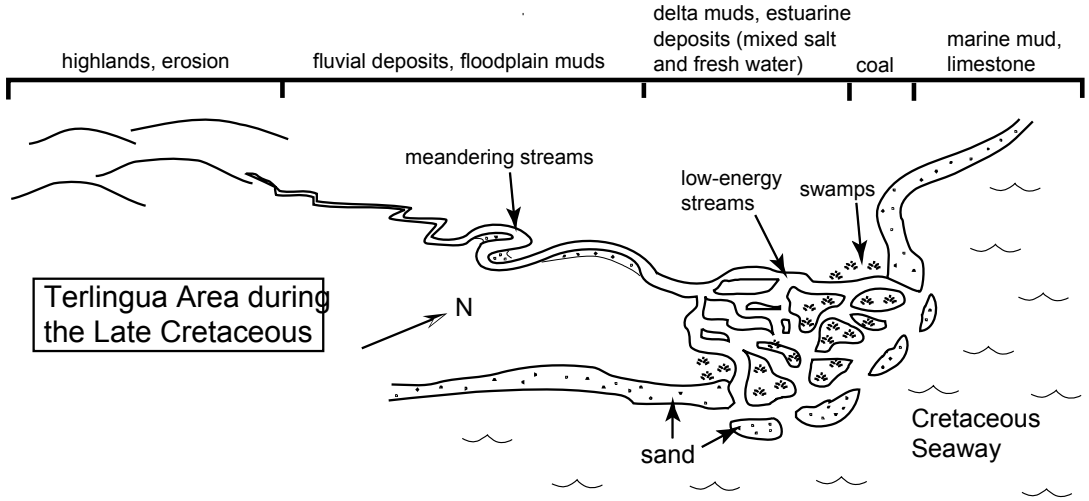
Geo 302D: Age of the Dinosaurs

LAB 10: Faunal analysis and microvertebrates

The activities this week revolve around an actual fossil locality in Big Bend National Park, the Terlingua Microvertebrate 1 (TM1) site. During the Cretaceous Period most of Texas was submerged beneath a shallow tropical sea (this is why we find fossils of marine organisms such as *Mosasaurus* and plesiosaurs here in Austin). The western shoreline of this sea ran north-south through the modern Big Bend area. Highlands even further west gave a constant supply of sediment to the various streams and rivers flowing east into the sea.

Recall that when streams empty into relatively calm or standing waters, a delta is built. Deltas grow seaward as sea levels fall and recede landward as sea levels rise. The areas in and around deltas are usually low lying and wet. This provides an ideal environment for plants and animals. Energy levels are very low within the delta (since the streams have pretty much reached sea level), so when combined with plenty of sediment the rate of deposition of clastic material is usually very high. By now you should know that this makes a nearly ideal setting for the burial and preservation of organic remains.



- **Geology of the site**:

The fossil producing layer at TM1 is only about 6" thick. It lies directly on top of a thicker layer of coal. What sort of environmental setting results in the deposition of coal? Below the coal layer is a mud unit with numerous plant remains, and below this is a thick layer of marine sand. Above the fossil layer is more delta mud but with less plant material that was probably laid down by the rear portions of the ancient delta as it grew seaward.

The bones and teeth within the layer are disarticulated. This means they have been totally pulled apart and removed from their natural positions in the skeleton. They are intermixed with pieces of wood, clay, coprolites, and amber, and bones of all sorts of

animals are jumbled together. Teeth are the most common fossils, which makes sense since they are the hardest parts of the vertebrate skeleton.

- **Collection of microvertebrate fossils**:

The term "microvertebrate" is sometimes used in reference to those vertebrates whose remains are usually not noticeable to the naked eye. Such small fossils are best collected by simply shoveling up large volumes of fossil-bearing sediment, then taking it back to a lab for screenwashing. As the name implies, water and a pair of screens are used to separate the bone from the surrounding mudrock. A coarse upper screen stops large bone and plant fragments, while a very fine lower screen catches the tiny fossils, bits of coal, and tough mudballs. This fine material is then separated using heavy (and carcinogenic!) heavy liquids. The remaining fine-grained material is called "concentrate", which you will be looking this week.

- **WHY?**

Why go through all this time intensive work for such tiny fossils? Fossils of larger animals are often much more attention-grabbing and exciting for many. But if you think about it, in any given environment large animals are outnumbered and outweighed by the smaller creatures that share their world. If you need convincing, think about your own apartment or dorm room. One or a few large humans occupy the space, but within the walls may be dozens of mice and rats and thousands of roaches. Because of their numbers, there is a bias for more common organisms to make it into the fossil record more often than rarer animals. Over the past couple of decades there has been intensification in the collection and study of microvertebrate fossils. Paleontologists also love microfossils for their utility in answering certain questions.

1.) Local paleoenvironment: Large animals such as most dinosaurs, humans, etc. can exist in a relatively wide range of habitats and conditions. When their fossils are found one can only make general comments as to their lifestyles, preferred environments, and the like. Small animals such as lizards, frogs, amphibians, and small mammals are much more restricted by their physical surroundings. Some require very specific conditions to survive. And none of them tend to travel very far from their home range. Even a small stream or patch of extra-dry earth can be a total barrier to their travel. If you find their remains at a site you can make relatively confident conclusions about the local paleoenvironment.

2.) Temporal constraint/dating of rock layers: In sedimentary rocks that cannot be dated using radiometric techniques, microfossils can be very useful. Small animals tend to reproduce rapidly, and individual species appear, exist for a short time (geologically speaking) and then go extinct. If you can somehow assign an age to certain species or kinds of animals, and they are common over large areas, you can use them to date rock units which contain their fossils. Remains of organisms that were common, distinctive, and existed for a relatively short period of time are called **index fossils**.

Exercises

Your job for this lab is to pick through the concentrate from TM1 and search for fossils. Your TA will explain the best techniques for doing this. Refer to your handout for identification of specimens. The course website also has a link to images of most of the fossils you can find. When you identify an item, mark it on the chart provided. Also determine the most common environment that organism occupied in life.

Fossils	**Environment**		
	T /	**F** /	**M**
Small Sharks	--	O	C
Large Shark	--	O	C
Sawfish	--	C	C
Rays	--	O	C
Gar fish	--	C	O
Bowfin fish	--	C	O
Salamanders	C	R	--
Frogs	C	C	--
Large soft-shelled turtle	--	C	R
Small crocodylians	--	C	O
Large crocodylians	--	C	O
Pterosaurs	C	--	--
Big theropods	C	--	--
Hadrosaurs	C	--	--
Ornithomimids	C	--	--
Lizards	C	--	--
Marsupial mammals	C	--	--
Multituberculate mammals	C	--	--

T = Terrestrial; **F** = Fluvial; **M** = Marine
C = Common; O = Occasional; R = Rare; "--" = Not Present

Terlingua Microfossils Locality 1

FOSSILS	# OF EACH
Bony fish vertebra:	
Shark vertebra:	
Bowfin vertebra:	
Small shark tooth:	
Large shark tooth:	
Ray denticle:	
Ray tooth:	
Sawfish tooth:	
Gar scale:	
Gar tooth:	
Misc. fish tooth:	
Amphibian jaw:	
Lizard jaw:	
Lizard scute:	
Small crocodilian tooth:	
Large crocodilian tooth:	
Theropod tooth:	
Hadrosaur tooth frag.:	
Ossified tendon frag.:	
Marsupial mammal tooth:	
Multituberculate mammal tooth:	

Additional Questions:

1.) What is the most common type of fossil recovered from TM1?

What is the most common environment that organism inhabited during life?

2.) Give two preservational biases that may have contributed to the abundance of the fossil named in #1:

1._____

2._____

3.) Why don't we find articulated material at TM1?

4.) If screenwashing of the sediments had not been done, what effect would that have on our ideas about the diversity of life in that area during the time of deposition?

5.) Look at the chart that shows various taxa and their stratigraphic ranges. The dark bars on the time scale indicate intervals where each kind of fossil is found (and hence the time ranges over which the organisms lived). Using the fossils collected by the class, determine the smallest geologic age range to which you can assign TM1.

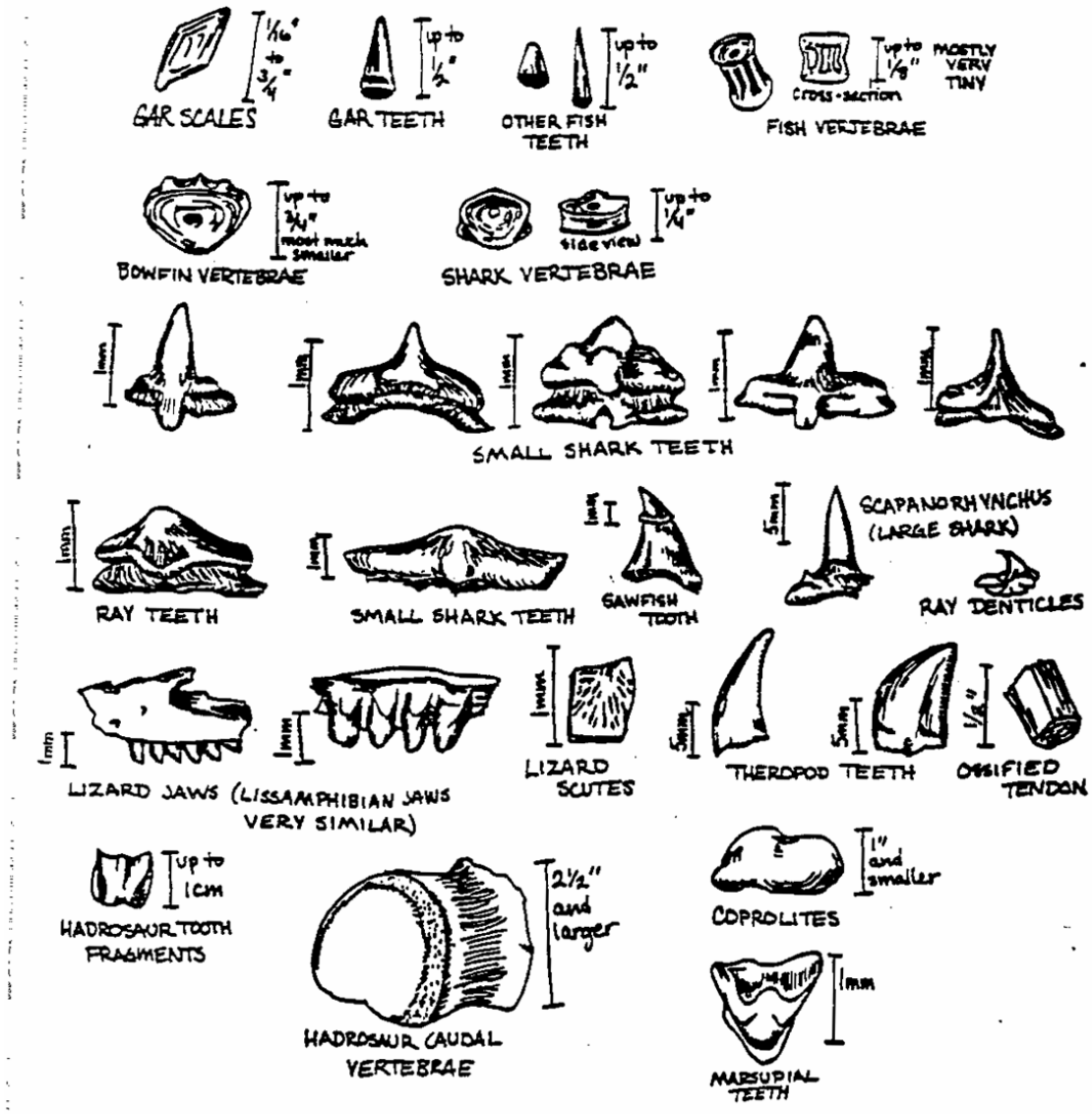
Maximum possible age = Minimum possible age =

How many years does this range span?

Are there any fossils in the class collection that could be considered an index fossil? If so, which one or ones?

On today's chart, what organisms would probably make the best index fossils?

6.) Based on our collection of fossils, what environment does TM1 most likely represent?



GAR SCALES, FISH TEETH, FISH VERTEBRAE, SHARK VERTEBRAE, DENTICLE, OSSIFIED TENDON
MODIFIED FROM TISCHLER, 1991

Fossils at TM1: The chart below shows a list of the fossil vertebrates known from the site. The stratigraphic ranges (the part of the geologic section in which their fossils are found) of each taxon is given as specifically as possible. Some groups have been studied more extensively than others, giving greater resolution. Some of the time ranges are for certain specific taxa found at the site, and are not the ranges of the larger monophyletic group to which the taxa belong. For example, the particular species of soft-shelled turtle found at TM1 is known only from rocks between 135 and 65 million years old. However, there are several other species of soft-shelled turtles still alive today.