BIODIVERSITY AND EXTINCTION PATTERNS OF CHONDRICHTHYES FROM THE CRETACEOUS-PALEOGENE BOUNDARY, CENTRAL TEXAS

A Senior Scholars Thesis

by

TRACEY JANUS

Submitted to the Office of Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as

UNDERGRADUATE RESEARCH SCHOLAR

April 2009

Major: Geology

BIODIVERSITY AND EXTINCTION PATTERNS OF CHONDRICHTHYES FROM THE CRETACEOUS-PALEOGENE BOUNDARY, CENTRAL TEXAS

A Senior Scholars Thesis

by

TRACEY JANUS

Submitted to the Office of Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as

UNDERGRADUATE RESEARCH SCHOLAR
Texas A&M University

Approved by:

Research Advisor: Thomas Stidham
Associate Dean for Undergraduate Research: Robert C. Webb

April 2009

Major: Geology

ABSTRACT

Biodiversity and Extinction Patterns of Chondrichthyes from the Cretaceous-Paleogene Boundary, Central Texas. (April 2009)

Tracey Janus
Department of Geology and Geophysics
Texas A&M University

Research Advisor: Dr. Thomas Stidham
Department of Biology

The Cretaceous-Paleogene (KP) mass extinction is the second largest mass extinction in the history of the world with over 70% of known marine and terrestrial species suffering extinction in that event. One of the most well studied KP sections is located in the Brazos River in Falls/Milam County and has been extensively studied for its sedimentology, isotopic properties, and latest Cretaceous microfossils, but the vertebrate fauna has not been studied until now. The Brazos River sites are composed of hummocky cross-bedded sandstone beds with intercalated bone beds between the hummocks.

I sorted hundreds of teeth from sharks, batoids, and bony fish, as well as thousands of bone fragments from the processed sediments. At present, I have identified at least 15 genera and 18 species of elasmobranchs including members of the genera *Rhinobatos, Rhombodus, Squalicorax, Carcharias,* and *Pararhincodon.* The chondrichthyian fauna

from the Brazos sites inhabited many different niches ranging from benthic to pelagic forms. Modern members of many of the chondrichthyian forms inhabit shallow, warm to temperate waters, with some forms that are found in deeper waters. Of the identified genera 73% are found after the KP Boundary, but none of the identified species are known to occur in the Paleogene. The Brazos River sites show a high degree of chondrichthyian biodiversity right before the KP Boundary. The Brazos River sites were compared to four other late Maastrichtian North American sites using Simpson's Faunal Similarity index. The Kemp Clay in Texas shared 86.67% of its genera with the Brazos sites; the Arkadelphia Formation in Arkansas shared 66.67% of its genera with the Brazos sites; the Peedee Formation in North Carolina shared 37.5% of its genera with the Brazos sites; and the New Egypt Formation in New Jersey shared 46.67% of its genera with the Brazos sites. As expected, geographically closer regions had a higher faunal similarity index than regions separated by greater distances.

ACKNOWLEDGMENTS

I would like to thank my advisor Dr. Thomas Stidham for providing me with the fossil material, the equipment necessary to research, and of course for his mentoring and guidance on this project. I would also like to thank the other lab students for helping me with the sorting and curation of the specimens. I would also like to thank the Texas A&M Office of Honors Programs and Academic Scholarships and the Undergraduate Research Program for providing me with travel grants that helped me travel to conferences to present my research.

NOMENCLATURE

KP	Cretaceous-Paleogene

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

The Cretaceous-Paleogene (KP) mass extinction is the second largest mass extinction in the history of the Earth, with an estimated 66%-75% of all species becoming extinct in less than 1 million years (Sepkoski, 1989; Kriwet and Benton, 2004). The KP mass extinction is one of the most well-studied extinction events, and yet, it continues to remain one of the most controversial subjects in paleontology. There is an ongoing debate within the paleotological community as to whether the KP extinction was rapid or gradual, and what caused the extinction. Some argue that the mass extinction began thousands of years before the KP Boundary and was caused by global climate change influenced by extreme volcanism or other factors (Keller, 2001; Keller, 2003; Wilf et al., 2003); others argue that the extinct was one huge, instantaneous event caused by a bolide impact (Alvarez et al., 1980; Hildebrand et al., 1991).

This project was focused on investigating the chondrichthyian biodiversity at the KP Boundary in Texas along the Brazos River. The Brazos River sites allow for a unique opportunity to study chondrichthyian extinctions at the KP Boundary. I used the data to interpret the paleoecology and to better understand the chondrichthyian extinction during

This thesis follows the style of *Journal of Vertebrate Paleontology*.

the KP mass extinction (65.95 million years ago (Kuiper et. al., 2008)). Simpson's Faunal Similarity Index (Raup and Crick, 1979) was used to compare the Brazos River chondrichthyian fauna to the chondrichthyian faunas from four other sites in the United States: the Kemp Clay Formation in Texas, the Peedee Formation in North Carolina, the New Egypt Formation in New Jersey, and the Arkadelphia Formation in Arkansas (Becker et al., 2006; Case, 1979; Case and Cappetta 1997; Case et al., 2001).

Geology

The Brazos River KP Boundary section is located in Falls/Milam County, Texas (Figure 1). Extensive micropaleontological, sedimentological, and isotopic studies have been conducted on this site (Keller, 1989; Schulte et al., 2006). The KP Boundary is located between the calcareous nannofossil zones CC26 and NP1 and foraminiferal zones CF1 and P0, which means the Brazos River sites are latest Cretaceous/ early Paleogene in age (Keller, 1989; Mai et al., 2003; Schulte, et al., 2006). The KP Boundary is defined by the first appearance of P0 foraminfera (*Woodringina hornerstownensis*, *Parvularugoglobigerina extensa* and *Globoconusa daubjergensis*), the iridium anomaly, the mass extinction, and the presence of spherules (Gradstein et al., 2004; Keller et al., 2008b). The KP Boundary complex at the Brazos River section is composed of a basal

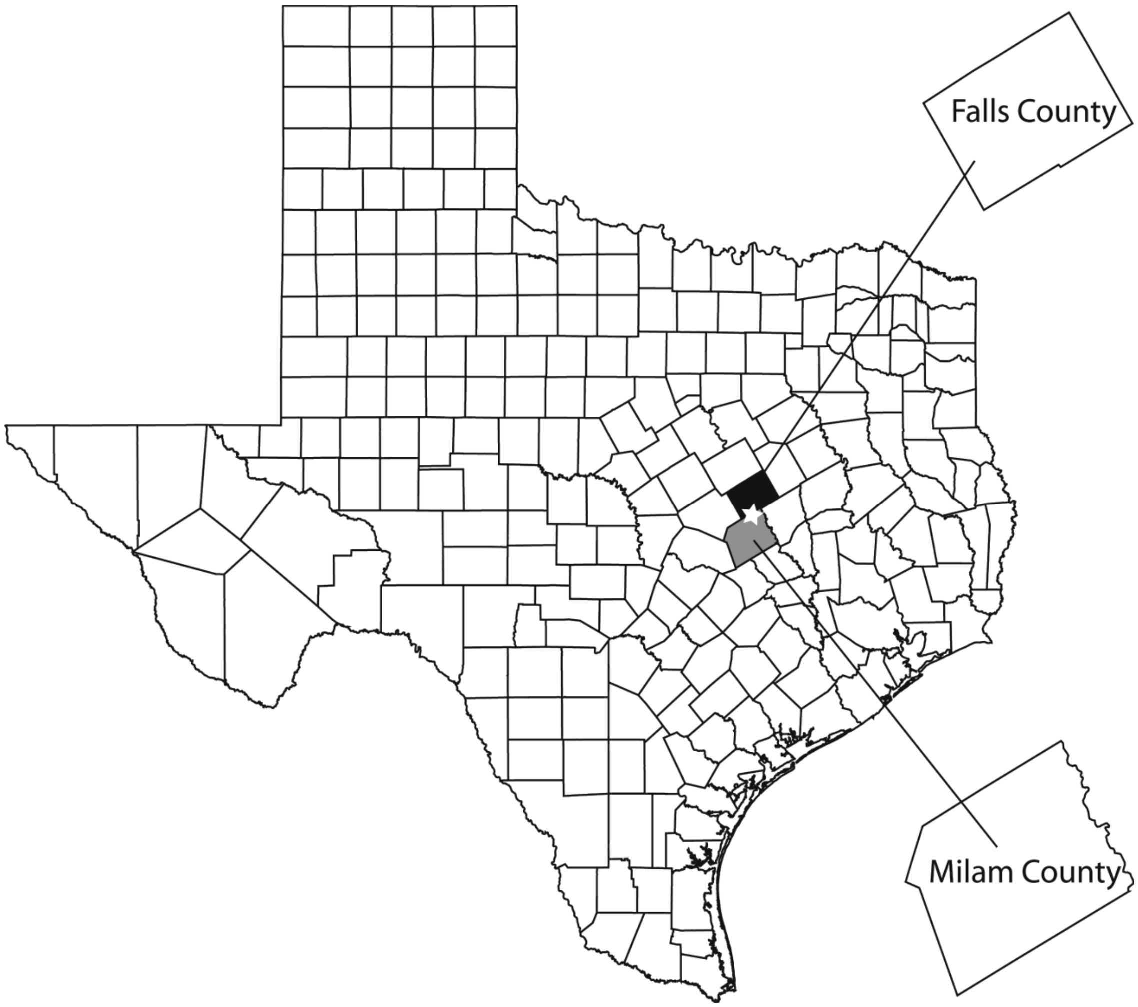


Figure 1: This is a map of Texas with Falls County and Milam County highlighted. The Brazos River site is denoted by the star.

conglomerate bed unconformably overlaying the Corsicana Formation (Yancey, 1996; Schulte et al., 2006). On top of that is a spherulitic conglomerate bed that contains purported impact ejecta (Schulte et al., 2006). The granular sand beds are intercalated with the hummocky cross-bedded sandstone units (Schulte et al., 2006). There are one to four repeating sequences of hummocky cross-bedded sandstone overlaying a granular sand bed unit (Yancey, 1996) (Figure 2). The Brazos River section is interpreted as having been deposited in several high-energy events (Schulte et al., 2006). The granular sand bed units contain the vertebrate fossils (Figure 3) (Janus and Stidham, 2008a; 2008b).

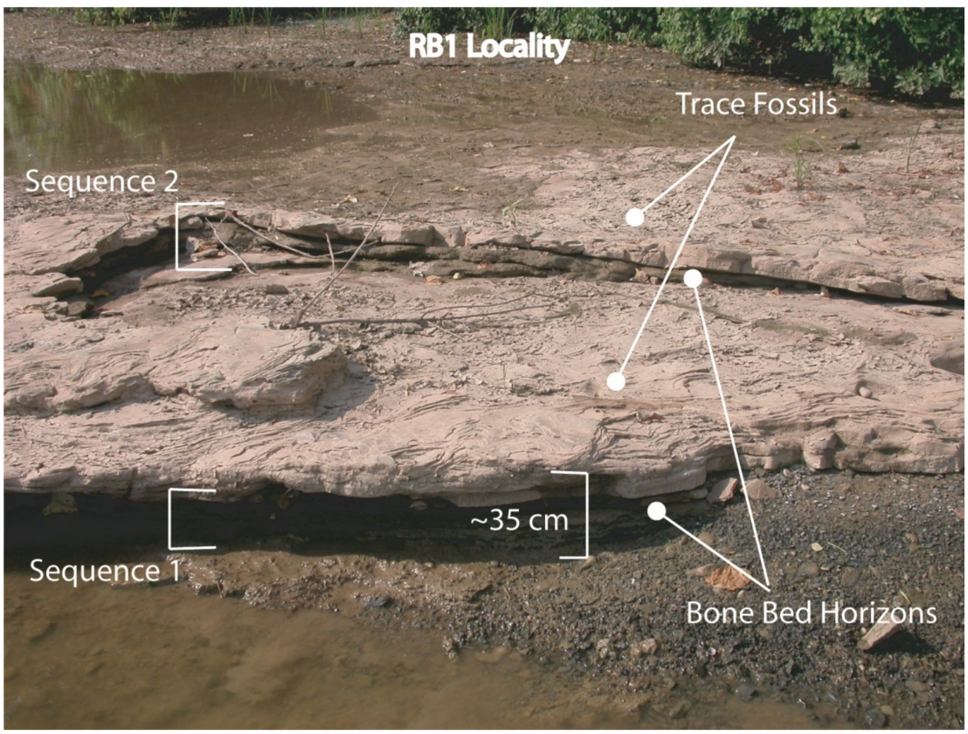


Figure 2: This is a photo of the KP Boundary section on the Brazos River at the RB1 locality. Trace fossils are marked, as well as the two bone beds and repeating sandstone sequences.

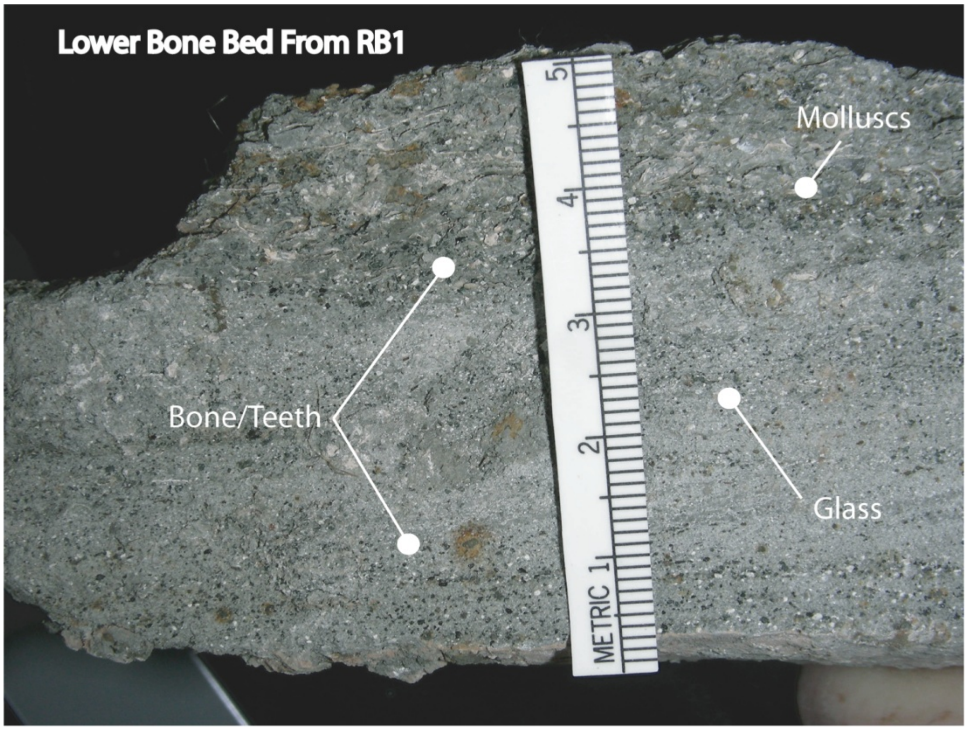


Figure 3: This is a close up of a piece of the lower bone bed from RB1. The bones, teeth, molluscs, and glass spherules are visible.

The Brazos River site is unique because it is the only site in the world where vertebrate fossils are found in KP Boundary sediments making it temporally well-constrained (Janus and Stidham, 2008a). This allows for a unique opportunity to study marine vertebrate extinctions at the KP Boundary. Thousands of bony fish and chondrichthyian elements have been sorted out from the sediment (Janus and Stidham, 2008b). There is no evidence of significant reworking of fossils because all of the microfossils found in this site are latest Cretaceous (Keller, 1989; Schulte et al., 2006). Therefore the vertebrate fossils are unlikely to be significantly reworked from much older sediments because they would not be selectively reworked from their original sediments, so microfossils from other zones would be present in the KP sediments. The fossils appear to have been transported because the bones are fragmentary and the roots of the fossilized teeth are completely or partially broken, but the crowns on the teeth are still sharp so they haven't been significantly transported or the crowns would have worn down as well.

Controversies and questions

There is a lot of debate on whether the KP mass extinction was caused by the bolide impact or if it was the result of other factors such as volcanism at the Deccan Traps (Keller et al., 2008a). There is evidence that the bolide impact in the Gulf of Mexico occurred 300,000 years before the boundary (Keller, 2007), that would imply that a single impact was not the causative factor for an extinction at the KP boundary. There is some evidence that the Deccan Traps played a role in the KP mass extinction because that volcanism coincided with extinction (Keller et al., 2008). There is also evidence that there were multiple impacts across the KP boundary (Stinnesbeck et al., 1999; Gale, 2006). This may have played a role in the KP mass extinction. The bolide collision at Chicxulub on the Yucatan Peninsula could have caused the KP mass extinction because it's "the largest probable impact crater on earth" and KP boundary age (Hildebrand et al., 1991, p. 871)

There is a lot of debate as to whether the extinction was rapid or gradual (Keller, 1989; Mai et al., 2003). There is a low biodiversity of Chondrichthyes in the Coniacian, and it increases until the end of the Maastrichtian then rapid decreases at the KP Boundary (Kriwet and Benton, 2004). Current calculated global extinction rates (34% $\pm$ 11%) for chondrichthyian genera (Kriwet and Benton, 2004) are consistent with the global extinction rates of other genera of organisms. Other faunas, such as the fauna from the Arkadelphia Formation also support the idea of a mass extinction because out of all the Maastrichtian species found at that site only one survived within 100,000 years of the KP boundary (Becker et al., 2006).

CHAPTER II

METHODS

Approximately 20 kilograms of sediment was collected from each of the Brazos River sites RB1, RB2, and RB3 (Figure 2 and Figure 3). The sediment was taken back to the Stidham lab at Texas A&M University in College Station, Texas. There it was screen washed in a #40 sieve (0.425 mm mesh) using a solution of Calgon™ and water so all fossils larger than 0.425 mm were saved and the fine sediments were removed. Once the concentrated sediment was dry it was stored in a plastic freezer bags. RB3 was sorted through in the lab under a dissecting microscope. All vertebrate fossils were sorted out from the other fossils and the processed sediment. The vertebrate fossils were then either collected in a storage vial or placed in individual specimen vials and pin-mounted. The pin-mounted specimens were then labeled with specimen numbers and identified (See Appendix A).

Specimens were identified based their morphological characteristics. Various orders of Chondrichthyes exhibit varying morphological characteristics in their dentitions and "dental characters provide at least some phylogenetic signal" (Shimada, 2005, p. 63). To identify fossil specimens from the Brazos River site, fossil specimens were compared to photographs and desciptions from the literature. In comparing the fossil specimens to photographs, descriptions, and actual specimens of both extinct and extant fish it is possible to identify those fossil specimens. There are many features of teeth that are very important for the identification process such as the crown shape, the size of the crown in comparison to the root, the number of cusps and cusplets present, whether the cutting edge is serrated or not, whether the cutting edge extends the full length of the crown, whether the crown is ornamented or smooth, the crown's symmetry, whether the labial flange overhangs the root or not, what the histology of the tooth is (orthodont or osteodont), whether the crown is flat or bulbous, and concave or convex. The structure of the root is (anaulacorhizous, hemiaulacorhizous, holaulacorhizous, or polyaulacorhizous) is also very important for identification. Characteristics that are important for identification when looking at the root are: 1) whether the root is bilobate or not, 2) whether a nutrient groove is present or not, 3) where and how many nutrient foramen are present and what direction they are facing, 4) whether the lingual protuberance is prominent or reduced, 5) whether the basal attachment surface is flat or concave. In addition to those characteristics, the size of the tooth should be considered as well. In order to identify the specimen, it is important to take into account all of these characteristics because each genus and species has a unique combination of these characteristics.

The Paleobiology Database (Paleobiology Database, 2009) (in addition to Cappetta, 1987) was used to compile Table 3 in the following manner: "The data were downloaded from the Paleobiology Database on April 11, 2009, using 'Search: Fossil Collection Records' using the following parameter: Taxon name = *Cantioscyllium*". The genera *Chiloscyllium, Pararhincodon, Squalicorax, Carcharias, Scyliorhinus, Galeorhinus, Rhombodus, Rhinobatos, Iscyrhiza, Sclerorhynchus,* and *Raja* also were searched in the same manner as *Cantioscyllium*. The Paleobiology Database did not have information for *Plicantoscyllium* so Cappetta, 1987 was used instead.

CHAPTER III

RESULTS- SYSTEMATIC PALEONTOLOGY

Class CHONDRICHTHYES Huxley, 1880
Subclass ELASMOBRANCHII Bonaparte, 1838
Cohort EUSELACHII Hay, 1902
Subcohort NEOSELACHII Compagno, 1977
DENTICLES

Material: RB3-1 to RB3-13, RB3-736, RB3-753 to RB3-756, RB3-876, RB3-892, RB3-907, RB3-925, elasmobranch denticles.

Description: Denticles resemble teeth. They have crowns that vary in shape and size. Sometimes folds and striations are present, sometimes they are absent. They typically have short broad bases, but some may have taller ones.

Discussion: It is difficult to tell what species, genus, or family of elasmobranchs the denticle belongs to. Elasmobranchs have denticles all over their bodies, and they vary by region of the body (Cappetta, 1987). Denticles are separated from teeth due to the lack of foramen on the "root".

Order ORECTOLOBIFORMES Applegate, 1972
incertae sedis

Material: RB3-759- to RB3-763, RB3-903, RB3-921, RB3-932, teeth

Description: The roots are broken. The crown is shaped similar to *Chiloscyllium* but with two small cusplets, one on either side of the main crown.

Discussion: This could possibly be another morphotype of *Chiloscyllium*, but more material and further research will be needed in order to assign a taxon name at the genus and species level.

Family GINGLYMOSTOMATIDAE Gill, 1862
Genus *CANTIOSCYLLIUM* Woodward, 1889
MORPHOTYPE 1
(Figures 4A and 4B)

Material: RB3-30, RB3-35, RB3-36, RB3-37, RB3-802, RB3-916, RB3-921, RB3-965, eight teeth.

Description: These teeth are around 2mm from the medial edge to the distal edge. Striations are present all the way up the crown but end right before the cusp apex. The crown is shorter than it is wide. The main cusp leans slightly distally. Reduced lateral cusplets may be present. The bottom part of the crown is rounded and slightly overhangs the root. The crown is dark in color, except for the very tip, which is yellowish. The labial side is almost completely flat from a lateral view. The root is strongly hemiaulacorhizous. From a basal view the root is triangular with the apex of the triangle being the lingual protuberance. A prominent nutrient foramen is present on the lingual protuberance. A large nutrient foramen is located in the middle of the basal aspect of the root. A third nutrient foramen is located on the distal side of the lingual protuberance.

Discussion: The only other Maastrichtian record of *Cantioscyllium* comes from the Kemp Clay reported by Case and Cappetta (1997). The species of these specimens has not yet been identified, but *Cantioscyllium decipiens* could possibly be assigned to these specimens. The approximate 20 million year temporal gap between the Coniacian and Late Maastrichtian (Gradstein et al., 2004) prevents a positive identification of these specimens as *C. decipiens* until more specimens are found in the sediment collected from RB3 so that a more complete range of variation within the species can be examined in order to better compare these teeth to the teeth of *C. decipiens* (Cappetta, 1987; Welton and Farish, 1993). This genus is not known to survive the KP Boundary (Cappetta, 1987; Welton and Farish, 1993; Paleobiology Database, 2009).

MORPHOTYPE 2
(Figures 4E-4G)

Material: RB3-29, RB3-30, RB3-800, RB3-801, RB3-803, five teeth.

Description: These teeth are generally 2-3 mm wide from the medial side to the distal side. The main cusp is very large and broad. One pair of small lateral cusplets are present and are very small. In general the crown is very symmetrical. The crown slightly overhangs the root on the posterior side and some striations are present. The cutting edge is not serrated. The labial side is moderately convex. The lingual side is very concave. The labial apron is rounded. On the bottom-most portion of the labial apron are two small bulbous areas. On the more lateral teeth the main cusp slightly leans distally. The root is hemiaulacorhizous. The nutrient foramen is sitting central in the lingual protuberance and is facing backwards. A large central foramen is located in the center of the basal root surface.

Discussion: These teeth strongly resemble *Cantioscyllium meyeri* except they are larger than what Case and Cappetta (1997) describe. *C. meyeri* was first described from the Kemp Clay (Case and Cappetta, 1997), and *C. meyeri* also was identified from the Campanian in South Carolina (Cicimurri, 2007).

Genus PLICANTOSCYLLIUM Case and Cappetta, 1997
PLICANTOSCYLLIUM ANTIQUUM Case and Cappetta, 1997
(Figure 4C)

Material: RB3-16, one tooth.

Description: This single specimen represents an anterolateral tooth. The main cusp is large and triangular with one pair of small triangular lateral cusplets. The cusplets are about one third the height of the crown. There is a triangular groove on the labial surface between the main cusp and each of the cusplets. The cutting edge lacks serrations. The main cusp leans slightly distally. The labial side of the tooth is flat. The tooth measures about 1mm wide, from the medial edge to the lateral edge. The root is completely broken off.

Discussion: This genus was first described from the Kemp Clay (Case and Cappetta, 1997). This specimen does not belong to the species *Plicantoscyllium derameei* because in *P. derameei* the tooth is smaller in general, the main cusp is half of the crown height, and there is only one pair of lateral cusplets. This species is not known to survive the KP boundary (Case and Cappetta, 1997).

Family HEMISCYLLIIDAE Gill, 1862
Genus *CHILOSCYLLIUM* Muller and Henle, 1837
(Figure 4D)

Material: RB3-33, one tooth.

Description: There is one main cusp and no lateral cusplets. The crown flairs out at the base. The labial side is flat. Faint striations are present on the base of the crown.

Discussion: This genus is also found in the New Egypt Formation (Maastrichtian) in New Jersey (Case et al., 2001). There is not enough material from RB3 to identify the specimen to the species level. This genus extends to the present day (Cappetta, 1987).

Family PARASCYLLIDAE Gill, 1862
Genus *PARARHINCODON* Herman in Cappetta, 1976
(Figures 4H-4I)

Material: RB3-27, RB3-737, two anterior teeth.

Description: These teeth tend to be very small; no larger than 1 mm. These teeth are anterior teeth because anterior teeth have asymmetric root lobes. The teeth have asymmetric root lobes in labial view. In labial view, the teeth form an isosceles triangle with the apex being the shorter root lobe. The root lobes are elliptical in labial view. The main cusp of the crown is slightly rounded to pointy. A lateral cusplet is present on the side with the shorter root lobe. Faint striations are present on the crown near the crown foot. In mesial view, the labial side of the crown is slightly convex. The lingual side is slightly concave. In mesial view, the whole crown is slightly boxy in shape. The crown is either translucent or slightly tinted orange. The lingual protuberance is reduced. The root is hemiaulacorhizous.

Discussion: The only Maastrichtian age *Pararhincodon* species, *Pararhincodon groessenssi* is from Germany (Herman, 1982). In Texas, the only *Pararhincodon* are Cenomian and Turonian in age (Welton and Farish, 1993). *Pararhincodon* is easy to separate from other genera because of its asymmetric root lobes and small size.

Order HETERODONTIFORMES Blainville, 1916
Family HETERODONTIDAE Gray, 1851
Genus *HETERODONTUS* Blainville, 1816
(Figures 5A and 5B)

Material: RB3-28, RB3-740, RB3-894, three anterolateral teeth.

Description: There is one big main cusp, a pair of medium lateral cusplets, and a pair of small lateral cusplets. Although the cusplets are paired, the shape of the each cusplet is not symmetrical to the shape of its counterpart. The crown is darkish brown and the tips of the cusps are yellowish. The cutting edge lacks serrations. The labial side is generally flat except at the cusps were it concaves up. These teeth are generally about 2 mm wide from the medial edge to the distal edge. In labial view the crown overhangs the root and makes a wide “w” with a rounded base in outline. The height of the root makes up most of the bulk of the tooth because the crown is very thin and flat. The root is bilobate. The root is horseshoe shaped/ wishbone shaped in lingual view. The root is hemiaulacorhizous. Four prominent nutrient foramen are present on the root (one on the front of the lingual protuberance, one on the basal surface of the lingual protuberance, and the other two are located on either side of the lingual protuberance). The lingual protuberance is slightly reduced.

Discussion: This genus is found in the Kemp Clay (Case and Cappetta, 1997) and the New Egypt formation (Case et al., 2001). This genus is easy to distinguish from other genera because of its distinctive flat, multicusped cusped crown and its horseshoe shaped root. The specimen could not be identified to the species level because a match was not found in the literature investigated. This genus is extant (Cappetta, 1987).

Order LAMNIFORMES Berg, 1958
Family ANACORACIDAE Casier, 1947
Genus SQUALICORAX Whitley, 1939
SQUALICORAX PRISTODONTUS Agassiz, 1843
(Figure 5C)

Material: RB3-1100, RB3-1101, two complete teeth and RB3-17, RB3-18, RB3-19, RB3-21, RB3- 22, RB3-722 to 735, RB3-775 to 776, RB3-778, RB3-780-791, RB3-866,

RB3-882, RB3-883, RB3-886, RB3-912, RB3-923, RB3-924, RB3-926, RB3-977, tooth fragments.

Description: This species is characterized by a heavily serrated cutting edge along the entire perimeter of the crown. Some of the serrations have a few even finer serrations on them. One cusplet is present on distal side of the main cusp. The main cusp leans distally. The angle between the main cusp and the cusplet is slightly obtuse. The tooth is quite labio-lingually flattened, with the labial side being slightly convex and the lingual side being slightly concave. The root is anaulacorhizous. The root extends very high on the crown. The largest tooth is 1.5 cm medially to distally. The lingual protuberance is greatly reduced to the stage of almost being absent. Most of the *Squalicorax* specimens are fragments of the crown. Only two complete *Squalicorax pristodontus* teeth have been recovered (RB3-1100 and RB3-1101).

Discussion: This species is very common in the Maastrichtian of Texas (Welton and Farish, 1993). This species is reported from the Littig Member of the Kincaid Formation in Texas (Bilelo, 1969). This species has a very wide range and is found everywhere except Antarctica during the Cretaceous (Cappetta, 1987). *S. pristodontus* is distinguished from *Squalicorax kaupi*, another common Maastrichtian species of *Squalicorax,* because the root extends higher up on the crown than in *S. kaupi* and the angle between the main cusp and the distal blade tends to be more obtuse is *S. pristodontus* (Welton and Farish, 1993).

Family ODONTASPIDIDAE Muller and Henle, 1839
Genus *CARCHARIAS* Rafinesque, 1810
(Figures 5H and 5I)

Material: RB3-53, RB3-905, two teeth.

Description: This tooth is about 1mm wide and about 2mm long. The crown is long and thin, and there are no lateral cusplets present. From a labial view, the base of the crown forms an upside down wide “v”. Striations are present all along the “v” of the crown. There are no striations on the lingual side. The crown is dark brown near the bottom and yellows towards the tip. The cutting edge is not serrated. The root is holaulacorhizous. The root is bilobate and outlines the “v” of the labial side on the lingual side of the tooth. A moderate nutrient groove separated the two lobes of the root. A single nutrient foramen is present in the lingual protuberance. The lingual protuberance is reduced.

Discussion: This genus is present in the Kemp Clay and the Arkadelphia Formation (Case and Cappetta, 1997; Becker et al., 2006). This genus is very wide spread throughout the world during the Cretaceous, similar to *Squalicorax* (Welton and Farish, 1993). The species could not be identified because it did not strongly resemble any of the species in the literature investigated and perhaps more fossil material is needed. In comparing it to the Kemp Clay fauna, *Carcharias heathi* can be ruled out because this specimen has striations on the lingual face, *C. heathi* does not. There also is a size discrepancy of several millimeters (Case and Cappetta, 1997). *Carcharias* cf. *samhammeri* also can be ruled out because that species too lacks striations on the enamel (Case and Cappetta, 1997). The species *Carcharias holmdelensis* from the Kemp Clay and the Arkadelphia Formation has a slight resemblance to the specimen from RB3. The main difference between *C. holmdelensis* and the specimen from RB3 is the presence of a pair of lateral cusplets on *C. holdelensis* and that are absent on the specimen from RB3 (Case and Cappetta, 1997; Becker at al., 2006).

Order CARCHARHINIFORMES Compagno, 1973
Family SCYLIORHINIDAE Gill, 1862
incertae sedis

Material: RB3-60, RB3-61, RB3-62, RB3-118 to RB3-144, RB3-846 to RB3-856, RB3-864, RB3-869, RB3-872, RB3-873, RB3-874, RB3-889, RB3-891, RB3-895, RB3-900, RB3-908, RB3-910, RB3-913, RB3-914, RB3-915, teeth.

Description: These teeth have the same general shape as *Scyliorhinus* morphotypes 1 and 2. They have varying degrees of morphologies, such as striations, between the two morphotypes. The root is the same bilobate, hemiaulacorhizous root that is characteristic of this family.

Discussion: It is difficult to assign these to other the other morphotypes because of their varying degrees of morphological traits. But, I also hesitate to designate them as their own morphotype or species because of the nature of the dentition of the Family Scyliorhinidae. The dentition of extant Scyliorhinidae varies so much between males and females of the same species making it difficult to interpret their fossil record (Compagno et al., 2005).

Genus *SCYLIORHINUS* Blainville, 1816
MORPHOTYPE 1
(Figures 5E and 5F)

Material: RB3-57, RB3-58, RB3-65, RB3-66, RB3-67, RB3-68, RB3-69, RB3-70, RB3-71, RB3-72, RB3-73, RB3-74, RB3-75, RB3-76, RB3-77, RB3-78, RB3-98, RB3-100,

RB3-101, RB3-102, RB3-103, RB3-104, RB3-105, RB3-106, RB3-107, RB3-108, RB3-114, RB3-115, RB3-116, RB3-117, teeth.

Description: These teeth have a large central cusp and a small cusplet on either side of the main cusp. The teeth are approximately 1-2 mm tall. The lingual side of the tooth is slightly concave, and the labial side is flat. In labial view, with the apical end of the cusp pointing up, the main cusp leans slightly to the right and the right cusplet leans slightly towards the midline of the tooth. The cusplets are approximately one-fifth of the height of the main cusp. The crown is completely void of any sort of striation or marking. The cutting edge lacks serrations. The tooth has a prominent lingual protuberance that is slightly flattened on the apical side and is rounded. The root is bilobate, with each side lobe of the root being round from occlusal view and flat on the basal attachment surface. The lobes resemble Mickey Mouse ears. They are fairly large in comparison to the crown, and from occulsal view can be seen extending slightly past the crown on the labial side. The nutrient foramen is positioned on the lingual side of the lingual protuberance. The root is hemiaulacorhizous.

Discussion: This family is common in Maastrichtian of Texas (Welton and Farish, 1993). This tooth is from the family Scyliorhinidae because of its size, lateral cusplets, “the presence of a large lingual protuberance, very flat basal attachment surface, general absence of a nutrient groove, and the presence of widely divergent root lobes” (Welton and Farish, 1993, p. 125). This family also makes up the largest percentage of individual chondrichthyian specimens from RB3 (Appendix). Morphotype 1 differs from Morphotype 2 in that Morphotype 1 lacks any sort of ornamentation on the crown.

Morphotype 1 and Morphotype 2 also have slightly different root shapes, Morphotype 1's roots are more rounded in labial view. Morphotype 1 did not resemble any of the species of *Scyliorhinus* in the literature that was investigated.

MORPHOTYPE 2
(Figure 5G)

Material: RB3-59, RB3-63, RB3-64, RB3-79, RB3-80, RB3-81, RB3-82, RB3-83, RB3-84, RB3-85, RB3-86, RB3-87, RB3-88, RB3-89, RB3-90, RB3-91, RB3-92, RB3-93, RB3-94, RB3-95, RB3-96, RB3-97, RB3-99, teeth.

Description: These teeth have large central cusps and a small cusplets on either side of the main cusp. The teeth are approximately 1 mm tall. The lingual side of the teeth is slightly concave, and the labial side is flat. In labial view, with the apical end of the cusp pointing up, the main cusp leans slightly to the right and the right cusplet leans slightly towards the midline of the tooth. The cusplets are very small in comparison to the main cusp. The main cusp has strong striations on the labial side extending from the base of the crown to approximately half way up the cusp. Where the striations end, the cusp changes from a brownish color to a yellowish color. The striations are present on both the labial and lingual side, becoming less pronounced nearer to the cutting edge. The cutting edge lacks serrations. The tooth has a prominent lingual protuberance that is slightly flattened on the apical side and is rounded. The root is bilobate, with each side lobe of the root being round from occlusal view and flat on the basal attachment surface. The lobes are slightly rounded and extend slightly past the crown in labial view. The nutrient foramen is positioned on the lingual side of the lingual protuberance. The root is hemiaulacorhizous.

Discussion: Morphotype 2 resembles *Scyliorhinus ivagrantae* from the Kemp Clay (Case and Cappetta, 1997). Both Morphotype 2 and *S. ivagrantae* are small, have very small lateral cusplets, and have striations and folds on the crown (Case and Cappetta, 1997). Perhaps after more rigorous examination and the collection of more specimens Morphotype 2 can be assigned to the species *S. ivagrantae*.

Family TRIAKIDAE Gray, 1851
incertae sedis

Material: RB3-751, RB3-752, RB3-865, three teeth.

Description: These teeth resemble *Galeorhinus* except cusplets are present on both sides of the main crown instead of just on the distal end like in *Galeorhinus*.

Discussion: More material and further research will be required in order to assign these specimens a genus or species name. These teeth are most likely a Triakidae because of the shape of the crown (Cappetta, 1987; Welton and Farish, 1993).

Genus *GALEORHINUS* Blainville, 1816
(Figure 5D)

Material: RB3-31, RB3-32, RB3-742 RB3-771, RB3-772, RB3-773, RB3-927, seven teeth.

Description: *Galeorhinus* has one large main cusp that leans distally with three to four lateral cusplets on the distal side of the main cusp. The medial side of the main cusp lacks cusplets. The cutting edge lacks serrations. The base of the crown is rounded. The labial side is flat. The base of crown slightly overhangs roots and has striations. From a labial view the tooth has a general triangle shape. The root is holaulacorhizous.

Discussion: This genus is common in the Maastrichtian in Texas and has been identified from the Littig Member of the Kincaid Formation (Welton and Farish 1993). The species *Galeorhinus* aff. *girardoti* was identified from the Kemp Clay (Case and Cappetta, 1997). These specimens resemble the Kemp Clay species except that it has some serrations or cusplets on the medial edge.

Superorder BATOIDEA Compagno, 1973
incertae sedis

Material: RB3-766, RB3-871, two teeth.

Description: These have a bilobate root. The crown has pustule-like ornamentation on it. The crown is very broken.

Discussion: These teeth slightly resemble *Rhombodus* but due to the condition of the specimens it is difficult to assign a genus or species name.

Order MYLOBATIFORMES Compagno, 1973
Family RHOMBODONTIDAE Cappetta, 1987
Genus *RHOMBODUS* Dames, 1881
RHOMBODUS BINHORSTI Dames, 1881
(Figures 6A-6D)

Material: RB3-23, RB3-24, RB3-25, RB3-792, RB3-893, five teeth.

Description: In occlusial view, the crown of *Rhombodus* is a rhombus, with the acute angles at the medial and distal corners and the obtuse angles at the anterior and posterior corners. In three dimensions, the crown resembles a box with its sides indenting inwards half way down the walls of the box. The vertical faces of the crown also have striations that run from the top of the crown to the bottom. In occlusal view, the crown has little folds and ridges on the surface of the crown that appear to be pock marks when in a lower magnification. The root is holaulacorhizous. The root is bilobate with a deep nutrient groove. The attachment surface of the root lobes are shaped like parabolas.

Discussion: The genus *Rhombodus* is common in the Maastrichtian (Case and Cappetta, 1997; Case et al., 2001). *Rhombodus* is easy to distinguish from other genera of batoids because of its distinctive box shaped crown and bilobated root. These teeth were identified as *R. binhorsti* because of the longitudinal folds on the vertical faces of the crown (Welton and Farish, 1993).

Order RAJIFORMES Berg, 1940
Family RHINOBATIDAE Muller and Henle, 1838
Genus *RHINOBATOS* Linck, 1790
RHINOBATOS UVULATUS Case and Cappetta, 1997
(Figures 6E and 6F)

Material: RB3-40, RB3-41, RB3-42, RB3-43, four teeth.

Description: These teeth tend to be small, about 1 mm wide from the medial edge to the distal edge. The crown tends to be dark brown. The crown is flat and unornamented in occlusal view. In occlusal view, the crown is rhombic in outline, with the wide acute angles of the rhombus being the medial and distal corners, and the obtuse angles of the rhombus being the anterior and posterior corners. The median uvula is large and prominent, and the lateral uvulas are prominent too. The median uvula extends almost to the base of the root. The lateral uvula extend about one third of the way down the median uvula. The transverse keel is shaped like an isosceles triangular, with the apex at the median uvula. The root is bilobate with a very deep and prominent nutrient groove. The nutrient groove is shaped like a circular canal.

Discussion: *Rhinobatos uvulatus* was first described from the Kemp Clay by Case and Cappetta (1997). The Brazos River site RB3 locality is the only other site where *R. uvulatus* has been found. These specimens are different from *R casieri* because they have a smaller thinner crown and are not conical in occlusal view (Case and Cappetta, 1997). These specimens differ from *R. craddocki* in that because *R. craddocki* has a much shorter uvula, the transverse keel is not triangular, and the lateral uvula are not present (Case and Cappetta, 1997).

RHINOBATOS CRADDOCKI Case and Cappetta, 1997
(Figures 6G and 6H)

Material: RB3-38, RB3-39, two teeth.

Description: These teeth are very small (1 mm or less). *Rhinobatos craddocki* has a flat occlusal surface. The labial and lingual surfaces make a 90 degree angle with each other. The occlusal surface is slightly rounded. The medial uvula is very short and reduced. The lateral uvula are completely absent. The root is a bilobate root with a very prominent nutrient groove.

Discussion: *Rhinobatos craddocki* was described from the Kemp Clay by Case and Cappetta (1997). *R. craddocki* is different from *Rhinobatos casieri* because they are much larger than *R. craddocki*. *R. uvulatus* is different than *R. craddocki* because no lateral uvula are present in *R. craddocki* and it is different in occlusal view. Like *Rhinobatos uvulatus* this species is endemic to Texas (Case and Cappetta, 1997).

Family SCLERORHYNCHIDAE Cappetta, 1974
Genus *SCLERORHYNCHUS* Woodward, 1889
SCLERORHYNCHUS PETTERSI Case and Cappetta, 1997
(Figure 7A)

Material: RB3-739, one oral tooth.

Description: The crown is very heavily striated. There is a small point in the middle of the crown. From an occulsal view the crown is elliptical in shape. The tooth is 3mm wide from medial edge to lateral edge. The root is holaulacorhizous. The root is bilobate with a very deep nutrient groove. The root is about two thirds the height of the entire tooth.

Discussion: This species was first described from the Kemp Clay (Case and Cappetta, 1997). This species is also known from the New Egypt Formation (Case et al., 2001). *S. pettersi* is characterized by the high crown (Case and Cappetta, 1997).

Genus *ISCHYRHIZA* Leidy, 1856
ISCHYRHIZA AVONICOLA Estes, 1964
(Figures 7B and 7C)

Material: RB3-26, RB3-738, two rostral teeth.

Description: The crown is short and cone shaped. There are a few ridges on the flange of the crown. The crown is about one third the height of the root. The base of the root is very wide. Starting at the base of the crown to the base of the root the root flairs out.

Discussion: This species is common in the Maastrichtian in Texas (Welton and Farish, 1993). This species has been found in the Littig Member of the Kincaid Formation (Slaughter and Steiner, 1968). This species is distinct from *I. mira* because the crown of *I. avonicola* is much shorter in comparison to the root than the crown of *I. mira* (Welton and Farish, 1993).

Genus *PTYCHOTRYGON* Jaekel, 1894
PTYCHOTRYGON TRIANGULARIS Reuss, 1844
(Figures 7G and 7H)

Materials: RB3-901, RB3-769, RB3-919, three teeth.

Description: The root is broken. There are 3 transverse ridges present on the occlusal surface of the crown. The crown is triangular in shape in occlusal view. The crown is pyramidal in labial view. The transverse ridges are separated.

Discussion: This genus is recorded in Texas (Case and Cappetta, 1997). These specimens are different than *Ptychotrygon agujaensis* because they have prominent transverse ridges, lack smaller ridges, and are pyramidal is shape in labial view (Welton and Farish, 1993).

Family RAJIDAE Bonaparte, 1831
Genus *RAJA* Linnaeus, 1758
(Figures 7D-7F)

Materials: RB3-741, RB3-764, RB3-765, RB3-881, four teeth.

Description: These teeth tend to be very small, no more than 1mm long. The labial side and the lingual side make a 90 degree angle. The crown is completely smooth, there are no striations or indentions like on *Rhombodus.* The crown overhangs the root. All of the edges of the crown are rounded. The root is holaulacorhizous. The nutrient groove is very prominent and is shaped like a circle with the bottom part open in labial view. The roots splays out in the medial-lateral direction.

Discussion: The genus is recorded in the Cretaceous in Texas (Welton and Farish, 1993; Case and Cappetta, 1997). The species could not be identified because it didn't really resemble any of the species in the literature investigated. The genus is extant (Compagno et al., 2005; Paleobiology Database, 2009).

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Composition

I compared the RB3 site to four other late Maastrichtian North America faunas: the Kemp Clay in Texas, the Peedee Formation in North Carolina, the Arkadelphia Formation in Arkansas, and the New Egypt Formation in New Jersey (Case, 1979; Case and Cappetta, 1997; Case et al., 2001; Becker et al., 2006) (Table 1). Every genus found in the Brazos River site is shared among at least one of the four other sites except *Pararhincodon,* that is not shared among any of the North American sites. I used the Simpson Faunal Similarity Index (Table 1) that is the percentage of similar taxa between two sites, to compare my site (RB3) to the four other aforementioned sites. The Simpson's Faunal Similarity Index is calculated by multiplying 100 by the number of common taxa between two fossil assemblages and dividing that number by the number of taxa in the smaller assemblage (Simpson, 1943; Raup and Crick, 1979). The Simpson Faunal Similarity Index (Raup and Crick, 1979) was 86.67% for the Kemp Clay, 66.67% for the Arkadelphia Formation, 46.67% for the New Egypt Formation, and 37.5% for the Peedee Formation. Geographically the Kemp Clay is the closest site to the Brazos River and these sites have the highest similarity index. The Arkadelphia Formation is the next furthest away and has the next highest faunal similarity. The two sites on the Atlantic coast, the New Jersey site and the North Carolina site, have the lowest faunal similarity index. Geographically closer sites would be expected to have higher percentages of because of their proximity to one another. Variables such as water depth would alter the faunal similarity index even in geographically close regions because those environments would be different enough that a different variety of organisms would inhabit those areas.

Table 1. Comparison and Analysis. Comparison of the chondrichthyian fauna found in the Littig Member, site RB3 to the chondrichthyian fauna from the other four formations, the number of species from each formation, and the Simpson's Faunal Similarity (SFS) index (Raup and Crick, 1979; Case, 1979; Case and Cappetta, 1997; Case et al., 2001; Becker et al., 2006).

Genera	Littig	Kemp Clay	Arkadelphia	New Egypt	Peedee
Hybodus					X
Lissodus		X			
Hexanxchus		X			
Squalus		X			
Squatina			X		
Heterodontus	X	X		X	
Cantioscyllium	X	X			
Chiloscyllium	X			X	
Hemiscyllium				X	
Brachaelurus				X	
Ginglymostoma		X	X	X	
Plicatoscyllium	X	X	X		
Pseudodontaspis				X	
Cretorectolobus		X			
Cretolamna		X		X	X
Serratolamna		X	X	X	
Plicantolamna					X
Pseudocorax		X			
Squalicorax	X	X	X	X	X
Carcharias	X	X	X		
Odontaspis		X	X		X
Scapanorhynchus		X			X
Anomotodon		X			
Galeorhinus	X	X	X		
Paleogaleus		X			
Squatigaleus		X			
Scyliorhinus	X	X			
Rhinobatos	X	X	X	X	
Protoplatyrhina		X		X	
Raja	X	X	X		
Ischyrhiza	X	X	X		X
Sclerorhynchus	X	X	X	X	
Schizorhiza			X		
Ptchotrygon	X	X	X	X	
Hamrabatis		X			
Dasyatis		X	X	X	
Couptatezia		X			
Texabatis		X			
Rhombodus	X	X	X	X	X
Ewingia		X			
Total Genera	14	32	16	15	8
Total Species	18	44	17	17	11
SFS Index	100	86.67	66.67	46.67	37.5

Paleoecology

Modern day members of the orders Heterodontiformes, Orectolobiformes, Myliobatiformes, Sclerorhynchidae inhabit warm, shallow, tropical to temperate waters and tend to be benthic feeders (Welton and Farish, 1993; Compagno et al., 2005). Other taxa such as the Lamniformes, Scyliorhinidae, and Rajiformes have broader ranged, inhabiting both shallow waters and deeper waters (Welton and Farish, 1993; Compagno et al., 2005). The large number of identified genera (15) and species (18) indicates high biodiversity of the gulf waters at the time of the KP mass extinction that is consistent with the other late Maastrichtian sites (Case, 1979; Case and Cappetta, 1997; Case et al., 2001; Kriwet and Benton, 2004; Becker et al., 2006) (Table 2). Some species, such as *Rhinobatos uvulatus* and *Rhinobatos craddocki* appear to be endemic to Texas (Case and Cappetta. 997; Janus and Stidham 2008a; 2008b). *Pararhincodon* has only one other known Maastrichtian locality that is in Germany (Herman, 1982; Welton and Farish, 1993; Paleobiology Database, 2009), so its biogeography in the Maastrichtian has been expanded to North America. The Brazos River site also seems to provide a good representation of both pelagic and benthic elasmobranchs. Even though Batoidea specimens represent only a tiny number of the specimens (approximately 30 individual specimens) collected from this site they make up 33% of the identified genera. Other benthic forms, such as the Orectolobiformes and Scyliorhindae are well represented, with Scyliorhinidae making up over 40% of the chondrichthyian specimens collected (Appendix). Pelagic forms are present as well (*Squalicorax* and *Carcharias*), but make up a much smaller percentage of the specimens identified. The lower number of pelagic specimens (only 2 whole *Squalicorax* teeth and two *Carcharias* teeth), suggest that the Brazos River site may have been in shallower marine waters. The chondrichthyian fauna is consistent with marine palynology data that suggest the ocean was receding, that would cause the ocean to become shallower (Prauss, 2008). These palynological data also show that the ocean was a warm, tropical to subtropical, that is also consistent with the elasmobranch fauna because members of the extant genera inhabit those environments (Prauss, 2008; Welton and Farish, 1993). The molluscan and foraminiferan fossils at the Brazos River site suggest that the environment was a mid- to outer shelf environment (Hansen et al., 1987). This would still be consistent with the elasmobranch fauna because all of the orders of Chondrichthyes found at the Brazos River site contain extant members that inhabit shelf environments (Compagno et al., 2005).

Table 2. Faunal list of Chondrichthyes from RB3. Number of specimens in parenthesis.

SELACHIA
Family Anacoridae - Extinct Crow Shark
Squalicorax pristodontus (2+ fragments)
Family Odontaspidae – Sand Tiger Shark
Carcharias sp. (1)
Family Heterodontidae - Bullhead Shark
Heterodontus sp. (3)
Family Hemiscyllidae - Bamboo Shark
Chiloscyllium sp. (1)
Family Ginglymostomatidae - Nurse Shark
Cantioscyllium Morphotype 1 (3)
Cantioscyllium Morphotype 2 (6)

Table 2 continued.

Plicantoscyllium antiquum(1)
Family Parascyllidae - Carpet Shark-like
Pararhincodon sp. (2)
Family Scyliorhinidae
Scyliorhinus Morphotype 1 (30)
Scyliorhinus Morphotype 2 (23)
Family Triakidae - Tope Shark
Galeorhinus sp. (6)
BATOIDEA:
Family Rhombodontidae - Extinct Ray
Rhombodus binhorsti (5)
Family Rhinobatidae - Guitarfish
Rhinobatos uvulatus (4)
Rhinobatos craddocki (2)
Family Sclerorhynchidae - Extinct Sawfish
Sclerorhyncus pettersi (1)
Ischyrhiza avonicola (2)
Ptychotrygon triangularis (3)
Family Rajidae
Raja sp. (4)

Extinction

It remains unclear whether these genera suffered a gradual or rapid extinction. Of the genera identified, 11 of the 15 (73%) survived beyond the KP Boundary (Table 3). None of the species identified are known to persist past the KP Boundary. My generic extinction rate (27%) is consistent with the global generic extinction rate calculated by Kriwet and Benton (2004), which is 34% ± 11%. *Carcharias, Heterodontus,* *Chiloscyllium, Plicantoscyllium, Pararhincodon, Galeorhinus, Rhombodus, Rhinobatos, Ischyrhiza, Raja* and *Scyliorhinus* all survived into the Paleocene.

Planktonic nannofossil species went extinct very rapidly at the KP Boundary, with a 90% loss of species (Mai et al., 2003). This extinction most certainly would have traveled up the food chain and affected the apex predators, like Chondrichthyes (Gallagher, 1991). Both benthic and pelagic Chondrichthyes would have been affected because plankton is the basis of the food chain in the ocean.

Table 3. Survival and Extinction of Chondrichthyes at RB3. This table compares the genera from the Brazos River site that had their first appearance before the Maastrichtian, during the Maastrichtian, and survived past the KP Boundary (Cappetta 1987; Paleobiology Database, 2009).

Genus	Pre- Maastrichtian	Maastrichtian	Post- Maastrichtian
Squalicorax	X	X	
Carcharias	X	X	X
Heterodontus	X	X	X
Chiloscyllium	X	X	X
Cantioscyllium	X	X	
Plicantoscyllium		X	X
Pararhincodon	X	X	X
Scyliorhinus	X	X	X
Galeorhinus	X	X	X
Rhombodus	X	X	X
Rhinobatos	X	X	X
Sclerorhynchus	X	X	
Ischyrhiza	X	X	X
Ptychotrygon	X	X	
Raja		X	X

LITERATURE CITED

Alvarez, L., Alvarez, W., Asaro, F., Michel, H., 1980. Extraterrestrial cause for the Cretaceous- Tertiary extinction. Science 208: 1095-1108.

Becker, M., Chamberlain, J., and Wolf, G. 2006. Chondrichthyans from the Arkadelphia Formation (Upper Createaceous: Upper Maastrichtian) of Hot Springs Arkansas. Journal of Vertebrate Paleontology; 80: 700-716.

Bilelo, M. 1969. The fossil shark genus *Squalicorax* in North-Central Texas. The Texas Journal of Science 20: 339-348.

Cappetta, H. 1987. Handbook of Paleoichthyology: Chondrichthyes II Mesozoic and Cenozoic Elasmobranchii Volume 3B. Gustav Fisher Verlag, New York. 193 pp.

Case, G. 1979. Cretaceous selachians from the Peedee Formation (Late Maestrichtian) of Duplin County, North Carolina. Brimleyana; 2: 77-89.

Case, G., Borodin, P., and Leggett, J. 2001. Fossil selachians from the new Egypt Formation (Upper Cretaceous, Late Maastrichtian) of Arneytown, Monmouth County, New Jersey. Palaeontographica Abteilung. A 261(4-6): 113-124.

Case, G. and Cappetta, H. 1997. A new Selachian fauna from the Late Maastrichtian of Texas (Upper Cretaceous/ Navarroan; Kemp Formation). Müncher geowissenschaftliche Abhandlungen. Reihe A, Geologie und Palaontologie 34: 131-189.

Cicimurri, D. 2007. A late Campanian (Cretaceous) selachian assemblage from a classic locality in Florence County, South Carolina. Southeastern Geology 45:59-72.

Compagno, L., Dando, M., and Fowler, S. 2005. Sharks of the World. Princeton University Press, Princeton, NJ. 368 pp.

Gale, A. 2006. The Createaceous-Paleogene boundary on the Brazos River, Falls County, Texas: is there evidence for impact-induced tsunami sedimentation? Proceedings of the Geologists' Association 117: 173-185.

Gallagher, W. 1991. Selective extinction and survival across the Cretaceous/Tertiary boundary in the northern Atlantic Costal Plain. Geology 19: 967-970.

Gradstein, F., Ogg, J., and Smith, A. 2004. A Geologic Time Scale. The Press Syndicate of the University of Cambridge, Cambridge, United Kingdom. 589 pp.

Herman, J. 1982. Die Selachier-Zahne aus der Maastricht-Stufe von Hemmoor, Niederelbe (NW= Deutschland). Geologisches Jahrbuch. Reihe A: Allgemeine und Regionale Geologie BR Deutschland und Nachbargebiete, Tektonik, Stratigraphie, Palaeontologie 61: 129-159.

Hildebrand, A., Penfield, G., Kring, D., Pilkington, M., Camargo, Z, A., Jacobsen, S., Boynton, W. 1991. A possible Cretaceous/Tertiary boundary impact crater on the Yucatan Peninsula, Mexico. Geology 19: 867-871.

Janus, T. and Stidham, T. 2008a. Marine vertebrates from the K-P boundary complex, Brazos River, Texas. Geological Society of America, South-Central Section, 42nd annual meeting. Abstracts with programs- Geological Society of America 40(3): 4.

Janus, T. and Stidham, T. 2008b. Marine vertebrates from the KP Boundary in eastern Texas. Geological Society of America, 2008 Annual Meeting. Abstracts with Programs- Geological Society of America. 40(6): 506.

Keller, G. 1989. Extended period of extinctions across the Cretaceous/Tertiary boundary in planktonic foraminifera of continental- shelf sections: implications for impact and volcanism theories. Geological Society of America Bulletin 101: 1408-1419.

Keller, G. 2001. The end-Cretaceous mass extinction in the marine realm: year 2000 assessment. Planetary and Space Science 49: 817-830.

Keller, G. 2003. Biotic effects of impacts and volcanism. Earth and Planetary Science Letters 215: 249-264.

Keller, G. 2007. Chicxulub impact predates K-T Boundary; new evidence from Brazos, Texas. Earth and Planetary Science Letters 255: 339-356.

Keller, G., Adatte, T., Gardin, S., Bartolini, A., Bajpai, S. 2008a. Main Deccan volcanism phase ends near the K–T boundary: Evidence from the Krishna–Godavari Basin, SE India. Earth and Planetary Science Letters 268: 293-311.

Keller, G., Adatte, T., Baum, G., and Berner, Z. 2008b. Reply to ‘Chicxulub impact predates K–T boundary: new evidence from Brazos, Texas’ Comment by Schulte et al. Earth and Planetary Science Letters 269: 621-629

Kriwet, J. and Benton, M. 2004. Neoselachians (Chondrichthyes, Elasmobranchii) diversity across the Cretaceous-Tertiary boundary. Palaeogeography, Paleoclimatology, Palaeoecology 214: 181-194.

Kuiper, K., Deino, A., Hilgen, F., Krijgsman, W., Renne, P., and Wijbrans, J. 2008. Synchronizing rock clocks of Earth history. Science 320: 500-504.

Mai, H., Speijera, R., and Schulte, P. 2003.Calcareous index nannofossils (coccoliths) of the lowermost Paleocene originated in the late Maastrichtian. Micropaleontology 49:189-195.

Paleobiology Database. 2009. The Paleobiology Database. Available at http://www.paleodb.org. Accessed April 11, 2009.

Prauss, M. 2008. The Cretaceous/Paleogene boundary at Brazos River, Texas, USA: A high resolution approach by marine palynology. Palynology. Abstracts of the proceedings of the fortieth annual meeting of the American Association of Stratigraphic Palynologists 32: 268.

Raup, D. and Crick, R. 1979. Measurement of faunal similarity in paleontology. Journal of Paleontology 53: 1213-1227.

Schulte, P., Speijer, R., Mai, H., and Kontny, A. 2006. The Cretaceous- Paleogene (KP) boundary, at Brazos, Texas: sequence stratigraphy, depositional events and the Chicxulub impact. Sedimentary Geology 182: 77-109.

Sepkoski, J. 1989. Periodicity in extinction and the problem of catastrophism in the history of life. Journal of the Geological Society 146: 7-19.

Shimada, K. 2005. Phylogeny of lamniform sharks (Chondrichthyes: Elasmobranchii) and the contribution of dental characters to lamniform systematics. Paleontological Research 9: 55-72.

Simpson, G. 1943. Mammals and the nature of continents. American Journal of Science 241: 1-31.

Slaughter, B. and Steiner, M. 1968. Notes on rostral teeth of ganopristine sawfishes, with special reference to Texas material. Journal of Paleontology 42: 233-239.

Stinnesbeck, W., Keller, G., Adatte, T., Stüben, D., Kramar, U., Berner, Z., Desremeaux, C., and Molière, E. 1999. Beloc, Haiti revisited: multiple events across the KT boundary in the Caribbean. Terra Nova 11: 303-310.

Welton, B. and Farish, R. 1993. The Collector’s Guide to Fossil Sharks and Rays from the Cretaceous of Texas. Before Time. Printed in the United States, 204 pp.

Wilf, P., Johnson, K., and Huber, B. 2003. Correlated terrestrial and marine evidence for global climate changes before mass extinction at the Cretaceous- Paleogene

Boundary. Proceedings of the National Academy of Sciences of the United States of America 100: 599-604.

Yancey, T. 1996. Stratigraphy and depositional environments of the Cretaceous-Tertiary boundary complex and basal Paleocene section, Brazos River, Texas. Transactions of the Gulf Coast Associates of Geological Societies 46: 433-442.

APPENDIX A

FIGURE 4- Orectolobiformes

A- *Cantioscyllium* Morphotype 1 (RB3-36) labial view scale = 3mm
B- *Cantioscyllium* Morphotype 1 (RB3-36) lingual view scale = 3mm
C- *Chiloscyllium* sp. (RB3-33) labial view scale = 1.5mm
D- *Plicantoscyllium antiquum* (RB3-16) labial view scale = 1.5mm
E- *Cantioscyllium* Morphotype 2 (RB3-803) labial view scale = 3mm
F- *Cantioscyllium* Morphotype 2 (RB3-803) distal view scale = 3 mm
G- *Cantioscyllium* Morphotype 2 (RB3-803) lingual view scale = 3mm
H- *Pararhincodon* sp. (RB3-27) apical view scale = 1 mm
I- *Pararhincodon* sp. (RB3-27) distal view scale = 1mm

FIGURE 4

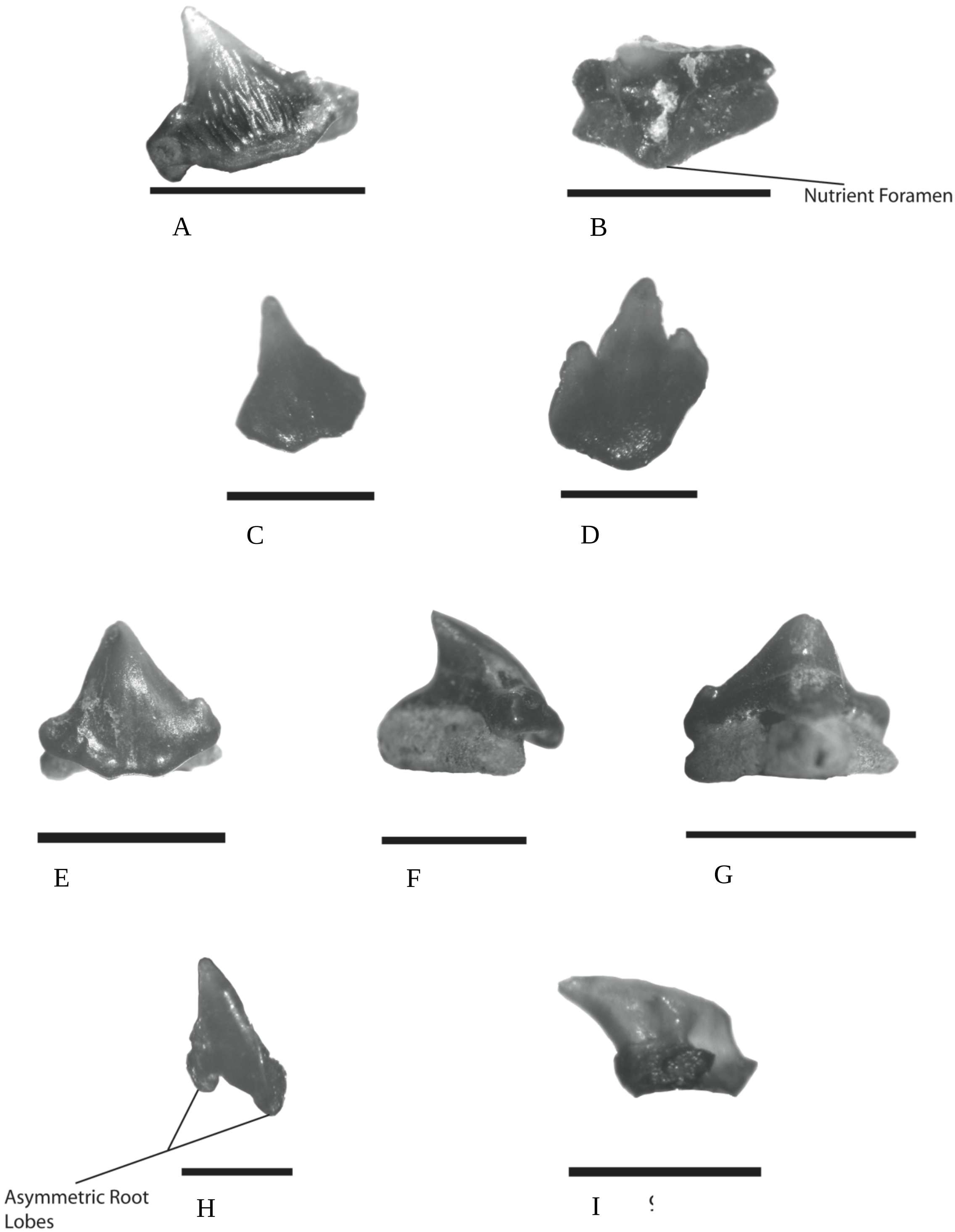


FIGURE 5- Heterodontiformes, Lamniformes, and Carcharhiniformes

A- *Heterodontus* sp. (RB3-28) labial view scale = 1.5mm
B- *Heterodontus* sp. (RB3-28) basal view scale = 1.5mm
C- *Squalicorax pristodontus* (RB3-1100) labial view scale = 1.5cm
D- *Galeorhinus* sp. (RB3-927) labial view scale = 3mm
E- Scyliorhinidae Morphotype 2 (RB3-93) lingual view scale = 1 mm
F- Scyliorhinidae Morphotype 2 (RB3-93) labial view scale = 1mm
G- Scyliorhinidae Morphotype 1 (RB3-70) labial view scale = 1mm
H- *Carcharias* sp. (RB3-55) labial view scale = 1mm
I- *Carcharias* sp. (RB3-55) lingual view scale = 1mm

FIGURE 5

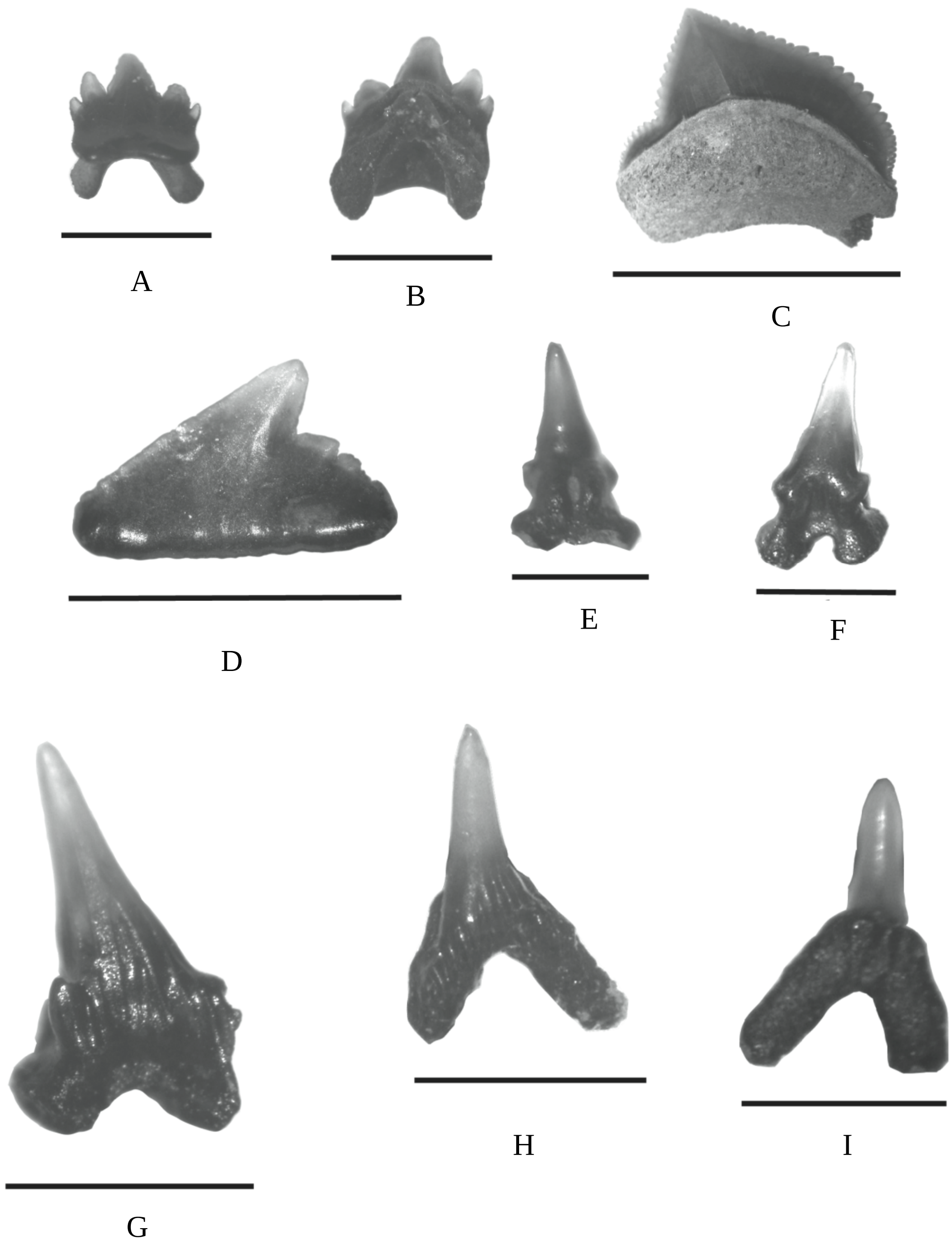


FIGURE 6- Mylobatiformes and Rajiformes

A- *Rhombodus binhorsti* (RB3-23) basal view scale = 4mm
B- *Rhombodus binhorsti* (RB3-23) labial view scale = 4mm
C- *Rhombodus binhorsti* (RB3-23) occlusal view scale = 4mm
D- *Rhombodus binhorsti* (RB3-23) mesial view scale = 3mm
E- *Rhinobatos uvulatus* (RB3-40) lingual view scale = 1.5mm
F- *Rhinobatos uvulatus* (RB3-40) occlusal view scale = 1mm
G- *Rhinobatos craddocki* (RB3-39) lingual view scale = 1mm
H- *Rhinobatos craddocki* (RB3-39) mesial view scale = 1mm
I- *Rhinobatos craddocki* (RB3-39) occlusal view scale = 1mm

FIGURE 6

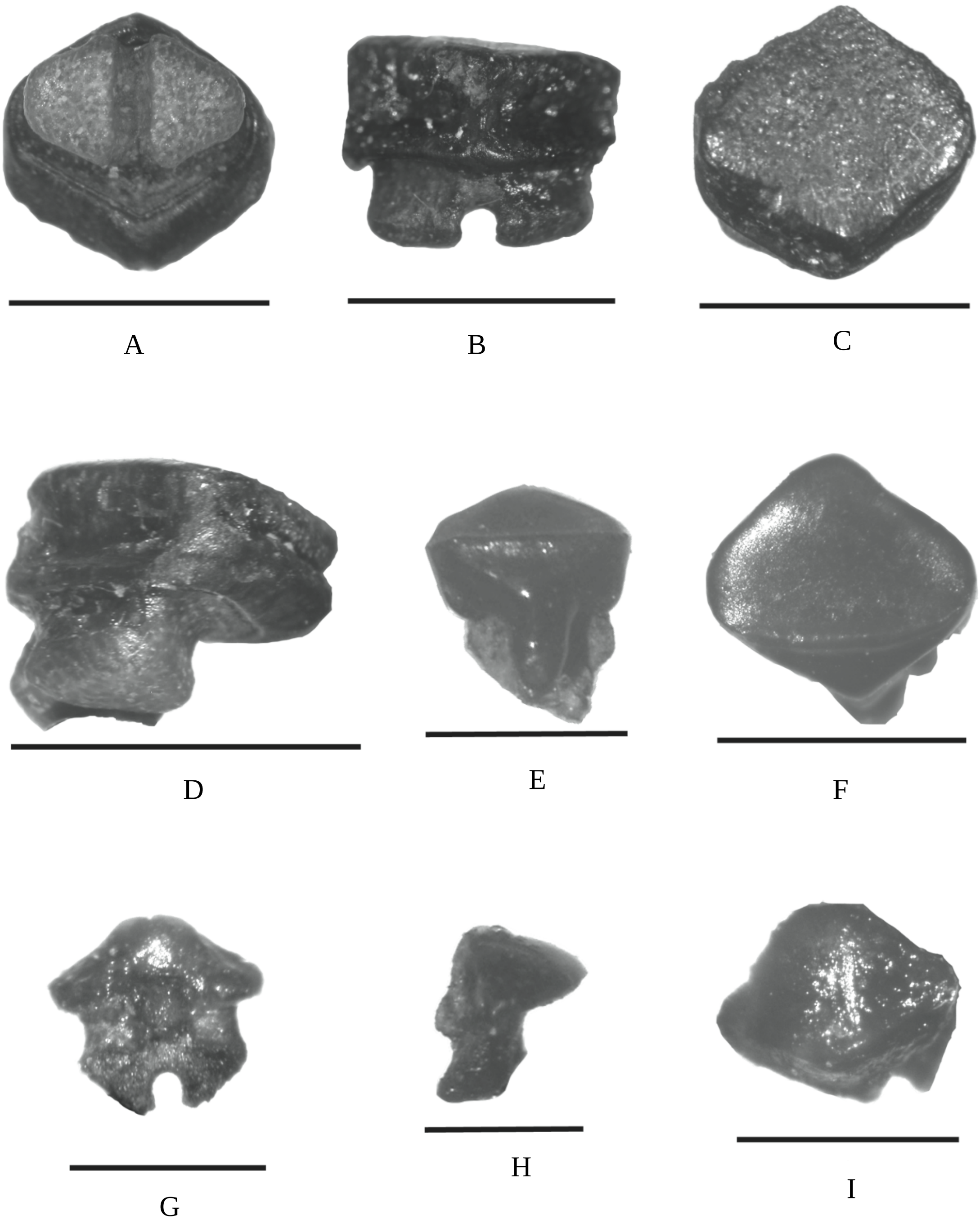
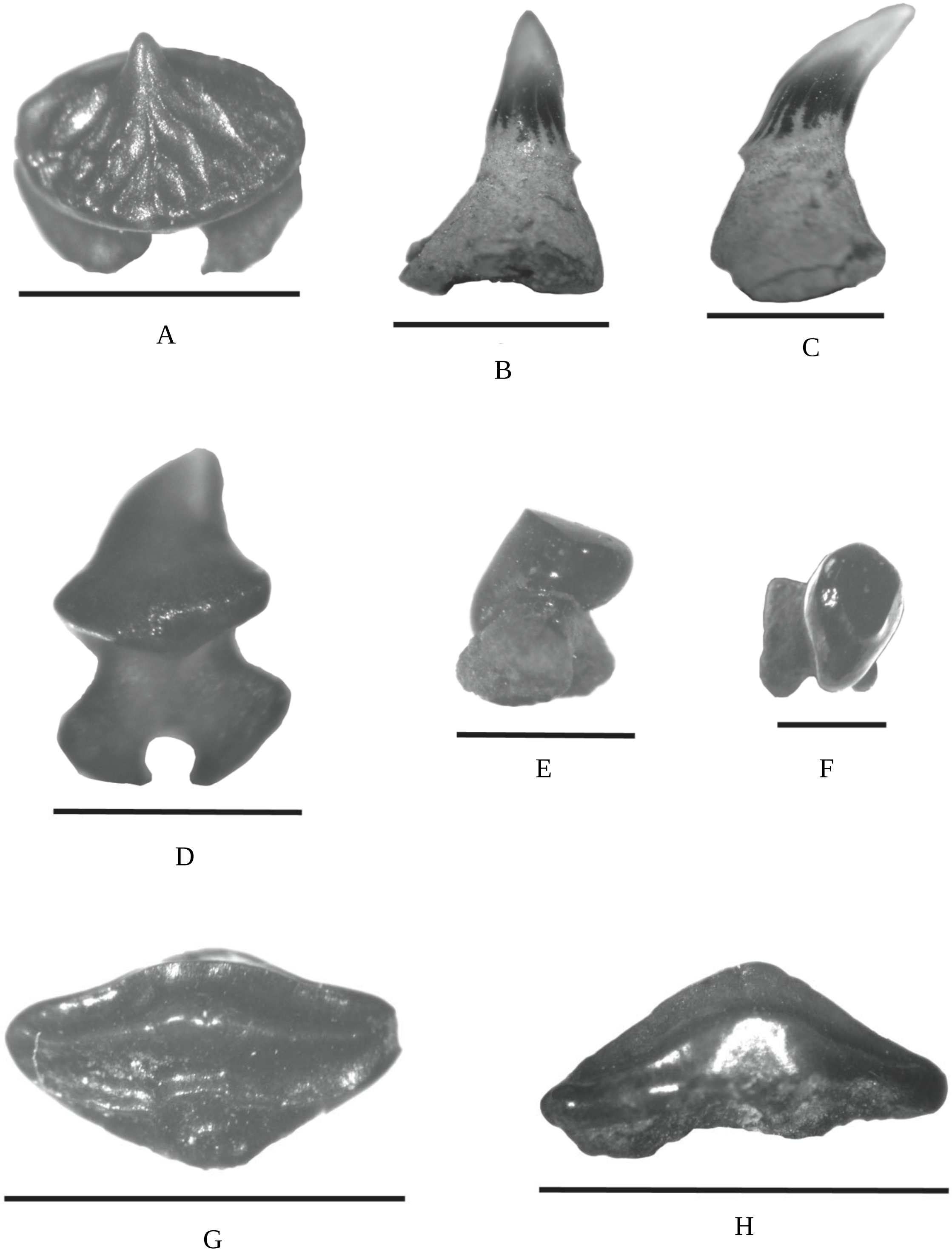


FIGURE 7- Rajiformes

A- *Sclerorhynchus pettersi* (RB3-739) labial view scale = 3mm
B- *Ischyrhiza avonicola* (RB3-738) labial view scale =2mm
C- *Ischyrhiza avonicola* (RB3-738) mesial view scale = 2mm
D- *Raja* sp. (RB3-764) labial view scale = 1mm
E- *Raja* sp. (RB3-741) distal view scale = 1.5mm
F- *Raja* sp. (RB3-741) occusal view scale = 1.5mm
G- *Ptychotrygon triangularis* (RB3-769) occlusal view scale = 3mm
H- *Ptychotrygon triangularis* (RB3-769) labial view scale = 3mm

FIGURE 7



APPENDIX B

This is a list of the specimen numbers of all the chondrichthyian teeth, denticles, and unidentified elements, and all the Osteichthyes teeth and bone fragments from RB3 that have been pin mounted.

1	chondrichthyian denticle type 1	Denticle
2	chondrichthyian denticle type 2	Denticle
3	chondrichthyian denticle type 2	Denticle
4	chondrichthyian denticle type 2	Denticle
5	chondrichthyian denticle type 2	Denticle
6	chondrichthyian denticle type 2	Denticle
7	chondrichthyian denticle type 2	Denticle
8	chondrichthyian denticle type 3	Denticle
9	chondrichthyian denticle type 4	Denticle
10	chondrichthyian denticle type 4	Denticle
11	chondrichthyian denticle type 4	Denticle
12	chondrichthyian denticle type 4	Denticle
13	chondrichthyian denticle type 5	Denticle
14	*Cantioscyllium* morphotype 1	Tooth
15	*Sclerorhyncus* sp.	Tooth
16	*Plicantoscyllium antiquum*	Tooth
17	*Squalicorax* sp.	Tooth fragment
18	*Squalicorax* sp.	Tooth fragment
19	*Squalicorax* sp.	Tooth fragment
20	*Squalicorax* sp.	Tooth fragment
21	*Squalicorax* sp.	Tooth fragment
22	*Squalicorax* sp.	Tooth fragment
23	*Rhombodus binhorsti*	Tooth
24	*Rhombodus binhorsti*	Tooth
25	*Rhombodus binhorsti*	Tooth
26	*Ischyrhiza avonicola*	Rostral Tooth
27	*Pararhincodon* sp.	Tooth
28	*Heterodontus* sp.	Tooth
29	*Cantioscyllium* morphotype 2	Tooth
30	*Cantioscyllium* morphotype 2	Tooth
31	*Galeorhinus* sp.	Tooth
32	*Galeorhinus* sp.	Tooth
33	*Chiloscyllium* sp.	Tooth
34	*Cantioscyllium* morphotype 2	Tooth
35	*Cantioscyllium* morphotype 1	Tooth
36	*Cantioscyllium* morphotype 1	Tooth
37	*Cantioscyllium* morphotype 1	Tooth
38	*Rhinobatos craddocki*	Tooth
39	*Rhinobatos craddocki*	Tooth
40	*Rhinobatos uvulatas*	Tooth
41	*Rhinobatos uvulatas*	Tooth
42	*Rhinobatos uvulatas*	Tooth
43	*Rhinobatos uvulatas*	Tooth

44	*Rhinobatos* sp.	Tooth
45	*Rhinobatos* sp.	Tooth
46	*Rhinobatos* sp.	Tooth
47	*Rhinobatos* sp.	Tooth
48	*Rhinobatos* sp.	Tooth
49	*Rhinobatos* sp.	Tooth
50	*Rhinobatos* sp.	Tooth
51	*Rhinobatos* sp.	Tooth
52	Unidentified Shark	Tooth
53	*Carcharias* sp.	Tooth
54	chondrichthyian denticle?	denticle
55	Unidentified Shark	Tooth
56	Unidentified Shark	Tooth
57	*Scyliorhinus* morphotype 1	Tooth
58	*Scyliorhinus* morphotype 1	Tooth
59	*Scyliorhinus* morphotype 2	Tooth
60	Scyliorhinidae	Tooth
61	Scyliorhinidae	Tooth
62	Scyliorhinidae	Tooth
63	*Scyliorhinus* morphotype 2	Tooth
64	*Scyliorhinus* morphotype 2	Tooth
65	*Scyliorhinus* morphotype 1	Tooth
66	*Scyliorhinus* morphotype 1	Tooth
67	*Scyliorhinus* morphotype 1	Tooth
68	*Scyliorhinus* morphotype 1	Tooth
69	*Scyliorhinus* morphotype 1	Tooth
70	*Scyliorhinus* morphotype 1	Tooth
71	*Scyliorhinus* morphotype 1	Tooth
72	*Scyliorhinus* morphotype 1	Tooth
73	*Scyliorhinus* morphotype 1	Tooth
74	*Scyliorhinus* morphotype 1	Tooth
75	*Scyliorhinus* morphotype 1	Tooth
76	*Scyliorhinus* morphotype 1	Tooth
77	*Scyliorhinus* morphotype 1	Tooth
78	*Scyliorhinus* morphotype 1	Tooth
79	*Scyliorhinus* morphotype 2	Tooth
80	*Scyliorhinus* morphotype 2	Tooth
81	*Scyliorhinus* morphotype 2	Tooth
82	*Scyliorhinus* morphotype 2	Tooth
83	*Scyliorhinus* morphotype 2	Tooth
84	*Scyliorhinus* morphotype 2	Tooth
85	*Scyliorhinus* morphotype 2	Tooth
86	*Scyliorhinus* morphotype 2	Tooth
87	*Scyliorhinus* morphotype 2	Tooth
88	*Scyliorhinus* morphotype 2	Tooth
89	*Scyliorhinus* morphotype 2	Tooth
90	*Scyliorhinus* morphotype 2	Tooth
91	*Scyliorhinus* morphotype 2	Tooth
92	*Scyliorhinus* morphotype 2	Tooth
93	*Scyliorhinus* morphotype 2	Tooth

94	*Scyliorhinus* morphotype 2	Tooth
95	*Scyliorhinus* morphotype 2	Tooth
96	*Scyliorhinus* morphotype 2	Tooth
97	*Scyliorhinus* morphotype 2	Tooth
97	*Scyliorhinus* morphotype 1	Tooth
99	*Scyliorhinus* morphotype 2	Tooth
100	*Scyliorhinus* morphotype 1	Tooth
101	*Scyliorhinus* morphotype 1	Tooth
102	*Scyliorhinus* morphotype 1	Tooth
103	*Scyliorhinus* morphotype 1	Tooth
104	*Scyliorhinus* morphotype 1	Tooth
105	*Scyliorhinus* morphotype 1	Tooth
106	*Scyliorhinus* morphotype 1	Tooth
107	*Scyliorhinus* morphotype 1	Tooth
108	*Scyliorhinus* morphotype 1	Tooth
109	Osteichthyes	Tooth
110	Osteichthyes	Tooth
111	Osteichthyes	Tooth
112	Osteichthyes	Tooth
113	Osteichthyes	Tooth
114	*Scyliorhinus* morphotype 1	Tooth
115	*Scyliorhinus* morphotype 1	Tooth
116	*Scyliorhinus* morphotype 1	Tooth
117	*Scyliorhinus* morphotype 1	Tooth
118	Scyliorhinidae	Tooth
119	Scyliorhinidae	Tooth
120	Scyliorhinidae	Tooth
121	Scyliorhinidae	Tooth
122	Scyliorhinidae	Tooth
123	Scyliorhinidae	Tooth
124	Scyliorhinidae	Tooth
125	Scyliorhinidae	Tooth
126	Scyliorhinidae	Tooth
127	Scyliorhinidae	Tooth
128	Scyliorhinidae	Tooth
129	Scyliorhinidae	Tooth
130	Scyliorhinidae	Tooth
131	Scyliorhinidae	Tooth
132	Scyliorhinidae	Tooth
133	Scyliorhinidae	Tooth
134	Scyliorhinidae	Tooth
135	Scyliorhinidae	Tooth
136	Scyliorhinidae	Tooth
137	Scyliorhinidae	Tooth
138	Scyliorhinidae	Tooth
139	Scyliorhinidae	Tooth
140	Scyliorhinidae	Tooth
141	Scyliorhinidae	Tooth
142	Scyliorhinidae	Tooth
143	Scyliorhinidae	Tooth

144	Scyliorhinidae	Tooth
145	*Enchodus* sp.	Tooth
146	*Enchodus* sp.	Tooth
147	*Enchodus* sp.	Tooth
148	*Enchodus* sp.	Tooth
149	*Enchodus* sp.	Tooth
150	*Enchodus* sp.	Tooth
151	*Enchodus* sp.	Tooth
152	*Enchodus* sp.	Tooth
153	*Enchodus* sp.	Tooth
154	*Enchodus* sp.	Tooth
155	*Enchodus* sp.	Tooth
156	*Enchodus* sp.	Tooth
157	*Enchodus* sp.	Tooth
158	*Enchodus* sp.	Tooth
159	*Enchodus* sp.	Tooth
160	*Enchodus* sp.	Tooth
161	*Enchodus* sp.	Tooth
162	*Enchodus* sp.	Tooth
163	*Enchodus* sp.	Tooth
164	*Enchodus* sp.	Tooth
165	*Enchodus* sp.	Tooth
166	*Enchodus* sp.	Tooth
167	*Enchodus* sp.	Tooth
168	*Enchodus* sp.	Tooth
169	*Enchodus* sp.	Tooth
170	*Enchodus* sp.	Tooth
171	*Enchodus* sp.	Tooth
172	*Enchodus* sp.	Tooth
173	*Enchodus* sp.	Tooth
174	*Enchodus* sp.	Tooth
175	*Enchodus* sp.	Tooth
176	*Enchodus* sp.	Tooth
177	*Enchodus* sp.	Tooth
178	*Enchodus* sp.	Tooth
179	*Enchodus* sp.	Tooth
180	*Enchodus* sp.	Tooth
181	*Enchodus* sp.	Tooth
182	*Enchodus* sp.	Tooth
183	*Enchodus* sp.	Tooth
184	*Enchodus* sp.	Tooth
185	*Enchodus* sp.	Tooth
186	*Enchodus* sp.	Tooth
187	*Enchodus* sp.	Tooth
188	*Enchodus* sp.	Tooth
189	*Enchodus* sp.	Tooth
190	*Enchodus* sp.	Tooth
191	*Enchodus* sp.	Tooth
192	*Enchodus* sp.	Tooth
193	*Enchodus* sp.	Tooth

194	*Enchodus* sp.	Tooth
195	*Enchodus* sp.	Tooth
196	*Enchodus* sp.	Tooth
197	*Enchodus* sp.	Tooth
198	*Enchodus* sp.	Tooth
199	*Enchodus* sp.	Tooth
201	*Enchodus* sp.	Tooth
202	*Enchodus* sp.	Tooth
203	*Enchodus* sp.	Tooth
204	*Enchodus* sp.	Tooth
205	*Enchodus* sp.	Tooth
206	*Enchodus* sp.	Tooth
207	*Enchodus* sp.	Tooth
208	*Enchodus* sp.	Tooth
209	*Enchodus* sp.	Tooth
210	*Enchodus* sp.	Tooth
211	*Enchodus* sp.	Tooth
212	*Enchodus* sp.	Tooth
213	*Enchodus* sp.	Tooth
214	*Enchodus* sp.	Tooth
215	*Enchodus* sp.	Tooth
216	*Enchodus* sp.	Tooth
217	*Enchodus* sp.	Tooth
218	*Enchodus* sp.	Tooth
219	*Enchodus* sp.	Tooth
220	*Enchodus* sp.	Tooth
221	*Enchodus* sp.	Tooth
222	*Enchodus* sp.	Tooth
223	*Enchodus* sp.	Tooth
224	*Enchodus* sp.	Tooth
225	*Enchodus* sp.	Tooth
226	*Enchodus* sp.	Tooth
227	*Enchodus* sp.	Tooth
228	*Enchodus* sp.	Tooth
229	*Enchodus* sp.	Tooth
230	*Enchodus* sp.	Tooth
231	*Enchodus* sp.	Tooth
232	*Enchodus* sp.	Tooth
233	*Enchodus* sp.	Tooth
234	*Enchodus* sp.	Tooth
235	*Enchodus* sp.	Tooth
236	*Enchodus* sp.	Tooth
237	*Enchodus* sp.	Tooth
238	*Enchodus* sp.	Tooth
239	*Enchodus* sp.	Tooth
240	*Enchodus* sp.	Tooth
241	*Enchodus* sp.	Tooth
242	*Enchodus* sp.	Tooth
243	*Enchodus* sp.	Tooth
244	*Enchodus* sp.	Tooth

245	*Enchodus* sp.	Tooth
246	*Enchodus* sp.	Tooth
247	*Enchodus* sp.	Tooth
248	*Enchodus* sp.	Tooth
249	*Enchodus* sp.	Tooth
250	*Enchodus* sp.	Tooth
251	*Enchodus* sp.	Tooth
252	*Enchodus* sp.	Tooth
253	*Enchodus* sp.	Tooth
254	*Enchodus* sp.	Tooth
255	*Enchodus* sp.	Tooth
256	*Enchodus* sp.	Tooth
257	*Enchodus* sp.	Tooth
258	*Enchodus* sp.	Tooth
259	*Enchodus* sp.	Tooth
260	*Enchodus* sp.	Tooth
261	*Enchodus* sp.	Tooth
262	*Enchodus* sp.	Tooth
263	*Enchodus* sp.	Tooth
264	*Enchodus* sp.	Tooth
265	*Enchodus* sp.	Tooth
266	*Enchodus* sp.	Tooth
267	*Enchodus* sp.	Tooth
268	*Enchodus* sp.	Tooth
269	*Enchodus* sp.	Tooth
270	*Enchodus* sp.	Tooth
271	*Enchodus* sp.	Tooth
272	*Enchodus* sp.	Tooth
273	*Enchodus* sp.	Tooth
274	*Enchodus* sp.	Tooth
275	*Enchodus* sp.	Tooth
276	*Enchodus* sp.	Tooth
277	*Enchodus* sp.	Tooth
278	*Enchodus* sp.	Tooth
279	*Enchodus* sp.	Tooth
280	*Enchodus* sp.	Tooth
281	*Enchodus* sp.	Tooth
282	*Enchodus* sp.	Tooth
283	*Enchodus* sp.	Tooth
284	*Enchodus* sp.	Tooth
285	*Enchodus* sp.	Tooth
286	*Enchodus* sp.	Tooth
287	*Enchodus* sp.	Tooth
288	*Enchodus* sp.	Tooth
289	*Enchodus* sp.	Tooth
290	Osteichthyes	Unidentified fragment
291	Osteichthyes	Unidentified fragment
292	Osteichthyes	Unidentified fragment
293	Osteichthyes	Unidentified fragment
294	Osteichthyes	Unidentified fragment

295	Osteichthyes	Unidentified fragment
296	Osteichthyes	Unidentified fragment
297	Osteichthyes	Unidentified fragment
298	Osteichthyes	Unidentified fragment
299	Osteichthyes	Unidentified fragment
300	Osteichthyes	Unidentified fragment
301	Osteichthyes	Unidentified fragment
302	Osteichthyes	Unidentified fragment
303	Osteichthyes	Unidentified fragment
304	Osteichthyes	Unidentified fragment
305	Osteichthyes	Unidentified fragment
306	Osteichthyes	Unidentified fragment
307	Osteichthyes	Unidentified fragment
308	Osteichthyes	Unidentified fragment
309	Osteichthyes	Unidentified fragment
310	Osteichthyes	Unidentified fragment
311	Osteichthyes	Unidentified fragment
312	Osteichthyes	Unidentified fragment
313	Osteichthyes	Unidentified fragment
314	Osteichthyes	Unidentified fragment
315	Osteichthyes	Unidentified fragment
316	Osteichthyes	Unidentified fragment
317	Osteichthyes	Unidentified fragment
318	Osteichthyes	Unidentified fragment
319	Osteichthyes	Unidentified fragment
320	Osteichthyes	Unidentified fragment
321	Osteichthyes	Unidentified fragment
322	Osteichthyes	Unidentified fragment
323	Osteichthyes	Unidentified fragment
324	Osteichthyes	Unidentified fragment
325	Osteichthyes	Unidentified fragment
326	Osteichthyes	Unidentified fragment
327	Osteichthyes	Unidentified fragment
328	Osteichthyes	Unidentified fragment
329	Osteichthyes	Unidentified fragment
330	Osteichthyes	Unidentified fragment
331	Osteichthyes	Unidentified fragment
332	Osteichthyes	Unidentified fragment
333	Osteichthyes	Unidentified fragment
334	Osteichthyes	Unidentified fragment
335	Osteichthyes	Unidentified fragment
336	Osteichthyes	Unidentified fragment
337	Osteichthyes	Unidentified fragment
338	Osteichthyes	Unidentified fragment
339	Osteichthyes	Unidentified fragment
340	Osteichthyes	Unidentified fragment
341	Osteichthyes	Unidentified fragment
342	Osteichthyes	Unidentified fragment
343	Osteichthyes	Unidentified fragment
344	Osteichthyes	Unidentified fragment

345	Osteichthyes	Unidentified fragment
346	Osteichthyes	Unidentified fragment
347	Osteichthyes	Unidentified fragment
348	Osteichthyes	Unidentified fragment
349	Osteichthyes	Unidentified fragment
350	Osteichthyes	Unidentified fragment
351	Osteichthyes	Unidentified fragment
352	Osteichthyes	Unidentified fragment
353	Osteichthyes	Unidentified fragment
354	Osteichthyes	Unidentified fragment
355	Osteichthyes	Unidentified fragment
356	Osteichthyes	Unidentified fragment
357	Osteichthyes	Unidentified fragment
358	Osteichthyes	Unidentified fragment
359	Osteichthyes	Unidentified fragment
360	Osteichthyes	Unidentified fragment
361	Osteichthyes	Unidentified fragment
362	Osteichthyes	Unidentified fragment
363	Osteichthyes	Unidentified fragment
364	Osteichthyes	Unidentified fragment
365	Osteichthyes	Unidentified fragment
366	Osteichthyes	Unidentified fragment
367	Osteichthyes	Unidentified fragment
368	Osteichthyes	Unidentified fragment
369	Osteichthyes	Unidentified fragment
370	Osteichthyes	Unidentified fragment
371	Osteichthyes	Unidentified fragment
372	Osteichthyes	Unidentified fragment
373	Osteichthyes	Unidentified fragment
374	Osteichthyes	Unidentified fragment
375	Osteichthyes	Unidentified fragment
376	Osteichthyes	Unidentified fragment
377	Osteichthyes	Unidentified fragment
378	Osteichthyes	Unidentified fragment
379	Osteichthyes	Unidentified fragment
380	Osteichthyes	Unidentified fragment
381	Osteichthyes	Unidentified fragment
382	Osteichthyes	Unidentified fragment
383	Osteichthyes	Unidentified fragment
384	Osteichthyes	Unidentified fragment
385	Osteichthyes	Unidentified fragment
386	Osteichthyes	Unidentified fragment
387	Osteichthyes	Unidentified fragment
389	Osteichthyes	Unidentified fragment
390	Osteichthyes	Unidentified fragment
391	Osteichthyes	Unidentified fragment
392	Osteichthyes	Unidentified fragment
393	Osteichthyes	Unidentified fragment
394	Osteichthyes	Unidentified fragment
395	Osteichthyes	Unidentified fragment

396	Osteichthyes	Unidentified fragment
397	Osteichthyes	Unidentified fragment
398	Osteichthyes	Unidentified fragment
399	Osteichthyes	Unidentified fragment
400	Osteichthyes	Unidentified fragment
401	Osteichthyes	Unidentified fragment
402	Osteichthyes	Unidentified fragment
403	Osteichthyes	Unidentified fragment
404	Osteichthyes	Unidentified fragment
405	Osteichthyes	Unidentified fragment
406	Osteichthyes	Unidentified fragment
407	Osteichthyes	Unidentified fragment
408	Osteichthyes	Unidentified fragment
409	Osteichthyes	Unidentified fragment
410	Osteichthyes	Unidentified fragment
411	Osteichthyes	Unidentified fragment
412	Osteichthyes	Unidentified fragment
413	Osteichthyes	Unidentified fragment
414	Osteichthyes	Unidentified fragment
415	Osteichthyes	Unidentified fragment
416	Osteichthyes	Unidentified fragment
417	Osteichthyes	Unidentified fragment
418	Osteichthyes	Unidentified fragment
419	Osteichthyes	Unidentified fragment
420	Osteichthyes	Unidentified fragment
421	Osteichthyes	Unidentified fragment
422	Osteichthyes	Unidentified fragment
423	Osteichthyes	Unidentified fragment
424	Osteichthyes	Unidentified fragment
425	Osteichthyes	Unidentified fragment
426	Osteichthyes	Unidentified fragment
427	Osteichthyes	Unidentified fragment
428	Osteichthyes	Unidentified fragment
429	Osteichthyes	Unidentified fragment
430	Osteichthyes	Unidentified fragment
431	Osteichthyes	Unidentified fragment
432	Osteichthyes	Unidentified fragment
433	Osteichthyes	Unidentified fragment
434	Osteichthyes	Unidentified fragment
435	*Enchodus* sp.	Tooth
436	*Enchodus* sp.	Tooth
437	*Enchodus* sp.	Tooth
438	*Enchodus* sp.	Tooth
439	*Enchodus* sp.	Tooth
440	*Enchodus* sp.	Tooth
441	*Enchodus* sp.	Tooth
442	*Enchodus* sp.	Tooth
443	*Enchodus* sp.	Tooth
444	*Enchodus* sp.	Tooth
445	*Enchodus* sp.	Tooth

446	*Enchodus* sp.	Tooth
447	*Enchodus* sp.	Tooth
448	*Enchodus* sp.	Tooth
449	*Enchodus* sp.	Tooth
450	*Enchodus* sp.	Tooth
451	*Enchodus* sp.	Tooth
452	*Enchodus* sp.	Tooth
453	*Enchodus* sp.	Tooth
454	*Enchodus* sp.	Tooth
455	*Enchodus* sp.	Tooth
456	*Enchodus* sp.	Tooth
457	*Enchodus* sp.	Tooth
458	*Enchodus* sp.	Tooth
459	*Enchodus* sp.	Tooth
460	*Enchodus* sp.	Tooth
461	*Enchodus* sp.	Tooth
462	*Enchodus* sp.	Tooth
463	*Enchodus* sp.	Tooth
464	*Enchodus* sp.	Tooth
465	*Enchodus* sp.	Tooth
466	*Enchodus* sp.	Tooth
467	*Enchodus* sp.	Tooth
468	*Enchodus* sp.	Tooth
469	*Enchodus* sp.	Tooth
470	*Enchodus* sp.	Tooth
471	*Enchodus* sp.	Tooth
472	Albulidae	Tooth
473	Albulidae	Tooth
474	*Lepisosteus*? sp.	Tooth
475	Osteichthyes	Tooth
476	Osteichthyes	Tooth
477	Osteichthyes	Tooth
478	Osteichthyes	Tooth
479	Osteichthyes	Tooth
480	Osteichthyes	Tooth
481	Osteichthyes	Tooth
482	Osteichthyes	Tooth
483	Osteichthyes	Tooth
484	Osteichthyes	Tooth
485	Osteichthyes	Tooth
486	Osteichthyes	Tooth
487	Osteichthyes	Tooth
488	Osteichthyes	Tooth
489	Osteichthyes	Tooth
490	Osteichthyes	Tooth
491	Osteichthyes	Tooth
492	Osteichthyes	Tooth
493	Osteichthyes	Tooth
494	Osteichthyes	Tooth
495	Osteichthyes	Tooth

496	Osteichthyes	Tooth
497	Osteichthyes	Tooth
498	Osteichthyes	Tooth
499	Osteichthyes	Tooth
500	Osteichthyes	Tooth
501	Osteichthyes	Tooth
502	Osteichthyes	Tooth
503	Osteichthyes	Tooth
504	Osteichthyes	Tooth
505	Osteichthyes	Tooth
506	Osteichthyes	Tooth
507	Osteichthyes	Tooth
508	Osteichthyes	Tooth
509	Osteichthyes	Tooth
510	Osteichthyes	Tooth
511	Osteichthyes	Tooth
512	Osteichthyes	Tooth
513	Osteichthyes	Tooth
514	Osteichthyes	Tooth
515	Osteichthyes	Tooth
516	Osteichthyes	Tooth
517	Osteichthyes	Tooth
518	Osteichthyes	Tooth
519	Osteichthyes	Tooth
520	Osteichthyes	Tooth
521	Osteichthyes	Tooth
522	Osteichthyes	Tooth
523	Osteichthyes	Tooth
524	Osteichthyes	Tooth
525	Osteichthyes	Tooth
526	Osteichthyes	Tooth
527	Osteichthyes	Tooth
528	Osteichthyes	Tooth
529	Osteichthyes	Tooth
530	Osteichthyes	Tooth
531	Osteichthyes	Tooth
532	Osteichthyes	Tooth
533	Osteichthyes	Tooth
534	Osteichthyes	Tooth
535	Osteichthyes	Tooth
536	Osteichthyes	Tooth
537	Osteichthyes	Tooth
538	Osteichthyes	Tooth
539	Osteichthyes	Tooth
540	Osteichthyes	Tooth
541	Osteichthyes	Tooth
542	Osteichthyes	Tooth
543	Osteichthyes	Tooth
544	Osteichthyes	Tooth
545	Osteichthyes	Tooth

546	Osteichthyes	Tooth
547	Osteichthyes	Tooth
548	Osteichthyes	Tooth
549	Osteichthyes	Tooth
550	Osteichthyes	Tooth
551	Osteichthyes	Tooth
552	Osteichthyes	Tooth
553	Osteichthyes	Tooth
554	Osteichthyes	Tooth
555	Osteichthyes	Tooth
556	Osteichthyes	Tooth
557	Osteichthyes	Tooth
558	Osteichthyes	Tooth
559	Osteichthyes	Tooth
560	Osteichthyes	Tooth
561	Osteichthyes	Tooth
562	Osteichthyes	Tooth
563	Osteichthyes	Tooth
564	Osteichthyes	Tooth
565	Osteichthyes	Tooth
566	Osteichthyes	Tooth
567	Osteichthyes	Tooth
568	Osteichthyes	Tooth
568	Osteichthyes	Tooth
570	Osteichthyes	Tooth
571	Osteichthyes	Tooth
572	Osteichthyes	Tooth
573	Osteichthyes	Tooth
574	Osteichthyes	Tooth
575	Osteichthyes	Tooth
576	Osteichthyes	Tooth
577	Osteichthyes	Tooth
578	Osteichthyes	Tooth
579	Osteichthyes	Bone
580	Osteichthyes	Bone
581	Osteichthyes	Bone
582	Osteichthyes	Bone
583	Osteichthyes	Bone
584	Osteichthyes	Bone
585	Osteichthyes	Bone
586	Osteichthyes	Bone
587	Osteichthyes	Bone
588	Osteichthyes	Bone
589	Osteichthyes	Bone
590	Osteichthyes	Bone
591	Osteichthyes	Bone
592	Osteichthyes	Bone
593	Osteichthyes	Bone
594	Osteichthyes	Bone
595	Osteichthyes	Bone

596	Osteichthyes	Bone
597	Osteichthyes	Bone
598	Osteichthyes	Bone
599	Osteichthyes	Bone
600	Osteichthyes	Bone
601	Osteichthyes	Bone
602	Osteichthyes	Bone
603	Osteichthyes	Bone
604	Osteichthyes	Bone
605	Osteichthyes	Bone
606	Osteichthyes	Bone
607	Osteichthyes	Bone
608	Osteichthyes	Bone
609	Osteichthyes	Bone
610	Osteichthyes	Bone
611	Osteichthyes	Bone
612	Osteichthyes	Bone
613	Osteichthyes	Bone
614	Osteichthyes	Bone
615	Osteichthyes	Bone
616	Osteichthyes	Bone
617	Osteichthyes	Bone
618	Osteichthyes	Bone
619	Osteichthyes	Bone
620	Osteichthyes	Bone
621	Osteichthyes	Bone
622	Osteichthyes	Bone
623	Osteichthyes	Bone
624	Osteichthyes	Bone
625	Osteichthyes	Bone
626	Osteichthyes	Bone
627	Osteichthyes	Bone
628	Osteichthyes	Bone
629	Osteichthyes	Bone
630	Osteichthyes	Bone
631	Osteichthyes	Bone
632	Osteichthyes	Bone
633	Osteichthyes	Bone
634	Osteichthyes	Bone
635	Osteichthyes	Bone
636	Osteichthyes	Bone
637	Osteichthyes	Bone
638	Osteichthyes	Bone
639	Osteichthyes	Bone
640	Osteichthyes	Bone
641	Osteichthyes	Bone
642	Osteichthyes	Bone
643	Osteichthyes	Bone
644	Osteichthyes	Bone
645	Osteichthyes	Bone

646	Osteichthyes	Bone
647	Osteichthyes	Bone
648	Osteichthyes	Bone
649	Osteichthyes	Bone
650	Osteichthyes	Bone
651	Osteichthyes	Bone
652	Osteichthyes	Bone
653	Osteichthyes	Bone
654	Osteichthyes	Bone
655	Osteichthyes	Bone
656	Osteichthyes	Bone
657	Osteichthyes	Bone
658	Osteichthyes	Bone
659	Osteichthyes	Bone
660	Osteichthyes	Bone
661	Osteichthyes	Bone
662	Osteichthyes	Bone
663	Osteichthyes	Bone
664	Osteichthyes	Bone
665	Osteichthyes	Bone
666	Osteichthyes	Bone
667	Osteichthyes	Bone
668	Osteichthyes	Bone
669	Osteichthyes	Bone
670	Osteichthyes	Bone
671	Osteichthyes	Bone
672	Osteichthyes	Bone
673	Osteichthyes	Bone
674	Osteichthyes	Bone
675	Osteichthyes	Bone
676	Osteichthyes	Bone
678	Osteichthyes	Bone
679	Osteichthyes	Bone
680	Osteichthyes	Bone
681	Osteichthyes	Bone
682	Osteichthyes	Bone
683	Osteichthyes	Bone
684	Osteichthyes	Bone
685	Osteichthyes	Bone
686	Osteichthyes	Bone
687	Osteichthyes	Bone
688	Osteichthyes	Bone
689	Osteichthyes	Bone
690	Osteichthyes	Bone
691	Osteichthyes	Bone
692	Osteichthyes	Bone
693	Osteichthyes	Bone
694	Osteichthyes	Bone
694	Osteichthyes	Bone
696	Osteichthyes	Bone

697	Osteichthyes	Bone
698	Osteichthyes	Bone
699	Osteichthyes	Bone
700	Osteichthyes	Bone
701	Osteichthyes	Bone
702	Osteichthyes	Bone
703	Osteichthyes	Bone
704	Osteichthyes	Bone
705	Osteichthyes	Bone
706	Osteichthyes	Bone
707	Osteichthyes	Bone
708	Osteichthyes	Bone
709	Osteichthyes	Bone
710	Osteichthyes	Bone
711	Osteichthyes	Bone
712	Osteichthyes	Bone
713	Osteichthyes	Bone
714	Osteichthyes	Bone
715	Osteichthyes	Bone
716	Osteichthyes	Bone
717	Osteichthyes	Bone
718	Osteichthyes	Bone
719	Osteichthyes	Bone
720	Osteichthyes	Bone
721	Osteichthyes	Bone
722	*Squalicorax* sp.	Tooth
723	*Squalicorax* sp.	Tooth
723	*Squalicorax* sp.	Tooth fragment
724	*Squalicorax* sp.	Tooth fragment
725	*Squalicorax* sp.	Tooth fragment
726	*Squalicorax* sp.	Tooth fragment
727	*Squalicorax* sp.	Tooth fragment
728	*Squalicorax* sp.	Tooth fragment
729	*Squalicorax* sp.	Tooth fragment
730	*Squalicorax* sp.	Tooth fragment
731	*Squalicorax* sp.	Tooth fragment
732	*Squalicorax* sp.	Tooth fragment
733	*Squalicorax* sp.	Tooth fragment
734	*Squalicorax* sp.	Tooth fragment
735	*Squalicorax* sp.	Tooth fragment
736	Chondrichthyian denticle type 2	denticle
737	*Pararhincodon* sp.	Tooth
738	*Ischyrhiza avonicola*	rostral Tooth
739	*Sclerorhynchus*	oral Tooth
740	*Heterodontus* sp.	Tooth
741	*Raja* sp.	Tooth
742	*Galeorhinus* sp.	Tooth
743	*Rhombodus?* sp.	Tooth
744	*Rhinobatos* sp.	Tooth
745	*Rhinobatos* sp.	Tooth

746	*Rhinobatos* sp.	Tooth
747	*Rhinobatos* sp.	Tooth
748	*Rhinobatos* sp.	Tooth
749	*Rhinobatos* sp.	Tooth
750	*Ptychotrygon* sp.	Tooth
751	Triakidae	Tooth
752	Triakidae	Tooth
753	chondrichthyian denticle	denticle
754	chondrichthyian denticle	denticle
755	chondrichthyian denticle	denticle
756	chondrichthyian denticle	denticle
757	Unidentified Shark	Tooth
758	Unidentified Shark	Tooth
759	Orectolobiform	Tooth
760	Orectolobiform	Tooth
761	Orectolobiform	Tooth
762	Orectolobiform	Tooth
763	Orectolobiform	Tooth
764	*Raja* sp.	Tooth
765	*Raja* sp.	Tooth
766	Batoid	Tooth
767	*Heterodontus* sp.	Tooth
768	*Rhinobatos* sp.	Tooth
769	*Ptychotrygon triangularis*	Tooth
770	Vertebrata	Tooth
771	*Galeorhinus* sp.	Tooth
772	*Galeorhinus* sp.	Tooth
773	*Galeorhinus* sp.	Tooth
774	Scyliorhinidae	Tooth
775	*Squalicorax* sp.	Tooth fragment
776	*Squalicorax* sp.	Tooth fragment
777	Scyliorhinidae	Tooth
778	*Squalicorax* sp.	Tooth fragment
779	Scyliorhinidae	Tooth
780	*Squalicorax* sp.	Tooth fragment
781	*Squalicorax* sp.	Tooth fragment
782	*Squalicorax* sp.	Tooth fragment
783	*Squalicorax* sp.	Tooth fragment
784	*Squalicorax* sp.	Tooth fragment
785	*Squalicorax* sp.	Tooth fragment
786	*Squalicorax* sp.	Tooth fragment
787	*Squalicorax* sp.	Tooth fragment
788	*Squalicorax* sp.	Tooth fragment
789	*Squalicorax* sp.	Tooth fragment
790	*Squalicorax* sp.	Tooth fragment
791	*Squalicorax* sp.	Tooth fragment
792	*Rhombodus binhorsti*	Tooth
793	*Rhinobatos* sp.	Tooth
794	*Rhinobatos* sp.	Tooth
795	*Rhinobatos* sp.	Tooth

796	*Rhinobatos* sp.	Tooth
797	*Rhinobatos* sp.	Tooth
798	*Rhinobatos* sp.	Tooth
799	*Rhinobatos* sp.	Tooth
800	*Cantioscyllium* morphotype 2	Tooth
801	*Cantioscyllium* morphotype 2	Tooth
802	*Cantioscyllium* morphotype 2	Tooth
803	*Cantioscyllium* morphotype 1	Tooth
804	*Squalicorax* sp.	Tooth
805	Scyliorhinidae	Tooth
806	Scyliorhinidae	Tooth
807	Scyliorhinidae	Tooth
808	Scyliorhinidae	Tooth
809	Scyliorhinidae	Tooth
810	Scyliorhinidae	Tooth
811	Scyliorhinidae	Tooth
812	Scyliorhinidae	Tooth
813	Scyliorhinidae	Tooth
814	Scyliorhinidae	Tooth
815	Scyliorhinidae	Tooth
816	Scyliorhinidae	Tooth
817	Scyliorhinidae	Tooth
818	Scyliorhinidae	Tooth
819	Scyliorhinidae	Tooth
820	Scyliorhinidae	Tooth
821	Scyliorhinidae	Tooth
822	Scyliorhinidae	Tooth
823	Scyliorhinidae	Tooth
824	Scyliorhinidae	Tooth
825	Scyliorhinidae	Tooth
826	Scyliorhinidae	Tooth
827	Scyliorhinidae	Tooth
828	Scyliorhinidae	Tooth
829	Scyliorhinidae	Tooth
830	Scyliorhinidae	Tooth
831	Scyliorhinidae	Tooth
832	Scyliorhinidae	Tooth
833	Scyliorhinidae	Tooth
834	Scyliorhinidae	Tooth
835	Scyliorhinidae	Tooth
836	Scyliorhinidae	Tooth
837	Scyliorhinidae	Tooth
838	Scyliorhinidae	Tooth
839	Scyliorhinidae	Tooth
840	Scyliorhinidae	Tooth
841	Scyliorhinidae	Tooth
842	Scyliorhinidae	Tooth
843	Scyliorhinidae	Tooth
844	Scyliorhinidae	Tooth
845	Scyliorhinidae	Tooth

846	Scyliorhinidae	Tooth
847	Scyliorhinidae	Tooth
848	Scyliorhinidae	Tooth
849	Scyliorhinidae	Tooth
850	Scyliorhinidae	Tooth
851	Scyliorhinidae	Tooth
852	Scyliorhinidae	Tooth
853	Scyliorhinidae	Tooth
854	Scyliorhinidae	Tooth
855	Scyliorhinidae	Tooth
856	Scyliorhinidae	Tooth
857	Unidentified Shark	Tooth
858	Orectolobiform	Tooth
859	Unidentified Shark	Tooth
860	Unidentified Shark	Tooth
861	Unidentified Shark	Tooth
862	Osteichthyes	Tooth
863	Unidentified Shark	Tooth
864	Scyliorhinidae	Tooth
865	Triakidae	Tooth
866	*Squalicorax* sp.	Tooth
867	Vertebrata	Unidentified element
868	Vertebrata	Unidentified element
869	Sclyiorhinidae	Tooth
870	Vertebrata	Unidentified element
871	Batoid	Tooth
872	Scyliorhinidae	Tooth
873	Scyliorhinidae	Tooth
874	Scyliorhinidae	Tooth
875	Unidentified Shark	Tooth
876	chondrichthyian denticle	Denticle
877	Vertebrate	Unidentified element
878	Unidentified Shark	Tooth
879	Unidentified Shark	Tooth
880	Vertebrate	Unidentified element
881	*Raja* sp.	Tooth
882	*Squalicorax* sp.	Tooth fragment
883	*Squalicorax* sp.	Tooth fragment
884	Unidentified Shark	Tooth
885	*Rhinobatos* sp.	Tooth
886	*Squalicorax* sp.	Tooth fragment
887	Vertebrata	Tooth
888	Unidentified Shark	Tooth
889	Scyliorhinidae	Tooth
890	Batoid	Tooth
891	Scyliorhinidae	Tooth
892	Batoid	Tooth
893	*Rhombodus binhorsti*	Tooth
894	*Heterodontus* sp.	Tooth
895	Scyliorhinidae	Tooth

896	Batoid	Tooth
896	Unidentified Shark	Tooth
898	Unidentified Shark	Tooth
899	Unidentified Shark	Tooth
900	Scyliorhinidae	Tooth
901	*Ptychotrygon triangularis*	Tooth
902	*Squalicorax sp.*	Tooth fragment
903	Orectolobiform	Tooth
904	*Squalicorax sp.*	Tooth
905	*Carcharias* sp.	Tooth
906	*Squalicorax* sp.	Tooth fragment
907	chondrichthyian denticle	Denticle
908	Scyliorhinidae	Tooth
909	*Rhinobatos* sp.	Tooth
910	Scyliorhinidae	Tooth
911	Unidentified Shark	Tooth
912	*Squalicorax* sp.	Tooth fragment
913	Scyliorhinidae	Tooth
914	Scyliorhinidae	Tooth
915	Scyliorhinidae	Tooth
916	Orectolobiform	Tooth
917	Batoid	Tooth
918	Scyliorhinidae	Tooth
919	*Ptychotrygon triangularis*	Tooth
920	Unidentified Shark	Tooth
921	Orectolobiform	Tooth
922	*Rhinobatos* sp.	Tooth
923	*Squalicorax* sp.	Tooth fragment
924	*Squalicorax* sp.	Tooth fragment
925	chondrichthyian denticle ?	Denticle
926	*Squalicorax sp.*	Tooth fragment
927	*Galeorhinus* sp.	Tooth
928	Unidentified Shark	Tooth
929	Vertebrata	Unidentified element
930	Unidentified Shark	Tooth
931	Osteichthyes	Tooth
932	Orectolobiform	Tooth
933	Vertebrata	Unidentified element
934	Unidentified Shark	Tooth
935	Vertebrata	Unidentified element
936	Unidentified Shark	Tooth
937	*Enchodus* sp.	Tooth
938	Unidentified Shark	Tooth
939	Vertebrata	Unidentified element
940	Unidentified Shark	Tooth
941	Vertebrata	Unidentified element
942	Vertebrata	Unidentified element
943	Unidentified Shark	Tooth
944	Vertebrata	Unidentified element
945	Unidentified Shark	Tooth

946	Unidentified Shark	Tooth
947	Unidentified Shark	Tooth
948	Unidentified Shark	Tooth
949	Vertebrata	Unidentified element
950	Unidentified Shark	Tooth
951	Vertebrata	Unidentified element
952	Vertebrata	Unidentified element
953	Unidentified Shark	Tooth
954	Unidentified Shark	Tooth
955	Unidentified Shark	Tooth
956	Scyliorhinidae	Tooth
957	Vertebrata	Unidentified element
958	Unidentified Shark	Tooth
959	Unidentified Shark	Tooth
960	Vertebrata	Unidentified element
961	Unidentified Shark	Tooth
962	Unidentified Shark	Tooth
963	Unidentified Shark	Tooth
964	Unidentified Shark	Tooth
965	*Cantioscyllium* morphotype 1	Tooth
966	Vertebrata	Unidentified element
967	Vertebrata	Unidentified element
968	Unidentified Shark	Tooth
969	Unidentified Shark	Tooth
970	Unidentified Shark	Tooth
971	Unidentified Shark	Tooth
972	Unidentified Shark	Tooth
973	Unidentified Shark	Tooth
974	Unidentified Shark	Tooth
975	Unidentified Shark	Tooth
976	Unidentified Shark	Tooth
977	*Squalicorax* sp.	Tooth fragment
978	Unidentified Shark	Tooth
979	Unidentified Shark	Tooth
980	Unidentified Shark	Tooth
981	Unidentified Shark	Tooth
982	Unidentified Shark	Tooth
983	Unidentified Shark	Tooth
984	Unidentified Shark	Tooth
985	Unidentified Shark	Tooth
986	Unidentified Shark	Tooth
987	Unidentified Shark	Tooth
988	Unidentified Shark	Tooth
989	Unidentified Shark	Tooth
990	Unidentified Shark	Tooth
991	Unidentified Shark	Tooth
992	Unidentified Shark	Tooth
993	Unidentified Shark	Tooth
994	Unidentified Shark	Tooth
995	Unidentified Shark	Tooth

996	Unidentified Shark	Tooth
997	Vertebrata	Unidentified element

CONTACT INFORMATION

Name:	Tracey Janus
Professional Address:	c/o Dr. Thomas Stidham Department of Biology 3258 TAMU Texas A&M University College Station, TX 77843-3258
Email Address:	tjanus1@gmail.com
Education:	B.S., Geology, Texas A&M University, December 2010 Undergraduate Research Scholar