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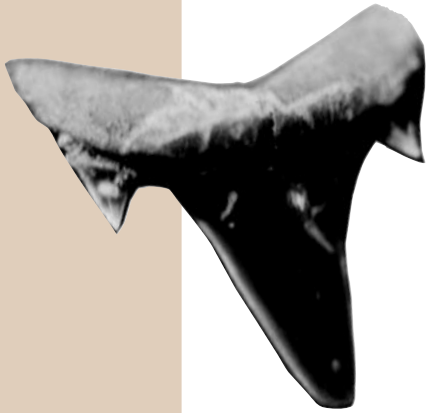

# 46-Million-Year-old Marine FOSSILS from the Cane River Site, North-central Louisiana

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Fossils, the preserved remains or evidence of past life, are the only direct means of documenting the history of life on the Earth. Fossils range in size from the microscopic shells of amoeba-like organisms known as foraminifera to the bones of 30 meter-long dinosaurs. The most common fossils are marine organisms, those that lived in the oceans, because oceans cover over 70% of the earth and provide a more suitable environment for fossil preservation than most environments on land. Specialists known as paleontologists study these glimpses into the past in order to unravel this planet's long and intriguing development of animals, protists (simple one-celled organisms), and plants (Pojeta and Springer, 2001).

Exposed strata or sediments where fossils may be recovered are known as fossiliferous outcrops. Such outcrops are rare in Louisiana for a variety of reasons. Outcrops exposed by road construction or by natural means will often be covered quickly by the state's abundant vegetation. Furthermore, in a geological context, the surface exposures of Louisiana are very young in age, and this affects the number and diversity of fossils. Examination of the Geologic Map of Louisiana (Snead and McCulloh, 1984) reveals that the oldest surface sediments are Cretaceous in age (approximately 70 million years old). These sediments are rare and occur only around salt domes where the strata have been pushed to the surface. The vast majority of surface exposures in Louisiana are Tertiary and Quaternary in age (less than 65 million years old); many of the sediments are even younger (less than 10,000 years old). This is in contrast to some states that have surface exposures that span hundreds of millions of years. This immense amount of time increases the probability of finding extinct organisms as well as a greater diversity of fossils. Also, large portions of the surface sediments in Louisiana were formed as parts of rivers, ancient deltas, and swamps. These terrestrial and transitional environments, which were common in the geologic past in Louisiana, are not nearly as conducive for the preservation of fossils as the marine environment. Therefore, these factors cause marine fossils to be relatively uncommon in the surface exposures in Louisiana.

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## The Importance of the Cane River Site

Natural erosional processes that occur on the earth can expose fossiliferous outcrops. However, exposures with fossils may be accidentally uncovered by human activity. This was the case during the construction of Interstate Highway 49 near Natchitoches in northwestern Louisiana where an excellent section of the Middle Eocene Cane River Formation was fortuitously exposed (Barnett, 1987; Stringer and Breard, 1996). This locality has become commonly known as the Cane River Site or the I-49 Site (Figure 1).

Any fossiliferous outcrop is important since fossils provide the only direct means of documenting the history of life on the earth, but this site on I-49 is particularly important because outcrops with marine fossils in Louisiana are so rare. The fossils are important not only to assist in unraveling the ancient history of the earth, but in understanding the geologic history of Louisiana. Another reason for the importance of the Cane River Site is that it represents the best exposure of the Cane River Formation known in Louisiana. Good outcrops of the Cane River Formation are very limited. The type locality (where the formation was first described) of the Cane River Formation is surrounded by buildings, concrete, and pavement in the city of Natchitoches, making the I-49 site even more important.

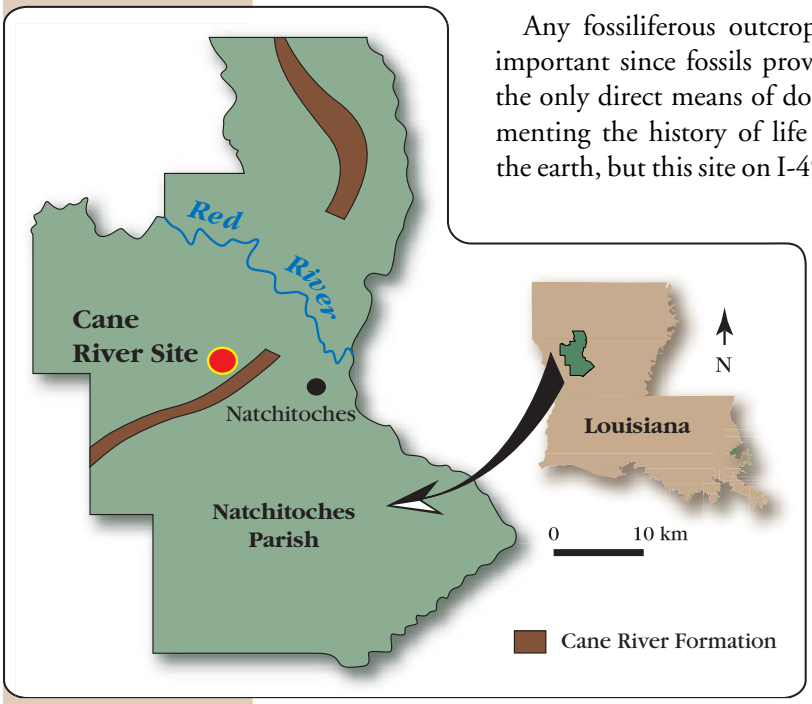


**Figure 1. The Cane River Site.**

Other reasons for the importance of the Cane River Site are the exceptional preservation and abundance of the fossil remains. Fossils composed of the mineral aragonite (calcium carbonate) are present; this is highly significant because a majority of the Cane River Formation outcrops are badly leached by groundwater that dissolves and destroys the fossils. Not only are the fossils at the site abundant, but there is a tremendous diversity of organisms present. Approximately 150 different species of invertebrate and vertebrate marine organisms have been identified from the site (see below). In addition, fossils from the I-49 site are some of the oldest found in Louisiana outcrops.

## Description of the Cane River Formation

The Cane River Formation, which ranges in age from 44.5 to 46.5 million years based on microfossils (Andersen, 1993), belongs to the Middle Eocene Claiborne Group and is the best-known fossiliferous formation in Natchitoches. This formation is equivalent to the Weches Formation of Texas, the Winona Formation of Mississippi, and the Lower Lisbon of Alabama (Dockery, 1980). The Cane River Formation was subdivided into three members in Natchitoches Parish by Andersen (1993) and includes (from the oldest):

1. Topy Creek Member,
2. Middle Glauconitic Clay Member, and
3. Upper Brown Clay Member (Figure 2)

The Middle Glauconitic Clay Member contains the largest number of fossils.

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## Types of Fossils Present

The diversity of marine fossils at the Cane River Site is outstanding, with various types of invertebrate (animals without backbones) and vertebrate (animals with backbones) marine organisms represented. The invertebrate fossil assemblage is characterized not only by macroscopic fossils, (easily seen with the naked eye) such as corals and bivalves, but also by microscopic fossils known as foraminifera and ostracodes. Foraminifera are the remains of microscopic protists or single-celled organisms similar to amoebas, except that foraminifers can produce a wide variety of shells. Microscopic examination of samples from the site by Stringer and Breard (1997) revealed 71 different species or types of foraminifera. There were 59 species of benthic foraminifera (bottom-dwelling forms) and 12 species of planktonic foraminifera (floating forms). Foraminifera are mainly microscopic in size, but there are some forms that become quite large (as large as a dime or nickel). One of these larger foraminiferal species, known as *Discocylina advena*, is very abundant at the site and is a guide or index fossil to the Middle Eocene (one of the fossils that tells us the formation is of Middle Eocene age).

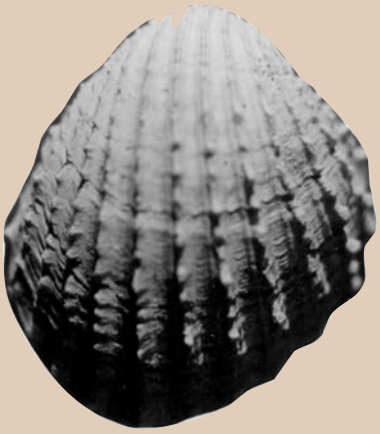
The second group of microscopic fossils at the site is the ostracodes. Ostracodes are actually arthropods (the same phylum as crabs, shrimp, lobsters, insects, and spiders), but they are microscopic in size and have a shell made of two valves like a clam. A study by Barnett (1987) found 27 species or types of ostracodes at the Cane River Site. Therefore, the different types of microscopic fossils number almost 100 at the site. However, there are also macroscopic invertebrate fossils present.

The macrofauna of the Cane River Site includes bivalves (such as clams and oysters; Figures 3-B, 3-C, 3-D, and 3-E), gastropods (snails), scaphopods (types of mollusk with shells that resemble the shape of an elephant tusk; Figure 3-F), cephalopods (such as squid and cuttlefish), colonial and solitary corals, bryozoans (colonial invertebrates that often form branching skeletons), crustaceans (arthropods such as crabs), and brachiopods (animals with two bilaterally symmetrical valves) (Toulmin, 1977; Emerson and Emerson, 2000). There are approximately 30 species of macroscopic invertebrates that have been identified from the site. The most common mollusks are the clams *Venericardia* (Figure 3-B) and *Corbula* and the oyster *Cubitostrea* (Figures 3-

**Figure 2.**

| Age | Stage | Group | Formation | Member | Lithology | Thickness | Macro-Fauna | Diagnostic Microfauna |
|---|---|---|---|---|---|---|---|---|
| Middle Eocene | Lutetian | Claiborne | Cane River | Upper Brown Clay Member | Chocolate brown clay with fine sand, silt, and scattered glauconite along bedding planes | 48 feet | Not recorded | *Cyclammina caneriverensis* |
| | | | | Middle Glauconitic Clay Member | Extremely glauconite organic-rich marly silty clay with rare quartz and a few limestone beds | 50 feet | Abundant clams, oysters, colonial corals, cephalopods, rare snails, and verebrates | *Marginulina viriata, Lamarckina claibornense, Morozovella aragonensis, and Discocyclina advena* |
| | | | | Topy Creek Member | Interbedded silts and clays, micaceous sands with some glauconite | 21 feet | Microgastropod fauna | *Bifarina "B"* |

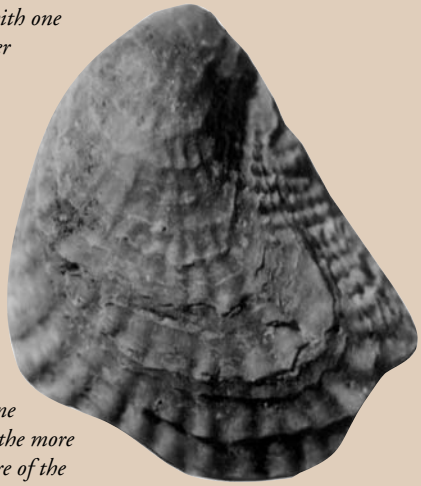
*A. An abundant colonial coral, Madracis sp.; magnification = x 3*



*B. A common bivalve or mollusk, Venericardia alticostata; magnification = x 2.5*

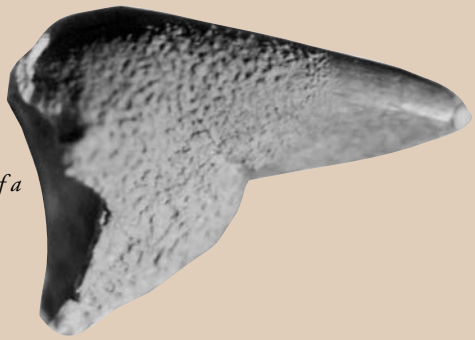
*C. The right valve of the most common bivalve, the oyster Cubitostrea lisbonensis; magnification = x1.5*

*D. The left valve of the most common bivalve, the oyster Cubitostrea lisbonensis; magnification = x 1.5 (note that the two valves are quite different with one smooth and the other ribbed)*



*E. One of the more rare of the oysters or bivalves, Cubitostrea divaricata; magnification = x 1.5*

*F. The shell of a type of mollusk known as a scaphopod, Dentalium minutistriatum; magnification = x 3.25*



*G. The rostrum or internal beak of a cuttlefish, a type of cephalopod, Belosaepia veatchi; magnification = x 3.25*

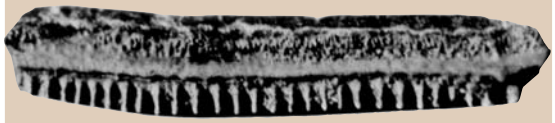
**Figure 3. Common Fossils from the Cane River Site near Natchitoches, Louisiana—Representative Invertebrate Fossils**

C and 3-D). Valves of the oyster *Cubitostrea* are so common that they form a 1.5-meter thick bed at the site. Gastropods are relatively scarce, but include several genera such as *Pseudoliva*, *Natica*, and *Architectonica*. The internal rostrums or beaks of the cephalopod *Belosaepia* (a cuttlefish; Figure 3-G) are fairly common at the site. Two of the most common macrofossils from the site are the colonial corals *Madracis* (Figure 3-A) and *Madrepora*. The corals are quite abundant in certain parts of the site and can be found scattered on the surface.

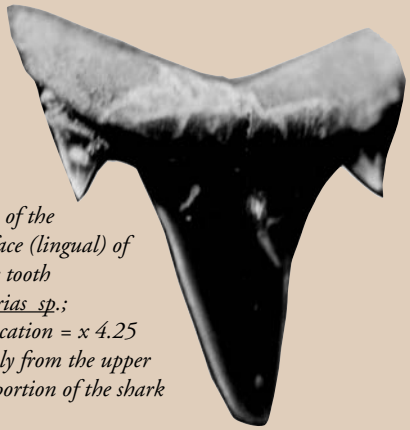
In addition to the invertebrate fossils, remains of marine vertebrates also are common, but are restricted to fossils of cartilaginous and bony fishes. Cartilaginous fishes (Class Chondrichthyes) are represented by modern taxa such as sharks, rays, skates, and sawfish. Fossil remains of cartilaginous fishes at the I-49 Site include shark teeth (Figure 4-B), shark vertebrae, ray teeth (Figure 4-A), ray caudal spines, and sawfish rostral pegs. Cartilaginous or chondrichthian species represented at the site include the sand tiger shark, tiger shark (two species), nurse shark, porbeagle shark, tope or houndsharks, catsharks, snaggletooth shark, extinct mako shark, extinct mackerel shark, eagle ray, chimaera or ratfish, and sawfish. The most abundant shark teeth are those of the sand tiger shark (*Carcharias*), characterized by a relatively long, narrow, unserrated blade.

The other vertebrate remains from the site are from the bony fishes (Class Osteichthyes): over twenty different types have been collected at the site (Stringer and Breard, 1997) and are represented by fossils such as otoliths (fish earstones; Figures 4-C and 4-D), teeth, and vertebrae. The otoliths are by far the most common bony fish remains at the site, representing at least 18 different types of fish. Otoliths are also among the most abundant of all vertebrate fossils represented there. Stringer and Breard (1997) found that almost half of the otoliths collected in their study belonged to a family of fishes known as cusk eels. Modern cusk eels are curious, elongate fishes that are common on soft and muddy bottoms. In the present-day Gulf of Mexico, cusk eels often burrow into the mud during the day (Hoese and Moore, 1977). Other major groups of fishes revealed by the otoliths included a type of bonefish, squirrelfishes, gobies, conger eels, codlets, flatfishes, and cardinalfishes. Teeth of three additional species of bony fishes have been found at the site and include the barracuda, cutlass fish, and wahoo.

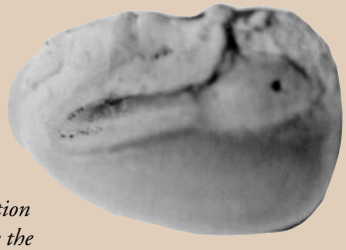
**Figure 4. Common Fossils from the Cane River Site near Natchitoches, Louisiana—Representative Vertebrate Fossils**



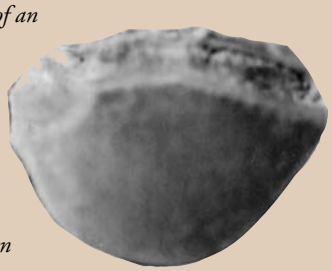
*A. Part of the crusher plate of an eagle ray, Myliobatis sp.; magnification = x 3.25*



*B. A view of the inner face (lingual) of a shark tooth Carcharias sp.; magnification = x 4.25 (probably from the upper lateral portion of the shark jaw)*



*C. The inner face of an otolith or earstone of a bonefish. Pterothrissus sp.; magnification = x 4.25 (note the diagnostic pattern on the otolith)*

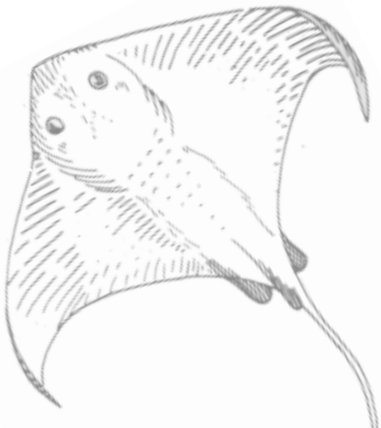


*D. The inner face of an otolith or earstone of a soldierfish, Myripristis sp.; magnification = x 4.25 (compare the diagnostic pattern or sulcus on this otolith to the pattern on the bonefish otolith)*

## Paleoecology

Paleontologists utilize invertebrate and vertebrate fossils to reconstruct the paleoecology, that is, the ancient environmental conditions present at a fossiliferous site. To determine these past environmental settings, the paleontologist makes use of a basic geological principle known as uniformitarianism. This principle contends that the past may be understood and interpreted by studying the present. The principle is commonly expressed as "the present is the key to the past." For example, most of the fossil bony fishes from the Cane River Site can be compared to modern fishes presently living in the Gulf of Mexico. By carefully studying and analyzing the preferred habitats of the modern representatives, the ancient ecological conditions can be determined. The fossils recovered from the Cane River Site enable paleontologists to determine the environment present in Louisiana over 46 million years ago.

The various fossils indicate that the paleoenvironment at the Cane River Site was probably a shallow ocean with tropical to subtropical conditions (Stringer and Breard, 1997; Barnett, 1987). The ancient water depth or paleobathymetry was probably around 20-50 meters. This depth was determined by analyzing and combining the depths of the modern habitats of the various invertebrate and vertebrate fossils. The otoliths or earstones from the bony fishes attested to a water depth ranging 40-100 m. By comparison, the ostracodes suggested a range from 0-50 m, foraminifera suggested 20-40 m, and macroinvertebrates 0-50 m. The unusual abundance of squirrelfishes and other reef organisms may indicate the presence of a patch reef environment similar to those presently in the Gulf of Mexico. These patch reefs are well offshore but in relatively shallow marine waters.



*"The present is the key to the past."*

## Conclusions

The Cane River Site is extremely important since it provides fossil evidence to directly document the history of life on earth and to understand the geologic history of Louisiana. The site probably represents the best exposure of the Cane River Formation known in Louisiana and has yielded some of the oldest and best preserved marine fossils known from the state. Approximately 150 different species of invertebrate and vertebrate marine organisms have been identified based on fossils from the site. The most abundant invertebrate fossils include microscopic forms such as foraminifera and ostracodes, as well as megascopic forms such as oysters and colonial corals. Vertebrate fossils were also well represented, with otoliths or earstones of bony fishes and teeth of sharks being the most abundant. The ancient environment or paleoenvironment for the Cane River Site approximately 46 million years ago was believed to be a patch reef environment in shallow ocean waters similar to those in the present Gulf of Mexico. The depth was probably about 20-50 m, and climatic conditions were tropical to subtropical.

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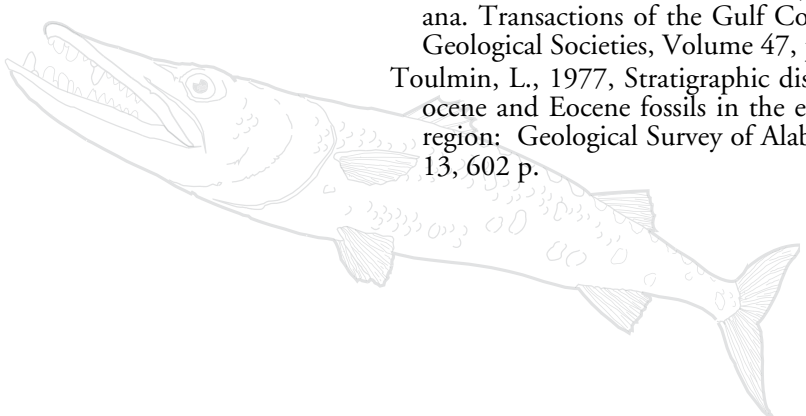
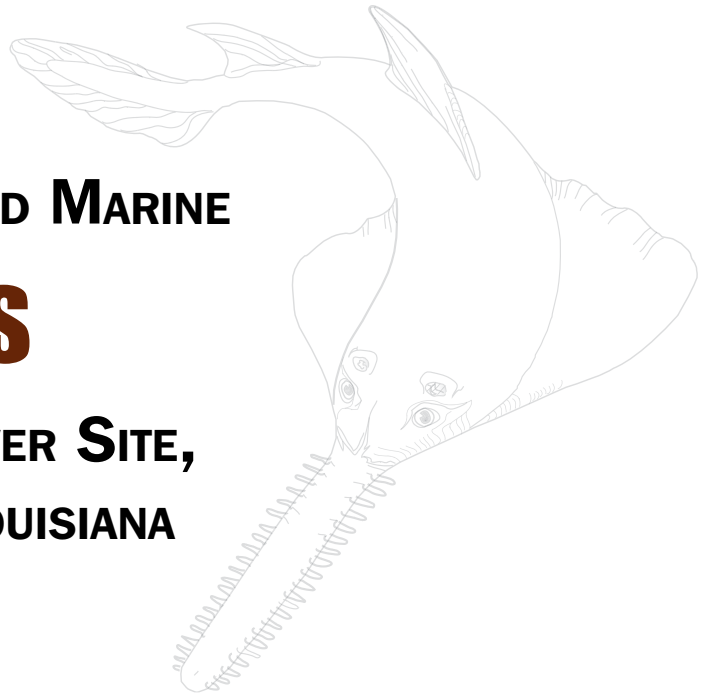


# 46-Million-Year-old Marine

# FOSSILS

## from the Cane River Site, North-central Louisiana

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