are listed by Brodkorb (1959b) for eight genera of American owls.

Phalanx I of digit II having (1) ventral side broad and flat; (2) in proximal view, ventral edge less strongly curved; (3) in dorsal view, shaft broader.

Measurements of the Inglis Otus asio are compared with those of several other owls in Table 37.

Remarks: Otus providentiae Brodkorb (1959b) of the late Pleistocene of New Providence Island, Bahamas, was smaller than Otus asio: coracoid, length from scapular facet (= total length) - 16.1, sternal width - 6.0; tibiotarsus, distal width - 5.2 mm.

Genus Speotyto Gloger

Speotyto *megalopeza Ford

Material: One premaxillary, one complete left femur, distal end of 1 left tibiotarsus.

Referred material: Distal (sternal) end of 1 left coracoid, proximal end of 1 right femur, distal end of 1 left femur. The 6 species represent a minimum of 2 individuals.

Table 37. Skeletal measurements (mm.) of Otus flammeolus, O. asio, Inglis O. asio, Aegolius funereus richardsoni, and Speotyto cunicularia floridana.

		<u>Otus</u> <u>flam.</u>	<u>Otus</u> <u>asio</u>	<u>Inglis</u> <u>Otus</u> <u>asio</u>	<u>Aegol.</u> <u>f. rich.</u>	<u>Speotyto</u> <u>c. flor.</u>
		1	4 ,3 ,3?		1	3 ,3
<u>Scapula</u>						
Proximal	R	4.5	5.1-6.9	5.3-6.0	6.1	5.9-7.0
Width	M	-	5.87	5.65	-	6.33
	N	1	10	2	1	6
<u>Coracoid</u>						
Total	R	17.4	21.8-25.4	22.9-23.2	24.2	24.5-27.0
Length	M	-	22.83	23.05	-	26.00
	N	1	10	2	1	6
Distal	R	6.1	6.4-7.5	7.2-7.3	7.2	7.3-8.1
Width	M	-	6.85	7.25	-	7.88
Sternal	N	1	10	2	1	6
<u>Humerus</u>						
Distal	R	6.4	7.8-9.3	8.1-8.9	8.5	8.0-9.3
Width	M	-	8.24	8.45	-	8.55
	N	1	10	4	1	6
<u>Radius</u>						
Distal	R	2.7	4.0-4.9	4.6-4.8	4.0	4.0-4.8
Width	M	-	4.30	4.70	-	4.33
	N	1	10	2	1	6
<u>Carpometacarpus</u>						
Total	R	17.5	24.9-28.8	26.9-27.7	24.6	28.7-33.1
Length	M	-	25.73	27.30	-	30.95
	N	1	10	2	1	6
Proximal	R	4.5	5.0-6.4	6.3	5.9	6.0-7.1
Width	M	-	5.54	-	-	6.57
	N	1	10	1	1	6
Distal	R	3.5	4.5-5.6	5.0-5.2	5.3	4.2-4.9
Width	M	-	4.93	5.10	-	4.55
	N	1	10	2	1	6

Table 37. Continued.

		<u>Otus</u> <u>flam.</u>	<u>Otus</u> <u>asio</u>	<u>Inglis</u> <u>Otus</u> <u>asio</u>	<u>Aegol.</u> <u>f. rich.</u>	<u>Speotyto</u> <u>c. flor.</u>
		1	4 ,3 ,3?		1	3 ,3
<u>Femur</u>						
Total	R	25.4	34.1-40.2	35.9	36.5	35.4-38.0
Length	M	-	36.16	-	-	36.94
	N	1	10	1	1	5
Proximal	R	4.6	5.7-6.7	6.4-6.5	6.9	6.5-7.3
Width	M	-	6.04	6.45	-	7.08
	N	1	10	2	1	5
Distal	R	4.4	5.6-7.0	6.5	6.7	6.6-7.6
Width	M	-	6.13	-	-	7.05
	N	1	10	1	1	6
<u>Tibiotarsus</u>						
Distal	R	4.5	5.8-7.0	6.0-6.3	6.4	6.0-6.9
Width	M	-	6.14	6.20	-	6.47
	N	1	10	2	1	6
Depth of	R	3.5	4.8-5.8	5.1	5.3	5.1-6.0
Internal	M	-	5.08	-	-	5.60
	N	1	10	1	1	6
Depth of	R	3.3	4.6-5.8	4.9	5.2	5.0-5.8
External	M	-	4.98	-	-	5.48
	N	1	10	1	1	6
<u>Tarsometatarsus</u>						
Total	R	20.9	29.9-33.0	30.8-33.4	21.9	42.1-48.0
Length	M	-	30.93	31.97	-	45.66
	N	1	10	3	1	5
Proximal	R	4.1	5.4-6.7	6.3-6.8	6.7	6.2-7.0
Width	M	-	5.86	6.55	-	6.48
	N	1	10	2	1	5
Midshaft	R	2.2	2.8-3.7	3.1-3.5	3.9	2.6-3.1
Width	M	-	3.15	3.27	-	2.78
	N	1	10	3	1	5
Midshaft	R	1.7	2.1-2.8	2.3	2.0	2.6-3.1
Depth	M	-	2.39	2.30	-	2.68
	N	1	10	3	1	5
Width	R	4.3	6.2-7.6	6.3-7.0	6.8	6.9-7.3
Across	M	-	6.59	6.57	-	7.04
Trochleae	N	1	10	3	1	5

Characters: Speotyto is distinguished from Otus by the following characters.

Premaxillary having, in ventral view, posterior edge of bone leading (dorsally) to a deeply excavated area (shallow area in Otus).

Coracoid having (1) sterno-coracoidal process longer; (2) sterno-coracoidal impression shallower; (3) sternal facet extending farther up dorsal side of bone.

Femur having (1) nutrient foramen placed in line with or just internal to posterior intermuscular line (foremen external to line in Otus); (3) popliteal depression shallower; (4) in anterior view, proximal ridge of internal condyle lower; (5) small round prominence above popliteal area set closer to proximal end.

Tibiotarsus having (1) distal end of bone in line with shaft (distal end projected toward internal side in Otus); (2) tendinal groove shallower; (3) in internal view, shaft above condyle broad (contracted in Otus).

Speotyto megalopeza is distinguished from Recent S. cunicularia by the following characters.

Premaxillary is more robust.

Femur having (1) distance between trochanter and head shorter; (2) in posterior view, ridge along iliac facet slanting towards distal edge of head (slanting towards distal edge in S. cunicularia); (3) in posterior view, area external to head less excavated; (4) posterior intermuscular line terminating proximally at level of nutrient foramen (line extending farther proximally in S. cunicularia); (5) condyles larger.

Tibiotarsus having (1) tendinal groove deeper; (2) groove for peroneus profundus deeper; (3) condyles set farther apart.

Measurements of femur: Total length - 38.9; proximal width - 6.8; distal width - 6.8 and 7.0.

Remarks: Speotyto megalopeza Ford (1966) is known for several elements from the Rexroad fauna of Kansas and the Hagerman fauna of Idaho (Ford and Murray, 1967), both from the Upper Pliocene. Ford (1966) describes this species as similar to and more robust than modern S. cunicularia. This is the first record of this species for Florida.

Subfamily Striginae (Vigors)

Strix varia Barton

Genus Strix Linnaeus

Barred Owl

Material: Distal end of 1 right humerus, 1 right carpometacarpus (missing metacarpal III), two phalanges II of digit II. The 4 specimens represent a minimum of 2 individuals.

Characters: The humerus of Strix varia is distinguished from that of Bubo virginianus by having a smaller size and from that of Tyto alba by having (1) deltoid crest longer; (2) brachial depression shallower; (3) entepicondylar prominence lower; and (4) external condyle wider.

The carpometacarpus of Strix varia differs from that of Bubo virginianus by having a smaller size and from that of Tyto alba by having (1) metacarpal I longer and less curved towards trochleae; and (2) in external view, intermetacarpal region (at proximal end) fused to level of intermetacarpal tuberosity (fused area terminates proximal to tuberosity in T. alba). The carpometacarpus of Strix varia differs

from that of Asio otus in having (1) trochleae larger; (2) metacarpal I longer; (3) distance from trochleae to intermetacarpal space longer; and (4) pollical facet larger.

Remarks: The Lower Miocene Strix dakota from South Dakota is about the size of the modern Screech Owl, Otus asio (Miller, A. H., 1944). Howard (1933) describes Strix brea from California's Upper Pleistocene as larger than S. varia and S. occidentalis.

Family Tytonidae Ridgway

Genus Tyto Billberg

Tyto alba (Scopoli)

Barn Owl

Material: Proximal half of 1 left femur.

Characters: The femur of Tyto alba is smaller than that of Bubo virginianus, larger than that of Asio flammeus, and differs from that of Strix varia in having (1) in posterior view, an unbroken ridge crossing the bone from obturator ridge to head; (2) in anterior view, anterior intermuscular line straight as it approaches proximal end of bone (line curves in S. varia); and (3) in anterior view, trochanteric ridge and anterior intermuscular line converging at trochanter (converge distal to trochanter in S. varia).

Remarks: The Mid-Pliocene Lechusa stirtoni from California is known from a coracoid similar in size to that of Tyto alba, but stouter (L. H. Miller, 1956).

Wetmore describes three extinct species of Tyto from the Upper Pleistocene of the Caribbean (Wetmore 1920, 1922, 1937). Tyto cavatica was a small barn owl from Puerto Rico. Tyto ostologa from Haiti was

gigantic, and T. pollens from Great Exuma Island in the Bahamas was even larger. Femur and tarsometatarsus measurements of these species and of T. alba are listed in Table 38. Two more huge species of barn owl, Tyto noeli and T. riveroi, are described from the Late Pleistocene of Cuba by Arredondo (1972a, 1972b).

Table 38. Femur measurements of Recent Tyto alba (1♂, 2♀), Inglis T. alba, and T. pollens (Wetmore 1937); tarsometatarsus measurements of T. cavatica (Wetmore 1920), Recent T. alba, and T. ostologa (Wetmore 1922).
* - estimated length.

		<u>Tyto</u> <u>cavatica</u>	<u>Tyto</u> <u>alba</u>	Inglis <u>T. alba</u>	<u>Tyto</u> <u>ostologa</u>	<u>Tyto</u> <u>pollens</u>
<u>Femur</u>						
Total	R		62.0-62.6			82.0
Length	M		62.30			-
	N		3			1
Proximal	R		11.2-11.8	12.0		16.8
Width	M		11.57	-		-
	N		3	1		1
<u>Tarsometatarsus</u>						
Total	R		75.9-80.0		*120.0	
Length	M		78.13		-	
	N		3		1	
Proximal	R	10.0	10.9-11.5		17.5	
Width	M	-	11.17		-	
	N	1	3		1	
Midshaft	R	4.0	4.6-5.0			
Width	M	-	4.77			
	N	1	3			

Genus Glaucidium BoieGlaucidium sp. 1

Material: Proximal ends of 2 right scapulae, proximal end of 1 right humerus, 1 complete left femur, distal end of 1 left femur, 1 complete right tibiotarsus, distal ends of 1 right and 1 left tibiotarsi, shaft of 1 left tibiotarsus, 1 complete left tarsometatarsus, proximal end of 1 left tarsometatarsus, distal end of 1 right tarsometatarsus. The 12 specimens represent a minimum number of 3 individuals.

Characters: The humerus of Glaucidium sp. 1 is much larger than that of G. minutissimum, and differs from that of G. gnoma in having: (1) bicipital crest larger and more rounded; and (2) ligamental furrow larger and deeper.

The femur of the Inglis Glaucidium sp. 1 differs from that of G. gnoma, the Northern Pygmy-Owl, in having (1) in proximal view, anterior edge of neck concave (convex in G. gnoma); (2) in anterior view, ridge joining trochanteric ridge and head (ridge absent in G. gnoma); (3) trochanteric ridge longer; (4) in external view, pit on fibular condyle more rounded; (5) external condyle larger; and (6) in distal view, pit in intercondylar fossa (pit absent in G. gnoma). The femur is much larger than that of G. minutissimum, the Least Pygmy-Owl.

The tibiotarsus of Glaucidium sp. 1 is larger than that of G. minutissimum, and G. gnoma in having (1) inner and outer cnemial crests extending farther down shaft; (2) shaft more robust; (3) in anterior view, prominence on anterior, internal side of tendinal groove set closer to distal end. The tibiotarsus is stockier than that of G. siju, the Cuban Pygmy-Owl.

The tarsometatarsus of Glaucidium sp. 1 differs from that of G. gnoma in having (1) tubercle for tibialis anticus larger; (2) metatarsal facet longer; and (3) trochleae smaller.

Measurements of Glaucidium sp. 1 and sp. 2 are compared with those of three Recent species of Glaucidium in Table 39.

Brodkorb (1959) described the first fossil species of the genus Glaucidium as G. dickinsoni of the Upper Pleistocene of New Providence Island, Bahamas.

This species is based on a distal piece of a tibiotarsus which Brodkorb compared with that of Recent G. siju. The tibiotarsus of the Inglis Glaucidium sp. 1 is larger than those of G. siju and G. dickinsoni, but resembles G. siju in the characters listed to distinguish these two species by Brodkorb (1959).

Remarks: Glaucidium sp. 1 is close to G. siju in characters, and differs from it slightly in size. Only one partial skeleton of Recent G. siju and one juvenile skeleton of G. brasilianum were available for examination. More comparative material and further study is required to determine the identities of Glaucidium sp. 1 and G. sp. 2.

This is the first fossil record of genus Glaucidium for Florida. No species of this genus occur in Florida today. Glaucidium gnoma and G. brasilianum occur in the western part of the United States.

Glaucidium sp. 2

Material: Proximal end of 1 right femur, one complete left tibiotarsus, proximal end of 1 left tibiotarsus. The 3 specimens represent a minimum number of 2 individuals.

Table 39. Measurements of the scapula, femur, tibiotarsus, and tarsometatarsus of Glaucidium sp. 2 (tibiotarsus and tarsometatarsus only), G. minutissimus (scapula and femur only), G. gnoma, G. brasilianum, and G. sp. 1.

		<u>G.</u> <u>sp. 2</u>	<u>G.</u> <u>minut.</u> 1 female	<u>G.</u> <u>gnoma</u> 1 female, 1 ?	<u>G.</u> <u>brasil.</u> 2 males, 2 females	<u>G.</u> <u>sp. 1</u>
<u>Scapula</u>						
Proximal	R		4.5	5.0-5.3	5.3-5.5	5.4-5.8
Width	M		-	5.15	5.40	5.60
	N		1	2	4	2
<u>Femur</u>						
Total	R		24.9	25.8-27.6	26.5-29.0	29.9
Length	M		-	26.70	27.68	-
	N		1	2	4	1
Proximal	R		4.9	5.2	5.2-5.8	5.3-5.8
Width	M		-	5.20	5.43	5.55
	N		1	2	4	2
Distal	R		4.9	5.1-5.3	5.4-5.9	5.7-6.0
Width	M		-	5.20	5.55	5.85
	N		1	2	4	2
<u>Tibiotarsus</u>						
Total	R	36.1		37.9	36.2-41.3	40.0
Length	M	-		-	39.28	-
	N	1		1	4	1
Head	R	3.6		4.4	4.3-4.8	4.6
Width	M	-		-	4.50	-
	N	1		1	4	1
Distal	R	4.4		4.9	5.0-5.5	5.2
Width	M	-		-	5.30	-
	N	1		1	4	1
<u>Tarsometatarsus</u>						
Total	R			19.5	19.1-21.6	20.0
Length	M			-	20.38	-
	N			1	4	1
Proximal	R	4.9		5.6	5.0-5.8	
Width	M	-		-	5.43	
	N	1		1	4	
Width	R			5.3	5.3-6.1	5.3-6.1
Through	M			-	5.68	5.35
Trochleae	N			1	4	2

Characters: The femur of Glaucidium sp. 2 is distinguished from that of G. gnoma by characters 1 and 2 listed for Glaucidium sp. 1, and differs from Glaucidium sp. 1 in having (1) smaller size; (2) in proximal view, posterior edge of neck less concave; (3) in posterior view, trochanteric ridge shorter; and (4) in internal view, small tubercle distal to head (absent in Glaucidium sp. 1). The femur is heavier and larger than that of G. minutissimum.

The tibiotarsus of Glaucidium sp. 2 differs from that of Glaucidium sp. 1 in having (1) smaller size; (2) outer cnemial crest more curved towards external side; (3) ridge proximal to flexor attachment more curved; and (4) tendinal groove shorter. The tibiotarsus is near the size of that of G. minutissimum, but differs in having: (1) fibular crest longer; and (2) shaft heavier.

See Table 39 for measurements.

Remarks: Glaucidium sp. 2 is much smaller than G. gnoma, G. brasilianum, Glaucidium sp. 1, and G. dickinsoni.

Subfamily Striginae (Vigors)

Genus Asio Brisson

Asio *priscus Howard

Material: Distal end of 1 left coracoid, distal end of 1 right humerus, distal end of 1 right tibiotarsus. The 3 specimens represent a minimum of 1 individual.

Characters: The coracoid of Asio priscus is larger than those of Otus asio, Speotyto cunicularia, Aegolius funereus, and Aegolius acadia, and smaller than that of Surnia ulula. The coracoid is larger than that of A. otus, smaller than that of A. flammeus, and differs from these species in having the coracoidal fenestra set closer to scapular facet.

The humerus of Asio priscus differs from that of A. flammeus in having: (1) proximal end of brachial depression shallower; (2) ridge internal to brachial depression broader; (3) depression proximal to internal condyle deeper, as in A. otus; and (4) scar just internal to proximal end of ectepicondylar prominence crescent-shaped, as in A. otus (rounder in A. flammeus).

The tibiotarsus of A. priscus differs from that of A. flammeus in having: (1) tendinal groove shallow, as in A. otus (deep in A. flammeus); (2) small pit on anterior, inner surface of external condyle, as in A. otus (absent in A. flammeus); and (3) prominence proximal to and internal to tendinal groove set farther away from distal end. The tibiotarsus is larger than that of A. otus, and the same size as that of A. flammeus. Howard (1964) lists characters of the tibiotarsus of A. priscus which separate it from A. otus and A. flammeus.

Measurements of the humerus and tibiotarsus of several species of Asio are given in Table 40.

Remarks: Asio brevipes Ford and Murray (1967), based on a distal piece of a tarsometatarsus from the Upper Pleistocene of Idaho, is distinguished from A. otus and A. flammeus by having a shorter and stouter shaft.

Asio priscus is recorded from California's late Pleistocene.

Table 40. Measurements of the humerus and tibiotarsus of Recent Asio otus (2♂, 1♀), Inglis A. priscus, Recent A. flammeus (1♂, 3♀), and Recent A. capensis (1♂, 1♀).

		<u>Asio</u> <u>otus</u>	<u>Inglis</u> <u>A. priscus</u>	<u>Asio</u> <u>flammeus</u>	<u>Asio</u> <u>capensis</u>
<u>Humerus</u>					
Distal	R	11.5-12.4	13.7	13.1-14.4	14.0
Width	M	12.00	-	13.83	14.00
	N	3	1	4	2
<u>Tibiotarsus</u>					
Distal	R	7.9-8.3	9.3	8.3-9.8	8.5-8.9
Width	M	8.03	-	9.03	8.70
	N	3	1	4	2
Depth of	R	6.6-7.8		6.5-7.8	7.2-7.5
External	M	7.17		7.23	7.35
Condyle	N	3		4	2
Depth of	R	6.5-7.0	7.5	6.3-7.4	7.5
Internal	M	6.70	-	6.98	7.50
Condyle	N	3	1	4	2

Order Piciformes (Meyer and Wolf)

Suborder Pici Meyer and Wolf

Family Picidae Vigors

Subfamily Picinae (Vigors)

Genus Campephilus Gray

Campephilus *dalquesti Brodkorb

Material: Distal end of 1 right humerus.

Characters: The distal end (10 mm) of a right humerus has small chips of bone worn away on the internal surface of the entepicondyle, on the palmar and anconal sides of the internal and external condyles, and along the external side, giving the fossil a porous appearance. This appears to be damage to the fossil rather than a sign of an immature individual.

The fossil was compared with three specimens of Dryocopos pileatus (Pileated Woodpecker), one Campephilus guatemalensis (Pale-bellied Woodpecker), and one C. rubricollis (Red-necked Woodpecker). The fossil differs from Dryocopos and agrees with Campephilus in having: (1) brachial depression deep and elongate (shallow and wide in Dryocopos); (2) ridge on external side of brachial depression distinct (ridge narrow and indistinct in Dryocopos); (3) ectepicondylar prominence small; (4) ectepicondylar prominence making an obtuse angle with shaft (right angle in Dryocopos), and (5) prominence internal to tricipital groove small.

Characters and measurements of the distal end of the humerus of the Inglis Campephilus are compared with those of C. rubricollis and C. guatemalensis in Table 41. The fossil humerus is intermediate in size between these two Recent species.

Table 41. Comparison of the humerus (distal end) of three species of Campephilus.

<u>Features</u>	<u>C. ribricollis</u>	<u>C. guatemalensis</u>	<u>C. dalquesti</u>
Olecranal fossa	Slight depression	Flatter surface	Resembles <u>C. rub.</u>
Anterior articular ligament facet	Width 2.1 mm	Width 3.6 mm	Width 2.5 mm
Entepicondyle	Width 1.9	Width 2.8	Width 2.5
Entepicondyle	Furrow parallel to line running through distal width	Furrow at 25° angle to this line	Resembles <u>C. rub.</u>
Internal condyle	Width 2.3	Width 2.9	Width 2.4
Internal condyle	Distal edge curved	Squared	Resembles <u>C. rub.</u>
External condyle	Width 2.4	Width 2.5	Width 2.5
External condyle	Length 3.8	Length 3.9	Length 3.8
Distal end	Width 10.5	Width 11.5	Width 11.0
Distal end	Depth 5.0	Depth 5.4	Depth 5.2

Remarks: Campephilus dalquesti Brodkorb (1970) is based on the distal end of a tarsometatarsus from the Upper Pliocene (early Blancan) of Beck Ranch, Texas. The tarsometatarsus (as is the humerus) is similar in size to those of C. rubricollis and C. guatemalensis, and is smaller than that of C. principalis, the Ivory-billed Woodpecker.

Remains of Campephilus principalis are recorded from several pre-historic sites in the eastern United States (Brodkorb, 1971), and is now believed to be extinct.

Two extinct genera and species are described from the Lower Pliocene of North America. Pliopicus brodkorbi Feduccia and Wilson (1967) is based on a tarsometatarsus from Kansas, and resembles the genus Melanerpes. Palaeonerpes shorti Cracraft and Morony (1969) from Nebraska is based on a tibiotarsus.

Brodkorb (1959) describes the coracoid of Bathoceleus hyphalus from the late Pleistocene of the Bahamas.

Genus Colaptes Vigors

Colaptes auratus (Linnaeus)

Yellow-shafted Flicker

Material: Proximal end of 1 right scapula, 1 left coracoid, 1 anterior sternal fragment, shaft of 1 left humerus, proximal end of 1 left ulna, distal ends of 3 right ulnae, distal end of 1 left tibiotarsus, shaft of 1 right tarsometatarsus. The 10 specimens represent a minimum number of 3 individuals.

Characters: Colaptes is easily distinguished from other genera of North American woodpeckers on the basis of size (Table 42).

Table 42. Measurements of the coracoid, humerus, ulna, femur, tibiotarsus, and tarsometatarsus of Dendrocoptes pubescens (1 male), D. borealis (2 females), Sphyrapicus varius (3 males), Melanerpes carolinus (3 males, 2 females), M. erythrocephalus (2 males), and Colaptes auratus (1 male).

	D. pub.	D. bor.	S. var.	M. car.	M. ery.	C. aur.
<u>Coracoid</u>						
Length to	R 17.3	19.4-21.1	20.8-22.1	22.6-23.6	23.2-23.9	29.8
Internal	M -	20.25	21.56	23.28	23.55	-
Sternal facet	N 1	2	3	5	2	1
<u>Humerus</u>						
Total	R 21.6	25.6-27.8	26.0-28.2	30.8-31.8	32.5-33.3	38.9
Length	M -	26.70	27.40	31.30	32.90	-
	N 1	2	3	5	2	1
<u>Ulna</u>						
Total	R 26.0	30.3-33.0	32.2-34.6	36.5-38.7	37.8-39.0	45.0
Length	M -	31.65	33.73	37.48	38.40	-
	N 1	2	3	5	2	1
<u>Femur</u>						
Total	R 15.8	18.8-19.8	18.0-20.1	21.9-22.6	22.6-22.9	30.1
Length	M -	19.30	19.36	22.30	22.75	-
	N 1	2	3	5	2	1
<u>Tibiotarsus</u>						
Length to	R 27.6	27.6	27.3-28.9	31.0-31.7	33.0	41.0
Head	M -	-	28.33	31.34	33.00	-
	N 1	1	3	5	2	1
<u>Tarsometatarsus</u>						
Total	R 16.2	20.0	20.0-21.4	20.2-21.1	22.0-22.4	29.0
Length	M -	-	20.80	20.76	22.20	-
	N 1	1	3	5	2	1

Colaptes auratus differs from C. cafer in having a slightly smaller size.

Remarks: No fossil species of Colaptes are known. The four known, extinct species of woodpeckers are listed under the Remarks in the section on Campephilus dalquesti. Colaptes auratus differs from these species in both size and in the characters listed by each author.

Genus Melanerpes Swainson

Melanerpes erythrocephalus (Linnaeus)

Red-headed Woodpecker

Material: One complete left coracoid, 1 complete right humerus, proximal ends of 3 right and 1 left humeri, distal ends of 2 left humeri, proximal ends of 3 right and 2 left ulnae, distal ends of 2 right and 3 left ulnae, proximal end of 1 left tibiotarsus, one complete left tarsometatarsus, distal ends of 2 right and 1 left tarsometatarsi, shafts of 2 left tarsometatarsi.

Referred material: Proximal ends of 2 right and 1 left coracoids, distal ends of 1 right and 1 left coracoids, proximal ends of 2 right humeri, distal ends of 2 left ulnae, distal end of 1 left radius, distal ends of 2 left femora, proximal end of 1 left tarsometatarsus.

The 38 specimens represent a minimum number of 7 individuals.

Characters: The coracoid of Melanerpes differs from that of Sphyrapicus and Dendrocopos in having (1) brachial tuberosity more in line with shaft, as in Sphyrapicus (rotated internally in Dendrocopos); (2) in external view, glenoid facet expanded proximally, (3) procoracoid larger; and (4) in ventral view, ridge proximal to sternal facet longer.

The scapula of M. erythrocephalus differs from that of M. carolinus in having (1) proximal triangular region (inside glenoid facet, furcular articulation, and coracoidal articulation) smaller; and (2) in external view, distal edge of glenoid facet closer to shaft extends farther dorsally in M. carolinus).

The humerus in having (1) internal tuberosity larger; (2) tricipital fossa larger; (3) brachial depression shallower; and (4) distal end larger.

The ulna in having (1) olecranon smaller; (2) internal cotyla larger and deeper; (3) external cotyla more rounded; (4) impression of brachialis anticus deeper proximally; and (5) external condyles larger and more rounded.

The tibiotarsus in having larger size.

The tarsometatarsus in having larger size.

The coracoid of Melanerpes erythrocephalus differs from that of M. carolinus in having, in dorsal view, procoracoid more medial to shaft (more internal to shaft in M. carolinus).

The humerus in having (1) bicipital crest smaller; (2) in palmar view, muscle scar on deltoid crest wider; (3) shaft more slender; and (4) impression of brachialis deeper.

The ulna in having (1) prominence for anterior articular ligament larger; and (2) tendinal groove longer and deeper.

The femur in having fibular condyle smaller.

The tibiotarsus in having fibular crest set farther distally on shaft.

The tarsometatarsus in having (1) in internal view, ridge on proximal end longer; and (2) condyles for trochlea of digit III set farther apart.

Measurements of M. erythrocephalus and several other species of woodpeckers are listed in Table 42.

Remarks: No extinct species of Melanerpes are known. Melanerpes is distinguished from Pliopicus and Palaeonerpes based on the characters in Feduccia and Wilson (1967) and Cracraft and Morony (1969), respectively. Campephilus (Brodkorb, 1971) and Bathoceleus (Brodkorb, 1959) are much larger than Melanerpes.

Genus Sphyrapicus Baird

cf. Sphyrapicus varius (Linnaeus)

Yellow-bellied Sapsucker

Referred material: Medial fragment of 1 pelvis.

Characters: The pelvis of Sphyrapicus differs from those of Dendrocopos and Melanerpes in having median dorsal ridge longer.

Remarks: No extinct species of Sphyrapicus have been described.

PALEOECOLOGY

The 39 mammalian taxa identified from Inglis IA indicate a community of scrub and grassland species (Klein, 1971). Meylan's (1980) description of the habitat as one of open high pine, xeric hammock, and savanna is based on his study of the 31 species of squamate reptiles.

Evidence that the Inglis IA sinkhole operated as a natural trap is presented by Meylan (1980). The huge number of elements of highly terrestrial species such as turkey and quail is what one might expect to find in a sinkhole trap. Another Florida sinkhole deposit, Coleman IIA, also contains a large number of individuals of gallinaceous species (Ritchie, 1980). The presence of standing water in the sinkhole or nearby sand could explain the abundance of the aquatic species of birds. The nearby forest of pine and xeric hammock was the source of the arboreal forms of the avifauna.

The numerous species of raptors would naturally be attracted to the dead or dying animals caught there. Ligon (1965) and Ritchie (1976) comment on the important contribution of the barn owl, Tyto alba, to the concentration of remains of small species of birds in sinkhole deposits of Florida. The barn owl as well as the black vulture, Coragyps atratus, may have roosted in the sides of the sink. Loye Miller (1943) comments on Aquila chrysaetos predation resulting in an accumulation of turkey bones at San Josecito Cavern, Mexico.

Meylan (1980) presents reptilian evidence of an east-west corridor connecting the savannas of western North America with that of Florida. The presence in the Inglis avifauna of Buteo-gallus fragilis, Neophrontops slaughteri, and the two species of Glaucidium supports this idea.

Klein (1971) suggests that the climate at the time of deposition may have been similar to that of modern Central America, with a minimum of 20 inches annual rainfall and winter temperatures rarely dropping below freezing.

COMPARISON WITH OTHER AVIFAUNAS

In Table 42 the Inglis avifauna is compared with those from the following sites: (1) Rexroad (Feduccia, 1975) of the Upper Pliocene of Kansas; (2) Hagerman (Feduccia, 1975) of the Upper Pliocene of Idaho; (3) Coleman IIA and III (Ritchie, 1980) of the Irvingtonian of Florida; (4) Arredondo (Brodkorb, 1959a) of the late Pleistocene of Florida; and (5) Rancho La Brea (Howard, 1930) of the late Pleistocene of California. The number of non-passerine species, the number of species in common with Inglis, and the percentage of extinct non-passerine species are listed for each of the six localities. The two Upper Pliocene sites have the lowest number of species in common with Inglis and the highest percentages of extinct non-passerine species. The three younger Pleistocene sites have much higher numbers of species in common with Inglis, and all four sites have a decreasing percentage of extinct species in order of decreasing age of each avifauna. The percentage of species in common with Inglis for each site is: Rexroad, 3.12%; Hagerman, 18.51%; Coleman, 50.00%; Arredondo, 34.48%; and Rancho La Brea, 26.00%.

The minimum number of individuals and percentage of total individuals for each order of birds is compared for Inglis IA, Coleman IIA, and Rancho La Brea in Table 43. The highest number of individuals for Inglis and Coleman are in the order Galliformes, and for Rancho La Brea in the order Accipitriformes.

Table 43. Comparison of Inglis IA with some other North American paleoavifaunas: Rexroad (Feduccia, 1975), Hagerman (Feduccia, 1975), Coleman IIA and III (Ritchie, 1980), Arredondo (Brodkorb, 1959a), and Rancho La Brea (Howard, 1930).

	<u>Rexroad</u> Upper Pliocene	<u>Hagerman</u> Upper Pliocene	<u>Inglis</u> Irvin.	<u>Cole.</u> Irvin.	<u>Arre.</u> Illin.	<u>RLB</u> Late Pleis.
# non- passerine species	32	27	47	26	29	50
# species in common with Inglis	1	5		13	10	13
% extinct non- passerine species	53	63	34	23	17	22

Table 44. Minimum number of individuals (Ind.) and percentage of total for each order of birds from Inglis IA, Coleman IIA (Ritchie, 1976), and Rancho La Brea (Howard, 1930).

	Inglis IA		Coleman IIA		Rancho La Brea	
	<u>Ind.</u>	<u>% of total</u>	<u>Ind.</u>	<u>% of total</u>	<u>Ind.</u>	<u>% of total</u>
Gaviiformes	1	0.39	0	0	0	0
Podicipediformes	4	1.55	1	1.79	1	0.03
Ardeiformes	4	1.55	3	5.36	39	1.02
Anseriformes	7	2.71	2	3.57	98	2.57
Accipitriformes	17	6.59	9	16.07	2526	66.14
Galliformes	165	63.95	32	57.14	618	16.18
Ralliformes	11	4.26	2	3.57	30	0.79
Charadriiformes	6	2.33	2	3.57	58	1.52
Columbiformes	6	2.33	2	3.57	13	0.34
Cuculiformes	6	2.33	0	0	12	0.31
Strigiformes	19	7.36	2	3.57	404	10.58
Piciformes	12	4.65	1	1.79	20	0.52
Totals	258		56		3819	

The Inglis avifauna is most similar to that of Coleman IIA, which was also a sinkhole deposit in the Late Eocene Ocala Limestone. Coleman IIA is dated to the late Illinoian Glacial Stage (Ritchie, 1976).

AGE OF DEPOSIT

Inglis IA has been dated as late Blancan by Klein (1971), Steadman (1975), and Ritchie (1976), and as early Irvingtonian by Webb (1974), Steadman (1980), and Meylan (1980). Comparisons with several North American avifaunas from the Upper Pliocene, middle Pleistocene, and late Pleistocene show Inglis to be much more similar to the middle Pleistocene (Irvingtonian) Coleman IIA than to two avifaunas from the Upper Pliocene (Blancan).

Inglis is in between the Blancan sites and Coleman IIA in its percentage of extinct species, and this percentage is closer to that of the younger Coleman site. The Blancan sites have 19% and 29% more extinct species than Inglis, while Coleman differs in having only 11% fewer extinct species. This analysis of the Inglis IA avifauna supports the placement of this deposit in the early Irvingtonian rather than the late Blancan. Klein (1971) and Webb (1974) place Inglis IA in the late Kansan Glacial Stage.

Figure 1. Titanis walleri, second cervical vertebra (axis) in dorsal view slightly smaller than natural size.

Figure 2. Titanis walleri, third cervical vertebra in dorsal view,
slightly smaller than natural size.

Figure 3. Titanis walleri, second cervical vertebra (axis)

- A Anterior view
- B Posterior view
- C Ventral view
- D Lateral view
- E Dorsal view

Figure 4. Titanis walleri, third cervical vertebra

- A Anterior view
- B Posterior view
- C Ventral view
- D Lateral view
- E Dorsal view

Figure 5. A and B Titanis walleri, left carpometacarpus in internal and external views.

C and D Ixobrychus n. sp., distal ends of left tarsometatarsus and left tibiotarsus in anterior and posterior views.

Figure 6. A and B Aquila n. sp., right carpometacarpus in
internal and external views.

C and D Bute n. sp., left carpometacarpus in
internal and external views.

A

metric 1 2 3 4 5 6 7

C

D

B

Figure 7. Neophrontops slaughteri

- A and D Left coracoid in ventral and dorsal views.
- B and E Proximal end of left tibiotarsus in external and internal views, and distal end of right tibiotarsus in posterior and anterior views.
- C and F Proximal and distal ends of right tarsometatarsi in anterior and posterior views.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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