

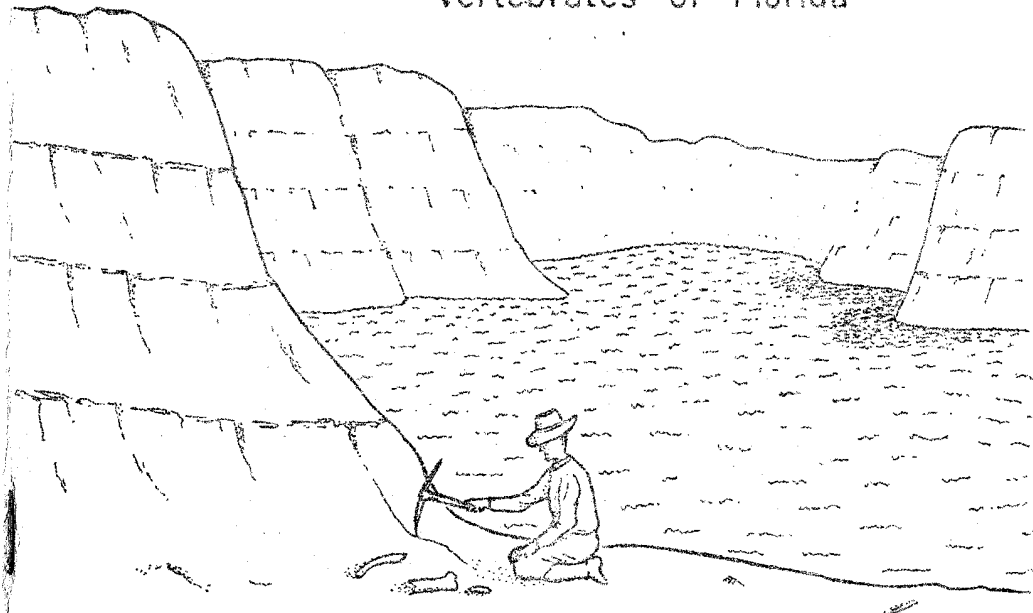
THE PLASTER JACKET IS A NEWSLETTER ABOUT FOSSIL vertebrate animals of Florida. Its purpose is to circulate authoritative material on vertebrate paleontology and to foster communication among the growing number of enthusiasts of this subject.

Questions, announcements and other communications are solicited from all readers. Information of general interest will be included in future issues.

It is our intent to produce this series at the rate of about one issue per quarter year. We hope to add as many genuinely interested paleontologists as possible to our mailing list. If you are interested, please send your name and address to the PLASTER JACKET. These issues are distributed free of charge to all interested people.

The
**PLASTER
JACKET**

-- about fossil
vertebrates of Florida



- FLORIDA STATE MUSEUM
- UNIVERSITY OF FLORIDA
- GAINESVILLE

FOSSIL VERTEBRATE DEPOSITS IN FLORIDA

by

Thomas H. Patton and S. David Webb

Geologic Setting

As is true the world over, the nature and occurrence of fossil vertebrate deposits in Florida is controlled primarily by the nature of its regional geology. The key to understanding the geologic framework in which fossil vertebrate deposits occur in the state of Florida lies in the fact that virtually the entire Florida Peninsula is underlain by vast limestone formations. These rocks, ranging in age from Eocene to Miocene, are highly soluble in ground water. Through the millions of years since their formation they have been subjected to the geologic process termed "karstification." This process results from the great solubility of limestone: water dissolves the surface in complex fashion and then diverts surface waters into underground routes. The majority of fossil vertebrate deposits presently known from Florida occur in situations resulting from this process; for example, caves, sinkholes, underground streams, pot-holes, fissures, etc. (Figure 1). Although this has been a fortunate circumstance in most respects, especially in the great numbers of potential fossil sites produced, it also has led to difficulties in others (see below).

The presence of such numerous sinkholes and caves has contributed much towards preservation of fossil vertebrate faunas in that 1) they act as natural "traps" into which many animals fall and die, in turn attracting carnivores and scavengers which themselves become trapped and preserved; 2) the skeletons of these animals remain in virtually the same area where they died or were killed, and are not transported, fragmented, and dispersed as they are in stream systems; 3) lime-saturated

ground water passing through these systems acts relatively quickly to preserve the skeletal parts; and 4) the deposits are generally not as subject to so much subsequent erosion as are most stream deposits.

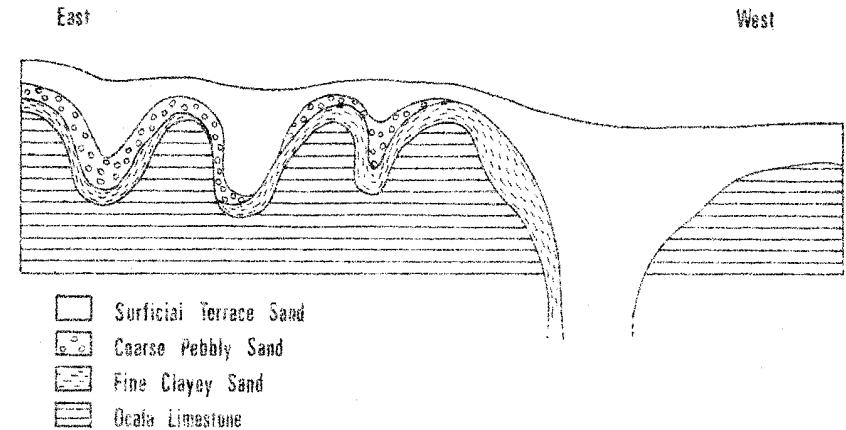


FIGURE 1.

Whereas this peculiar geologic configuration promotes the excellent preservation of exceptionally large numbers of fossil vertebrates, it has proved to be a mixed blessing. Perhaps the greatest drawback is encountered in attempts at stratigraphic correlation. In contrast to the generally widespread and highly visible (therefore traceable) fossil-bearing strata of the western United States, the majority of Florida's fossil deposits occur in a more complex geologic framework. Aside from the obscuring effect of the dense vegetation, much of the difficulty arises from the nature of the karst process mentioned above. Solution of the Suwannee and Ocala limestones which underly most of the fossiliferous deposits in this region has been active since Oligocene time. Numerous sinkhole, cave, and fissure deposits have accumulated at varying times throughout this period, so that study

of a series of adjacent sink or fissure deposits in one small geographic area (even within a few acres) might reveal faunas representing a total time span ranging from the Oligocene to the Recent. Obviously the isolated nature of the deposits makes physical correlation, even over a small area, difficult at best. Most of the deposits are contained within extremely small catchment basins; the sediments are usually locally derived, and reflect the influences of local climate, topography, and source lithology. As a result, physical (lithostratigraphic) correlation of such deposits over a broad geographic area becomes an impossible task. In any attempt at correlation, therefore, reliance has to be placed on evidence derived from the fossils themselves (biostratigraphic correlation). A complication to this approach lies in the rather strong ecologic bias one occasionally encounters from one deposit to another. In some localities, the restricted areal extent of the fossil deposits favors the interment of a fauna representing only one kind of ecology, so that within a given area one fauna may reflect a spring or pond association while another one may represent a sink or marsh environment. As a consequence of such limited sampling, it is often difficult to achieve a clear picture of the broad ecologic associations of animals in one region at a given time. This is especially true of the older Tertiary faunas which are few and far between. Furthermore, the presence within one solution complex of closely situated deposits yielding faunas of various ages and reflecting perhaps quite different climatic conditions introduces the additional problem of separating temporally isolated faunas. This unfortunate situation presents to the paleontologist a dilemma wherein he must decide which aspects of a fauna he may attribute to ecological influences and which are the result of evolutionary events.

Certainly other kinds of sedimentary environments are also important in producing fossil vertebrates in Florida; for example, streams, ponds, lagoons, estuaries, and dunes. Of these by far the most prolific are the various creeks and rivers throughout the state. Slow moving and seasonally clear, these streams are a vertebrate paleontologist's

paradise. Many are virtually paved with fossil bones. Whereas in some streams the bones are distributed rather uniformly, most are found in potholes or other depressions where the streams carrying power is reduced. In recent years many of the most significant discoveries of Pliocene and Pleistocene vertebrates have been made along stream bottoms. Accordingly, a major portion of the Florida State Museum's paleontological activities has been directed toward underwater (SCUBA) exploration of Florida's waterways.

The Faunas

The remainder of this article is designed to familiarize the reader with the fossil vertebrate faunas collected from the various rock units present in Florida. In order to provide a clearer view of the stratigraphic units involved in this discussion, we have included the following geologic column in which some of the vertical, lateral, and temporal relationships are portrayed (Figure 6).

Cretaceous

Although in Florida rocks of Cretaceous age occur no nearer the surface than 9,000 feet, a fossil vertebrate of this vintage is nonetheless known from the state. In 1905 an oil company drilling near Lake Okeechobee produced a well core containing a partial skeleton of an aquatic turtle. The incredible improbability of this find (a six-inch hole hitting dead center on a fossil turtle buried 9,210 feet beneath the earth's surface!) is obvious and is not likely to be repeated.

The nearest vertebrate-yielding Cretaceous deposits occurring at the surface are found near Selma, Alabama. This deposit, known as the Selma Chalk, extends across Alabama into Mississippi and in several localities has produced dinosaur and other vertebrate remains.

Eocene

The foundation of Florida and the oldest rocks exposed on the surface belong to part of the Eocene series. These calcareous rocks, composed in large part of the remains of marine microinvertebrates, constitute what is called the Ocala Limestone, of Late Eocene age. Presumably entirely marine in origin, the Ocala has produced a remarkable invertebrate fauna, but as would be expected, relatively little in the way of fossil vertebrates. Of those vertebrates known from the Ocala, by far the most numerous are the sharks (Plaster Jacket, #1), of which Carcharodon, Isurus, Odontaspis, and Otodus are the most common forms. Other marine fish remains include fragments of various skates and rays (Plaster Jacket, #2). Some fragmentary evidence of marine turtles has also occurred. The most impressive vertebrates in the Eocene of Florida are the extinct zeuglodont whales, Basilosaurus and Pontogeneus. These unusual creatures reached 40 feet in length and apparently were very quick and agile swimmers adapted to preying on fish and other large marine animals. Sirenians (manatee relatives) occur in the same deposits. These vertebrates may be found wherever the Ocala Limestone outcrops.

Oligocene

The Oligocene deposits of Florida are almost entirely marine. Formal stratigraphic divisions include the Marianna Limestone and the Suwannee Limestone. The former two units are restricted mostly to the Panhandle, whereas the latter extends farther down into the Florida Peninsula. These marine formations have yielded numerous shark teeth, which, in addition to some of those genera found also in the Ocala Limestone, include Carcharinus, Negaprion, Hemispristus, Rhizoprionodon, and Galeocerdo. Several kinds of Teleost fishes are very well preserved in the Marianna Limestone (see Plaster Jacket, #7).

Until recently, no Oligocene land vertebrates had ever been found in Florida. Now, however, we have a remarkable

land vertebrate fauna of Late Oligocene age from a tiny solution cavity in the Ocala Limestone near Gainesville. Known as the I-75 fauna, this represents the oldest extensive Cenozoic terrestrial vertebrate fauna in eastern North America and has revealed the former presence in Florida of a large and surprisingly diversified assemblage of land vertebrates. There are two toads, two salamanders, a turtle, a tortoise, three kinds of lizards, five kinds of snakes. The mammals number more than a dozen species including mouse-like (cricetid) rodents, small canids, horses of the genus Meshippus, several oreodonts. Most of these animals have never been described from eastern United States; some are unknown anywhere else in North America. The I-75 discovery is particularly significant in demonstrating that terrestrial vertebrate faunas were flourishing in north central Florida at a time when we previously had supposed it to be beneath the sea! The Oligocene and Miocene localities are shown in Figure 2.

Miocene

Until 1963 practically all that was known of Miocene land vertebrates in Florida had come from the Thomas Farm Quarry in Gilchrist County. A few bones and teeth had been recovered from Midway and Quincy in north Florida, but were shown to be only slightly younger than those from the Thomas Farm. Several other scattered localities produced little but isolated and fragmentary fossil specimens. In recent years, however, we have extended our knowledge of the Florida Miocene to include segments of both the early and late parts of that geologic period. In 1963 a small Late Miocene vertebrate fauna was discovered near Ashville, Florida, just south of the Georgia state line. Since then a few more isolated specimens of probable Late Miocene age were found across the state line in Statenville, Georgia, and from a small site near Ocala.

Particularly significant among the new finds is the recognition of an apparently Early Miocene vertebrate

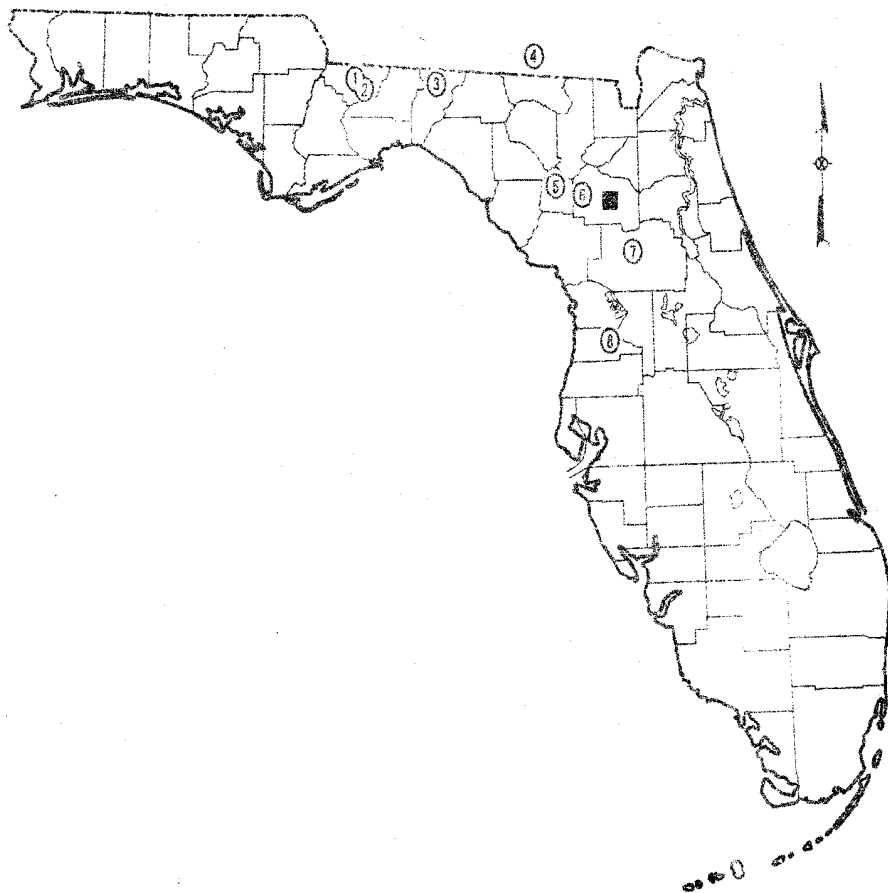


FIGURE 2.- Oligocene and Miocene Vertebrate Localities in Florida. Oligocene: 1-75. Miocene: 1) Quincy; 2) Midway, Leon, Gadsden; 3) Ashville, near Georgia line; 4) Statenville, Georgia; 5) Thomas Farm, 6) Buda; 7) Anthony Martin; 8) Brooksville.

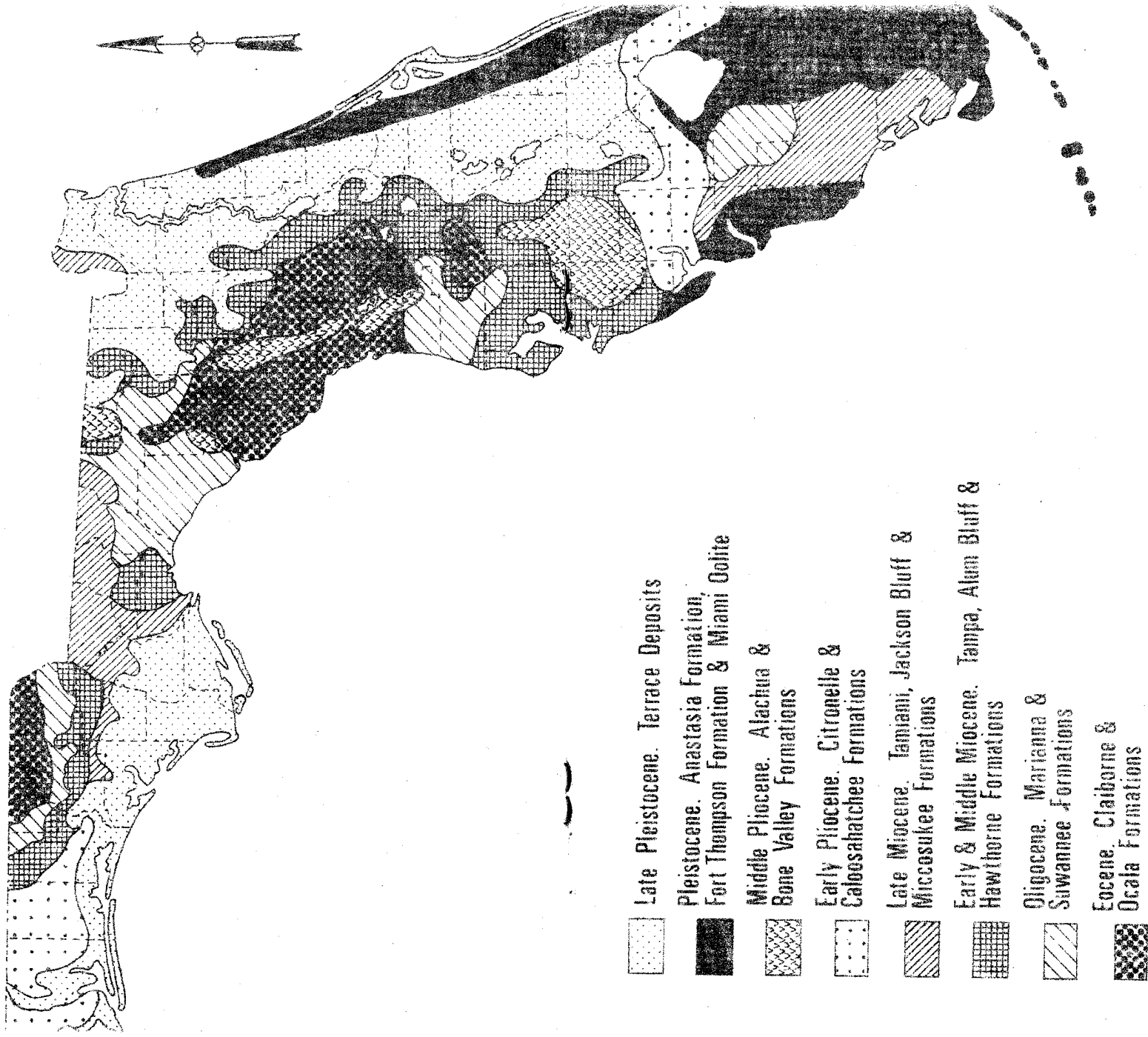
locality northeast of Brooksville, in Hernando County. This is the only evidence we now have of Early Miocene land vertebrate life in Florida. To date, the Brooksville site has yielded alligators, canids, tapirs, rhinocerotids, and oreodonts.

The most important Miocene vertebrate locality in Florida and the most productive vertebrate quarry in eastern North America is the Thomas Farm deposit in Gilchrist County. Since its discovery, this quarry has produced a continuous harvest of valuable skeletal material, now comprising an extensive fauna of quite varied aspect. Physical and faunal evidence indicate that the fossil-bearing sediments accumulated in a sinkhole formed in the underlying Ocala Limestone.

The Thomas Farm fauna is notable not only for its profusion of fossil specimens but also for its great diversity of animals represented, many of which are found only in Florida and the Gulf Coastal Plain. Unlike most Tertiary deposits the Thomas Farm has yielded numerous remains of amphibians and reptiles. Among these are different kinds of frogs, toads, and salamanders, and a large variety of lizards and snakes, including several boas. Also, over a dozen species of birds are present. The mammals are represented by 32 species, unusually high for a fauna so ancient. Among the smaller species are shrews, bats, and several kinds of rodents. At least five kinds of dogs are present, including such widespread genera as *Cynodesmus* and *Tomarctos*. The huge dog-like bear, *Amphicyon*, is one of the more exciting carnivores to be found in North American fossil faunas. In addition to these large predators, three species of small mustelid carnivores, much like weasels and badgers, are also found.

The hoofed mammals include some of the most interesting and unusual members of the Thomas Farm fauna. The horses are represented by a large conservative horse, *Anchitherium*, and two advanced species, the small *Parahippus blackbergi* and the large *Parahippus leonensis*. Two rhinoceroses, the small *Diceratherium* and the larger *Floridaceras* are conspicuous. The pigs are represented by a single species, *Desmathyas olseni*. The Thomas Farm contains two tiny deer both not much larger than a jackrabbit, the widely known genus *Blasatomyx* and the fragil *Machaeromyx*. Undoubtedly the

FIGURE 3.



most unusual mammals found in the Thomas Farm are the various camels. These include the delicate and slender Nothokemas and the unique Floridatragulus, a smallish camel with a strikingly long and narrow snout, probably adapted to a browsing habit. A distant relative of the camels is the bizarre horned protoceratid, Prosynthetoceras. This remarkable animal has, in addition to a pair of cow-like horns on the back of its head, a single long, forked horn arising from near the tip of its nose! This creature and its relatives are surely one of the most distinctive horned ungulate groups that ever lived.

As mentioned earlier, fossil vertebrates from Quincy and Midway are considered to be slightly younger than those from Thomas Farm.

Still another remarkable new Miocene find was made near Buda, Florida, in which were found the remains of a large carnivore, a large oreodont, and a dwarf version of the large chalicothere (a heavybodied herbivore with long, clawed-bearing limbs) common in western faunas. We believe the Buda fauna to be similar in age to the Thomas Farm but to represent a different habitat.

The majority of these Miocene sites scattered around Florida are of Middle Miocene age. These include sites in Alachua, Gilchrist, and Marion counties, as well as those farther north in Leon and Gadsden counties. This particular circumstance is attributable to the fact that during the Middle Miocene this portion of Florida was above sea level. Away from this area, i.e., off the central ridge, the Middle Miocene is represented by marine deposits.

Pliocene

The Pliocene vertebrate sites of Florida fell along a line that runs from the middle of the Georgia border (north of Lake City) southward to the Kissimmee Prairie and the Sarasota area (Figure 4); a distance of about 240 miles. This line passes along the western flank

of the Ocala Arch, a major structural arch that forms the backbone of the Florida Peninsula.

The phosphate mining districts in Florida also fall along this same line. Furthermore, these phosphate deposits are major sources of fossil bones and

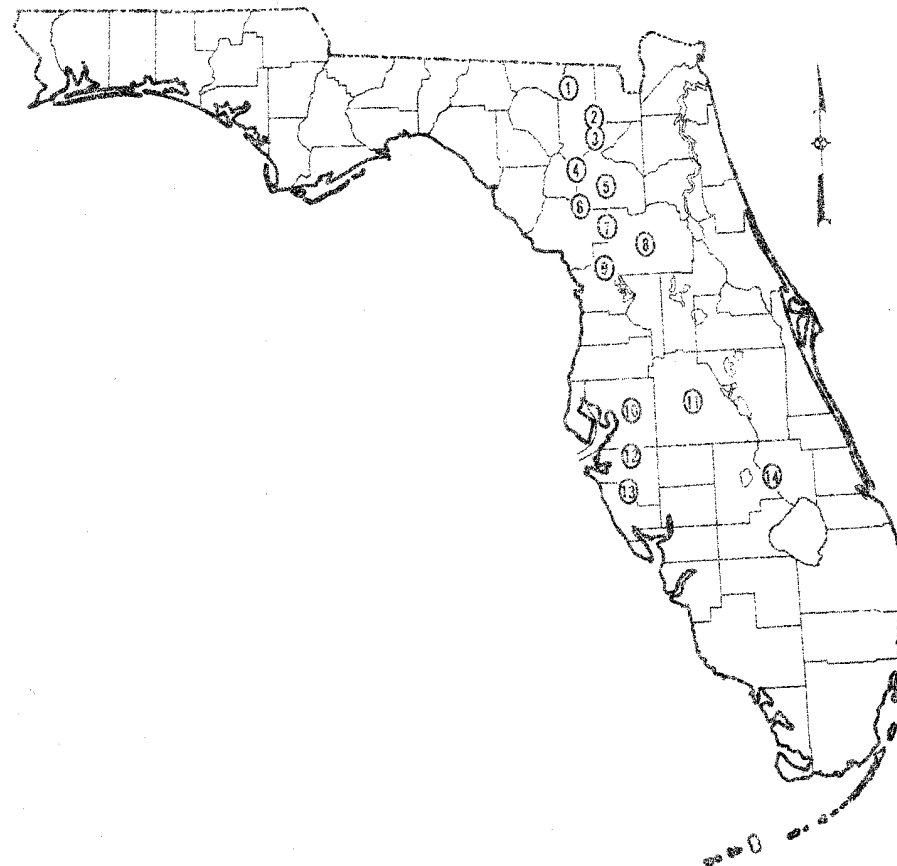


FIGURE 4.- Pliocene Vertebrate Localities in Florida. 1) Occidental Mine; 2) Lulu; 3) Santa Fe; 4) McGehee, Haile, Newberry; 5) Gainesville sites; 6) Archer; 7) Mixson's Bone Bed; 8) Emathla; 9) Withlacoochee, Dunelton sites; 10) Tampa Bay; 11) Bone Valley sites; 12) Manatee Dam; 13) Sarasota; 14) Kissimmee River.

teeth. It would appear that the conditions that favored preservation of the fossil vertebrates also frequently favored deposition of high grade phosphatic sands. However, a few important Pliocene sites occur in clay with relatively low phosphate content.

Clearly this alignment of Pliocene fossil sites and phosphate mines must have an explanation. All of the phosphatic fossil sites contain very complex mixtures of marine and terrestrial vertebrates. Abundant sharks and dugongs are closely associated with such quadrupeds as mastodons and rhinos. Similarly the sediments represent a very complex set of depositional environments. Cross bedded lenses of various grades of phosphatic sands are cut by major gravel channels and are interspersed with massive units of clay. All of this Pliocene complex is laid down on eroded limestone surfaces sloping down the western flanks of the Ocala Arch. The bulk of these deposits occur between 80 and 120 feet above present sea level, although some reach down to present sea level.

These deposits of Pliocene fossils and phosphates evidently originated in the mouths of rivers that emptied along the west coast of Florida. The sea stood at 80 to 120 feet above its present level during much of that time. Coastal marshes and prairies were intimately associated with shallow bays and tidal flats. The rich warm seas lay quietly protected from the higher energy seas of the Atlantic Ocean as they are today. Therefore, strand lines and coastal buildup did not sharply separate terrestrial and brackish environments from marine habitats. These conditions produced deposits rich in both fossils and phosphates.

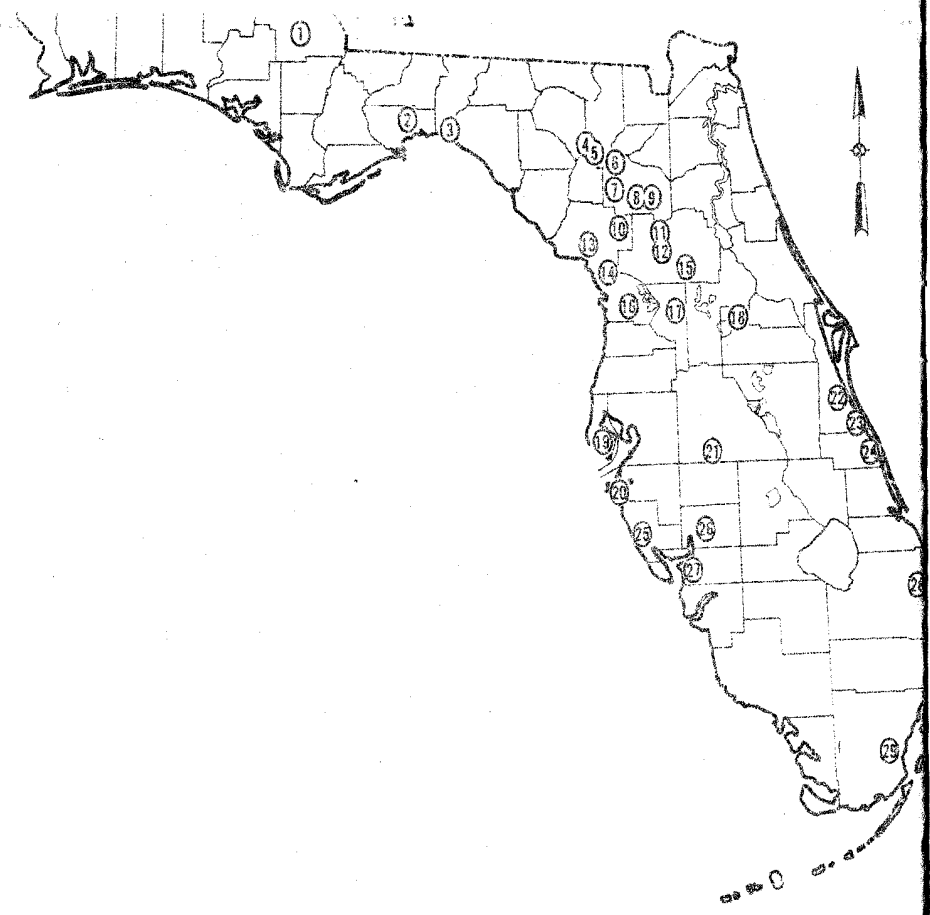
The Pliocene vertebrate fauna includes major marine and terrestrial components. The most abundantly preserved marine vertebrates are the sharks and rays and the dugongs (extinct heavy-boned mammals related to the living manatees). Porpoises and whales, seals and walruses, sea turtles and a great variety of bony fishes are somewhat rarer. Crocodilians, including Alligator

and the extinct Gavialosuchus, amphibians and various turtles occur in fresh and brackish water situations. A large extinct cormorant, Phalacrocorax wetmorei is by far the most abundant species of bird. The large sea birds and numerous fresh to brackish water birds are surprisingly well represented in the phosphate deposits. Terrestrial vertebrates include several kinds of gomphotheres and mastodons, rhinocerotids, both the short-legged amphibious genus Teleoceras and the long-legged terrestrial genus, Aphelops. At least six genera of Pliocene horses ranged over the coastal grasslands and savannas, as did at least three camelids, two antilocaprids, two deer, three kinds of peccaries and one species of tapir. Carnivores are rarer, as required by nature's balance; but they include many unusual types ranging from omnivorous raccoons and bone-crushing canids to biting and stabbing cats and fierce bears. Smaller terrestrial animals including small carnivores, rodents, rabbits, moles and snakes are present but extremely rare.

Pleistocene

The number of fossil sites in each age tends to increase as the age approaches the present. This is clearly shown in the fossil vertebrate sequence of Florida, where each age contains more major sites than the one preceding. The trend is most dramatically exemplified by the Pleistocene Period. The number of sites shown in Figure 5 could be multiplied almost indefinitely; many sites have been combined under one number and many other sites simply have been omitted. Not only are these sites numerous, but also they often contain extraordinarily well preserved and complete specimens. No fossil vertebrate field in the world exceeds the richness of Florida's Pleistocene deposits.

Two special factors help produce the wealth of skeletal material being found in the Pleistocene. These operate in addition to the factors discussed above that have long favored Florida's paleontological heritage. First, the recency of the Pleistocene has allowed little time for erosion to strip away or for deposition to cover up the



fossil deposits. Presumably this is the reason for the increasing number of sites from deposits of younger age. Secondly, the unique climatic history of the Ice Ages (equals Pleistocene) has favored greater deposition of fossil material, principally by causing changes in the level of the sea. The vast volumes of water that were locked up in continental glaciers caused the oceans to drop hundreds of feet during each glacial maximum. Then during interglacial episodes the seas rose to levels higher than the present. As a result, vast areas of land were repeatedly exposed and then covered with water, thus favoring deposition of great hordes of animals. Even on the land, the rise and fall of the sea caused the water table and associated lakes and streams to wax and wane. Consequently, large areas above even the highest seas were repeatedly exposed and covered by water.

The variety of habitats represented by Pleistocene sites is hardly less than what we know now. Nonetheless, the most productive sites are found in one of the following situations: 1) sinkholes or fissures filling in early Tertiary limestones; 2) bottom sediments of present rivers or springs; or 3) deposits in former coastal marshes and intracoastal waterways. The sinkhole or karst deposits are particularly significant in the central part of the state. One of the first fossil sites in Florida was the Ocala Rock Crevice described by Leidy in 1889.

Extensive accumulations of Pleistocene vertebrates occur in the bottom sediments of certain stretches of present day rivers and spring runs. The Peace River and the Ichetucknee River are examples that were discovered and explored early. More recently, scuba diving and other underwater techniques have made possible more extensive exploration and collection in Florida waters.

Rich fossil deposits are found along both the east and west coasts of the Florida Peninsula. They include such renowned sites as Vero and Melbourne, Apollo Beach and West Palm Beach. Their fame has spread partly be-

FIGURE 5.- Pleistocene Vertebrate Localities in Florida. 1) Chipola River sites; 2) Wakulla Springs; 3) Aucilla River sites, 4) Ichetucknee River sites; 5) Santa Fe River sites, 6) Hornsby Springs; 7) Haile sites; 8) Arredondo sites; 9) Payne's Prairie; 10) Williston and Devel's Den; 11) Reddick sites; 12) Kendrick sites; 13) Waccasassa River sites; 14) Withlacoochee River sites; 15) Ocklawaha River sites; 16) Sabertooth Cave; 17) Coleman IIA; 18) Rock Springs; 19) Seminole Field; 20) Bradenton sites; 21) Pool Branch; 22) Melbourne; 23) Sebastian Canal; 24) Vero; 25) North Havana Road; 26) Joshua Creek, 27) Punta Gorda; 28) west of Jupiter Inlet; 29) Nichol's Hammock.

cause of their proximity to the major population centers of the state, but, of course, also because of the wealth of beautifully preserved fossil vertebrates.

The Pleistocene faunas include every species of animal that now lives in Florida, and several others besides. The most impressive members of the Pleistocene fauna are the large extinct herbivores: mammoths, mastodons, ground sloths and giant tortoises. Llamas, horses, tapirs and peccaries also abounded. With so many herds of grazing and browsing animals, it is not surprising that the kinds of large carnivores were more varied than today. The cats included two genera of sabre-toothed tigers, jaguars, biting cats larger than lions, and a considerable variety of smaller cats including margays, bobcats, and jaguarundis. The bear and dog families were also more diversified than now. The most remarkable rodents were the giant amphibious capybaras and beavers. Of numerous extinct birds, the most impressive was Titanis, a flightless predator that stood about 12 feet tall.

The final extinction of many of these vertebrates including nearly every one of the large impressive ones, occurred during the very late Pleistocene. The question of what caused these extinctions is fascinating to ponder but exceedingly difficult to answer. The arrival of man in temperate North America during the late Pleistocene certainly led to organized hunting of several species of game animals, but it cannot be proved that he caused any to become extinct. The Bison, which bore the brunt of the paleo-Indians hunting, was thriving long after the Pleistocene extinctions. The end of the Pleistocene brought on a climate of extremes of heat and cold and persistent drought. Possibly this interval of climatic stress caused vast vegetational changes and thereby induced the extinction of many Pleistocene species. The answer to this complex problem may itself be very complex.

FIGURE 6.- Stratigraphic columns relating Principal Florida Vertebrate Localities to Mammal Ages and Absolute Ages.

EPOCHS	NORTH AMERICAN LAND-MAMMAL AGES	ABSOLUTE AGE (in millions of years before present)	FLORIDA LOCALITIES
PLEISTOCENE	Rancholabrean	1	Devil's Den Vero-Melbourne Seminole Field Reddick-Arredondo
	Irvingtonian	3	Coleman II A Inglis IA Hall's XVA
	Blancan		Santa Fe River Sites
PLIOCENE	Hemphillian	5	Bone Valley Sites Withlacoochee River Mixon's Bone Bed
	Clarendonian	10	McGehee Farm
MIOCENE	Barstovian	15	Ashville
	Hemingfordian	20	Quincy-Midway Thomas Farm Buda
	Arikareean	25	Brooksville
OLIGOCENE	Whitneyan	30	I-75