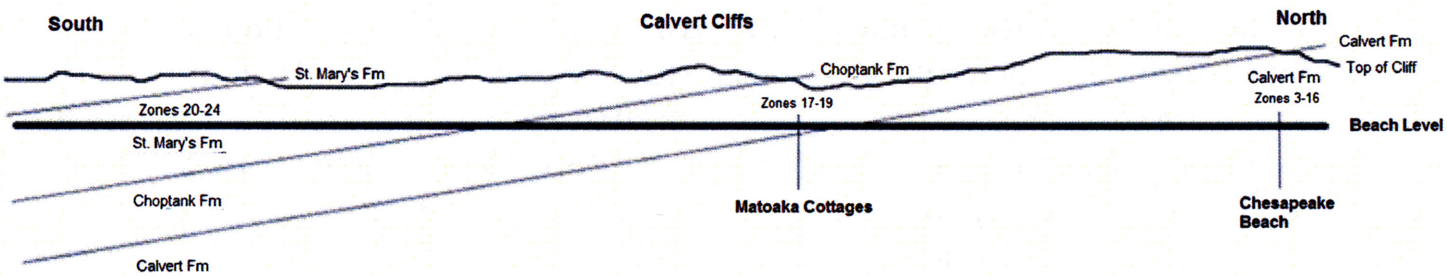
Geology and Fossils of the Calvert Cliffs

The Calvert Cliffs are mostly non-lithified layers of sand, mud, clay, and fossil remains deposited 8 –18 million years ago (mya) during the Miocene epoch. The Calvert Cliffs do not represent the entire Miocene epoch (23 mya to 5 mya), nor are a completely uninterrupted sequence. The cliffs outcrop along the western shore of the Chesapeake Bay for about 30 miles, from Fairhaven in the North to Drum Point in the South. Shattuck (1904) identified 24 distinct layers, known as Shattuck Zones, that are still referred to today. 3 Formations have been identified in the Calvert Cliffs: **Calvert** (north Zones 1-16), **Choptank** (middle Zones 17-20), and **St. Mary's** (south Zones 21-24). The 3 formations represent different sea environments with the Calvert Formation being the deepest water (warmest environment), and the Choptank and St. Mary's being shallower (and cooler). Overall there is a slight dipping of the layers to the south so different layers are exposed as you move up or down the coast.



Fossils: Molluscan fossil shells are most abundant, shark teeth fairly common, and fossil vertebrate bones being less common. Associated or articulated skeletal remains are extremely rare, but a complete articulated Hemipristis shark was found inland recently, and is on display at the Calvert Marine Museum (CMM). If you should ever spot what looks to be the remains of an articulated skeleton or skull please contact the CMM. Do not attempt to dig it out. Isolated bones of dolphins, whales, crocodiles, sharks, and birds can be found.

Value of Fossils: Fossils are valuable recordings of the history of life on our planet, often they are the only way we know of certain species, and they also can give clues about the living and post-death environment. Knowing and recording where a fossil came from geographically and from which layer is essential information. Fossils that are in their original enclosing material are referred to as 'in-situ'. Fossils that are not are referred to as 'float' or 'loose'. In-situ samples usually yield more information than float samples, such as a more accurate "relative age" of the fossil. This is important when establishing relationships between different species, and also aids in 'correlating' the age of rocks from different locations. However, in certain circumstances, float samples can also be of value. Fossils that are common over a large geographic area but only exist during a specific time period are referred to as **Index Fossils**.

Collecting at the Cliffs: It is VERY DANGEROUS to stand close to the cliffs. DO NOT dig in the cliffs without permission of the property owner. Maryland law allows collecting of fossils within the surf zone, so fallen blocks are fair game for extracting fossils if lying in the surf zone. Always note from which zone (layer) a fallen block came from. If not certain, include some of the surrounding sediment with collected fossils. It is helpful to have plastic zip lock bags to insert fossils and your notes written in pen. At minimum, always record the geographic location and the zone-layer from which any fossil is found, and include some sediment and other surrounding fossils, as this additional 'context' information might be helpful.

Sedimentary Rocks and Strata: a. Lower layers (strata) of a sequence were deposited before higher layers so are older than higher layers. This allows for 'relative' dating. **b.** Coarser sediments in a sedimentary rock or layer usually indicate a higher energy deposition environment (coarse sand and gravel indicate near shore deposition whereas clay and mud indicates deeper off shore deposition). We can apply this knowledge to what geologists call "fining upward" or "coarsening upward" when describing vertical sequences, and to dating.

Identifying, Recording, Analyzing, and Storing Fossils: This is known as 'curation'. Devise a system that works for your purposes and be consistent. Always note essential information in the field as you are collecting...do not put it off until later. Keep a log or create a database for your finds, noting at minimum, the **Genus/Species**, the **Formation/Member/Bed**, and the **Geographic Location**. There is much more you can record, such as taking photos (always include a measurement scale), the lithology of the matrix, the orientation of the fossil(s), etc.

An Example Study - Examining the Evolution of Mollusks along the Calvert Cliffs: A study done by Patricia Kelley shows that ***Shell Thickness*** and ***Internal Body Volume*** of the mollusks ***Anadara*** and ***Astarte*** have undergone evolutionary change over time. **Key to this study:** Collecting samples from *layers that represent different times.* Making measurements of *many* in-situ whole samples that were found in 'life position' representing various stages of the life cycle. *Recording* and *analyzing* the data so that the change in shell thickness and internal volume could be confirmed. **Conclusions:** **Changing shell thickness and internal volume is a co-evolutionary process associated with predation by Turridae (marine snails). Through preferential consumption by boring snails of thinner shelled organisms (and less internal volume), thicker-shelled bivalves were able to survive and reproduce. Over many generations, as more thicker-shelled bivalves reproduced, the entire population of *Astarte* and *Anadara* mollusks within the Salisbury Embayment were characterized by this increase in shell thickness and volume.** http://www.uvm.edu/perkins/evolution/fieldtrip/chesapeake/

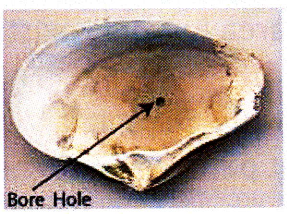
Miocene Shark Teeth Census: Utilizing float shark teeth samples collected along the surf and on the beaches, we attempt to determine the relative abundance of the various species of sharks that lived in the area at the time. By collecting *large quantities over time*, and always *without bias* (collect **ALL *identifiable*** samples regardless of size or condition), a good ***proxy*** can be established for an actual in-situ collection. By collecting at sites that represent the different formations (times), we can determine any variation in proportional abundances over time.

I encourage you to participate in the above Shark Tooth Census, and to devise your own studies. Find opportunities...Blaze trails...Be a paleo-scientist!

Other cool links:

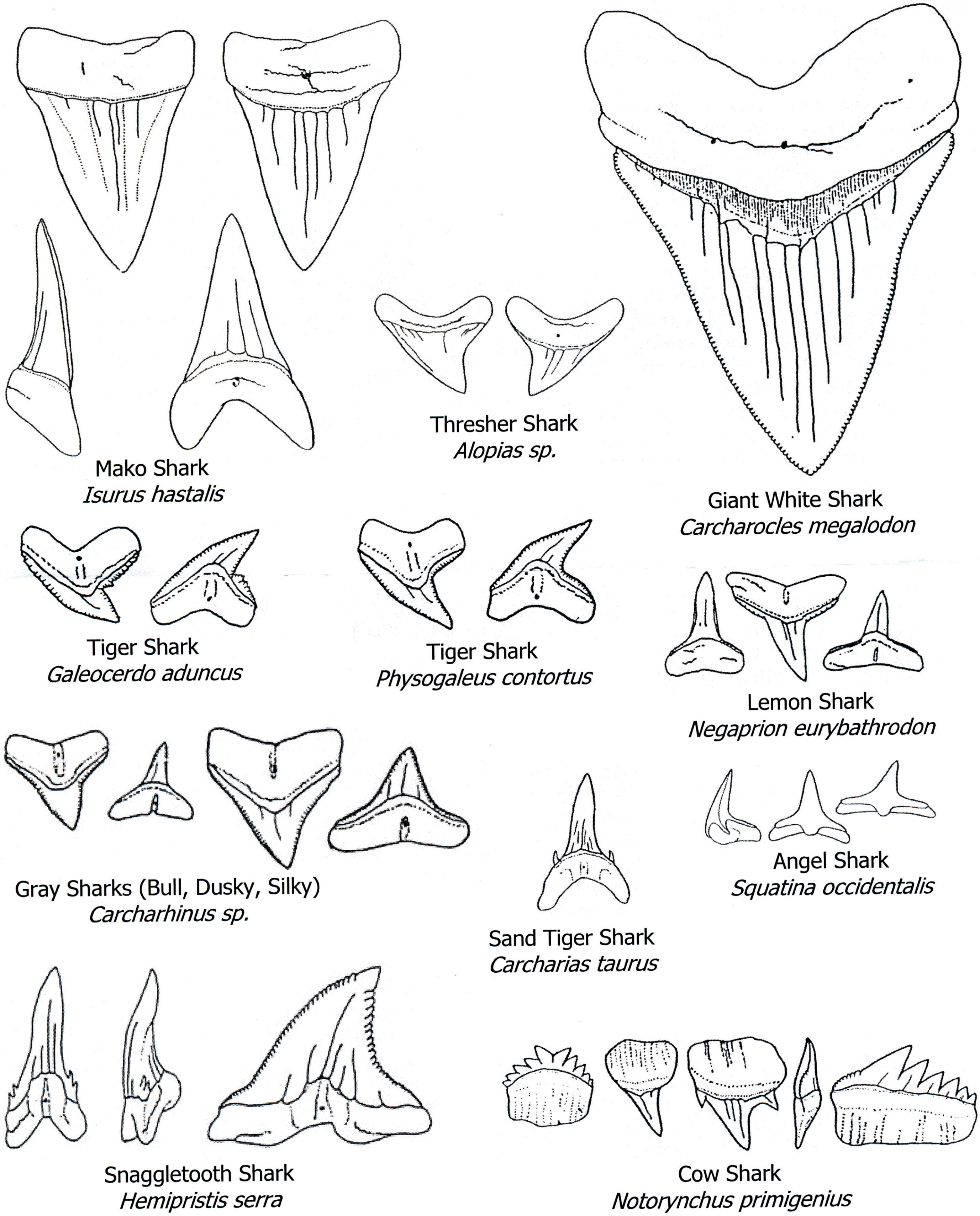
https://www.youtube.com/watch?v= NJrFxKJaX0

https://www.youtube.com/watch?v=suC2vQQz1Ak



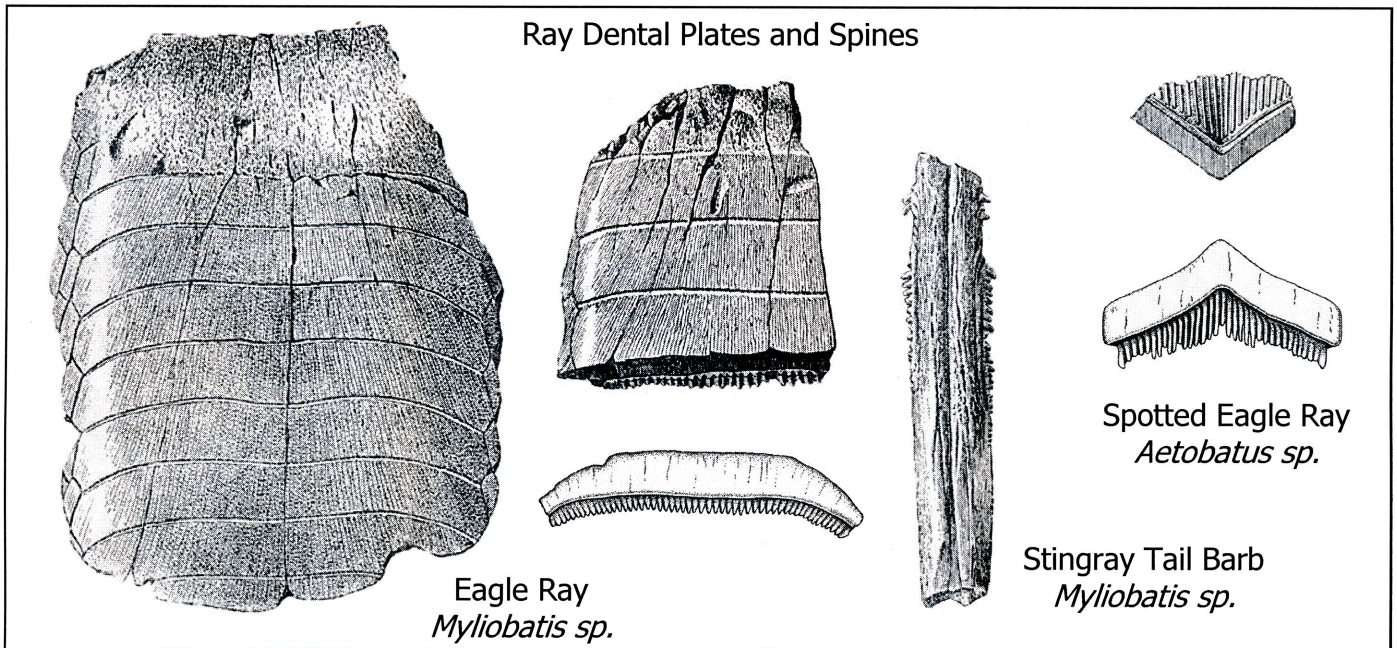
Turridae (Marine Snail

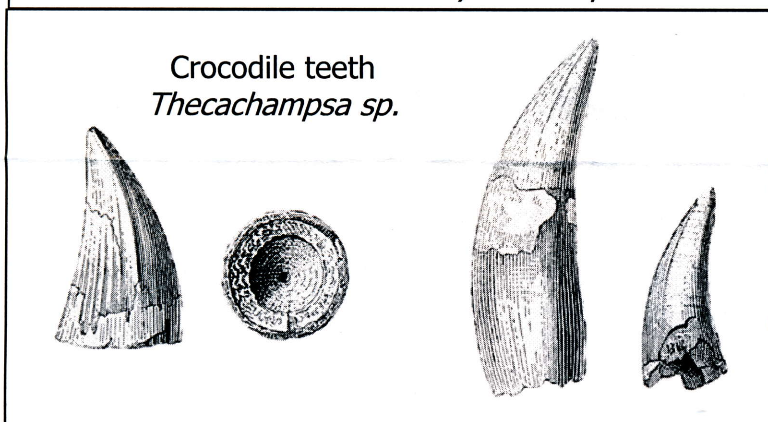
Fossil Shark Teeth of the Maryland Miocene

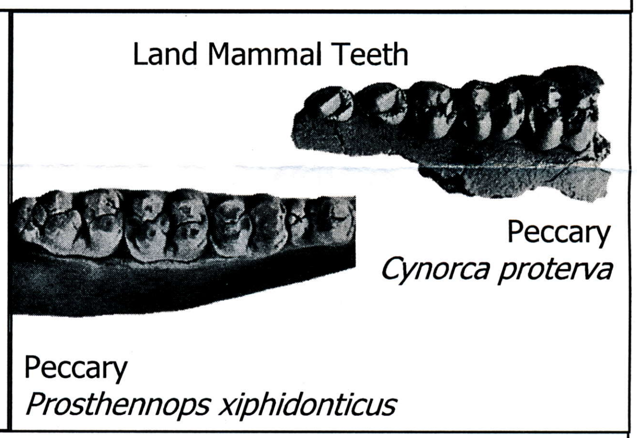


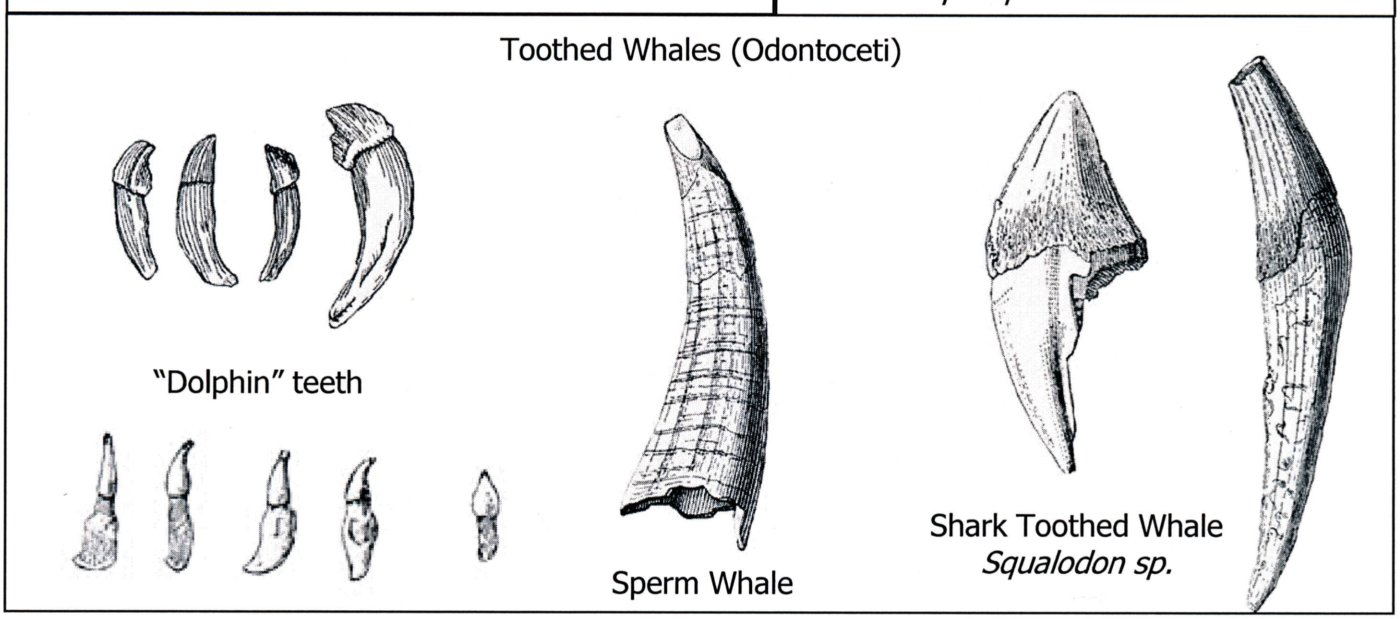
Kent, Bretton W. "Fossil Sharks of the Chesapeake Bay Region. Egan Rees & Boyer." *Inc., Columbia, Maryland* (1994).

Other Fossil Teeth of the Maryland Miocene









Clark, W.B., et al., 1904, Miocene Plates, Maryland Geological Survey, Baltimore, MD
Wright, David B., and Ralph E. Eshelman. "Miocene Tayassuidae (Mammalia) from the Chesapeake Group of the Mid-Atlantic coast and their bearing on marine-nonmarine correlation." *Journal of Paleontology* (1987): 604-618.
Stephen Godfrey, ray plate line drawings