J. Paleont., 62(2), 1988, pp. 290–301

0022-3360/88/0062-0290$03.00

LATE CRETACEOUS FISH FROM THE BLUFFTOWN FORMATION (CAMPANIAN) IN WESTERN GEORGIA

GERARD R. CASE AND DAVID R. SCHWIMMER
129 Carlton Avenue, Jersey City, New Jersey 07306 and
Department of Chemistry and Geology, Columbus College,
Columbus, Georgia 31993

ABSTRACT—A Campanian fish assemblage is described from the uppermost Blufftown Formation in western Georgia. Fifteen chondrichthyan and eight osteichthyan taxa are identified, virtually all for the first time from the region. The study area represented a transitional zone between the Atlantic and eastern Gulf of Mexico Coastal Plain Provinces during the Late Cretaceous, and shows faunal relationships with both.

INTRODUCTION

SHARK TEETH are common fossils in many Upper Cretaceous marginal and epicontinental marine strata; the thick, detrital sediments in the lower Chattahoochee River Valley of the Georgia–Alabama region are not exceptional in this regard. Nevertheless, the regional literature pays scant attention to Cretaceous fish fossils. Recent work reported here has yielded an unusually diverse and abundant assemblage of cartilaginous and bony fish represented by teeth and other materials from the uppermost few meters of the Blufftown Formation, mid-to-late Campanian age, in western Georgia. Work is in progress by the authors on another regional fossil fish assemblage, that of the Eutaw Formation (locally of probable mid-Santonian age).

PREVIOUS REGIONAL STUDY

L. W. Stephenson (1911) first described the Cretaceous paleontology of the Georgia Coastal Plain, and this became the basis for most subsequent lists of Cretaceous taxa presented in the stratigraphic literature. Stephenson reported by name (with identifications attributed to J. W. Gidley), but without systematic description, only four fish taxa from the entire Cretaceous section: *Lamna texana* Roemer, *Otodus appendiculatus* Agassiz, *Corax falcatus* Agassiz, and *Ischyrhiza mira* Leidy. Subsequent stratigraphic studies of Cretaceous units in the Georgia Coastal Plain, by Cooke (1943) and Eargle (1955), essentially repeated lists of fossils from regional units derived from Stephenson (1911). Several regional guidebooks also reproduced Stephenson's slender list of Cretaceous fish taxa; these include Herrick and LaMoreaux (1944), Richards and Hand (1958), and Marsalis and Friddell (1975).

More recent, nonsystematic articles by Schwimmer (1981, 1986a, 1986b) summarized a newly discovered vertebrate biota in the Blufftown Formation from western Georgia, which is the same stratum under present consideration. Case (1987a) described a new sawfish taxon from the Blufftown Formation in the study area, coming from a stratum approximately two meters below and lithologically distinct from the material described here. As discussed below, the stratigraphic unit yielding fossils for this study shows clear evidence of sedimentary redeposition whereas the unit in Case (1987a) does not suggest the same history; hence, the species discussed there is not included in this report.

LOCATION AND STRATIGRAPHIC SETTING

All fossils in this study came from a 2-m-thick zone of the uppermost beds of the Blufftown Formation, along the banks of Hannahatchee Creek, a westward-flowing tributary of the Chattahoochee River. This locality is in Stewart County, western Georgia, in the Chattahoochee River Valley at an approximate latitude of 32°8′15″ and ranging plus or minus 30″ of longitude 84°57′40″, 40 km due south of Columbus, near the Georgia–Alabama border. The most intensely collected site, identified in Figure 1, yielded specimens of all taxa described herein. Fossils to be described occur throughout the streamside exposure; however, very rich zones of phosphatic debris are localized and yield especially high concentrations of vertebrate material.

Figure 2 is a composite regional stratigraphic column, which includes the interval and collections in study. A conspicuous disconformity is evident in the uppermost portion of the Blufftown Formation in the study area, visually traceable along most of the streamside exposure. Further, there is evidently a direct relationship between the great abundance of vertebrate fossils and the erosional episode that produced the disconformity. Most teeth in the studied sample show significant ablation and/or rounding of surfaces and points, suggesting that a considerable amount of transportation occurred. Reptile bones and teeth, including abundant remains of turtles and less common fragments from crocodiles, mosasaurs, and ornithischian and saurischian dinosaurs, are present in the strata (Schwimmer, 1986b), and these typically show considerable rounding and ablation. The high concentration of vertebrate material in the studied interval, together with the evidence of transportation and subaerial exposure, suggests that the material has been reworked and redeposited from a portion of the formation below the disconformity.

Since these strata lie very near the top of the Blufftown Formation or possibly occur directly within the contact zone between the Blufftown and the overlying Cusseta Formation (which is a matter in current study and which depends largely on one's use of historical versus empirical definitions of the formations), there is little doubt that the fossils are redeposited from an indeterminable horizon down in the Blufftown section. The Campanian age assigned to this assemblage is based on biostratigraphic studies of the Blufftown, especially Sohl and Smith (1981). Figure 3 shows ages and correlations of the Blufftown and other Cretaceous units in the Chattahoochee River Valley and stratigraphic sections farther to the west in the Gulf of Mexico Coastal Plain Province.

Paleoenvironmental analysis of the entire Blufftown Formation in western Georgia may be found in Reinhardt (1981), and specific paleoenvironmental analysis of the uppermost units discussed here is in Schwimmer (1986a). In summary, the strata represent back-barrier marine environments, at near-normal marine salinity, but with considerable fluvial input. The vertebrate beds in study represent especially shallow paleoenvironments (hence the subaerial erosion), with substantial fluvial input; an estuarine or other river-mouth location is suggested.

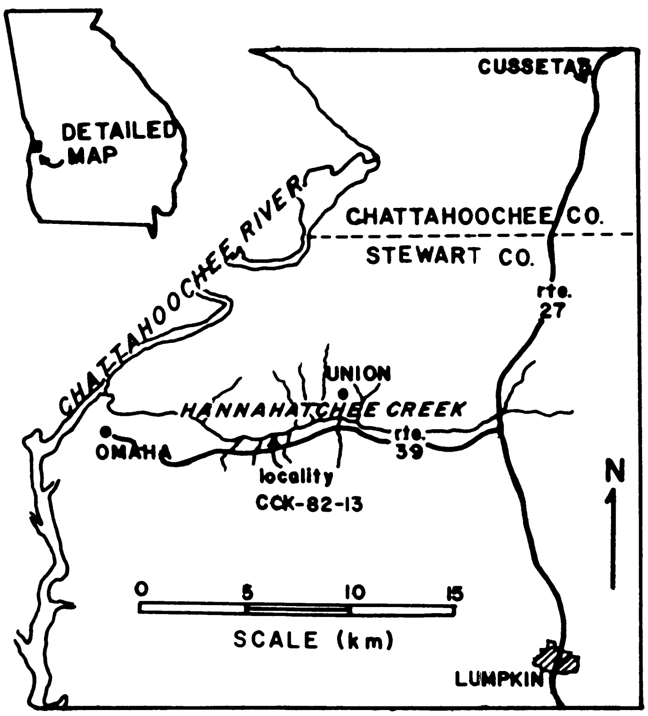


FIGURE 1—Map of Hannahatchee Creek, in Stewart County, western Georgia, showing the location of the principal collecting site (CCK-82-13) which yielded the majority of fish fossils discussed here. The outline map of Georgia shows the position of the detailed map.

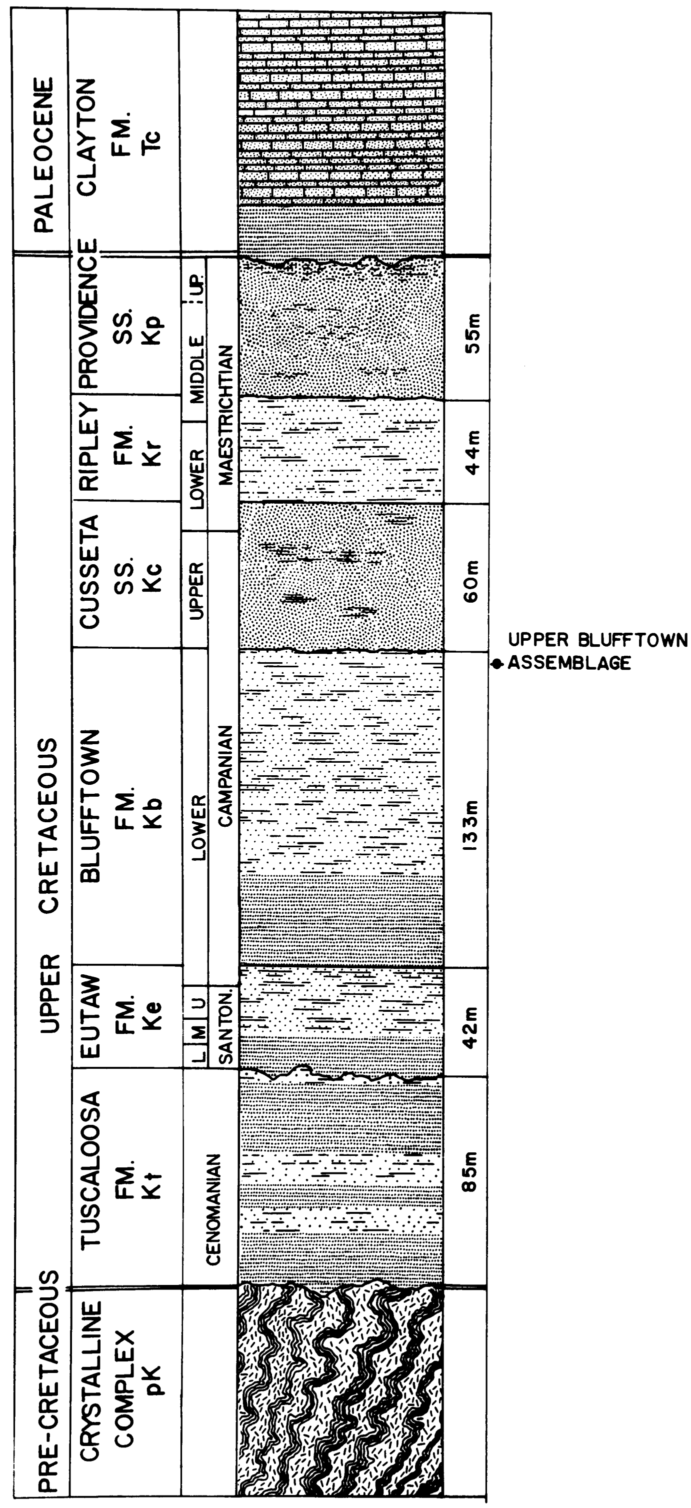


FIGURE 2—Representative stratigraphic column of the Cretaceous and bounding formations in Stewart County, western Georgia. The position of the vertebrate beds in study is indicated. Thicknesses of units are based on Eargle (1955) and D.R.S. field data.

COLLECTIONS, MATERIALS, AND REPOSITORY

The fossiliferous stratum is a poorly consolidated, clayey, silty sand, which readily yields fossils to hand, pick, and sieve collection. Few described taxa are locally rare, and several localities have yielded examples of virtually all described taxa. A substantial portion of the fish fossils occur as microfauna, which were collected from the principal site labeled in Figure 1 and were concentrated in the field using bulk screening techniques.

Figures 4, 5, and 6 are drawn from voucher specimens housed at Columbus College. A centralized Georgia State Museum is currently in planning and, if constructed, all materials and voucher specimens described below will be transferred to the state repository.

SYSTEMATIC PALEONTOLOGY

Full synonymies for selachian species described below may be found in Cappetta and Case (1975b) and Case (1978, 1979). Suprafamily designations do not have authors and dates because of the uncertainty of assignment.

Class CHONDRICHTHYES
Subclass ELASMOBRANCHII
Order SELACHII
Suborder CTENACANTHOIDEI
Family HYBODONTIDAE Owen, 1846
Genus HYBODUS Agassiz, 1837
HYBODUS sp. 1 Cappetta and Case, 1975
Figure 4.1–4.4

Hybodus sp. 1 CAPPETTA AND CASE, 1975b, p. 5, text-fig. 2.

Material.—CCK-82-13-4, one lower, lateral tooth lacking roots. CCBCK-82-3-2,3, two cephalic claspers.

Description.—An isolated central cusp with a partial lateral apron but no side cusps, showing much abrasion and complete absence of roots. Weak, short plications, averaging one-third central cusp-height, are scattered irregularly along the crown. The cephalic clasper hooks have trilobed roots and a sharply

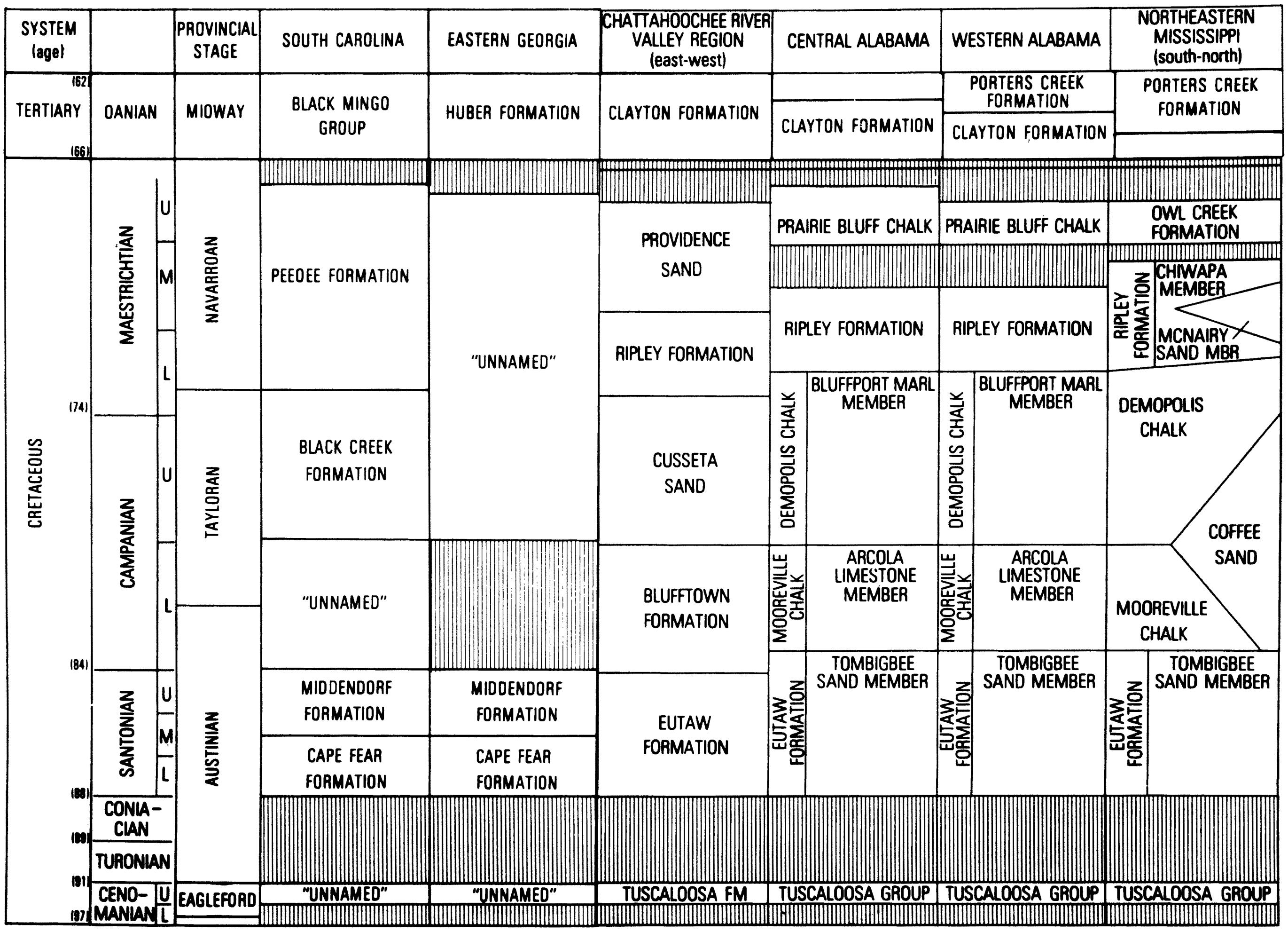


FIGURE 3—Correlations of Upper Cretaceous deposits in the southern Atlantic and eastern Gulf of Mexico Coastal Plain Province. (Reproduced, with author's permission, from J. Reinhardt, 1986.)

recurved anterior hook; both specimens show ablation of the anterior hook and posterior roots.

Discussion.—Isolated, worn central cusps of hybodontids are fairly common in most Late Cretaceous sediments. The specimen here compares very well with *Hybodus* sp. 1 in Cappetta and Case (1975b) from the Maastrichtian Monmouth Group in New Jersey. Absence of the tooth-root in hybodont sharks is not at all unusual, since the border between the osteodentinous root and the enamelled portion of the crown is heavily fenestrated and breaks easily (refer to Case, 1978).

The cephalic claspers are present in male hybodontids, set into the skull just above the eyes. Hybodontid clasper appendages are generally rare fossils, and they may be ornamented, unlike the specimens at hand, with rugosities, striae, and recurved barbs (Case, 1978).

Genus LISSODUS Brough, 1935
LISSODUS BABULSKII (Cappetta and Case, 1975)
Figure 4.9–4.12

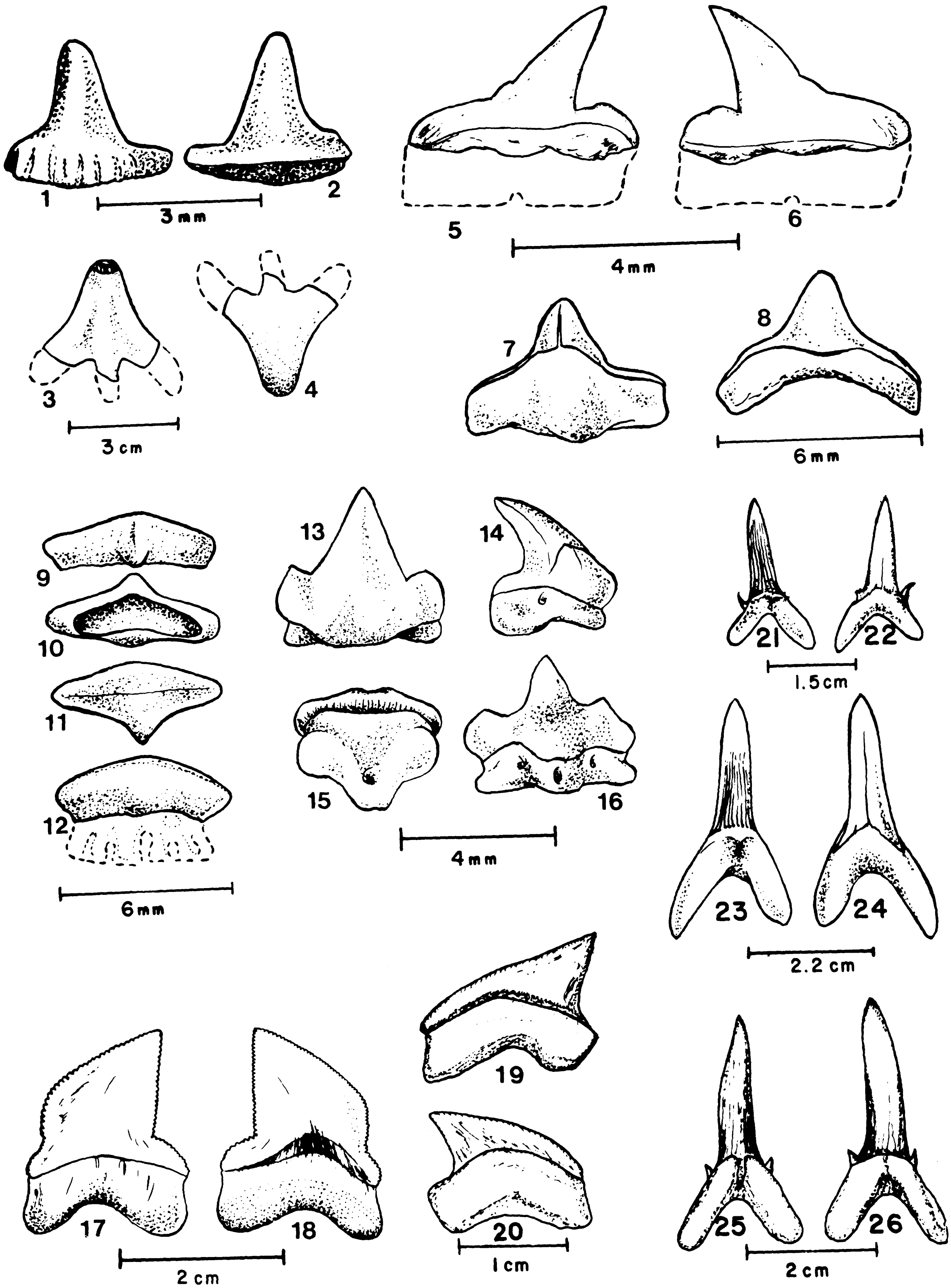
Lonchidion babulskii CAPPETTA AND CASE, 1975b, p. 6, Pl. 1, figs. 7–12.

Material.—CCK-82-13-5, two lateral teeth without roots. Three additional specimens have been collected.

Description.—Isolated lateral battery teeth, devoid of roots but otherwise showing little wear or postmortem ablation. Crowns show a "labial peg" in labial view (Figure 4.9, 4.10), which in the jaw battery butts up against the lingual aspect of the tooth anterior in file.

Discussion.—Isolated *Lissodus* crowns are very common in the Late Cretaceous of the Coastal Plain Province. *Lonchidion*

FIGURE 4—*1–4, Hybodus* sp. 1 Cappetta and Case. *1, 2,* CCK-82-13-4, lower, lateral tooth crown, labial and lingual views; *3, 4,* CCBCK-82-3-2,3, cephalic clasper, dorsal and ventral views. *5, 6, Pseudocorax affinis* (Agassiz), CCK-82-13-7, lateral tooth crown and ablated root, labial and lingual views. *7, 8, Squatina* sp., CCK-82-13-8, anterolateral tooth, lingual and labial views. *9–12, Lissodus babulskii* (Cappetta and Case), CCK-82-13-5, lateral tooth crown, labial, basal, occlusal, and lingual views. *13–16, Ginglymostoma globidens* Cappetta and Case, CCK-82-13-9, lateral tooth, labial, lateral, basal, and lingual views. *17–20, Squalicorax kaupi* (Agassiz). *17, 18,* CCK-82-13-6, anterior tooth, labial and lingual views; *19, 20,* CCK-82-13-3, lateral tooth, labial and lingual views. *21–26, Scapanorhynchus texanus* (Roemer). *21, 22, 25, 26,* CCK-82-13-10a,b, lower jaw anterior teeth; *21, 22,* smaller individual, lingual and labial views; *25, 26,* larger individual, lingual and labial views; *23, 24,* CCK-82-13-11, upper jaw anterior tooth, lingual and labial views.


1
2
3 mm
5
6
4 mm
3
4
3 cm
7
8
6 mm
9
10
11
12
6 mm
13
14
15
16
4 mm
21
22
1.5 cm
23
24
2.2 cm
17
18
2 cm
19
20
1 cm
25
26
2 cm

(Estes, 1964) was first described from the Lance Formation in eastern Wyoming and has since been reported in Cenomanian through late Maastrichtian strata; according to Duffin (1985), *Lonchidion* is a junior subjective synonym of *Lissodus*. *Lissodus* is observed (G.R.C.) in rocks as old as Albian in the Gulf Coastal Plain, but not in the pre-Maastrichtian of the Atlantic Coastal Plain; the study area in this regard demonstrates Gulf Coast affinities.

Suborder ANACORACOIDEI
Family ANACORACIDAE Casier, 1947
Genus SQUALICORAX Whitley, 1939
SQUALICORAX KAUPI (Agassiz, 1843)
Figure 4.17–4.20

Corax kaupi AGASSIZ, 1843, p. 225, Pl. 26a, figs. 25–34, Pl. 26, figs. 4–8.

Material.—CCK-82-13-6, one anterior tooth and one anterior-lateral tooth from either jaw. CCK-82-13-3, one posterior tooth from either jaw. More than 100 additional teeth have been collected.

Description.—Anterior teeth, identical in upper and lower jaws, showing erect or slightly curved blade with robust root approximately one-half entire tooth height. The edge of the blade is evenly serrated, with a small lateral shoulder. There is no furrow or groove on the root-boss, but some specimens show a small foramen near the center, whereas the labial aspect shows a multitude of foramina traversing the root, occasionally forming a fenestration.

Posterior tooth showing evenly serrated, curved, partly recumbent blade, lacking a lateral shoulder. Root similar to that of anterior teeth.

Discussion.—*Squalicorax* teeth, especially the species *kaupi*, are ubiquitous in vertebrate-bearing Upper Cretaceous marine strata (see, for example, Case, 1987b). Bilelo (1969) discussed relationships among the species *falcatus, pristodontus,* and *kaupi,* and she noted that *S. kaupi* could be distinguished by the "hump" in the mid-anterior edge of the anterior tooth blade.

Genus PSEUDOCORAX Priem, 1897
PSEUDOCORAX AFFINIS (Agassiz, 1843)
Figure 4.5, 4.6

Corax affinis AGASSIZ, 1843, p. 227, Pl. 26, fig. 2, Pl. 26a, figs. 21–24.

Material.—CCK-82-13-7, one lateral tooth from either jaw.

Description.—An essentially complete blade with a very reduced single accessory cusp; the blade is narrow, sharply angled, and devoid of serrations.

Discussion.—This is a widely distributed tooth, generally recovered from Maastrichtian and Danian strata in Holland; it is relatively rare in the New World. The primary difference between *Squalicorax* and *Pseudocorax* lies in the typical (but not inevitable) lack of serrations in the latter. A *Pseudocorax* species from Texas is described in Cappetta and Case (1975a).

Clade EUSELACHIFORMES
Order EUSELACHII
Suborder SQUATINOIDEI
Family SQUATINIDAE Bonaparte, 1838
Genus SQUATINA Risso, 1810
SQUATINA sp.
Figure 4.7, 4.8

Material.—CCK-82-13-8, one antero-lateral tooth from upper or lower jaw.

Description.—An abraded antero-lateral tooth-cusp, with an ablated root. The cusp is short and blunt, with strongly sloping shoulders, showing considerable wear or postmortem erosion. The root lacks the nutritive foramen at the base of the root-boss in the lingual aspect, due to the worn condition.

Discussion.—*Squatina* is previously known from Campanian and/or Maastrichtian strata in Europe (Leriche, 1929) and New Jersey (Cappetta and Case, 1975b). Previous occurrences of the taxon are in fluvio-marine sediments, which fit well into models of Blufftown deposition derived from many sources of evidence.

Family ORECTOLOBIDAE Gill, 1895
Genus GINGLYMOSTOMA Müller and Henle, 1838
GINGLYMOSTOMA GLOBIDENS Cappetta and Case, 1975
Figure 4.13–4.16

Ginglymostoma globidens CAPPETTA AND CASE, 1975b, p. 12, text-fig. 6, Pl. 9, figs. 24, 25.

Material.—CCK-82-13-9, two lateral teeth. Three additional teeth have been collected.

Description.—Lateral teeth with one elevated central cusp and two lateral cusplets (or vestigial denticles). A low apron is present on the labial surface, not extending below the level of the root base. A large foramen is present in the center of the root-boss on the lingual surface, and this connects with a centrally-located foramen on the basal surface. An additional pair of foramina are present in the root-boss of the lingual surface, located below the lateral cusplets (termed lateral facette foramina).

Discussion.—*Ginglymostoma* species, the nurse sharks, are common littoral-zone dwellers of Late Cretaceous through Recent times; and as with *Squatina,* they underscore by their presence the nearshore model for deposition of this Blufftown material. The teeth are distinctive among euselachians in being rasping rather than piercing structures.

Family MITSUKURINIDAE Jordan, 1898
Genus SCAPANORHYNCHUS Woodward, 1889
SCAPANORHYNCHUS TEXANUS (Roemer, 1852)
Figures 4.21–4.26, 5.1–5.6

Lamna texana ROEMER, 1852, p. 29, Pl. 1, fig. 7.

Material.—CCK-82-13-10, two lower jaw anterior teeth. CCK-82-13-11, one upper jaw anterior tooth from the symphysial area, sans denticles. CCK-82-13-12, one lower jaw antero-lateral tooth. CCK-82-13-13, one upper jaw lateral tooth. CCK-82-13-14, one extreme posterior tooth from either jaw. More than 1,000 additional teeth have been collected.

Description.—Complete description of all the various tooth morphologies from this aberrant, very common taxon is given in Cappetta and Case (1975b).

Discussion.—*Scapanorhynchus texanus* teeth are easily the most common Upper Cretaceous shark fossils in Atlantic and eastern Gulf Coastal Plain deposits. The diversity of tooth morphologies in this single species has caused considerable confusion and production of junior subjective synonyms (see p. 38 in Cappetta and Case, 1975b); nevertheless, modern specimens of the "goblin shark" prove this variety of teeth exists in a single species.

Family ODONTASPIDAE
Müller and Henle, 1839
Genus SYNODONTASPIS White, 1931
SYNODONTASPIS HOLMDELENSIS
(Cappetta and Case, 1975)
Figure 5.7, 5.8

Scapanorhynchus tenuis CASE, 1973, p. 21, fig. 72.

Material.—CCK-82-13-15, one anterior tooth and one lateral tooth, probably from the lower jaw.

Description.—Odontaspid teeth of small size, rarely exceeding 1 cm in height, root to tip. Lingual face of crown striated from the root apron up three-fourths of the blade. Lateral cusplets relatively large; root relatively gracile.

Discussion.—Cappetta and Case (1975b) described as follows the features which distinguish this tooth-species from *Scapanorhynchus texanus*: "...ses dents à couronne d'aspect plus gracile, à striation interne plus forte, et ses denticules proximaux plus développés (... the teeth have relatively slender crowns with stronger inner-surface striations, and the lateral denticles are more developed)." Given that these teeth invariably co-occur with *Scapanorhynchus* specimens, one of us (D.R.S.) considers the distinctions insufficient to erect a new taxon; these may simply be well-preserved, little-transported, anterior teeth from small individuals of *Scapanorhynchus.*

Family Cretoxyrhinidae Glyckman, 1958
Genus Cretolamna Glyckman, 1958
Cretolamna appendiculata (Agassiz, 1843)
Figure 5.9–5.12

Otodus latus Agassiz, 1843, p. 271, Pl. 32, fig. 26.

Material.—CCK-82-13-16, one upper jaw lateral tooth. CCK-82-13-17, one upper jaw postero-lateral tooth. Five additional teeth have been collected.

Description.—Crowns broad, triangular. Roots short, broad. Lateral denticles relatively strong, broadly triangular. Anterior teeth symmetrical, lower jaw teeth with erect crowns and pinched roots, upper jaw teeth with laterally spread-out crowns and accessory cusplets. Posterior and posterolateral teeth asymmetrical, leaning toward the commissure of the jaw. Symphyseal and intermediate teeth absent. Small foramen centrally located on the root-boss, and slight fenestration below the root apron in the lingual aspect.

Discussion.—This is among the few fossil shark species assigned subspecies (Herman, 1973; Cappetta and Case, 1975b) to distinguish among the numerous variants in its global distribution. Despite the extremely wide geographic distribution, specimens, at least in the strata in study, are relatively rare.

Genus Cretodus Sokolov, 1965
Cretodus borodini (Cappetta and Case, 1975)
Figure 5.13–5.15

Plicatolamna borodini Cappetta and Case, 1975b, p. 23, Pl. 3, figs. 1–9.

Material.—CCK-82-13-18, one lower lateral tooth. Two additional specimens have been collected.

Description.—Tip of crown ablated, otherwise a complete specimen. Small lamnoid teeth, generally less than 1 cm in total height. The crown is constricted near the root, heavily ornamented with rugose striations in labial aspect, striations extending three-quarters of the blade height. Lateral denticles proportionately large and recurved toward the labial side. The lingual aspect shows a pronounced root-boss, which may be smooth or may have a small central foramen or depression. Root lobes proportionately massive.

Discussion.—*Cretodus borodini* shares the massive root lobes with *C. macrorhiza* of the Lower Cretaceous of England. It also resembles *C. sulcata* from the Upper Cretaceous of Bohemia in all aspects but its consistently small size.

Order Batöidei
Suborder Ganopristinidea
Family Sclerorhynchidae Cappetta, 1974
Genus Ischyrhiza Leidy, 1856
Ischyrhiza mira Leidy, 1856
Figure 5.16–5.20

Ischyrhiza mira Leidy, 1856, p. 221.

Material.—CCK-82-13-19, two lateral oral teeth. CCK-82-13-20, two rostral teeth. More than 10 additional oral teeth and 9 additional rostral teeth have been collected.

Description.—Small oral teeth, rarely more than 4 mm in any dimension. Crown includes a slight, vertical crest, best viewed in the occlusal aspect. Lateral lobes extend from the mid-line and overhang the root. Roots, as viewed from basal aspect, are bi-lobed. A lateral facette foramen, viewed from lingual aspect, is present on the root below the contact with crown enamel.

Rostral teeth are composed of an osseous root and an enamelled shaft, extending two-thirds the total length. Roots are bifurcate, with strongly developed saddle extending across the basal mid-line, and with sharply folded basal perimeter. Crowns are slender, sharply pointed, slightly ovate, slightly bent posteriorly at the juncture with the root, and with a posterior carina extending from the tip to the base of the crown at the flexure.

Discussion.—The rostral teeth of *Ischyrhiza* are extremely common in Late Cretaceous rocks. However, the oral teeth are not nearly as well reported, perhaps an artifact of their small size. Descriptions of the taxon are abundant, and may be found in McNulty and Slaughter (1964), Johnson and Storer (1974), Storer and Johnson (1974), and Cappetta and Case (1975b). Slaughter and Steiner (1968) discussed subspecies of *I. mira,* as well as *I. avonicola* Estes, a very small ganopristine sawfish which has not to date been found in the Blufftown Formation.

Order Batöidei Incertae Sedis
Genus Ptychotrigon Jaekel, 1894
Ptychotrygon vermiculata Cappetta, 1975
Figure 5.21–5.26

Ptychotrygon triangularis (Reuss). Cappetta and Case, 1975b, p. 33, fig. 9A–D, Pl. 4, figs. 23–28.

Material.—CCK-82-13-21, two oral teeth. CCK-82-13-22, one rostral tooth. More than 10 additional oral teeth and two additional rostral teeth have been collected.

Description.—Oral teeth basically similar to those of *Ischyrhiza,* but with broadly wrinkled occlusal enamel surface, also bearing a posteriorly extended apron and lacking an occlusal crest.

Rostral teeth (denticles) differ from those of *Ischyrhiza* in the concave basal region, which was set onto (rather than into, as in *Ischyrhiza*) the rostrum.

Discussion.—The systematics of *Ptychotrygon,* which is a sawfish with possible relationship to *Ischyrhiza,* have undergone considerable review (McNulty and Slaughter, 1972; Cappetta, 1975; Cappetta and Case, 1975b; Case, 1978). The genus is widespread in Upper Cretaceous rocks, and is probably as abundant as *Ischyrhiza,* but it is easily overlooked because of the small size of rostral (as well as oral) teeth.

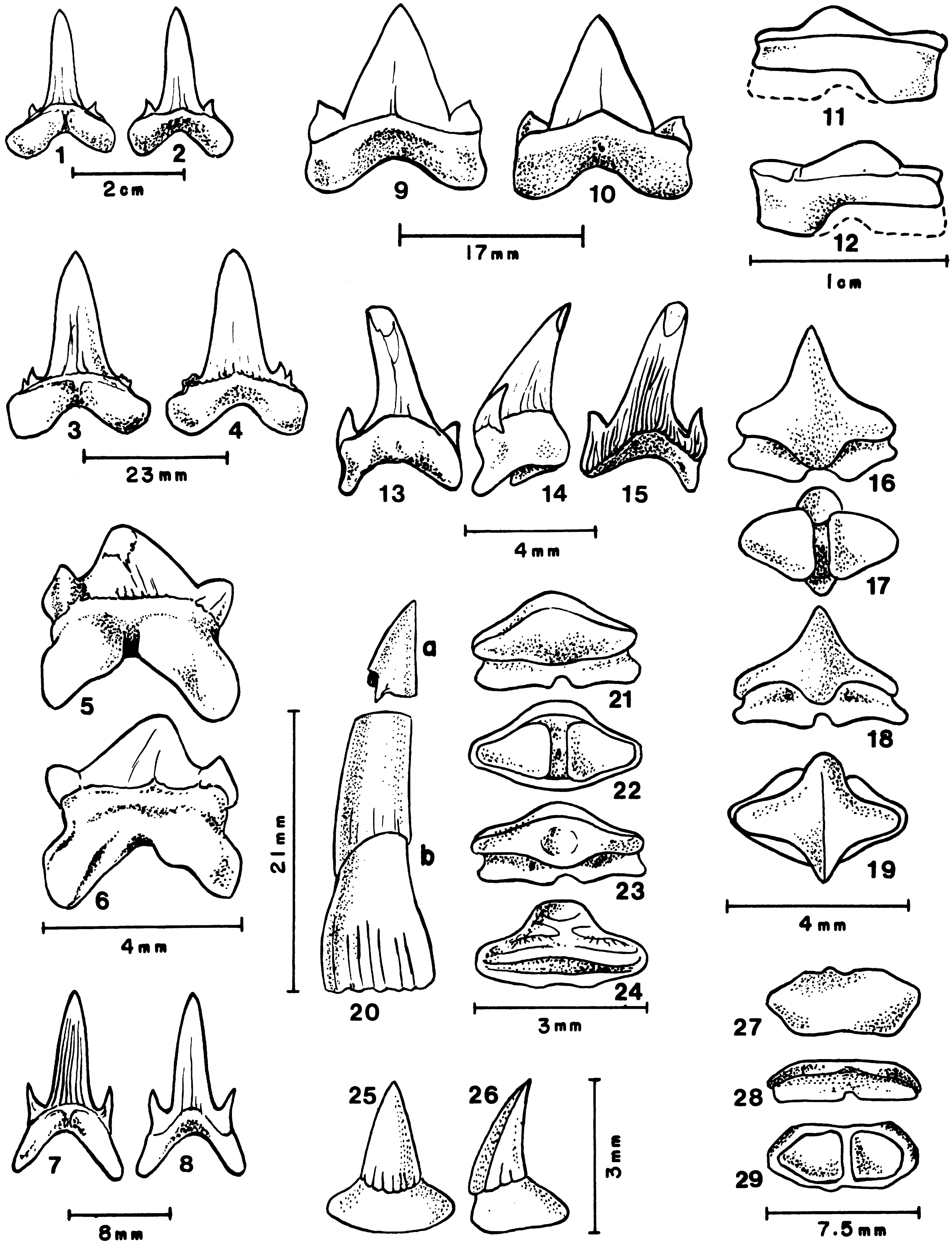
Suborder Dasyatoidei
Family Myliobatidae Bonaparte, 1838
Genus Brachyrhizodus Romer, 1942
Brachyrhizodus wichitaensis Romer, 1942
Figure 5.27–5.29

Brachyrhizodus wichitaensis Romer, 1942, p. 221, Pl. 1, figs. 7, 8.

Material.—CCK-82-13-23, one lateral oral pavement chevron from either jaw.

Description.—A worn, isolated chevron from the crushing pavement, showing a bi-lobed root, partially ablated. Occlusal surface showing low-relief (probably due to wear) sculpture on the enamel, which is relatively thin. Overall outline from occlusal view is irregularly hexagonal, width more than twice the length.

Discussion.—This primitive rhinopterid (cow-nosed) ray is


1
2
2 cm
9
10
17 mm
11
12
1 cm
3
4
23 mm
13
14
15
4 mm
16
17
18
19
4 mm
5
6
4 mm
a
b
21 mm
20
21
22
23
24
3 mm
7
8
8 mm
25
26
3 mm
27
28
29
7.5 mm

abundant in the Upper Cretaceous of New Jersey (Cappetta and Case, 1975b). Chevrons from the jaw center were probably wider than those from the lateral regions, based on the modern ray *Rhinoptera.* Specimens of *Brachyrhizodus* with 3–6 inter-laminaires (rootlets divided by grooves) are more common than are those with two-part roots as the present specimen shows.

Genus PSEUDOHYPOLOPHUS
Cappetta and Case, 1975
PSEUDOHYPOLOPHUS sp.
Figure 6.1–6.5

Pseudohypolophus CAPPETTA AND CASE, 1975a, p. 306.

Material.—CCK-82-13-24, three oral pavement chevrons from either jaw. CCK-82-13-25, one tentatively assigned dermal denticle. Ten additional oral chevrons and one additional denticle have been collected.

Description.—Oral teeth are rounded-hexagonal in occlusal aspect, with smooth surface enamel on the cap. Basal aspect shows a strongly bilobed root, largely ablated in the collected specimens.

Dermal denticles tentatively assigned are, in overall form, strikingly reminiscent of a very blunt rose thorn. They are notably bilateral in surface aspect, with a well-developed, asymmetrically erect median crest. The base is nearly flat in lateral aspect, with a hollow basal surface.

Discussion.—The oral teeth form a pavement mosaic similar to the modern ray *Hypolophus sephen.* Distinction between this Cretaceous ray tooth-form and *Brachyrhizodus* is largely based on the exclusively bi-lobed root in *Pseudohypolophus* versus the variable number of root lobes in the other genus. Although the roots of all *Pseudohypolophus* collected in the Blufftown are ablated, the bilobed nature is indicated from the remains. Teeth assigned to *Pseudohypolophus* are known from strata as old as the Albian in North Texas (Thurmond, 1971) up through the Campanian of Delaware (Lauginiger and Hartstein, 1983).

Genus RHOMBODUS Dames, 1881
RHOMBODUS LAEVIS Cappetta and Case, 1975
Figure 6.6–6.9

Rhombodus laevis CAPPETTA AND CASE, 1975b, p. 36, Pl. 9, figs. 12–20, ?figs. 21–23.

Material.—CCK-82-13-26, three oral teeth. Three additional teeth have been collected.

Description.—Rhomboidal to subhexagonal tooth caps in occlusal view. Enamel on the cap relatively thick and smooth. Roots are relatively small, bilobed, with lateral facette foramina on the root aprons.

Discussion.—*Rhombodus laevis* is a relatively common microfossil, notably in the Early Maastrichtian estuarine sands in New Jersey (Cappetta and Case, 1975b). The small size, thick enamel, foramina on the root aprons, and commonly rhomboid shape differentiate this tooth-species from the other rays of its time. The variable outline in occlusal view seems to be a response to packing within the jaw mosaic, suggesting more similarity to the modern guitarfish *Rhinobatos,* a skate, than the ray *Hypolophus*; nevertheless, no jaw material is known and *Rhombodus* may in fact be a ray with skate-like dentition.

Class OSTEICHTHYES
Subclass ACTINOPTERYGII
Infraclass HOLOSTEI
Order SEMIONOTIFORMES
Suborder LEPISOSTEIOIDEI
Family LEPISOSTEIDAE Cuvier, 1825
Genus LEPISOSTEUS Lacépède, 1803
LEPISOSTEUS sp.
Figure 6.10, 6.11

Lepidotus occidentalis LEIDY, 1856, p. 73.
Lepisosteus occidentalis COPE, 1877, p. 574.

Material.—CCK-82-13-27, one isolated dentary tooth. CCBCK-82-03-1, one isolated ganoine scale.

Description.—Dentary tooth with a long base, showing a labyrinthodontine cross section, terminating in a small, slightly bulbous enameloid tip, comprising one-fifth the total length. The bone of the tooth-root appears resinous, with cracks running orthogonal to the tip-to-base ornamentation. Tooth-tip is slightly crimped along the upper edge, creating a cutting surface.

The large, isolated scale is from the lateral line region of the body trunk, with rugose patterning on the ganoid surface, also showing patchy resorption of enamel, suggesting an old individual. Anterior portion of scale missing (reconstructed in Figure 6.10). Reverse of scale slightly bulbous but smooth.

Discussion.—*Lepisosteus* species from the Late Cretaceous occur widely in estuarine deposits: a sample of references includes Estes (1964, 1976), Estes and Berberian (1970), Estes et al. (1969), Johnson and Storer (1974, which includes an illustration of the ganoid scales), and Case (1978). The teeth, which are evenly placed around the jaw margins as in modern garpikes, are rarely illustrated.

Order PYCNODONTIFORMES
Family PYCNODONTIDAE Owen, 1846
Genus ANOMOEODUS Forir, 1887
ANOMOEODUS PHASEOLUS (Hay, 1899)
Figure 6.12–6.16

Pycnodus phaseolus HAY, 1899, p. 788.

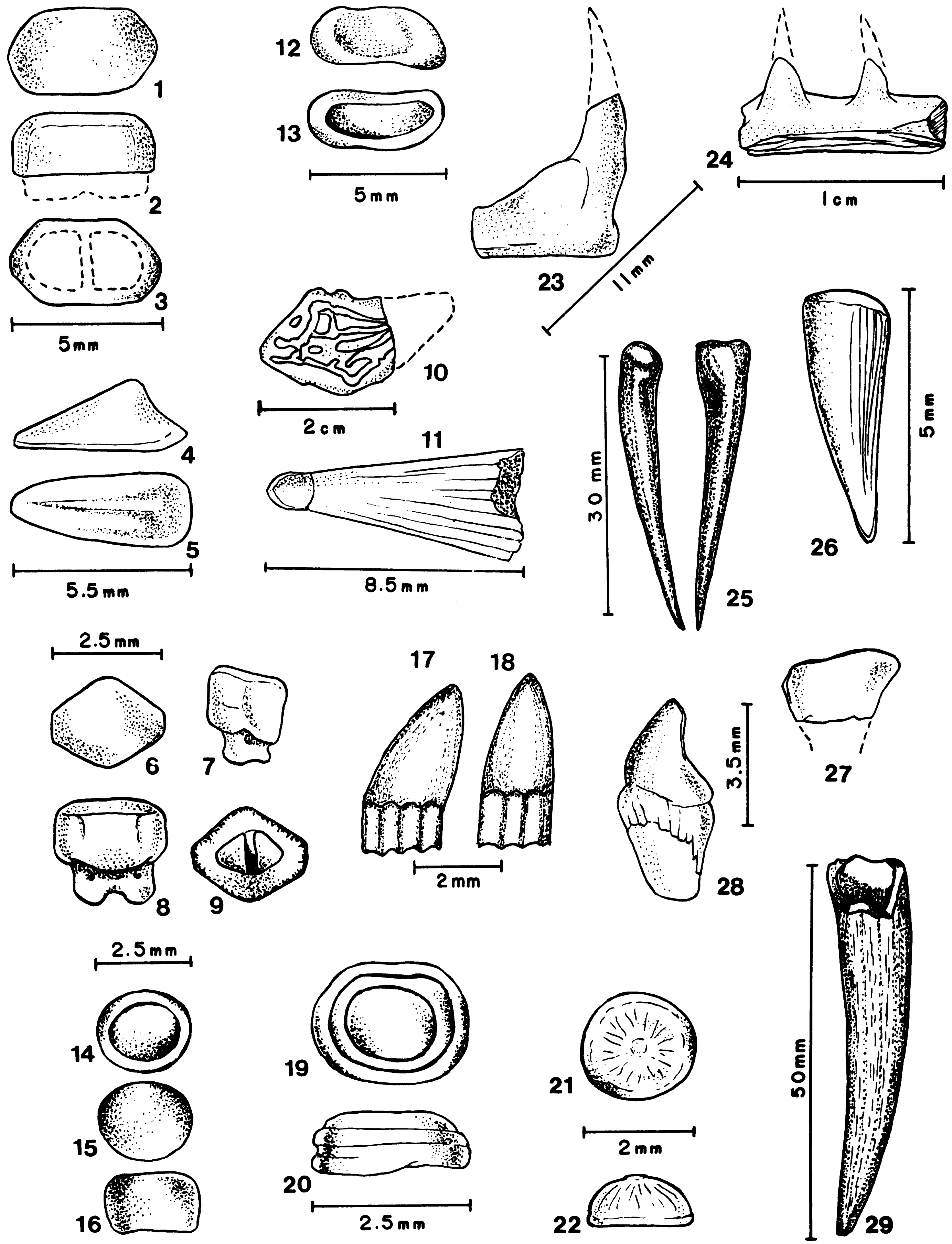
Material.—CCK-82-13-28, one worn mandibular tooth and one anterior tooth cap from the vomerine. One additional vomerine tooth cap has been collected.

Description.—A worn, median splenial tooth, from the lower jaw, comprising only the tooth cap. Occlusal surface is smooth. All root material absent; the basal aspect shows a canoe-shaped concavity.

The smaller tooth cap is from the anterior vomerine plate, also worn, smooth surfaced, and lacking root material. The overall crown is more circular than the above, but with the same concave basal morphology.

Discussion.—The hollow basal aspect in the absence of root

←
FIGURE 5—*1–6, Scapanorhynchus texanus* (Roemer). *1, 2,* CCK-82-13-12, lower jaw anterolateral tooth, lingual and labial views; *3, 4,* CCK-82-13-13, upper jaw lateral tooth, lingual and labial views; *5, 6,* CCK-82-13-14, extreme posterior tooth, from the jaw commissure region, lingual and labial views. *7, 8, Synodontaspis holmdelensis* (Cappetta and Case), CCK-82-13-15, one lateral lower jaw tooth, lingual and labial views. *9–12, Cretolamna appendiculata* (Agassiz). *9, 10,* CCK-82-13-16, upper jaw lateral tooth, labial and lingual views; *11, 12,* CCK-82-13-17, upper jaw posterolateral tooth, root partially restored, labial and lingual views. *13–15, Cretodus borodini* (Cappetta and Case), CCK-82-13-18, lower jaw lateral tooth, tip ablated, lingual, lateral, and labial views. *16–20, Ischyrhiza mira* (Leidy). *16–19,* CCK-82-13-19, lateral oral tooth, labial, basal, lingual, and occlusal views; *20,* CCK-82-13-20, rostral spine, dorsal view. *21–26, Ptychotrygon vermiculata* Cappetta. *21–24,* CCK-82-13-21, oral tooth, labial, basal, lingual, occlusal views; *25, 26,* CCK-82-13-22, rostral spine, posterior and lateral views. *27–29, Brachyrhizodus wichitaensis* Romer, CCK-82-13-23, lateral oral pavement chevron, occlusal, lateral, basal views.


1
2
3
5mm
4
5
5.5mm
12
13
5mm
10
2cm
11
8.5mm
23
11mm
24
1cm
25
30 mm
26
5mm
2.5mm
6
7
8
9
17
18
2mm
28
3.5mm
27
29
50mm
2.5mm
14
15
16
19
20
2.5mm
21
2mm
22

material, and the commonly canoe-like morphology, are diagnostic for the species. Isolated tooth caps of *Anomoeodus phaseolus* are common in Upper Cretaceous marine deposits, whereas additional material from the species is rare. Fowler (1911, p. 147, fig. 90) shows a mandibular fragment with the characteristic teeth.

Order AMIIFORMES
Suborder AMIODEI
Family AMIIDAE Bonaparte, 1837
AMIIDAE gen. and sp. indeterminate
Figure 6.17, 6.18

Material.—CC-82-13-29, one marginal tooth.

Description.—An isolated, small, worn, styliform marginal tooth, with partially ablated tip and much of the root intact. Crown is circular in cross section, with shiny enamel surface, becoming translucent near the tip and bearing faint vertical striations on entire crown surface. Tooth is inwardly curved above the root. Root columnar in overall form, with prominent, vertical fluting on the surface.

Discussion.—Assignment of this single tooth to the Amiidae is based on the columnar root, inward curvature of the crown, and round cross section. Estes and Sanchiz (1982) showed comparably small and generally similar teeth from the Lower Cretaceous of Spain; however, their specimens, as well as the teeth of modern *Amia calva,* do not show the fluting on the base observed in this specimen.

Infraclass TELEOSTEI
Order ELOPIFORMES
Suborder ALBULOIDEI
Family ALBULIDAE Cope, 1871
Genus ALBULA Bloch and Schneider, 1801
ALBULA sp.
Figure 6.19, 6.20

Material.—CCK-82-13-31, four tooth caps. Ten additional specimens have been collected.

Description.—Small isolated tooth caps, with triple rows of annular ornamentation encircling occlusal surfaces. Enamel surfaces are otherwise smooth. Most specimens are circular in occlusal outline; however, some are nearly square due to apparent packing compression. The teeth lack distinctive roots. The basal aspect is irregularly flat, suggesting direct attachment to the jawbone.

Discussion.—These isolated bonefish tooth caps are widely distributed and abundant in the Upper Cretaceous of the Atlantic and Gulf Coastal Plains, and the Mesaverde Formation (Upper Campanian) of Wyoming.

Suborder LABROIDEI
Family PHYLLODONTIDAE Sauvage, 1875
Subfamily PARALBULINAE Estes, 1969
Genus PARALBULA Blake, 1940
PARALBULA CASEI Estes, 1969
Figure 6.21, 6.22

Colobodus sp. CASE, 1967, p. 10, fig. 45.
Paralbula casei ESTES, 1969, p. 323–324, fig. 3.

Material.—CCK-82-13-32, two tooth caps. Twenty-five additional specimens have been collected.

Description.—Isolated tooth caps with hemispherical to square lateral outline. Occlusal outline circular, surface ornamented with faint rugosity, extending from near the margin to the center, from which it radiates. Basal aspect slightly concave near the center, with enamel extending from there to the margin, and continuing to the apex of the tooth.

Discussion.—Although relatively recently described, these isolated tooth caps are widely distributed and abundant in most North American Upper Cretaceous marine deposits, and in England. A well-preserved pharyngeal plate of this bonefish, the type specimen, is illustrated by Case (1982, p. 298, figs. 25–76).

Order SALMONIFORMES
Suborder ENCHODONTOIDEI
Family ENCHODONTIDAE Lydekker, 1899
Genus ENCHODUS Agassiz, 1835
ENCHODUS PETROSUS Cope, 1874
Figure 6.23–6.26

Tetheodus pephredo COPE, 1874, p. 43.
Enchodus petrosus COPE, 1874, p. 44.

Material.—CCK-82-13-33, an anterior dentary fragment with a partial preserved tooth. CCK-82-13-34, a dentary fragment with the preserved bases of two teeth. CCBBK-116-1, an isolated palatine tooth. CCK-82-13-35, an isolated dentary or premaxillary tooth. One additional anterior dentary fragment, three additional dentary or premaxillary teeth, and one additional palatine tooth have also been collected.

Description.—Anterior dentary fragment from a small individual, with approximately one-half of the anteriormost tooth remaining. A small part of the anterior symphyseal region and a small projection of the more posterior dentary are present on the fragment.

Palatine tooth from large individual worn and broken off just above the base, asymmetrically compressed in cross section, slightly recurved just above the base and then straight to the tip. Double cutting edges are formed by lateral compression, with both edges smooth and obliquely oriented in the jaw. Inner enamel surface covered with fine but persistent striations.

Dentary fragment bearing two ablated teeth, from a very small individual. Specific location indeterminable since the dentary is uniform posterior to the large anterior tooth and its base.

Isolated dentary or premaxillary tooth laterally compressed, moderately curved, with a sharp anterior cutting surface and a rounded posterior surface. Outer enamel surface smooth, inner enamel surface striated from the base up approximately four-fifths of the length.

Discussion.—*Enchodus* species are globally distributed in the Upper Cretaceous, with approximately two dozen species described, including more than 17 from North America. Goody (1976) recognized only five valid North American species, of which *E. petrosus* is characterized by several features of the palatine teeth, including the presence of two cutting surfaces

←

FIGURE 6—*1–5, Pseudohypolophus* sp. *1–3,* CCK-82-13-24, oral pavement chevron, occlusal, lateral, and basal views; *4, 5,* CCK-82-13-25, dermal denticle, lateral and surficial views. *6–9, Rhombodus laevis* Cappetta and Case, CCK-82-13-26, oral tooth, occlusal, lateral, lingual, basal views. *10, 11, Lepisosteus,* sp. *10,* CCBCK-82-03-1, ganoine scale, partially restored, surficial view; *11,* CCK-82-13-27, dentary tooth crown, lingual view. *12–16, Anomoeodus phaseolus* (Hay). *12, 13,* CCK-82-13-28, median splenial tooth-cap, occlusal and basal views; *14–16,* vomerine tooth-cap, basal, occlusal, lateral views. *17, 18,* Amiidae, gen. and sp. indet., CCK-82-13-29, marginal tooth, lateral and lingual views. *19, 20, Albula* sp., CCK-82-13-31, tooth-cap, occlusal and lateral views. *21, 22, Paralbula casei* Estes, CCK-82-13-32, tooth-cap, occlusal and lateral views. *23–26, Enchodus petrosus* Cope. *23,* CCK-82-13-33, anterior dentary fragment with tooth tip restored, lateral view; *24,* CCK-82-13-34, dentary fragment with tips of two teeth restored, lateral view; *25,* CCBBK-116-1, palatine tooth missing base, lingual and lateral views; *26,* CCK-82-13-35, dentary or premaxillary tooth, lingual view. *27, 28, ?Stephanodus* sp., CCK-82-13-36, premaxillary tooth, lateral view; CCK-82-13-37, pharyngeal tooth, lateral view. *29, Xiphactinus audax* Leidy, CCK-79-03-28, an anterior premaxillary tooth, lingual view.

lacking serrations, the fine striations on the inner enamel surface, and the generally straight morphology of the teeth.

Order TETRAODONTIFORMES (PLECTOGNATHI)
Suborder BALISTOIDEI
Family TRIGONODONTOIDAE Weiler, 1929
Genus STEPHANODUS Zittel, 1883
?STEPHANODUS sp.
Figure 6.27, 6.28

Material.—CCK-82-13-36, one premaxillary tooth. CCK-82-13-37, one pharyngeal tooth. One additional pharyngeal tooth has been collected.

Description.—Premaxillary tooth asymmetrical, incisor-like, with root largely absent. Crown features translucent, smooth enamel, with an opaque central region.

Pharyngeal tooth with flattened, strongly hooked crown composed of translucent enamel with opaque center, similar to the above. Tooth retains a thick, flattened trapezoidal root which becomes tapered toward the jaw.

Discussion.—The identification of these teeth is questionable, as indicated, because similar teeth have been assigned variously to the Pycnodontidae (Applegate, 1970), Sclerodontidae (Case, 1982), and the tentative assignment here, the Trigonodontidae (von Zittel, 1932; Case, 1982).

Order CLUPEIFORMES
Suborder CHIROCENTROIDEA
Family CHIROCENTRIDAE
Cuvier and Valenciennes, 1846
Genus XIPHACTINUS Leidy, 1870
XIPHACTINUS AUDAX Leidy, 1870
Figure 6.29

Xiphactinus audax LEIDY, 1870, p. 12.
Portheus molossus COPE, 1871, p. 175.

Materials.—CCK-79-03-28, a large anterior premaxillary tooth. CCK-83-81-3, a large dorsal vertebra. CCK-82-13-38, a maxillary or dentary tooth. Six additional premaxillary teeth and four additional smaller teeth have also been collected.

Description.—Anterior tooth elongate, recurved posteriorly and very slightly medially, 58 mm in preserved length, minus root and extreme tip. Cross section oval near the base, becoming laterally compressed toward the tip. Anterior edge carinate near the tip, whereas the posterior edge is rounded from base to tip. Surface covered with very shiny enamel featuring fine surface cracks of such uniformity as to resemble vertical striations. Slight faceting of enamel also evident on the lingual surface.

Dorsal vertebra large, oval, reaching 40 mm maximum diameter, 29 mm anteroposterior length. Strongly biconcave with small median notochord foramen. Several types of large longitudinal pits and grooves present around the sides of the centrum, including three pairs which penetrate almost to the notochord opening.

Smaller dentary or maxillary tooth 11 mm preserved length, grossly similar to the premaxillary fang described above, but less tapered and relatively more compressed laterally. Surface covered with the same finely cracked enamel, lacking any faceting.

Discussion.—This is the same large, common Cretaceous fish known from the Kansas chalks as *Portheus molossus* Cope (see Thurmond and Jones, 1981, for discussion of nomenclature). The very large premaxillary fangs are readily identifiable, as are the distinctively pitted, large vertebrae. One premaxillary fang, broken off above the base, measures over 62 mm in length.

SUMMARY

The Blufftown fish fauna in western Georgia is taxonomically diverse and relatively rich in numbers of specimens, but poorly represented in terms of quality of materials. The specific composition shares many elements with penecontemporaneous strata in nearby South Carolina, North Carolina, and western Alabama.

However, there are differences in the relative representation of taxa among these Cretaceous collections, most especially in comparisons between the Blufftown fauna in Georgia and the Mooreville Chalk fauna in Alabama (Applegate, 1970; Thurmond and Jones, 1981). Overall, there are many more taxa known from the Mooreville, typically with several species for each, compared with the complete absence of multi-species genera in the Georgia collections. Then, too, many fish from western Alabama are represented by complete or partial skeletons as compared with the largely tooth-fauna from Georgia. These differences may be attributed to the detritus-dominated, marginal-marine conditions prevailing in western Georgia during the Campanian, compared with contemporary carbonate-rich, epicontinental environments in western Alabama.

The Blufftown fauna also differs, to a lesser degree, from the Peedee fauna in North Carolina (Case, 1979), even though the latter formed in similar detrital marginal-marine conditions. The differences here may be attributed to faunal provinciality (i.e., the Blufftown formed in the easternmost Gulf of Mexico Province, whereas the Peedee formed in the Atlantic Coastal Plain Province). Two notable differences between the faunas are the abundance of *Cretolamna appendiculata* and the scarcity of *Xiphactinus audax* in North Carolina, contrasted with the converse situation in Georgia. *Xiphactinus* is also absent in a newly studied Cretaceous assemblage from South Carolina (J. Hall, personal commun.).

ACKNOWLEDGMENTS

We thank D. Baird for guidance and assistance in literature search during the preparation of this manuscript. We also wish to acknowledge the contributions of specimens by the following amateur and student collectors (listed chronologically by the first date of collaboration): R. Best, W. Childers, and R. Rollier. J. T. Thurmond and D. Baird critically reviewed the manuscript, and D. Wolberg made additional constructive suggestions. Partial funding of this study was provided by the Columbus College Foundation through faculty research grants to D.R.S.

REFERENCES

AGASSIZ, L. 1843. Recherches sur les poissons fossiles. Vol. 3. Neuchâtel, Switzerland, 422 p.

APPLEGATE, S. P. 1970. The vertebrate fauna of the Selma Formation in western Alabama: Pt. VIII: the fishes. Fieldiana, Geology Memoirs, 3:383–433.

BILELO, M. A. M. 1969. The fossil shark genus *Squalicorax* in north-central Texas. Texas Journal of Science, 20:339–348.

CAPPETTA, H. 1975. *Ptychotrygon vermiculata* nov. sp., sélacien nouveau du Campanien du New Jersey. Comptes Rendus Sommaires, Société Géologique de France, p. 164–166.

——, AND G. R. CASE. 1975a. Sélaciens nouveaux du Crétacé du Texas. Géobios, 8:303–307.

——, AND ——. 1975b. Contribution à l'étude des sélaciens du Groupe Monmouth (Campanien-Maestrichtien) du New Jersey. Palaeontographica, Abteilung A, 151:1–46.

CASE, G. R. 1973. Fossil Sharks, a Pictorial Review. Personal Publication, New York, New York, 64 p.

——. 1978. A new selachian fauna from the Judith River Formation (Campanian) of Montana. Palaeontographica, Abteilung A, 160:176–205.

——. 1979. Cretaceous selachians from the Peedee Formation (late Maestrichtian) of Duplin County, North Carolina. Brimleyana, 2:77–89.

——. 1982. A Pictorial Guide to Fossils. Van Nostrand Reinhold, New York, 515 p.

——. 1987a. *Borodinopristis schwimmeri,* a new ganopristine sawfish from the upper Blufftown Formation (Campanian) of the Upper Cretaceous of Georgia. New Jersey Academy of Science Bulletin, 32:25–33.

——. 1987b. A new selachian fauna from the late Campanian of Wyoming (Teapot Sandstone Member, Mesaverde Formation, Big Horn Basin). Palaeontographica, Abteilung A, 197:1–37.

COOKE, C. W. 1943. Geology of the Coastal Plain of Georgia. U.S. Geological Survey Bulletin 941, 121 p.

COPE, E. D. 1871. [Letter to Professor Lesley giving an account of a journey in the valley of the Smoky Hill River, in Kansas.] American Philosophical Society Proceedings, 12:174–176.

——. 1874. Review of the Vertebrata of the Cretaceous Period found west of the Mississippi River. U.S. Geologic and Geographic Survey of Territories, Bulletin 1:3–48.

——. 1877. Report on the geology of the region of the Judith River, Montana, and on the vertebrate fossils obtained on or near the Missouri River. U.S. Geologic and Geographic Survey of Territories, Bulletin 3:565–597.

DUFFIN, C. J. 1985. Revision of the selachian genus *Lissodus* Brough (1935). Palaeontographica, Abteilung A, 188:105–152.

EARGLE, D. H. 1955. Stratigraphy of outcropping Cretaceous rocks of Georgia. U.S. Geological Survey Bulletin 1014, 101 p.

ESTES, R. 1964. Fossil vertebrates from the Late Cretaceous Lance Formation, eastern Wyoming. University of California Publications on Geological Sciences, 49, 187 p.

——. 1969. Studies on fossil phyllodont fishes: interrelationships and evolution in the Phyllodontidae (Albuloidei). Copeia, 2:317–331.

——. 1976. Middle Paleocene lower vertebrates from the Tongue River Formation, southeastern Montana. Journal of Paleontology, 50:500–520.

——, AND P. BERBERIAN. 1970. Paleoecology of a Late Cretaceous vertebrate community from Montana. Museum of Comparative Zoology, Harvard, Breviora, 343:1–34.

——, ——, AND C. A. M. MESZOELY. 1969. Lower vertebrates from the Late Cretaceous Hell Creek Formation, McCone County, Montana. Museum of Comparative Zoology, Harvard, Breviora, 337:1–33.

——, AND B. SANCHIZ. 1982. Early Cretaceous lower vertebrates from Galve (Teruel), Spain. Journal of Vertebrate Paleontology, 2:21–29.

FOWLER, H. W. 1911. A description of the fossil fish remains of the Cretaceous, Eocene and Miocene Formations of New Jersey. Geological Survey of New Jersey Bulletin, 4, 192 p.

GOODY, P. C. 1976. *Enchodus* (Teleostei: Enchodontidae) from the Upper Cretaceous Pierre Shale of Wyoming and South Dakota with an evaluation of the North American enchodontid species. Palaeontographica, Abteilung A, 152:91–113.

HAY, O. P. 1899. On some changes in the names, generic and specific, of certain fossil fishes. American Naturalist, 33:783–792.

HERMAN, J. 1973. Les sélaciens des terraines néocrétacés et paléocènes de Belgique et des contrées limitrophes. Service Geologique de Belgique, Memoire 15, 450 p.

HERRICK, S. M., AND P. E. LAMOREAUX. 1944. Upper Cretaceous Series (of the southwest Georgia Coastal Plain). Georgia Geological Society Field Trip Guidebook, p. 6–20.

JOHNSON, H., AND J. E. STORER. 1974. A guide to Alberta vertebrate fossils from the age of dinosaurs. Provincial Museum of Alberta Publication 4, 129 p.

LAUGINIGER, E. N., AND E. C. HARTSTEIN. 1983. A guide to fossil sharks, skates, and rays, from the Chesapeake and Delaware Canal area, Delaware. Delaware Geological Survey Open File Report 21, 64 p.

LEIDY, J. 1856. Notices on remains of extinct vertebrate animals of New Jersey, collected by Professor Cook, of the state geological survey, under the direction of Dr. W. Kitchell. Academy of Natural Sciences of Philadelphia Proceedings, 8:220–221.

——. 1870. Remarks on Ichthyodorulites from Kansas and Tennessee and on mammalian remains from Illinois. Academy of Natural Sciences of Philadelphia Proceedings, 22:12–13.

LERICHE, M. 1929. Les poissons du Crétacé marin de la Belgique et du Limbourg Hollandais. Belgium Society of Geology, Paleontology and Hydrology Bulletin, 37:199–299.

MARSALIS, W. E., AND M. S. FRIDDELL. 1975. A guide to selected Upper Cretaceous and lower Tertiary outcrops in the lower Chattahoochee River Valley of Georgia. Georgia Geological Society Field Trip Guidebook, 15, 88 p.

MCNULTY, C. L., AND B. H. SLAUGHTER. 1964. Rostral teeth of *Ischyrhiza mira* from northeast Texas. Texas Journal of Science, 16: 107–117.

——, AND ——. 1972. The Cretaceous selachian genus *Ptychotrygon* Jaekel, 1894. Eclogae Geologicae Helvetiae, 65:647–656.

REINHARDT, J. 1981. Upper Cretaceous depositional environments, p. 2–8. *In* J. Reinhardt and T. G. Gibson (eds.), Upper Cretaceous and Lower Tertiary geology of the Chattahoochee River Valley, western Georgia and eastern Alabama. Georgia Geological Society Field Trip Guidebook, 16.

——. 1986. Stratigraphy and sedimentology of the Cretaceous continental and nearshore sediments in the eastern Gulf Coastal Plain, p. 3–10. *In* J. Reinhardt (ed.), Upper Cretaceous strata of the lower Chattahoochee Valley. Society of Economic Paleontologists and Mineralogists Annual Meeting (Atlanta) Field Trip Guidebook 3.

RICHARDS, H. G., AND B. M. HAND. 1958. Fossil shark teeth from the Coastal Plain of Georgia. Georgia Mineral Newsletter, 11:91–94.

ROEMER, FERDINAND. 1852. Die Kreidebildungen von Texas und ihre organischen Einschlüsse. Mit einen die Beschreibung von Versteinergungen aus paläozoischen untertiären Schichten enthaltenden Anhange und mit 11 von C. Hohe nach der Natur auf Stein gezeichneten Tafeln. Bonn, 100 p.

ROMER, A. S. 1942. Notes on certain American Paleozoic fishes. American Journal of Science, 240:216–228.

SCHWIMMER, D. R. 1981. A distinctive Upper Cretaceous fauna, 3–4 meters below the Blufftown-Cusseta contact in the Chattahoochee River Valley, p. 81–88. *In* J. Reinhardt and T. G. Gibson (eds.), Upper Cretaceous and lower Tertiary geology of the Chattahoochee River Valley, western Georgia and eastern Alabama. Georgia Geological Society Field Trip Guidebook, 16.

——. 1986a. A distinctive biofacies in a downdip exposure, Blufftown Formation, Stewart County, Georgia, p. 19–28. *In* J. Reinhardt (ed.), Upper Cretaceous strata of the lower Chattahoochee Valley. Society of Economic Paleontologists and Mineralogists Annual Meeting (Atlanta), Field Trip Guidebook, 3.

——. 1986b. Late Cretaceous fossils from the Blufftown Formation (Campanian) in western Georgia. The Mosasaur, 3:109–123.

SLAUGHTER, B., AND M. STEINER. 1968. Notes on rostral teeth of ganopristine sawfishes, with special reference to Texas material. Journal of Paleontology, 42:233–239.

SOHL, N. F., AND C. C. SMITH. 1981. Notes on Cretaceous biostratigraphy, p. 8–19. *In* J. Reinhardt and T. G. Gibson (eds.), Upper Cretaceous and Lower Tertiary geology of the Chattahoochee River Valley, western Georgia and eastern Alabama. Georgia Geological Society Field Trip Guidebook, 16.

STEPHENSON, L. W. 1911. Cretaceous (rocks of the Coastal Plain of Georgia), p. 66–215. *In* J. O. Veatch and L. W. Stephenson, Preliminary report on the geology of the Coastal Plain of Georgia. Georgia Geological Survey Bulletin 26:66–215.

STORER, J. E., AND H. JOHNSON. 1974. *Ischyrhiza* (Chondrichthyes: Pristidae) from the Upper Cretaceous Foremost Formation (Campanian) of Alberta. Canadian Journal of Earth Sciences, 11:712–715.

THURMOND, J. T. 1971. Cartilaginous fishes of the Trinity Group and related rocks (Lower Cretaceous) of north-central Texas. Southeastern Geology, 13:207–227.

——, AND D. E. JONES. 1981. Fossil vertebrates of Alabama. University of Alabama Press, University, Alabama, 244 p.

ZITTEL, K. A. VON. 1932. Text-book of Palaeontology. Macmillan and Company, Ltd., London, 533 p.

ACCEPTED 7 JULY 1987