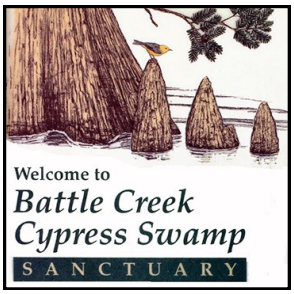


Cultural & Natural History of the Mid-Atlantic:

Trees with knees, art with heart, a house with legs, and a beach with teeth.

Exploring Calvert County, Maryland

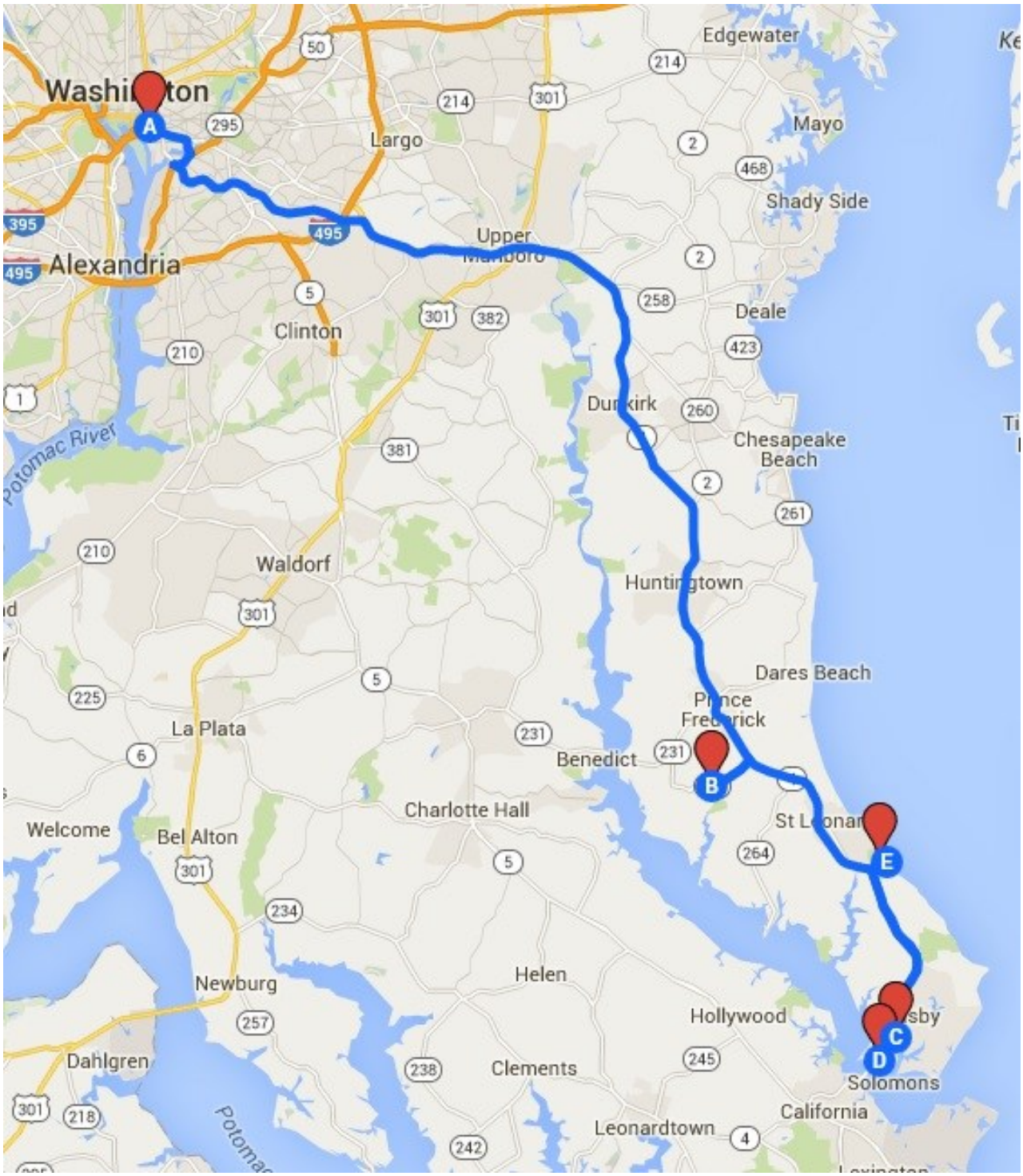
Saturday, August 17, 2024

Smithsonian Associates

ENTERTAINING. INFORMATIVE. ECLECTIC. INSIGHTFUL.

A Map of Today's Tour Route & Links to Other Maps

Today's tour has four site stops all of which are in Calvert County, Maryland: Battle Creek Cypress Swamp; The AnnMarie Gardens; the Calvert Marine Museum; and the Flag Ponds Beach and Nature Center. These are shown on the map below which traces our route from DC to Solomons, Maryland. You may access an interactive Google Map at the following link: **http://tinyurl.com/jfmjned** and a Google Map of additional sites of interest at : **http://tinyurl.com/j98q6bk**.



Before The Facts & Figures - A few thoughts

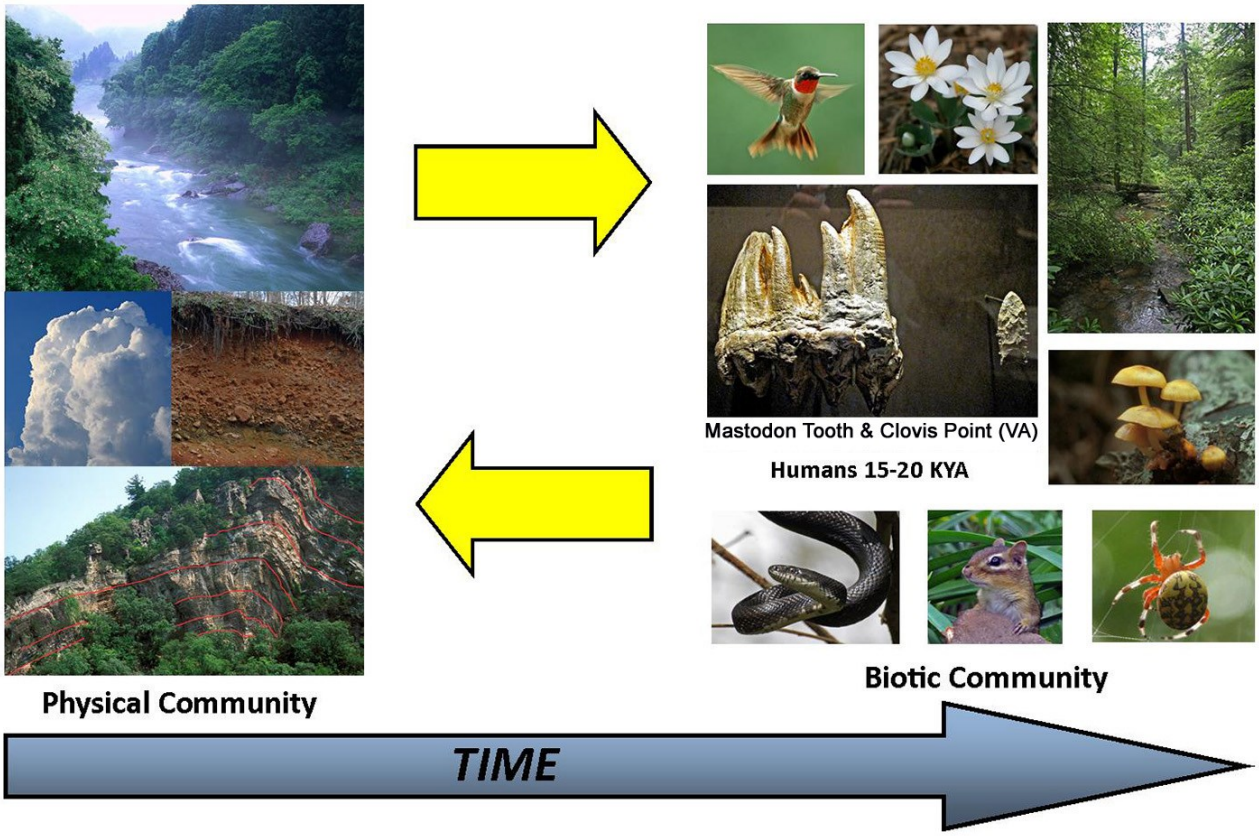
Today's sites and interpretation will expose you to geology, natural history, cultural history, and art exploration among other topics and themes. While I love sharing what I know with you, I want to encourage each of you to open yourselves to the wonders of each place that we will visit and let the magic of each 'place' speak to you directly. If you leave the tour today not only more informed but spiritually and emotionally enriched, I will have succeeded in my goal to let you experience not only the environments but the 'places' as well. The following quote has informed my interpretation on Smithsonian tours and continues to shape my thinking about how the Natural World can nurture each of us as we do our best to move ahead in these trying times.

"There is a great deal of talk these days about saving the environment. We must, for the environment sustains our bodies. But as humans we also require support for our spirits, and this is what certain kinds of places provide. The catalyst that converts any physical location -any environment if you will -into a place, is the process of experiencing deeply. A place is a piece of the whole environment that has been claimed by feelings. Viewed simply as a life-support system, the earth is an environment. Viewed as a resource that sustains our humanity, the earth is a collection of places. We never speak, for example, of an environment we have known; it is always places we have known -and recall. We are homesick for places, we are reminded of places, it is the sounds and smells and sights of places which haunt us and against which we often measure our present."

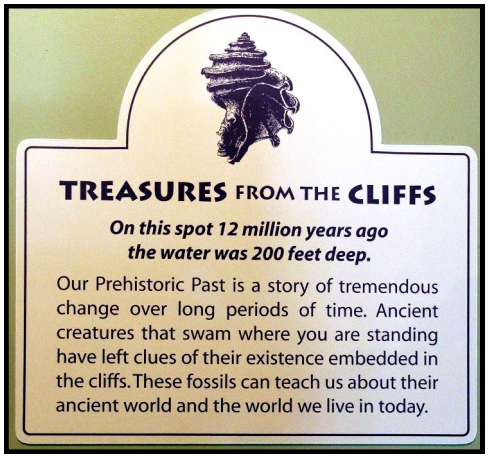
Alan Gussow

From '*A Sense of Place*' (1970)

Environmental History



In any given region of Planet Earth, the ***Physical Community*** is constantly interacting with, and affecting the regional ***Biotic Community*** and vice versa. These subtle changes have been going on ever since life began on Earth an estimated 3.8 Billion Years ago. While the day-to-day changes are slight and subtle, the long-term changes wrought by climate and by the movement of tectonic plates can totally change the face of the continents and the character of ecosystems. With the arrival of humans (15-22,000 years ago), environmental changes related to human activities have become a major factor in shaping the regional environment. The Chesapeake Bay is currently experiencing the most rapid sea level rise in the US and being adversely affected by a number of factors driven by the rapid growth of regional cities and farms and the pollutants they generate.



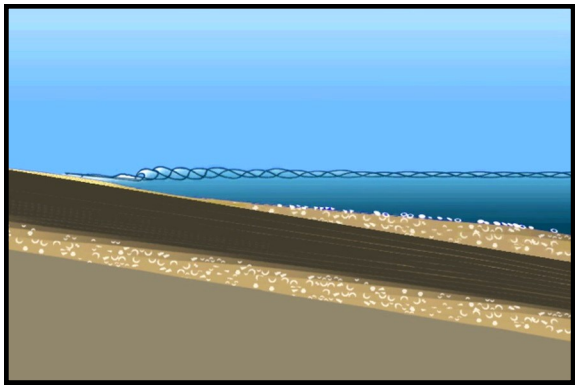
Sign at the Calvert Marine Museum

As we explore Calvert County today, remain aware of how things have changed over time both for the environment and for the human cultural community: Slavery to Civil Rights; oars to steam engines to gas turbines; tropical cypress swamps to seasonal deciduous forests; fields of tobacco plants now full of townhouses or corn. While regional change is inevitable, we can make choices about how to address that change and thereby take an active role in shaping our future. **W<u>hat we (collectively and individually) do or not do today will have impacts on the Bay's future health</u>**.

Landscapes Are Multilayered Creations

The Physical History of A Landscape

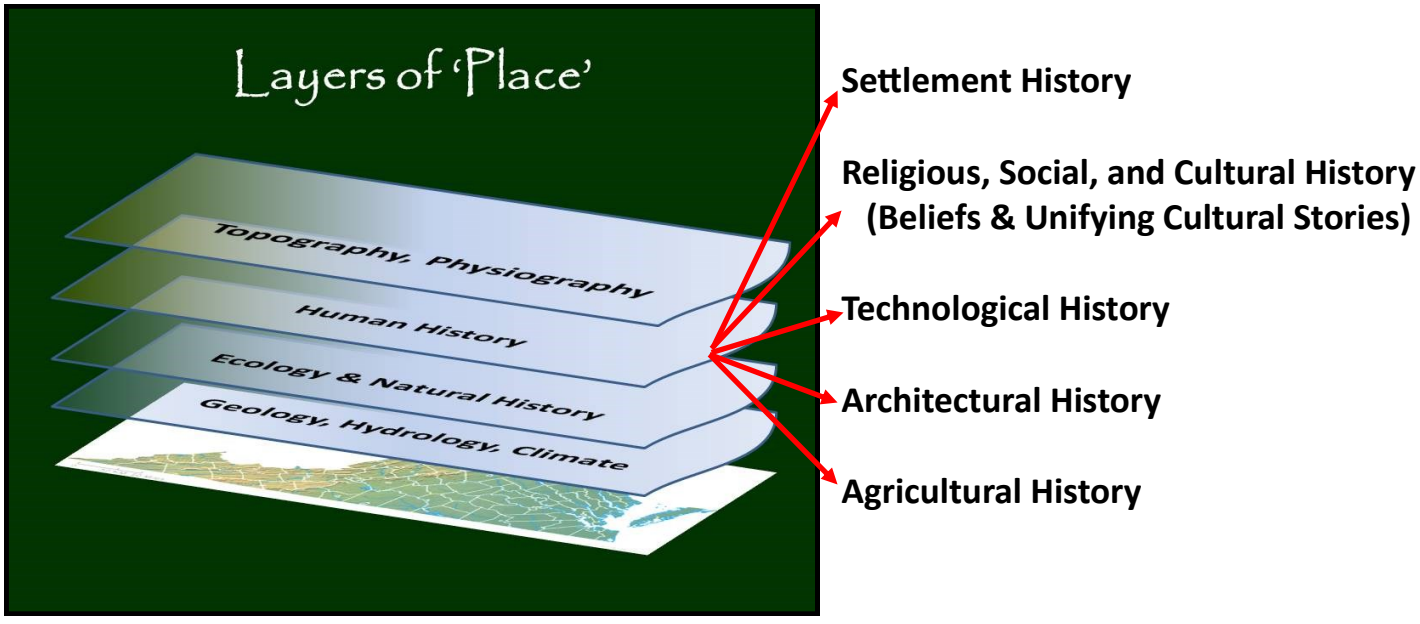
NOTE: Watch the Calvert Cliffs video at the Museum to learn how the cliff sediments were formed. You will see the 'Push to Start' button on the wall of the little alcove with seats and the TV screen. Of all the films at the CMM, this is the one with the biggest 'Aha!' factor.



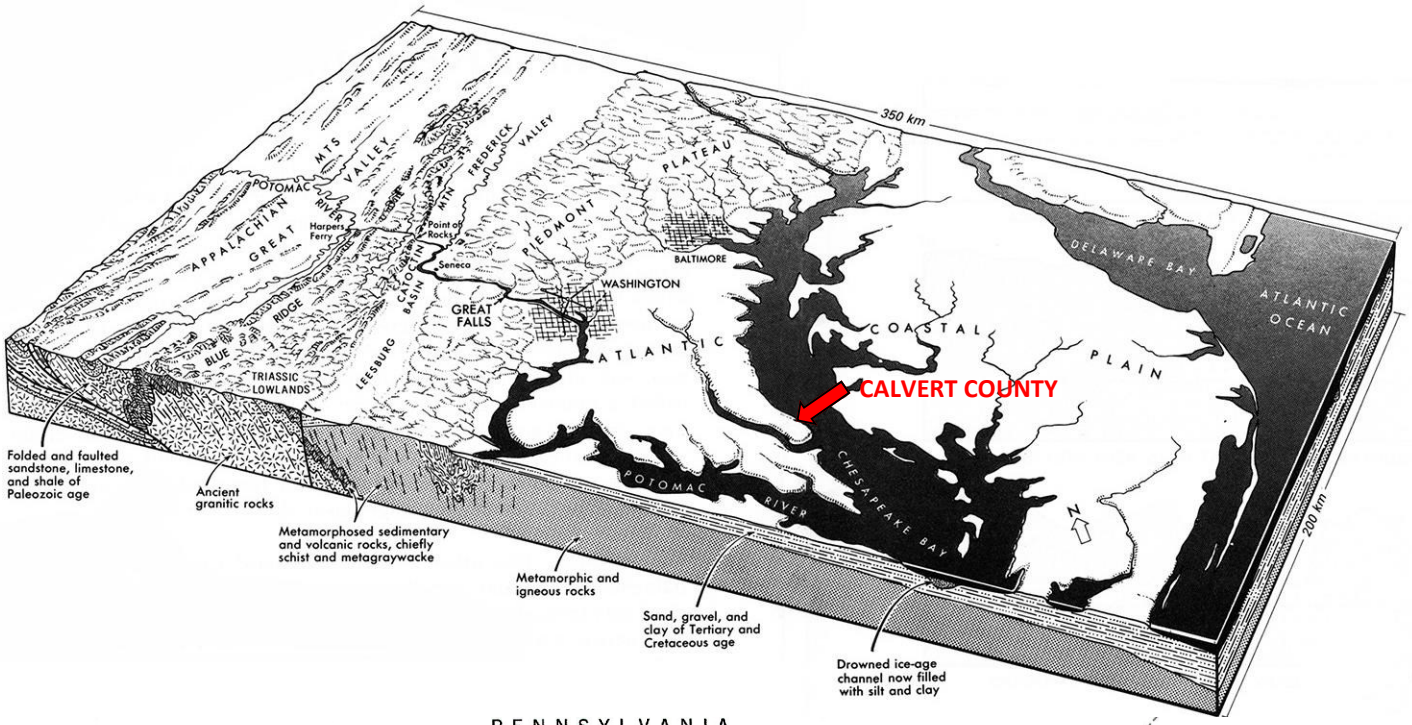
You can see the sedimentary layers in the Calvert Cliffs in the picture above taken from Flag Ponds Beach. These layers were created by cycles of rising and falling sea levels during the Miocene Era which lasted for almost 20 Million Years.

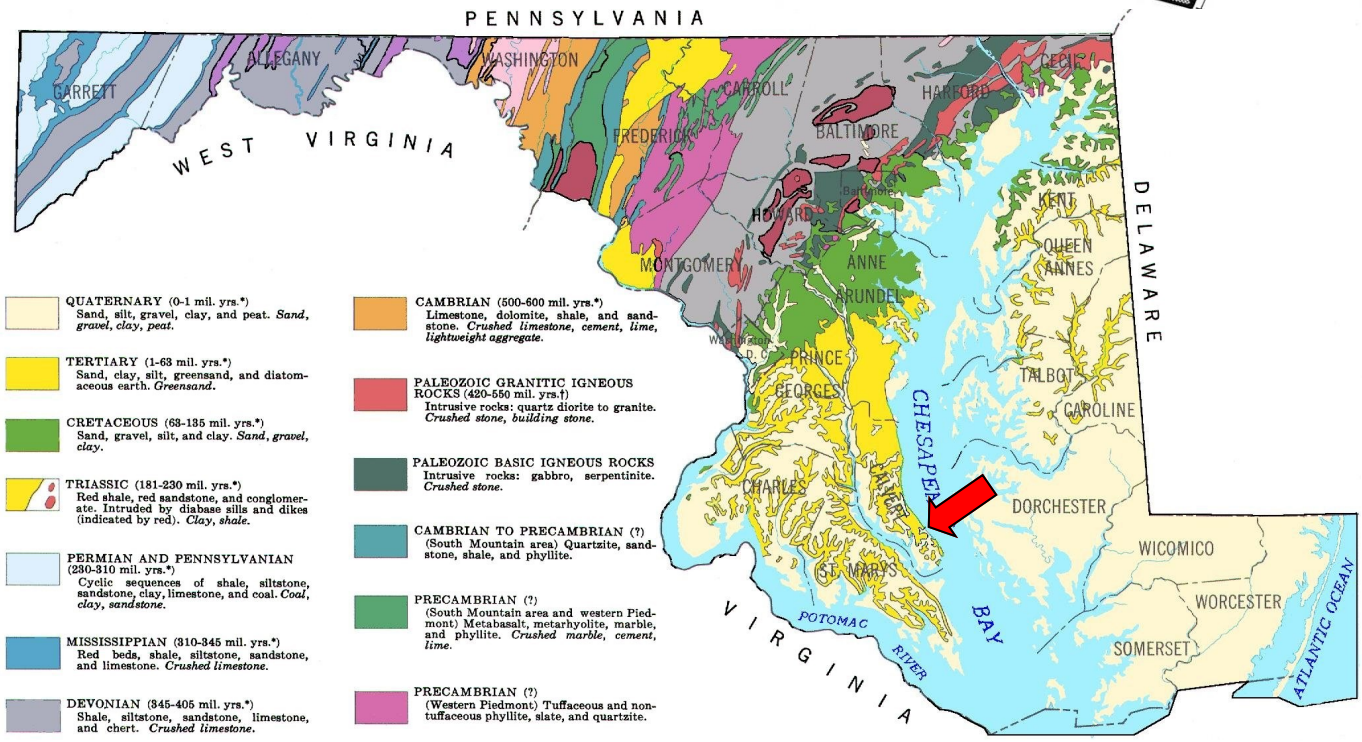
The Land Shapes Life - Life Shapes The Land

Just as the Calvert Cliffs are made up of multiple layers, so too are 'places' a composite of different layers of history: **Topography and Physiography** (Geology and Climate interacting over time); **Ecology and Natural History** (Climate, Physiography and Biological Evolution interacting over time); **Geology, Hydrology and Climate** (As tectonic plates move, rocks move , transform and recycle; climates change as mountains rise and fall and continents move across the equator); and of course **Human History** with it own sub-layers as shown below. Life (Plants and Animals) has always adapted to the climate and environment in which it is found and in turn affects the environment (e.g., altering temperature and rainfall and helping break down rocks). Human impacts on the environment are wide-reaching and are probably the greatest (controllable) variable in planetary health.



Ancient Geologic History Beneath Our Feet





QUATERNARY (0-1 mil. yrs.*)
Sand, silt, gravel, clay, and peat. *Sand, gravel, clay, peat.*

TERTIARY (1-63 mil. yrs.*)
Sand, clay, silt, greensand, and diatomaceous earth. *Greensand.*

CRETACEOUS (63-135 mil. yrs.*)
Sand, gravel, silt, and clay. *Sand, gravel, clay.*

TRIASSIC (181-230 mil. yrs.*)
Red shale, red sandstone, and conglomerate. Intruded by diabase sills and dikes (indicated by red). *Clay, shale.*

PERMIAN AND PENNSYLVANIAN (230-310 mil. yrs.*)
Cyclic sequences of shale, siltstone, sandstone, clay, limestone, and coal. *Coal, clay, sandstone.*

MISSISSIPPIAN (310-345 mil. yrs.*)
Red beds, shale, siltstone, sandstone, and limestone. *Crushed limestone.*

DEVONIAN (345-405 mil. yrs.*)
Shale, siltstone, sandstone, limestone, and chert. *Crushed limestone.*

SILURIAN (405-425 mil. yrs.*)
Shale, mudstone, sandstone, and limestone. *Glass sand, crushed limestone.*

ORDOVICIAN (425-500 mil. yrs.*)
Limestone, dolomite, shale, siltstone, and red beds. Slate and conglomerate in northern Harford County. *Crushed limestone, cement, clay, lime.*

CAMBRIAN (500-600 mil. yrs.*)
Limestone, dolomite, shale, and sandstone. *Crushed limestone, cement, lime, lightweight aggregate.*

PALEOZOIC GRANITIC IGNEOUS ROCKS (420-550 mil. yrs.†)
Intrusive rocks: quartz diorite to granite. *Crushed stone, building stone.*

PALEOZOIC BASIC IGNEOUS ROCKS
Intrusive rocks: gabbro, serpentinite. *Crushed stone.*

CAMBRIAN TO PRECAMBRIAN (?)
(South Mountain area) Quartzite, sandstone, shale, and phyllite.

PRECAMBRIAN (?)
(South Mountain area and western Piedmont) Metabasalt, metarhyolite, marble, and phyllite. *Crushed marble, cement, lime.*

PRECAMBRIAN (?)
(Western Piedmont) Tuffaceous and nontuffaceous phyllite, slate, and quartzite.

PRECAMBRIAN (?)
(Eastern Piedmont) Schist, metagraywacke, quartzite, marble, and metavolcanic rocks. *Crushed stone, crushed marble, building stone.*

PRECAMBRIAN BASEMENT COMPLEX (1100 mil yrs.†)
Gneiss, migmatite, and augen gneiss.

MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

GENERALIZED GEOLOGIC MAP OF MARYLAND‡

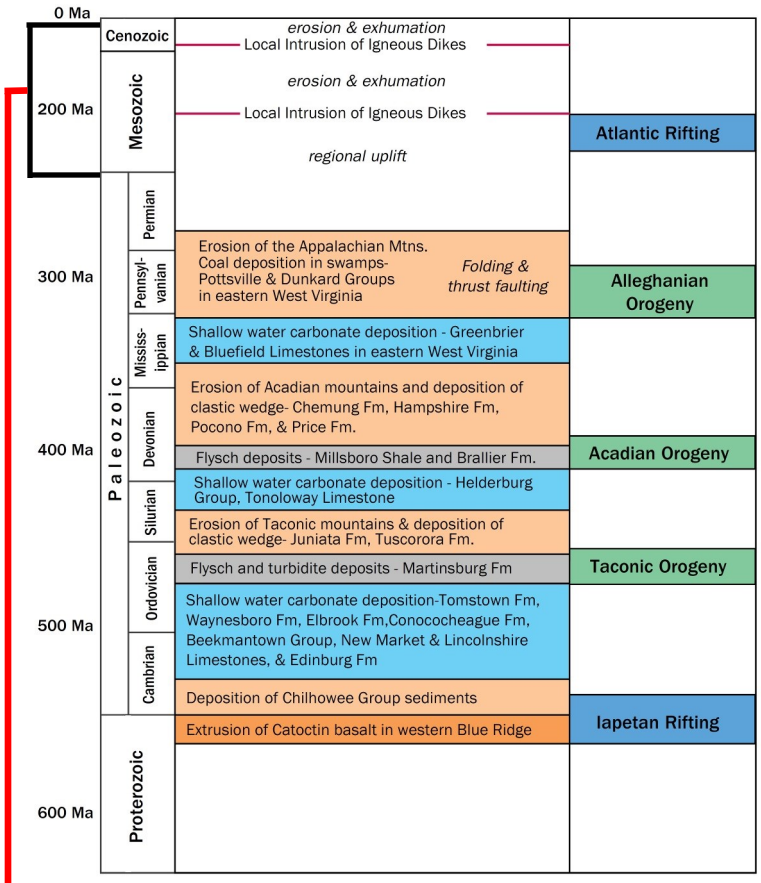
1967

10 0 10 20 30 40
1 inch equals 25 miles

Most important mineral products in italics.
* Age ranges from Kulp, J. L., 1961, Geologic time scale: Science, v. 133, no. 3459, p. 1105-1114.
† Radiometric dates made on Maryland rocks.

‡ A detailed Geologic Map of Maryland, 1968 at a scale of 1 inch equals 4 miles, is also available.

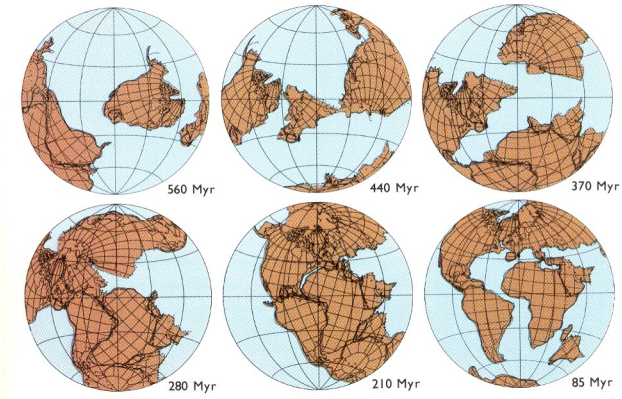
A Geological 'Score Card'



GEOLOGICAL TIME SCALE (mya = millions of years ago)			
ERA	PERIOD	EPOCH	DURATION
CENOZOIC Age of Mammals	Quaternary	Holocene	Present–10,000 yrs.ago
		Pleistocene	10,000 yrs.ago–1.6 mya
	Tertiary	Pliocene	1.6–5 mya
		Miocene	**5–24 mya**
		Oligocene	24–35 mya
		Eocene	35–56 mya
		Paleocene	56–65 mya
MESOZOIC Age of Reptiles	Cretaceous		65–145 mya
	Jurassic		145–210 mya
	Triassic		210–245 mya
PALEOZOIC			245–570 mya
PROTEROZOIC			> 570 mya

The chart to the left shows the major geologic events that created the Mid-Atlantic Coast over the last 500 Million Years.

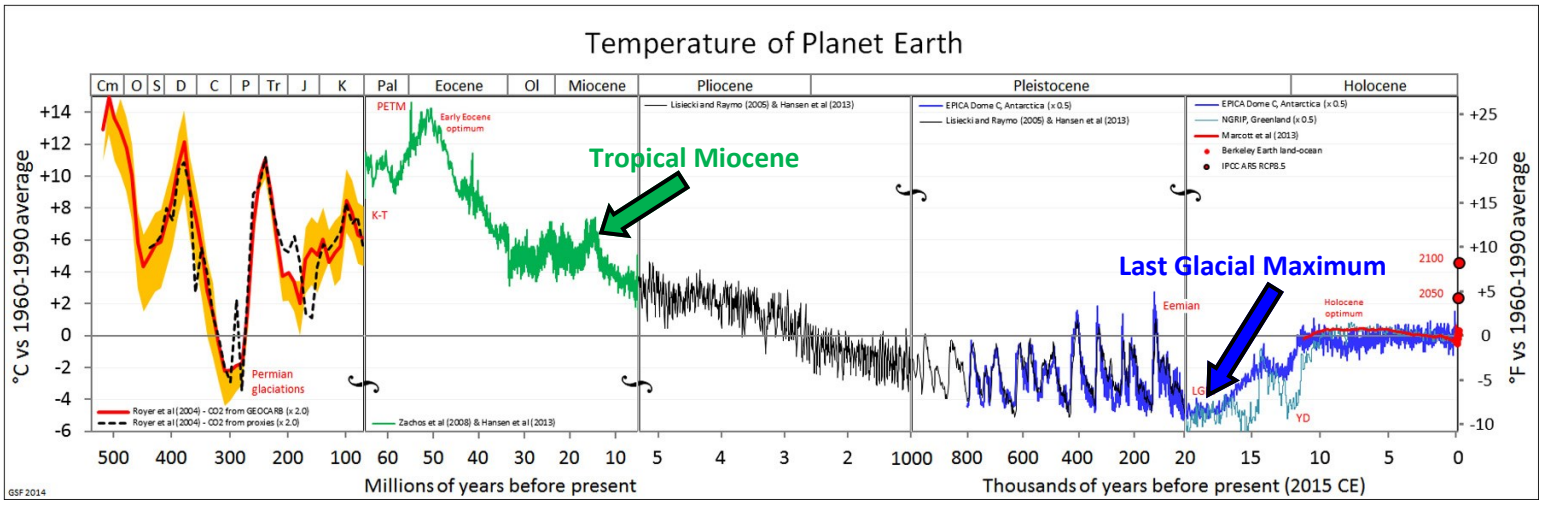
- Three mountain-building events (Orogenies) shaded **GREEN**
- Two ocean-building (Rifting) events shaded **DARK BLUE**
- Four erosional/sediment depositional events shaded **TAN**
- Two Basin-filling (Flysch/Turbidite) events shaded GRAY
- Ocean incursions shaded **LIGHT BLUE**
- One volcanic extrusion (basalt) event shaded **ORANGE**

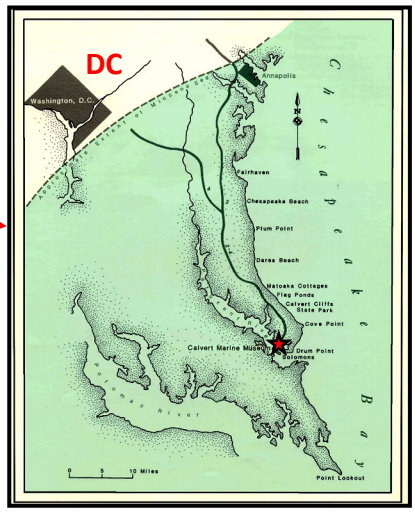


The 6-part diagram above shows the movement of the continental plates over the last 560 Million Years.

The chart to the left highlights the temporal location of the **Miocene Epoch (5-24 MYA).** The sediment layers and the fossils found in the **Calvert Cliffs** were deposited on ocean floors during several ocean incursions during the Miocene Epoch. The video at the museum shows how these layers were deposited to create the bands we see in the Cliffs today.

Changing Temperatures & Sea Levels

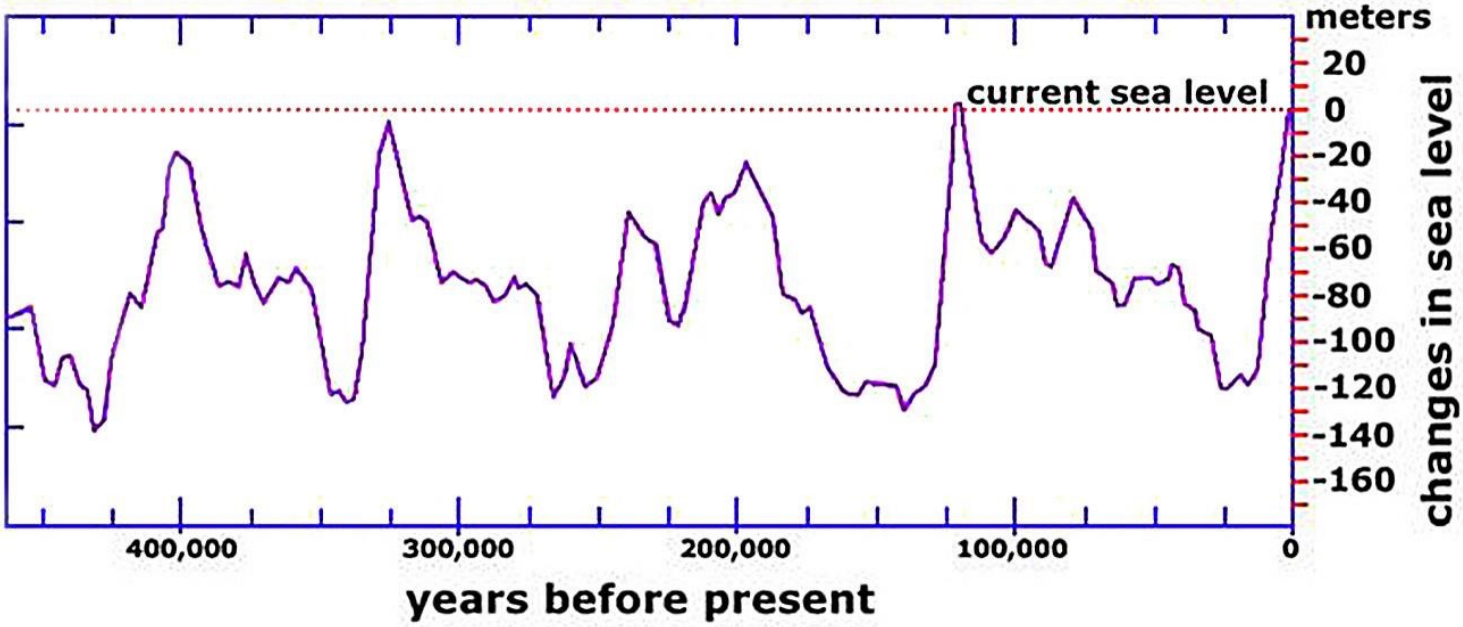




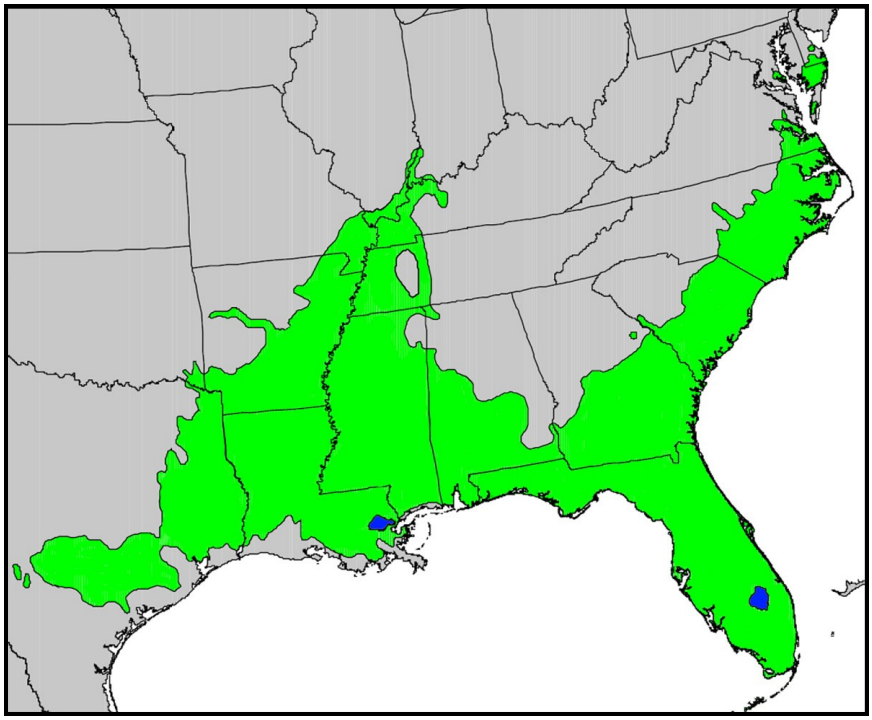
(Far Left) Atlantic Coast during the Early Miocene 15 MYA

(Near Left) Detail of Ocean Incursion in local area during Early Miocene 15 MYA

Late Pleistocene and Holocene Sea-level Curve



Bald Cypress Distribution in the US



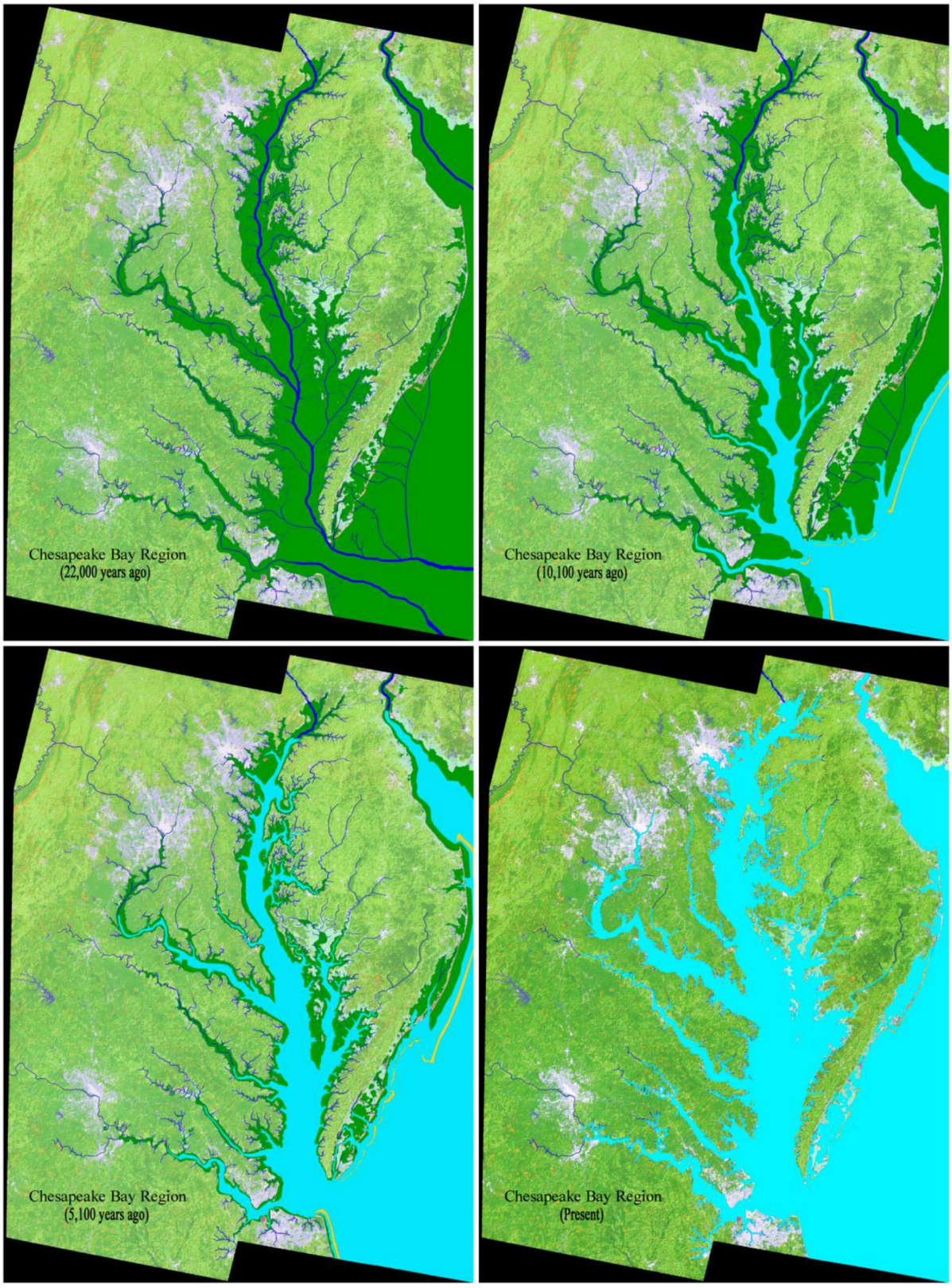
Bald Cypress

(Taxodium distichum)

- Are in the same plant family as the Coast Redwoods and Giant Sequoias
- Oldest in US : 1,622 years old.
- Tallest in US : 44 m, Williamsburg, VA
- Stoutest in US: 5.2 m, Cat Island, LA
- Excellent wood for water resistance.

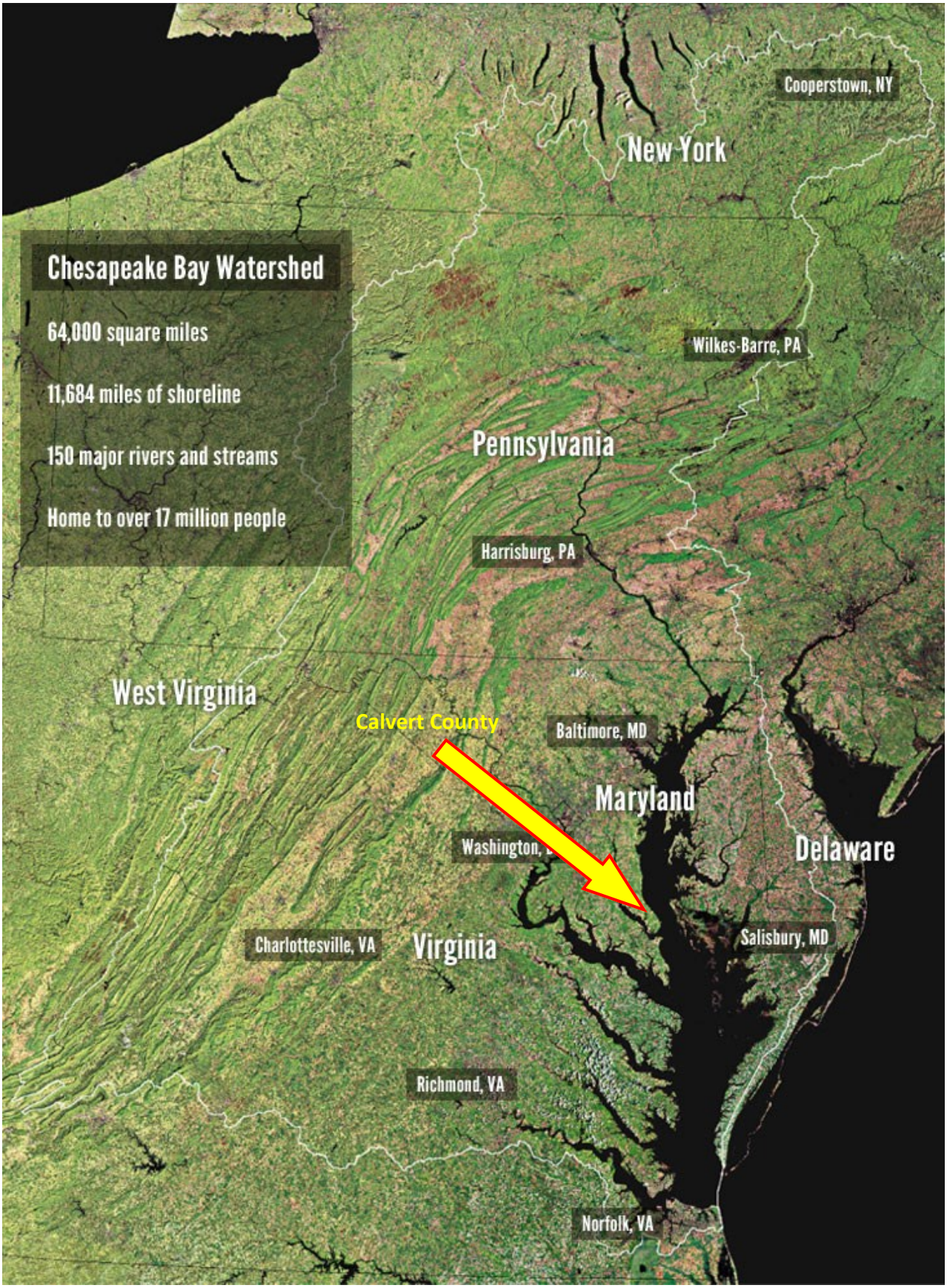
The Bald Cypress trees you will see at ***Battle Creek Cypress Swamp*** provide a modern day approximation of what Miocene Era forests in Maryland may have resembled as shown in the background of the diorama that you will see when you tour the Calvert Marine Museum exhibits (see below). Looking at the map above, please note that the Bald Cypress is at the northern edge of its historic range in Maryland. As the climate warms, their distribution may move north into Virginia and Pennsylvania.

From Ancient Rivers to 'The Bay' of Today

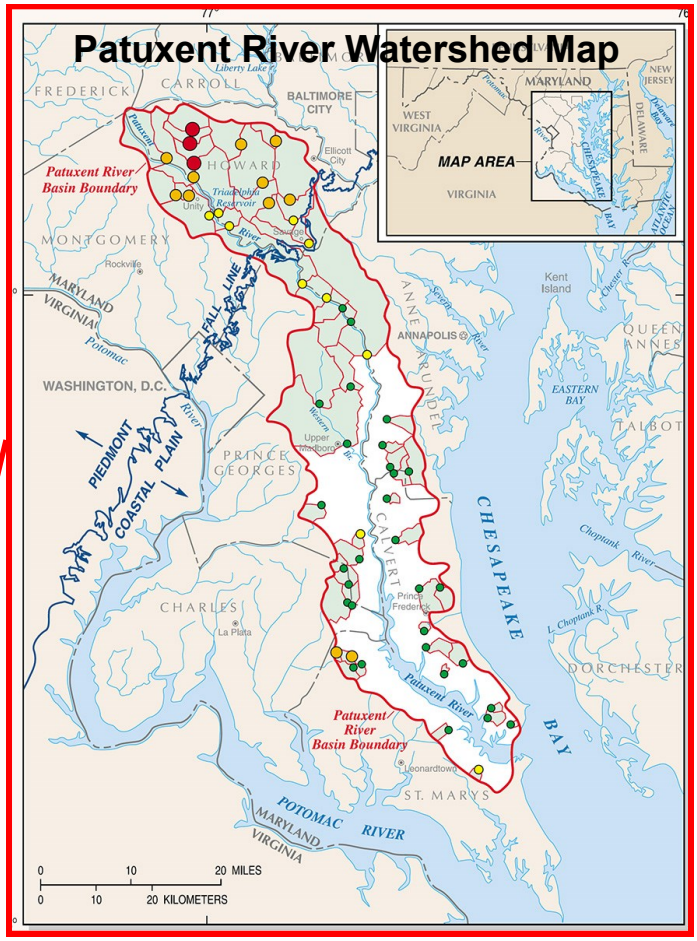


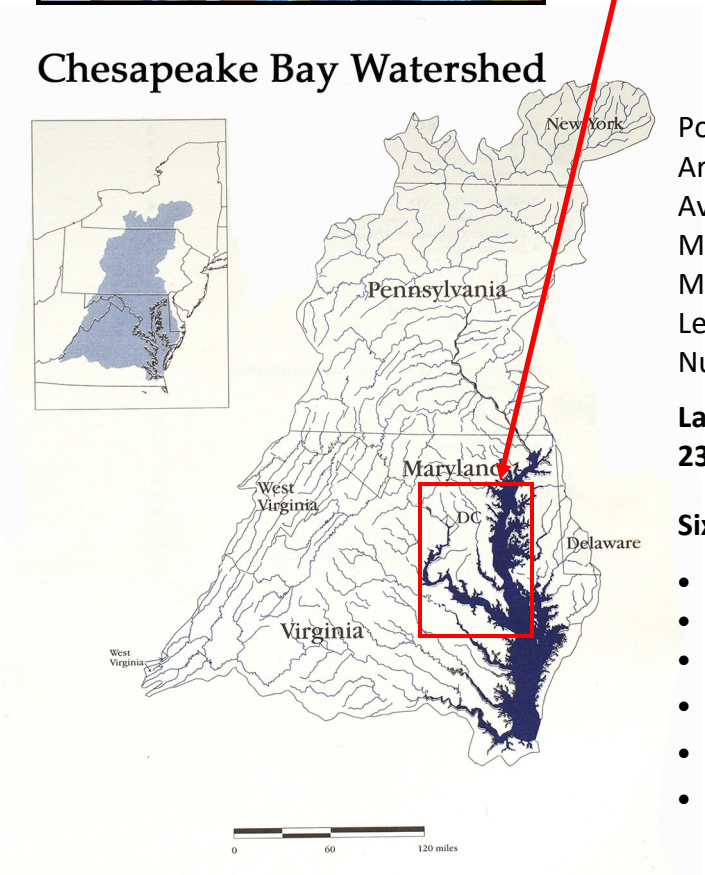
From '*Sea Level Rise in Coastal Virginia: Understanding Impacts to Archaeological Resources'* by Lowery, O'Neal, Cariso & Montini, VA Department of Historic Resources, 2012

The Chesapeake Bay Watershed



The Patuxent River is 115 miles long and drains an area of 937 square miles including much of Calvert County. The River served as the primary route for the British attack on Washington in 1812 and later as a major transportation artery during the steamboat era. It has long been a source of employment for watermen, but with the rapid increase in development within its drainage (watershed), the health of the river and the diversity of aquatic life in the river has been seriously compromised. Retired MD State Senator, Bernie Fowler (at right below), hosted an annual 'Wade In' Event to highlight the decreasing water clarity (and health) of the river from 1988 until June of 2021 six months before his death at age 97.





Bay Watershed Facts:

Population	18,130,000 **(2016)**
Area (sq miles)	66,388
Average Depth (ft) (w/o rivers)	27
Miles of shoreline (Bay only)	~4,000
Miles of shoreline (Total)	11,684
Length (miles)	193
Number of Plant and Animal Species	3,600

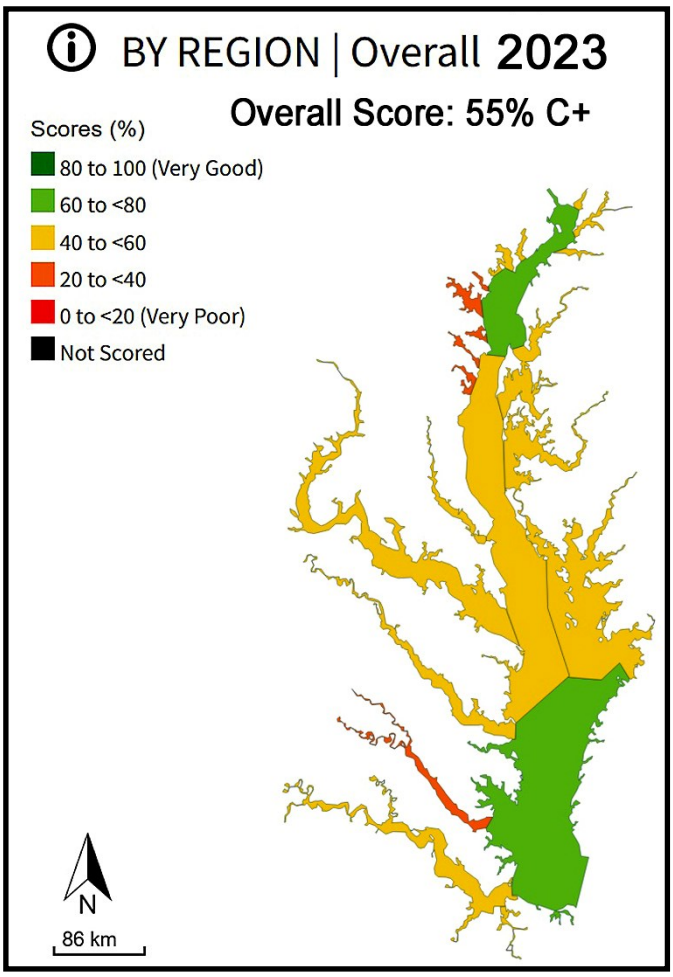
Land Drainage Area/Water Volume Ratio:
23 times greater than for the Great Lakes.

Six Major Rivers feed into the Bay :

- Susquehanna River 27,500 square miles
- Patuxent River 937 square miles
- Potomac River 14,700 square miles
- Rappahannock River 2,848 square miles
- York River 2,669 square miles
- James River 10,432 square miles

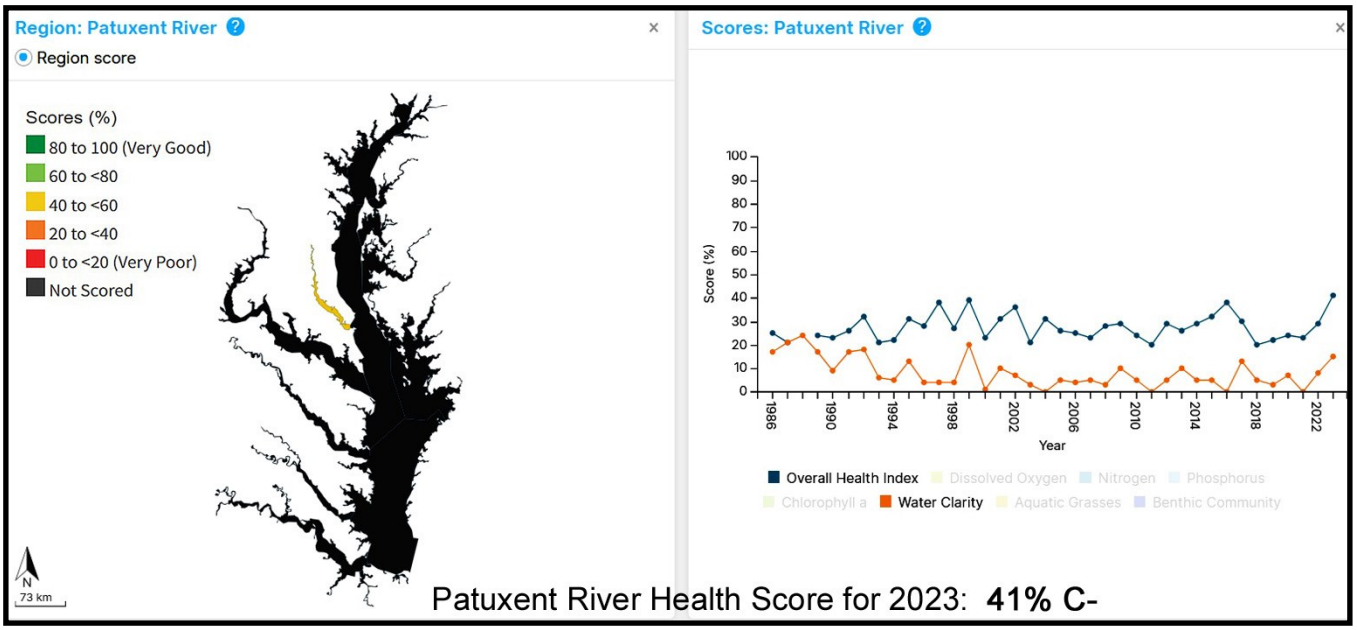
Combined Drainage 59,086 sq. mil. (89% of total)

Health Status of the Bay and Patuxent River



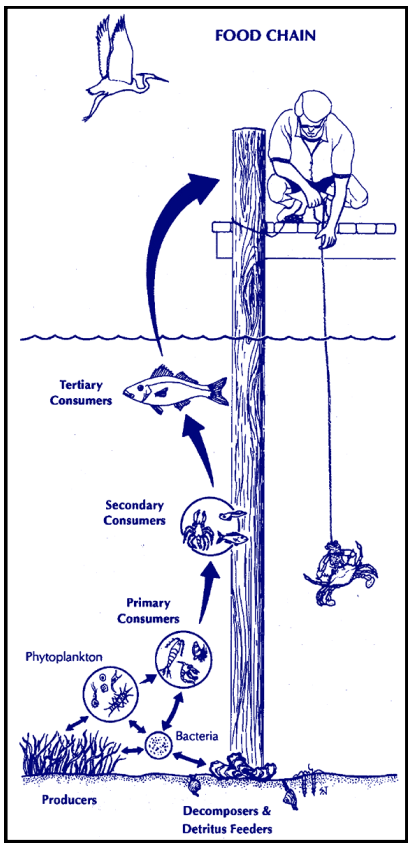
The graphic to the left presents the health of the Bay in different locations that include both the main stem (upper, middle, lower) and the tributary rivers and streams that flow into the Bay. These 'grades' are composites of a variety of health factors including: water clarity; dissolved Oxygen levels; health of bottom grasses; the levels of Nitrogen and Phosphorus; algal concentrations; and the diversity and integrity of the plant/animal communities on the bottom.

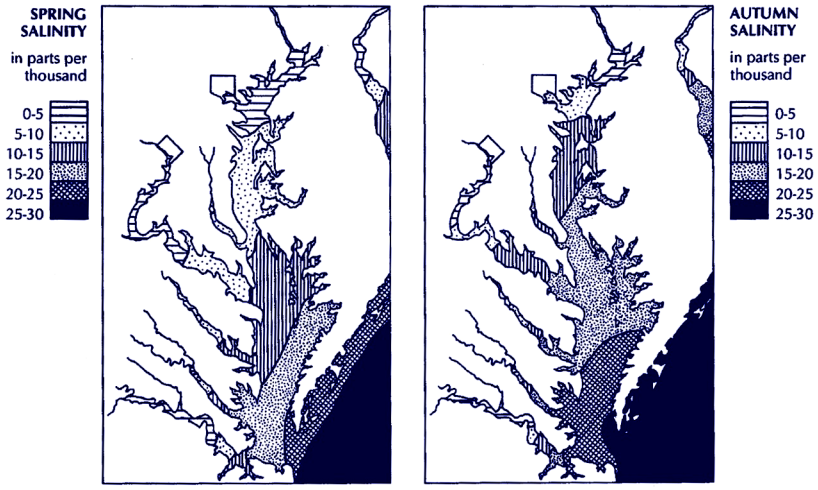
With the Bay Watershed's human population at 18.1 Million people, there has been a steady increase in pressure from development (loss of marsh and wetlands habitat), from increases in pollutants flowing into the bay from water and air, and from increased agricultural activity. Add to this the pressures of increased harvesting of fish and shellfish from the Bay and the devastating effects of two parasites (Dermo and MSX) on Bay oysters, and we find the Bay in poor health. Increased citizen awareness of what can be done to alleviate this situation will hopefully lead to concerted actions at home, at work, and in the field that will create lasting positive change in the health of the largest and most productive estuary in the USA.



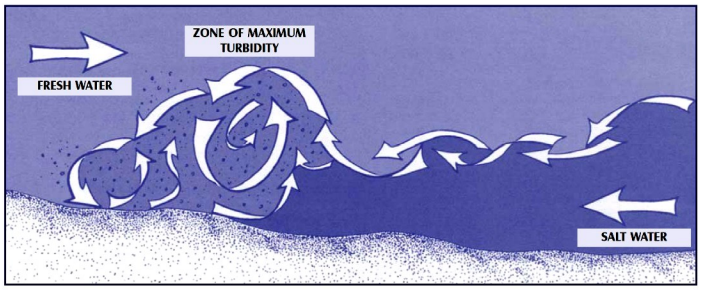
This graphic shows the **overall health scores** for the Patuxent River watershed over the past 37years along with the measurement of **water clarity** which was State Senator Bernie Fowler's main concern at his much publicized 'wade ins' (see page 12).

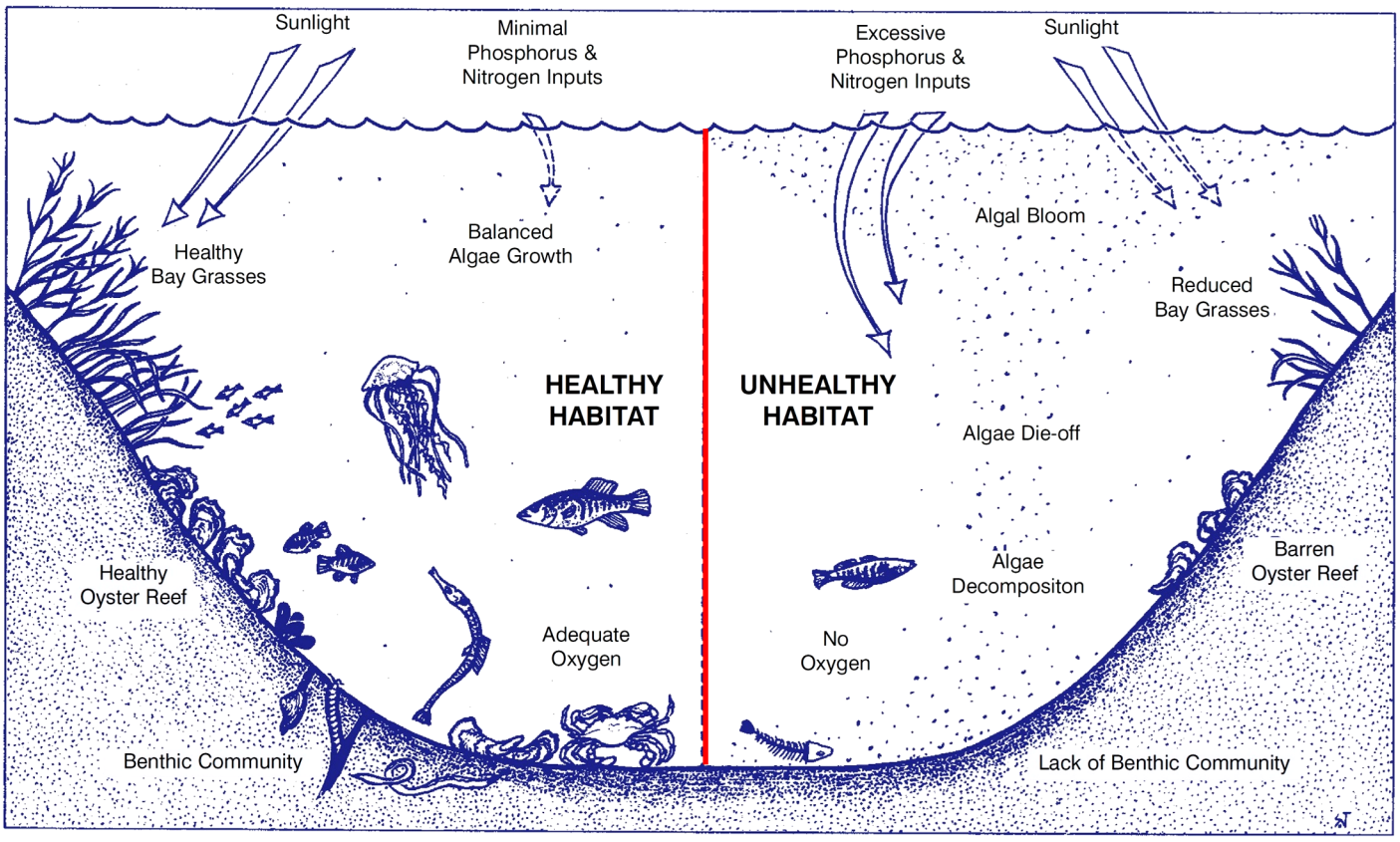
The Bay: An Estuary In Trouble



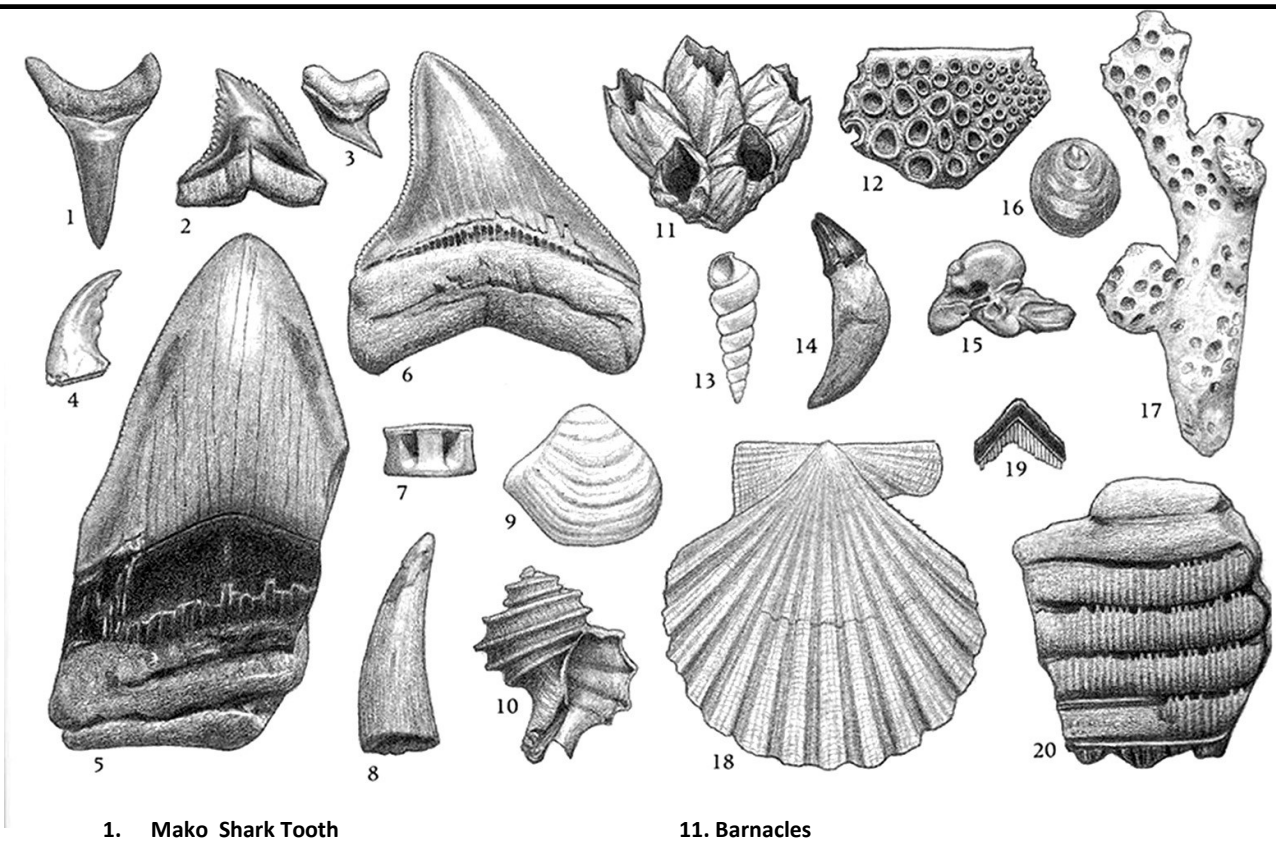


Isohalines mark the salt content of surface water. The salinity gradient varies during the year due to freshwater input: fresher during spring rains, saltier during the drier months of autumn.





Fossils Of Miocene Era (23 MY BCE - 5.3 MY BCE) Maryland Found At The Calvert Cliffs



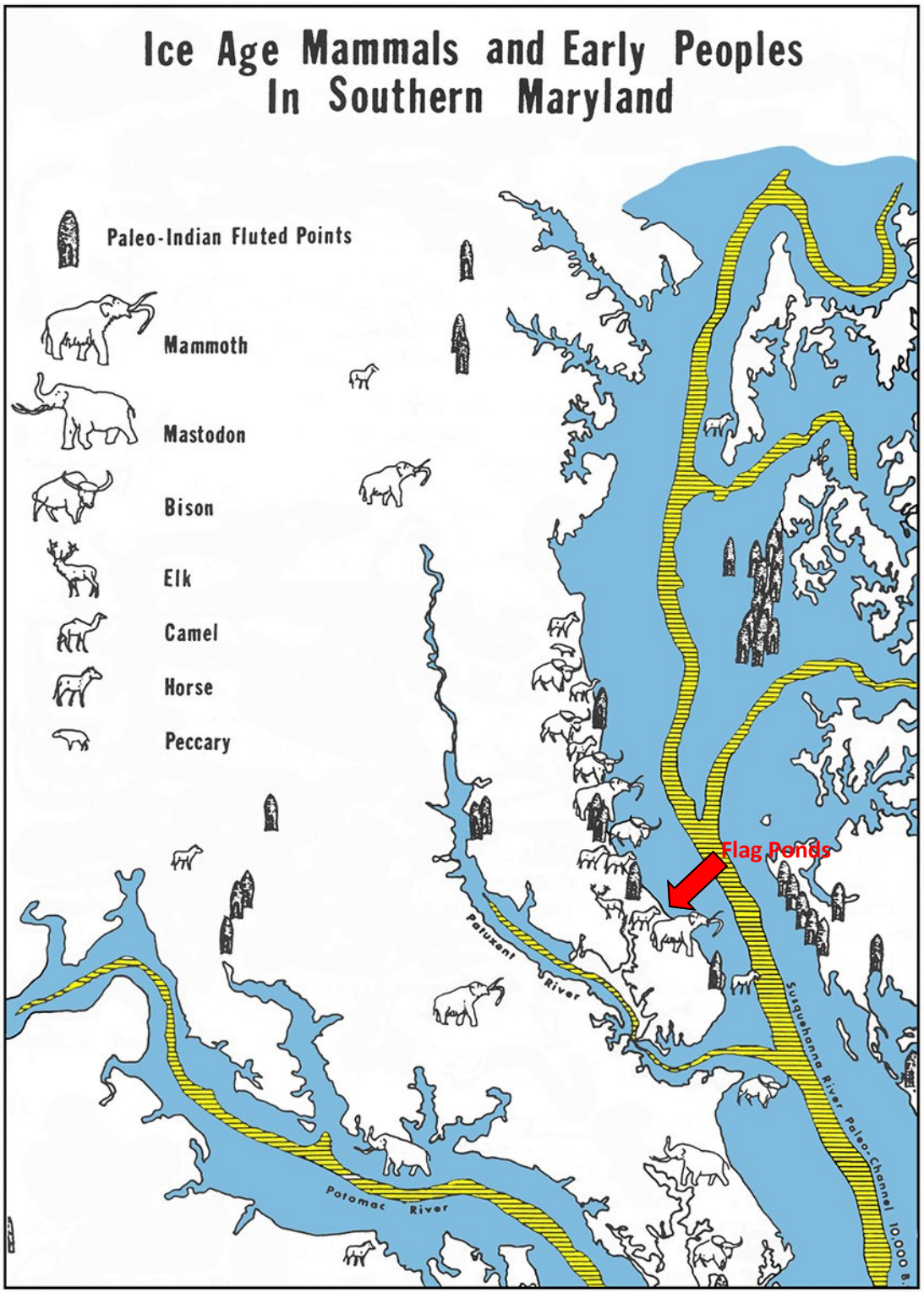
1. **Mako Shark Tooth**
2. **Snaggletooth Shark Tooth**
3. **Tiger Shark Tooth**
4. **Stone Crab Claw**
5. **Great White Shark Tooth**
6. **Great White Shark Tooth**
7. **Shark Vertebra**
8. **Crocodile Tooth**
9. **Pelecypod Shell**
10. **Ecophora Shell (MD State Fossil)**
11. **Barnacles**
12. **Drum Fish Jaw Fragment**
13. **Gastropod (Turritella) Shell**
14. **Porpoise Tooth**
15. **Inner Ear Bone (Periotic) Porpoise**
16. **Brachiopod Shell**
17. **Coral (Astrhelia sp.)**
18. **Scallop (Chesapecten sp)**
19. **Ray Dental Plate**
20. **Ray Dental Plate**

Fossils from 12,000 Years ago:

Mammoth tooth at left, Mastodon tooth at right, and Horse teeth and bone at bottom.

More Ice Age species are shown on the next page.

Animal Fossils from Maryland's Last Ice Age (2.5 MY BCE - 9,500 BCE)



Herbivores:

Ground Sloth

Horse

Camel

Bison

Woodland Musk Oxen

Wooly Mammoth

Mastodon

Giant Beaver

Peccary

Tapir

Carnivores:

Saber-toothed Cats

Dire Wolf

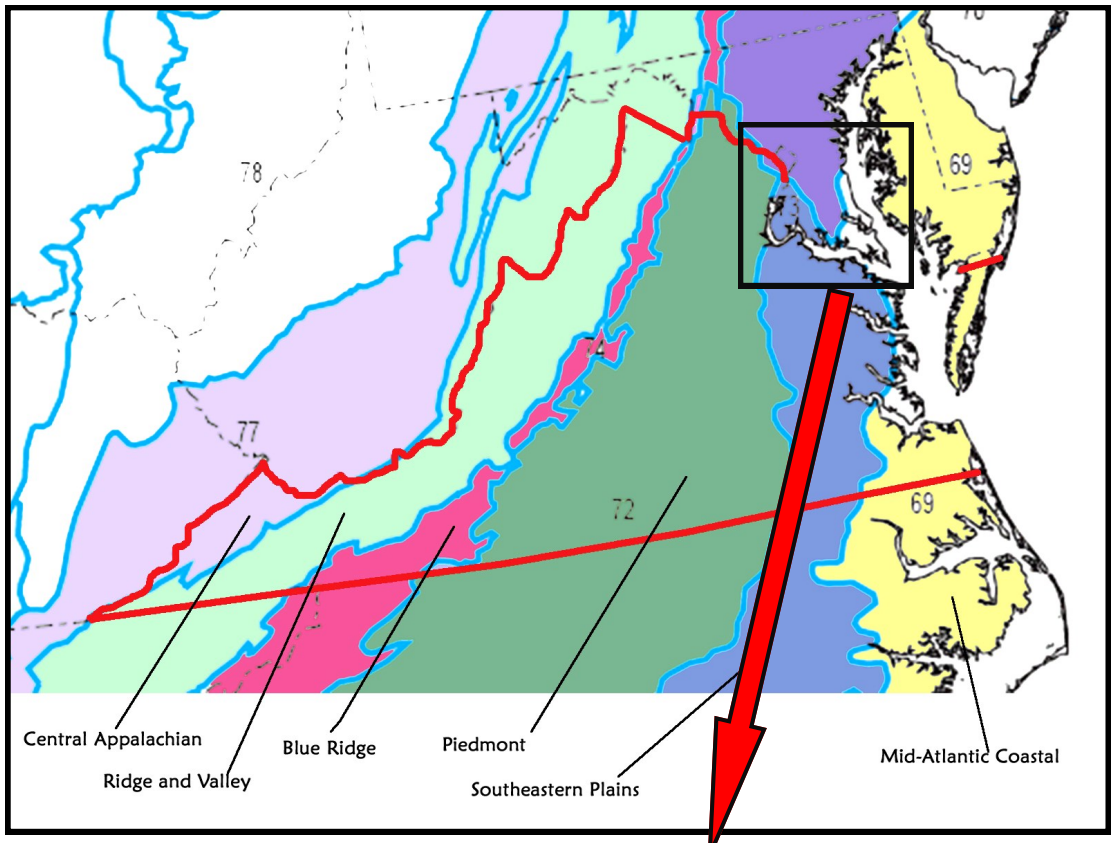
Wolf

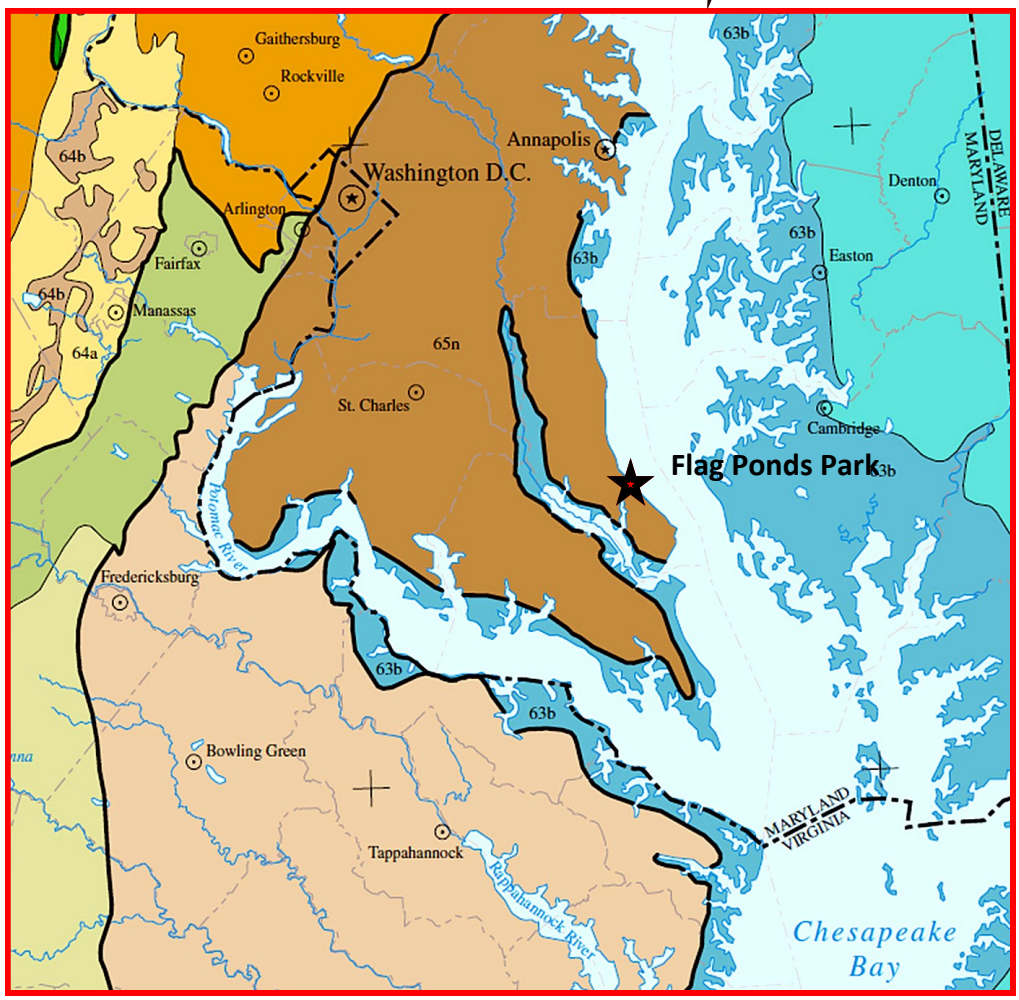
Short-faced Bear

(and Humans after 13,000 BCE)

NOTE: At the geological time for this map (2.5 MY BCE - 9,500 BCE), there was dry land where you see **BLUE** (modern day rivers and Bay). The **YELLOW** hatched areas were the ancestral rivers that later filled as sea levels rose to create the Bay we know today (See graphic upper left on Page 10).

Mid-Atlantic Ecoregions Levels III & IV





Ecozones: Ecoregions in Miniature

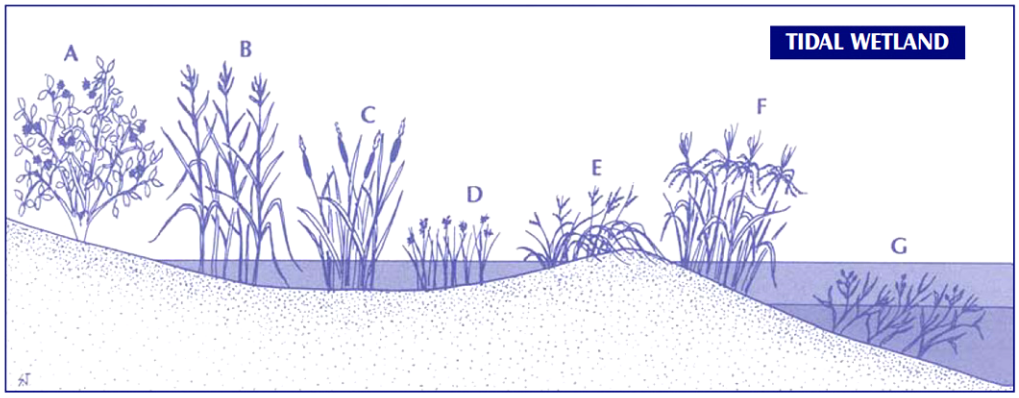
Ecoregions are defined as areas of relative homogeneity in ecological systems and their components which include: geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.

Ecozones are the next level of environmental grouping at the local, walking scale.

From the preceding map you can see we cross from Ecoregion 65n *(Chesapeake Rolling Coastal Plain)* and encounter Ecoregion 63b (*Chesapeake – Albemarle Silty Lowlands and Tidal Marshes)*. As we visit Flag Ponds Nature Center and walk down to the beach. You will see the sign below on our walk.

Both of these ecoregions lie within the geological province of the Coastal Plain (see Figures on Page 6) and as such are dominated by sandy soils that are low in plant nutrients which is a primary factor in determining what plants can adapt to these conditions. A second factor that comes into play near the shores of the rivers and Chesapeake Bay is the plants' ability to tolerate salt spray during strong on-shore storms. Any plants with a low salt tolerance will not survive close to salt water and thus as we walk down to Flag Ponds Beach from the parking lot, you will see a definite transition from hard-wood trees and leafy understory plants in areas higher up and further back from the beach where the drainage and soil quality is better to pine trees, plants with waxy leaf surfaces, and plants adapted to very sandy soil and periodic exposure to salt spray.

One Bay - Many Habitats



A Button bush *(Cephalanthus occidentalis)*

B Big cordgrass *(Spartina cynosuroides)*

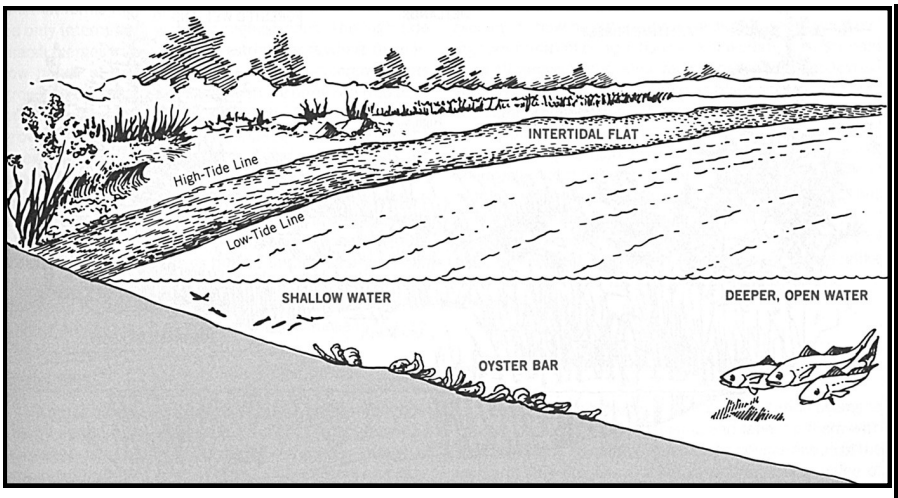
C Narrow-leaved cattail *(Typha angustifolia)*

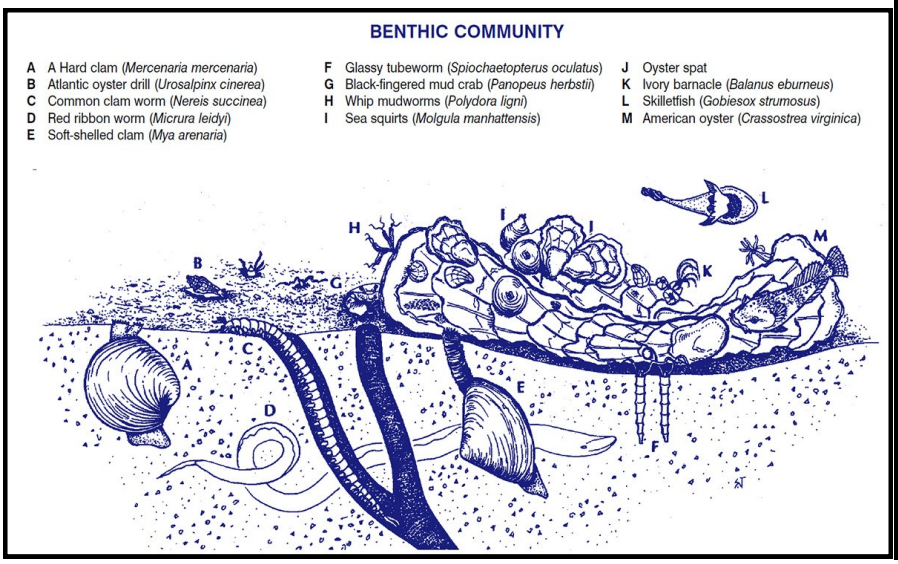
D Black needlerush *(Juncus roemerianus)*

E Saltmeadow cordgrass *(Sparina patens)*

F Wild rice *(Zizania aquatica)*

G Widgeon grass *(Ruppia maritima)*

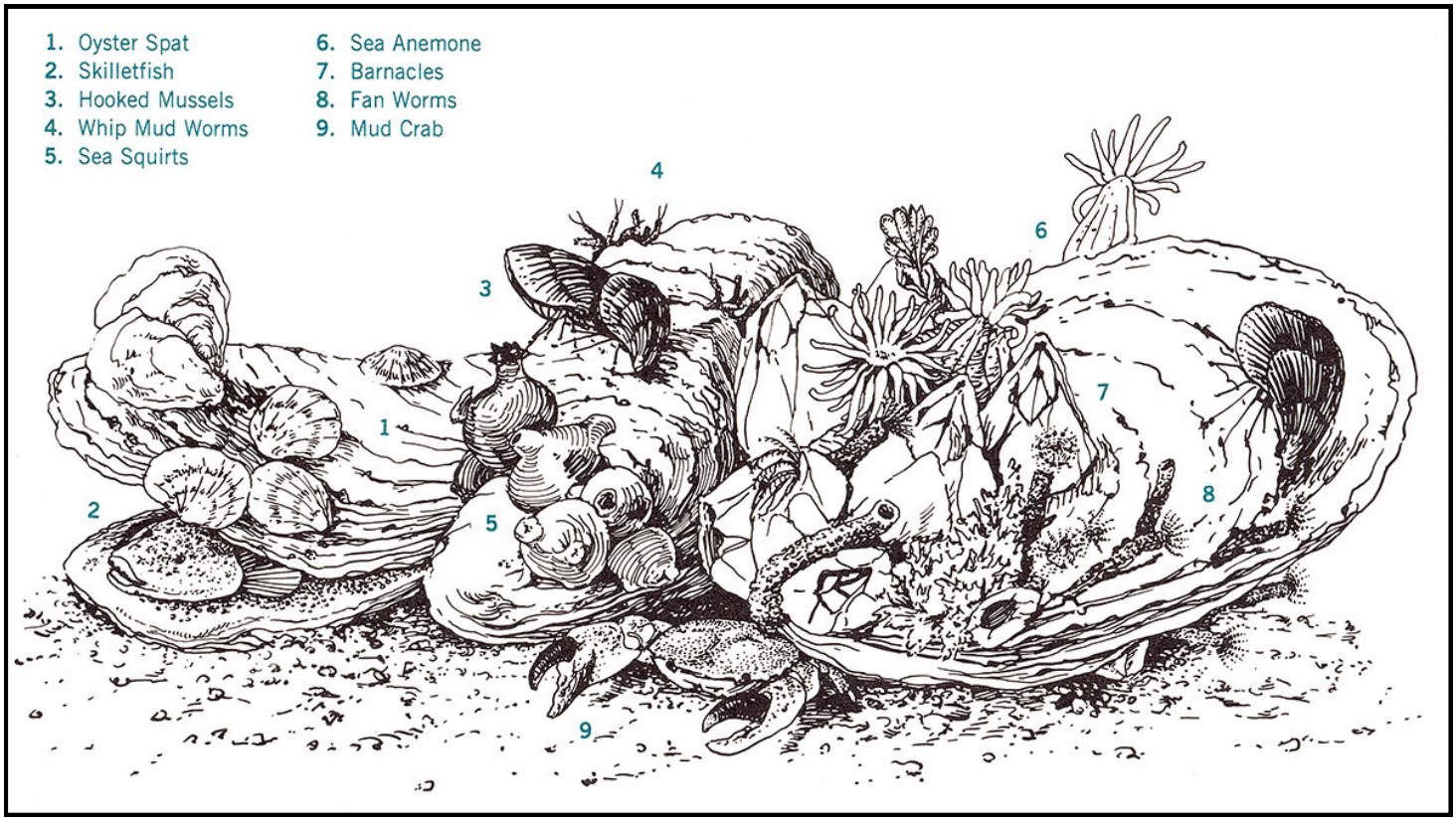


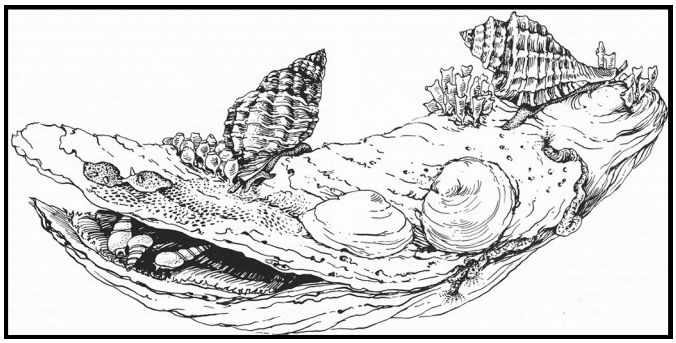


When you take the time to look carefully at the land bordering the Bay, you will notice different 'zones' in which you find similar plants grouped at a certain distance and/or elevation from the water's edge. Plants have different tolerances to temperature, sunlight, wind, salinity, and soil type and will thus be abundant in zones that meet their needs and absent in those that do not.

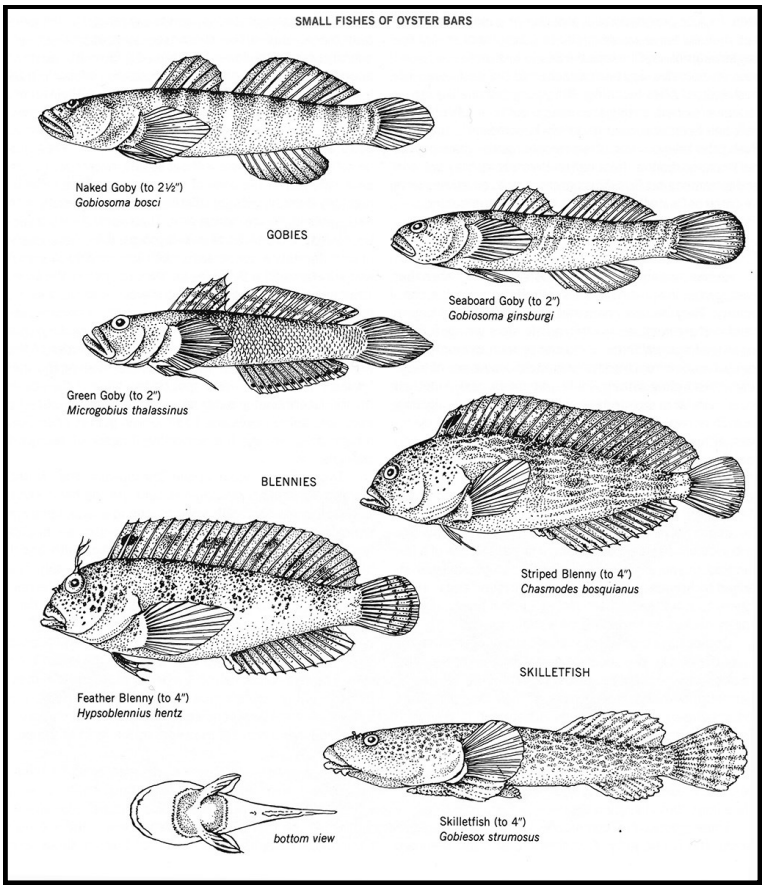
The same type of 'sorting' by 'comfort zone' and life requirements applies to life IN the bay under the water. Some animals and plants can survive in the tidal zone where they can be out of water for up to 6 hours at a time; others must be submerged at all times or risk drying out. Some animals move to catch their food; others remain stationary and let the currents bring the food to them. Some burrow; others swim. Some eat only plant material; others only flesh; others eat both depending on what's available. And so it is: one Bay but with many different habitats that support over 3,600 species of plants and animals.

The Oyster Bar Community

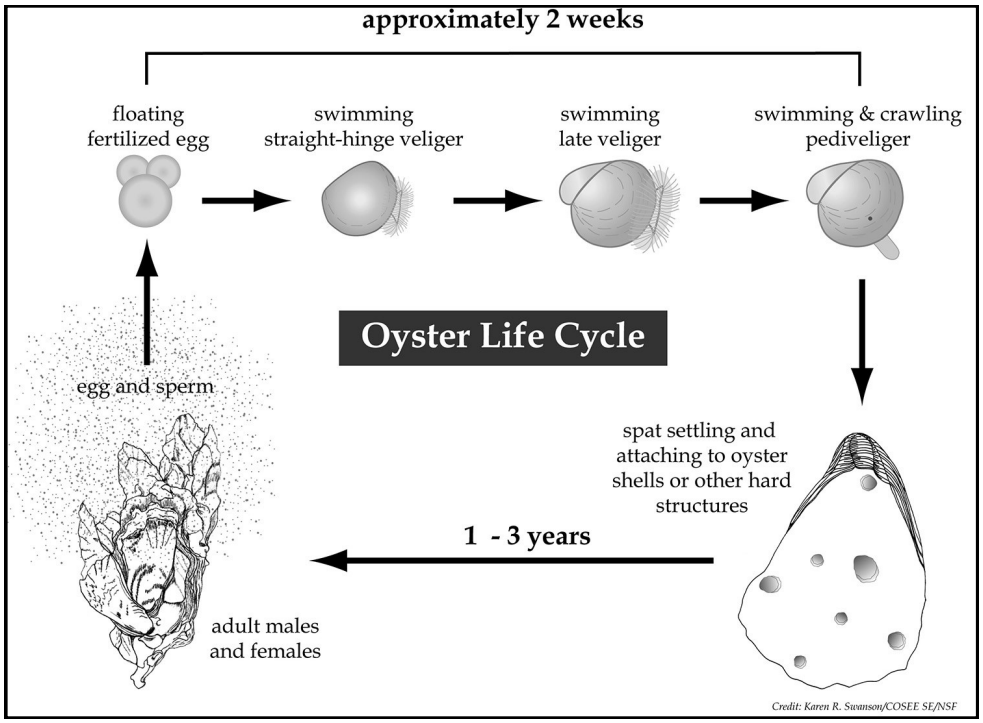




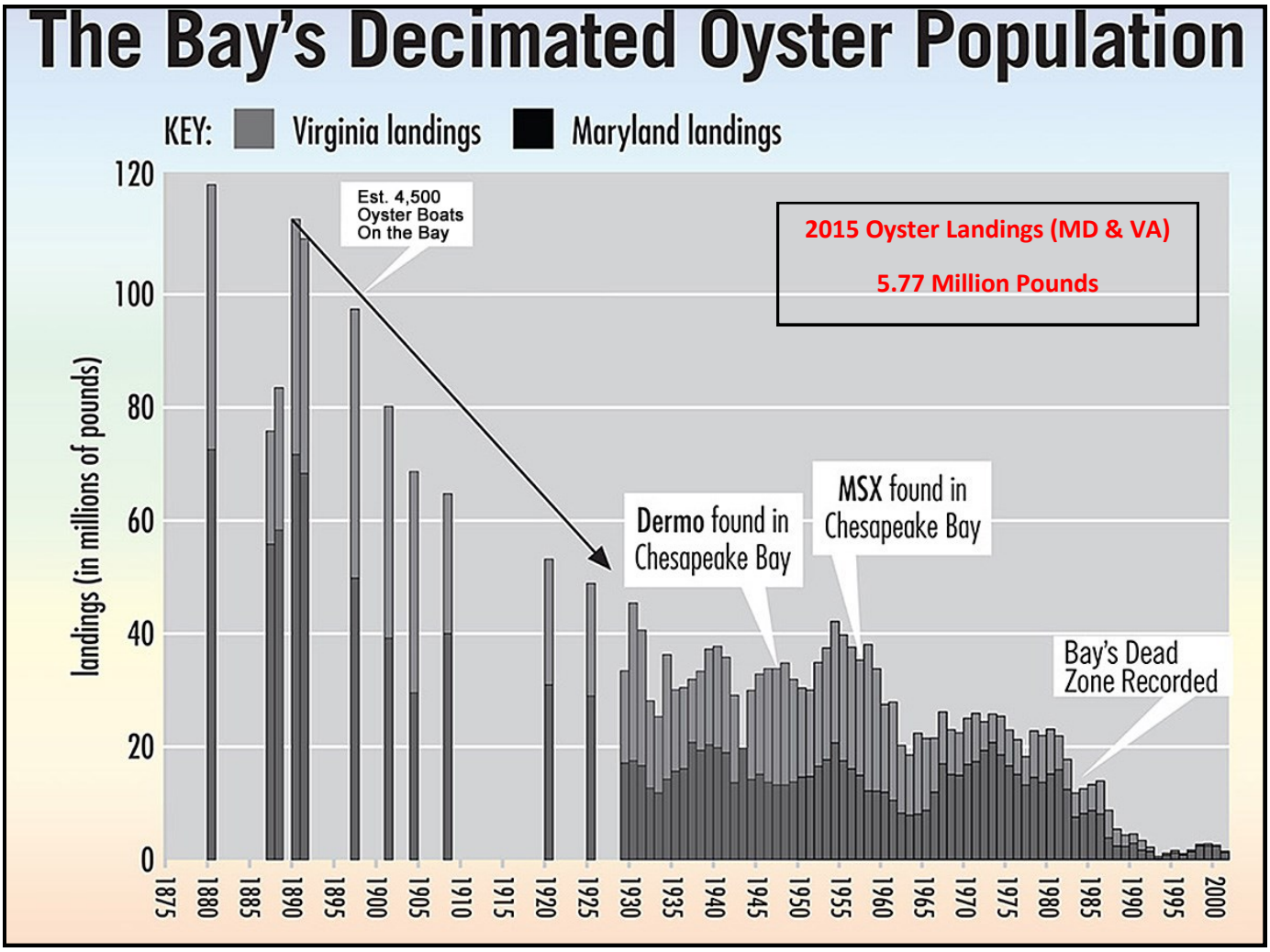
Oyster Bars are not just a bunch of Oysters on the bottom of the Bay; they **are a COMMUNITY** of many different species who live in, on, around and in between the individual oyster shells. Sponges, fish, crabs, worms, algae are only a few of the groups of organisms who live in this community. The Bay can be thought of as a complex 'superorganism' whose overall health is dependent of the health of all its constituent communities and the species that live in the Oyster Bars are just one example of a little interconnected community of many organisms who all depend on each other for their livelihoods and continued health. **Look for the Oyster Bar aquarium display at the Calvert Marine Museum.**



Oysters - A Crucial Bay Species



At the left is a diagram of the Chesapeake Oyster's (*Crassostrea virginica*) Life Cycle. Probably the most crucial part of the cycle is the 3rd week after fertilization in the early summer when the free swimming larvae need to settle and cement themselves to a firm substrate and begin the stationary portion of their life cycle. This process is called 'setting' and when attached, the young oysters are called 'spat.' Probably the most important factor in having the larvae have a successful 'set,' is to have a **CLEAN, hard surface** on which to cement themselves and by far the best substrate is the shell of an adult oyster. If there is an excess of algae or silt covering the bottom and/or oyster shells, the larvae are unable to set and are lost. Authorities are working to create and improve some oyster habitat by dumping large quantities of fresh or fossil ('cultch') oyster shells onto bottom areas where they want new oysters to 'set' and grow into adults which can then be harvested.

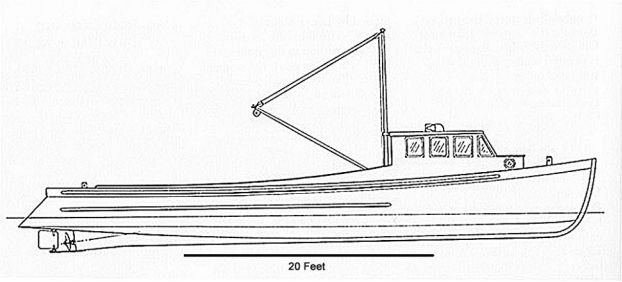


Boats in the Oyster Trade

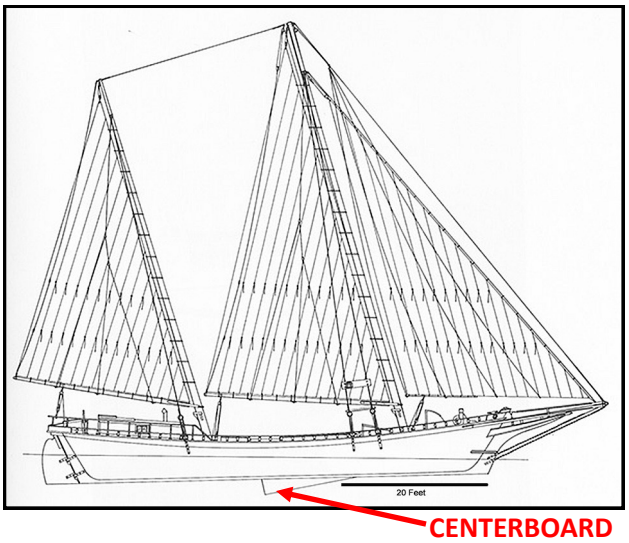
Each boat built for oystering on the Bay is the end result of many years of new ideas being tested under the harsh cold weather conditions when oysters are normally harvested. Cost and ease of construction, the power to pull one or two dredges over the bottom, handling in rough seas with 150 bushels of oysters on the deck, and above all the ability to bring captain and crew home safely were all criteria for successful larger boat designs.

Of the sailing craft most successful at oystering several stand out: two craft with multi-log hulls: the **log canoe** with a 3-5 log hull, and **the Bugeye** with its 9-log hull; and (ca. 1885) **the Skipjack** which was made with readily available planed pine planks instead of logs and had a **centerboard** (introduced in 1820) like the Bugeyes which could be raised or lowered thus allowing oystering in shallow waters. The ***'Edna Lockwood' (****built 1889)* recently had her 9-log hull replaced at the Chesapeake Bay Maritime Museum after considerable research on how to replicate such a hull. There are several videos online which allow you to appreciate what a feat this was and how the log hull is joined with the plank portion of the hull.

Oysters were originally taken in shallow water with hand tongs, but as stocks were depleted, dredge and patent tongs operations in deeper water became the norm. Shipbuilding trends followed suit as watermen moved from small boats for river and creek use to larger open water craft that could deal with the more demanding environment. The introduction of steam and combustion engines allowed for newer, smaller and more mobile craft to be used to reach and work oystering grounds with the size of the boat tailored to the size of the equipment being used to harvest (e.g. hand tongs, patent tongs, or dredge).

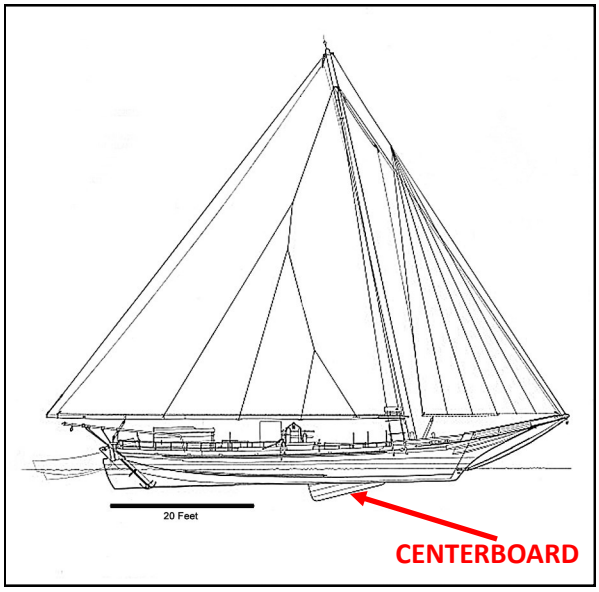


Hooper Is. Draketail: 'Penguin' 45' long



Bugeye: *'William B. Tennison' 65' long*

Hand Tongers in Log Canoes 1895
Photo: Wm. Henry Jackson



Skipjack E. C. Collier, 52' Long

Watermen, Their Catches and The Tools of The Trade

Shellfish: Blue Crabs, Oysters, Scallops, Clams, Mussels

Fin Fish: Rockfish, Shad, Herring, Perch, Croaker, Spot, Bluefish, Menhaden, Eel, Flounder, and many others

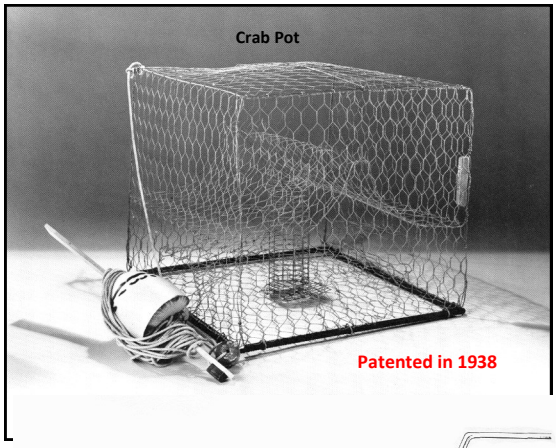
Blue Crab:

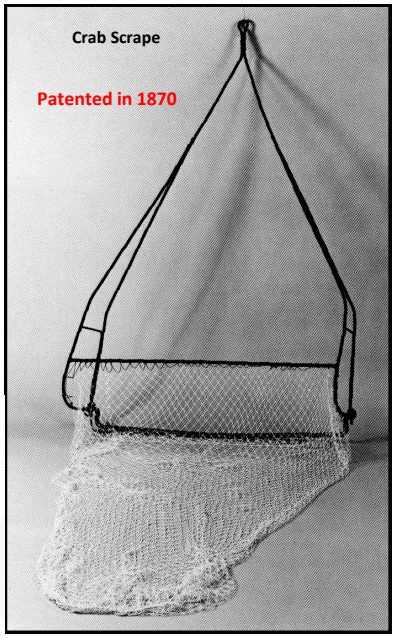
Crab Pots

Trot Lines

Dip Nets

Crab Scrape





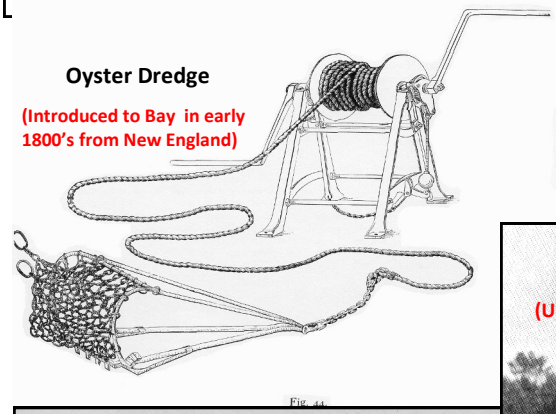
Oysters:

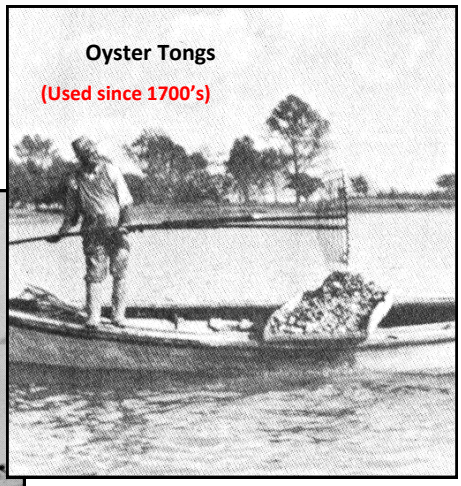
Tongs

Nippers

Dredge

Patent Tongs





Fin Fish:

Seine Netting

Gill Netting

Hand Lining

Pound Netting

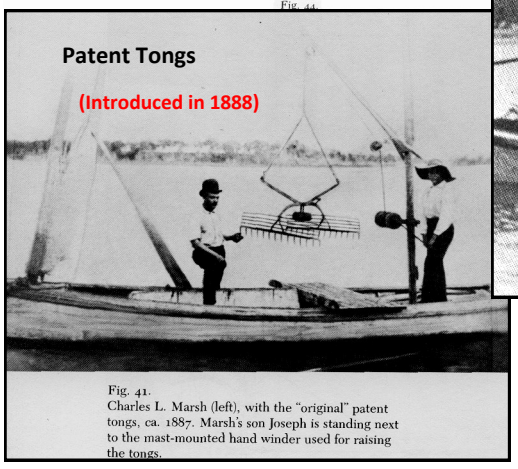
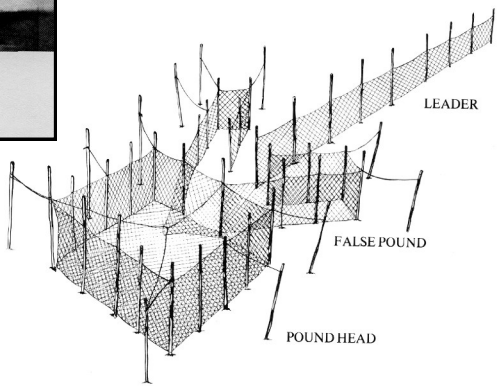


Fig. 41.
Charles L. Marsh (left), with the "original" patent tongs, ca. 1887. Marsh's son Joseph is standing next to the mast-mounted hand winder used for raising the tongs.



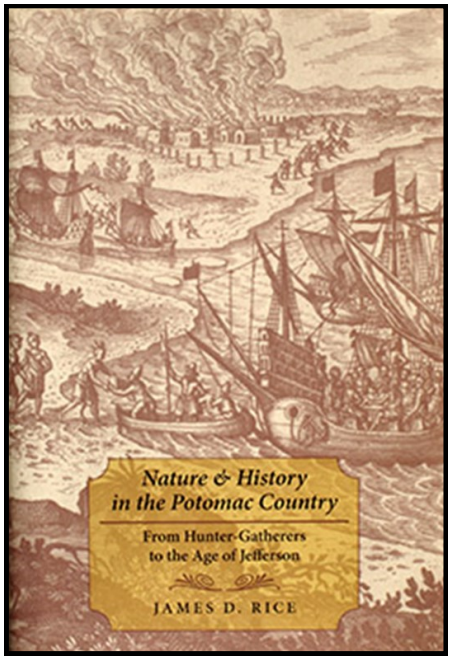
Pound Net

Fig. 17.
Pound net.

These are the tools of the waterman's trade that allowed watermen to make a good living for their families all year long. The Calvert Marine Museum exhibits provide added depth and context as well as personal stories.

Food As A Political Force & Bargaining Chip

James Rice's '4 C's Hypothesis':



Dr. Rice puts forth the following interpretation of Native American history in the Mid-Atlantic states from 800 years BCE to the time of the Jamestown settlement in 1607. It focuses on how the cultivation of, and growing **dependence on, corn** (which needed 120 frost-free days in its growing season) changed their social structure within and the interactions between villages over time.

Corn; **C**limate; **C**ompetition; & **C**onflict

Up to 800 CE - Few fixed villages. Small roving bands. Diversified foraging & hunting

800 – 1300 CE - ***'Hunters Who Farm'*** - Corn part of diet after 790 CE; 'Medieval Warm Period' optimal for corn farming; pottery for storage & prep.; bow & arrow improve hunting; farming shifts to more sedentary life. Egalitarian society. Villages still open.

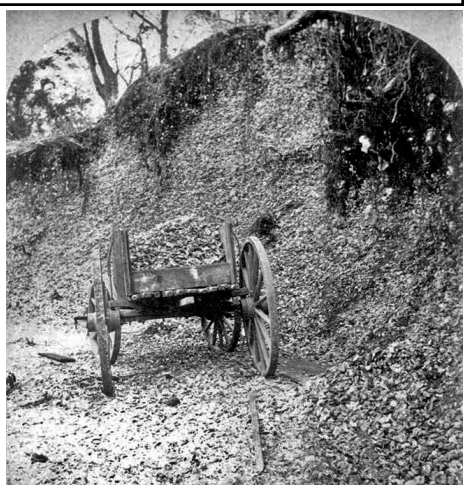
1300 – 1500 CE - ***'Farmers Who Hunt'*** - Villages now depend on corn for calories. Arrival of 'Little Ice Age 'drops growing season below 120 frost-free days north of Appalachians; after 1400 most villages are palisaded as competition for prime sites increases. Inter-village competition and social stratification become more common cultural features.

Middle 1500's - Formation of the ***League of Five Nations*** means tribes cannot take captives to replace lost members from allies. Mourning Wars (in which captives are taken) thus move to the south; attacks on Potomac and Shenandoah Valley villages and further south to Carolinas. Along Potomac, tribal alliances are established with a hierarchy with tributes of goods made to the Primary Chief (e.g., Powhatan.)

1608 - The European colonists enter into an area shaped by conflict, political alliances, trade, and the availability of food resources - it was not a 'blank slate' as is often portrayed. Tribes used their food stores (corn in particular) and political clout when bargaining with the newly arrived and ill-prepared English colonists who founded the Jamestown Settlement.

One of the factors underpinning the power of the Powhatan Confederacy was access to the enormous **oyster beds** along the rivers on the Bay's Western Shore. Member tribes would harvest huge quantities of this protein rich food in the Autumn before cold weather set in and also smoked some for consumption during the Winter months. Over the centuries of such oyster feasting, shell piles ('middens') 30 to 40 feet thick in some cases, accumulated in the areas where this occurred. With limestone deposits absent in the Tidewater/Coastal Plain geology, these middens were mined for the shells from the 1600s through the 20th century and the shells were then crushed (for chicken feed, paving, industrial use in Iron-making, white wash, and liming fields to raise pH) or burned to make quicklime (CaO) for use in plaster and cement. Because of their archaeological potential, most middens are now protected and no longer mined. Currently there is a major shortage of clean oyster shells to use in restoration of oyster grounds and restaurants and packing houses are paid to keep their shells and make them available for reseeding operations.

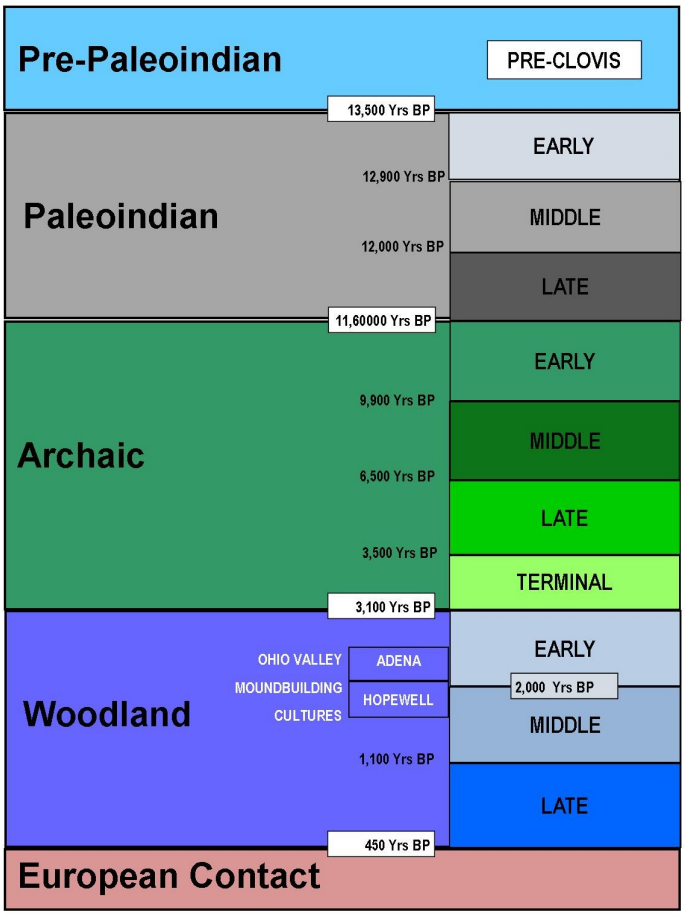
At left: A typical exposure of ancient oyster midden found in the coastal Mid-Atlantic states (about 3 feet thick).

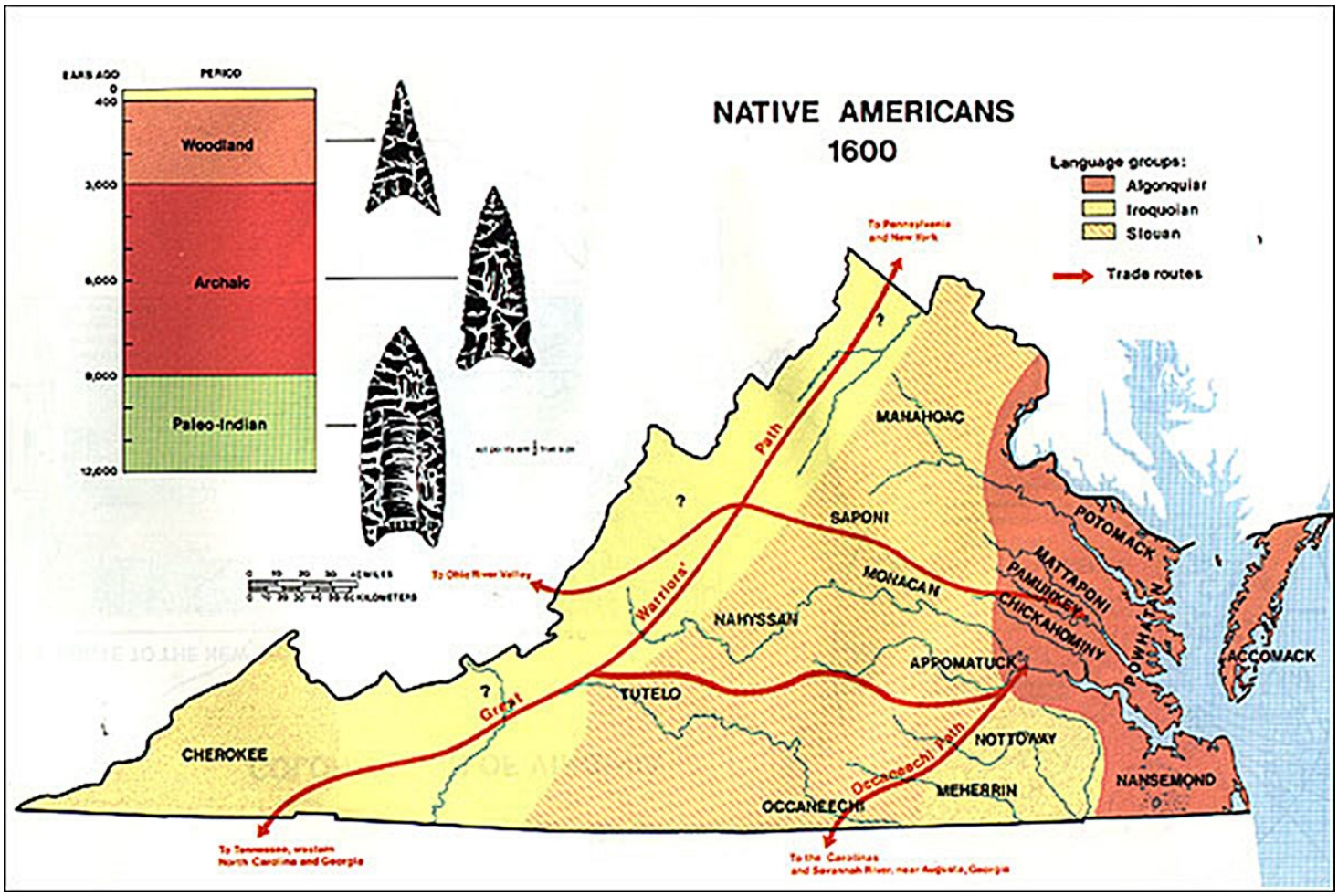


At right: An ancient oyster midden (Whale Back Midden) in Maine that is about 15-20 feet thick.

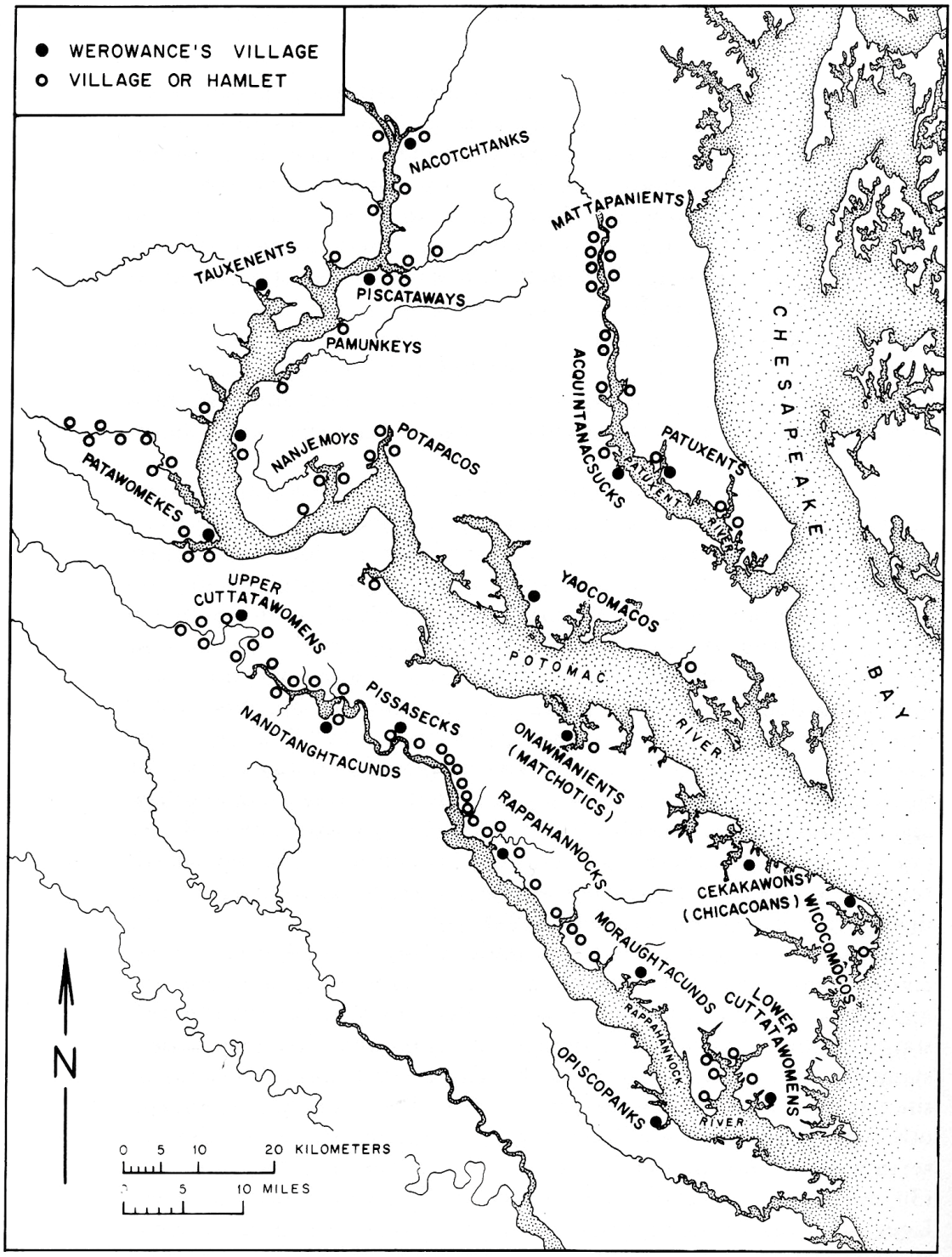
History books show European portrayals of native peoples at the time of the Jamestown settlement (1607), but they rarely mention that PaleoIndians arrived in this area between 15,000 and 20,000 ago. Indian stone points (below) changed design across time and are thus useful in dating Indian sites. To aid in discussion, archaeologists and anthropologists have divided this time up into named periods (graphic at right). In 1600 the Indians in Virginia (and around much of the Bay) spoke 3 main dialects which are shown in the bottom map.

Points from Tangier Island





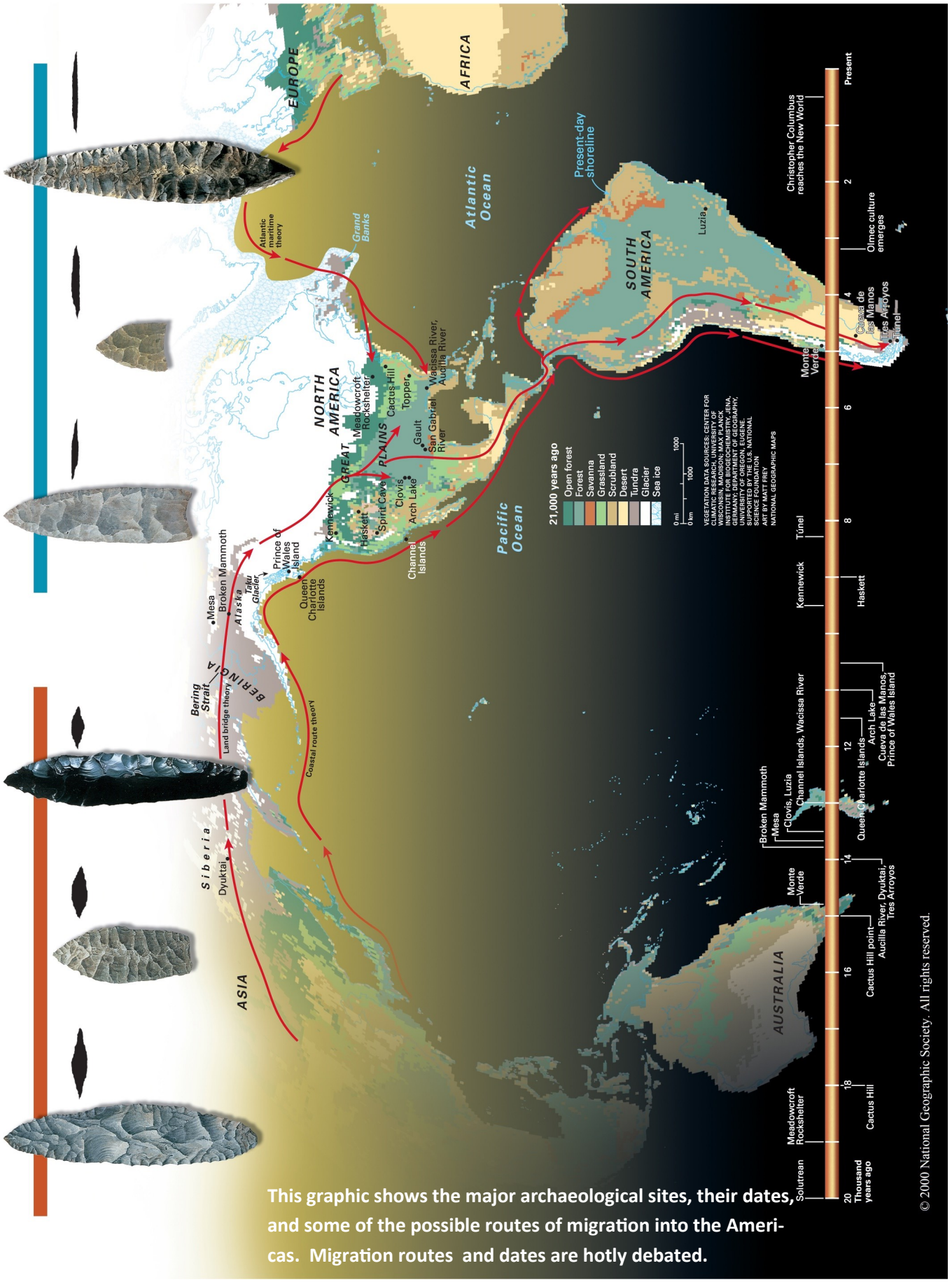
A map of Indian Villages along the Bay's western shore circa 1608 when John Smith made his explorations up the Bay and into the rivers. ***Villages that fronted on the rivers had access to oysters and to the millions of fish that migrated up the rivers each Spring.***



1. Native groups and villages on the lower Patuxent, Potomac, and Rappahannock rivers, ca. 1608. (Map by G. Robert Lewis)

Map from '**Commoners, Tribute, and Chiefs'** by Stephen R. Potter, University Press of Virginia, 1994 Page 10

Peopling of the Americas—Current Theories



This graphic shows the major archaeological sites, their dates, and some of the possible routes of migration into the Americas. Migration routes and dates are hotly debated.

Sea Level Rise In The Bay (I)

Pages 28-31 **provide some pertinent background on the topic of regional sea level rise: It is here, it is real, and localities must address it.**

FACT: The Sea Level in the Bay has risen 1 Foot since 1900.
PREDICTION: 2-3 Feet of additional rise likely by 2100 using **conservative** modeling.

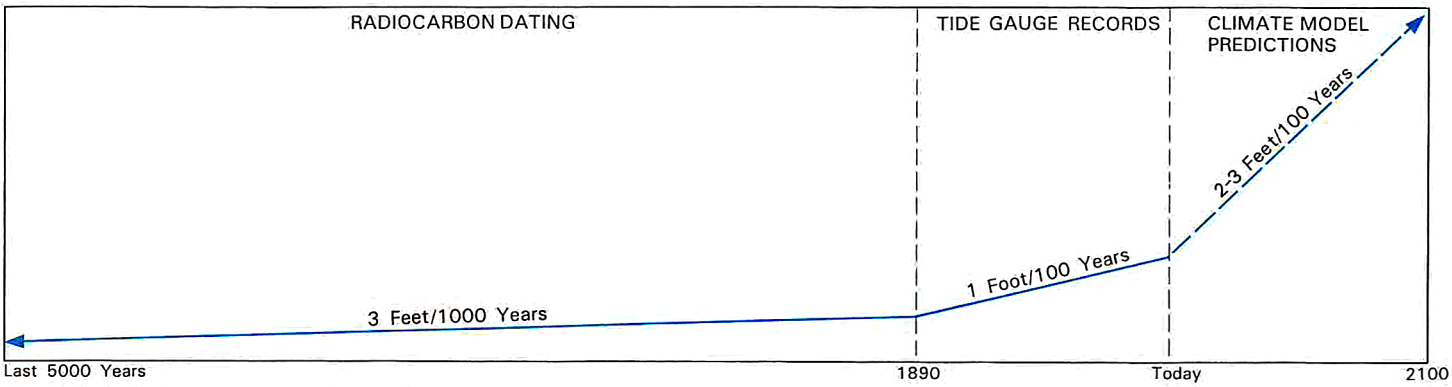


Figure 10. Sea-level rise curve: past and projected.

Isostatic Subsidence (Glacial 'See Saw')

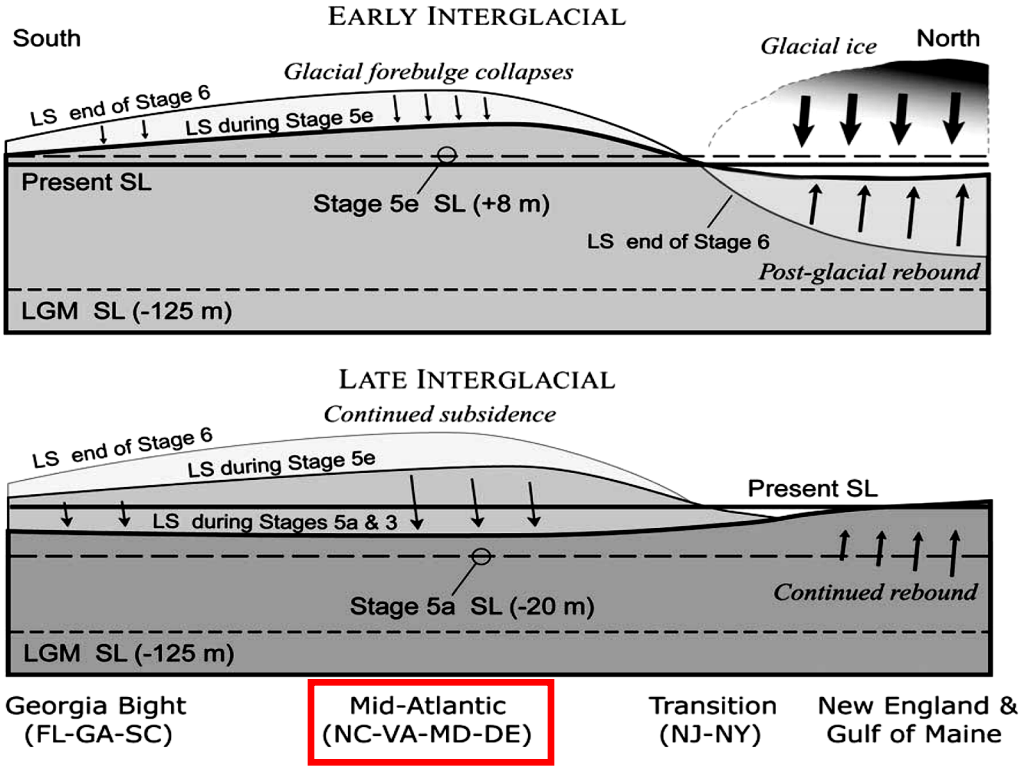


Figure 16. Regional isostatic response of the Atlantic coast after Illinoian glacial period (marine stage 6). LS, land surface; SL, sea level; LGM, last glacial maximum (Fig. 12 from Hobbs et al., with permission).

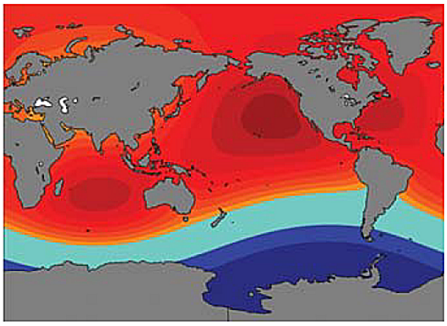
Sea Level Rise In The Bay (II)

What's Driving Sea Level Rise

Sea level is rising along Maryland's coasts faster than the global average increase. Scientists identified causes and estimated the likely contribution of each.

	Maryland							World-wide
Year	Amount of sea level rise (in feet)							(in feet)
	Ocean thermal expansion	Antarctica melting	Greenland melting	Other glaciers melting	Gulf Stream change	Sinking land	**Total**	**Total**
By 2050	0.3	0.3	0.1	0.2	0.3	0.2	1.4	0.9
By 2100	0.8	1.0	0.3	0.4	0.6	0.5	3.7	2.7

Note: Subtotals are rounded and so may not sum to total.



Sea Level Rise Fingerprint

The map at left depicts the melting "fingerprint" that would arise if the West Antarctic Ice Sheet collapsed today. Dark red zones show areas where the sea level would rise by up to 40 percent more than the average change in sea level around the globe. Dark blue zones show where the level would actually fall.

A dangerous mix, sea level rise along the Chesapeake Bay *stems from a variety of factors, according to a scientific review led by the University of Maryland Center for Environmental Science (table, above). Together, these factors make the region a "hot spot" for sea level rise and include the impacts of sinking land, melting ice in Antarctica, and changes to the flow of the Gulf Stream.* TABLE SOURCE, "UPDATING MARYLAND'S SEA-LEVEL RISE PROJECTIONS" REPORT; MAP, COURTESY OF CARLING HAY AND ELSEVIER

DC's 17th Street NW Flood Control Barrier

Sea Level Rise In The Bay (III)

CLIMATE CHANGE IMPACTS FOR DC

In order to plan for climate change, we first must understand the changes we are likely to experience. DOEE worked with leading climate scientists to identify likely changes for the District from today through the 2080s. The results of that study are summarized below.

The District's Climate Future

As a result of climate change, DC will experience:

- Much warmer average temperatures
- Up 2-3 times as many dangerously hot days
- Longer, hotter, and more frequent heat waves
- More frequent and intense heavy rain events
- Higher tides as a result of rising sea level

While scientists are not yet able to model the local effects of climate change on extreme weather like the 2012 derecho, the likelihood of severe storms fueled by warmer temperatures and more water in the atmosphere is expected to grow in the future.

These are excerpts from two brochures on Climate Change and Sea Level Rise prepared by the Maryland Commission of Climate Change (MCCC) and Climate Ready DC (CRDC). While many Maryland citizens of the Eastern Shore are highly skeptical of Climate Change as a cause of land erosion that they can see, legislators in Annapolis are working to get out front on these issues and plan for how to mitigate the impacts. You can download the Maryland Fact Sheets at **http://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Pages/index.aspx;** the CRDC brochure at **https://doee.dc.gov/climateready.** Below is a sadly prophetic image and caption from the Maryland Climate Change Fact Sheet - Ellicott City was flooded again in 2018.

Events such as the devastating 2016 Ellicott City flash flood could become more frequent in the future.

MARYLAND IS ALREADY EXPERIENCING THE IMPACTS OF CLIMATE CHANGE, INCLUDING:

SEA-LEVEL RISE
Sea-level rise of more than one foot in the last century, causing increased coastline flooding and erosion.

WATER TEMPERATURE
Increasing water temperatures in the Chesapeake Bay, which reduces suitable habitat for blue crab and oysters.

HEAVY RAINS
More frequent heavy rain and flooding events, which can devastate local communities.

HEAT WAVES & DROUGHT
Intensifying heat waves and drought, which damage agricultural crops, raise energy bill costs and put vulnerable populations at risk.

TOURISM IMPACTS
Climate change impacts threaten tourism through reduced opportunities for winter snow sports and loss of beach coastline.

NUISANCE FLOODING DAYS: AVERAGE DAYS PER YEAR

1957-1963
Baltimore: 1.3
Annapolis: 3.8

2007-2013
Baltimore: 13.1
Annapolis: 39.3

Resources for Continued Exploration

1. Books:

- ***Life in the Chesapeake Bay:*** Alice J. and Robert L. Lippson THE go-to guide for life in, on, and around the Bay. **EXCELLENT!**
- ***Working the Water*** - The Commercial Fisheries of Maryland's Patuxent River, University of Virginia Press, 1988 The background on many of the objects in the Calvert Marine Museum collections.
- **The Roadside Geology of Maryland, Delaware and Washington, DC** by John Means, Mountain Press Publishing, 2010 A really fine book – great illustrations, easy to understand. Highly recommended.
- ***From Blue Ridge to Barrier Islands*** ed. by Minichiello and White, Johns Hopkins, 1997. A wonderful anthology of writings from colonial times to the present day that offer looks at this region and those who lived there through the eyes of many different travelers. A sinfully enjoyable book if you love local history.
- ***Follow the Water*****:** Varley Lang, John. F. Blair publishing, 1961 A well-written first person account of being a waterman.
- ***Chesapeake Bay Sailing Craft (Expanded Edition):*** Robert H. Burgess, Tidewater Publishers, 2005 The major Bay boats lovingly photographed and described by one of the great scholars of bay craft.
- ***Maryland Sea Grant 'Chesapeake Perspectives' Series:*** Five short books that examine both the cultural and ecological dimensions of the Chesapeake Bay and its many communities. Visit **http://ww2.mdsg.umd.edu/store/books/cp/** for details.
- ***Discovering the Chesapeake*** by Curtin, Brush & Fisher, Johns Hopkins Press, 2001. Does a wonderful job of looking at the forces that created and shaped the Bay Region and that continue to shape it today.
- ***John Smith's Chesapeake Voyages*** by Helen Rountree, Wayne Clark and Kent Mountford, University of Virginia, Press, 2002 Combines ecology, environmental history, and current science with the Journals of Captain John Smith and his bay voyages of 1607-1609. Truly a marvel of cross-disciplinary interpretation.
- ***Chesapeake Legacy*** - Tools and Traditions by Larry Chowning, Tidewater Publishers, 1995

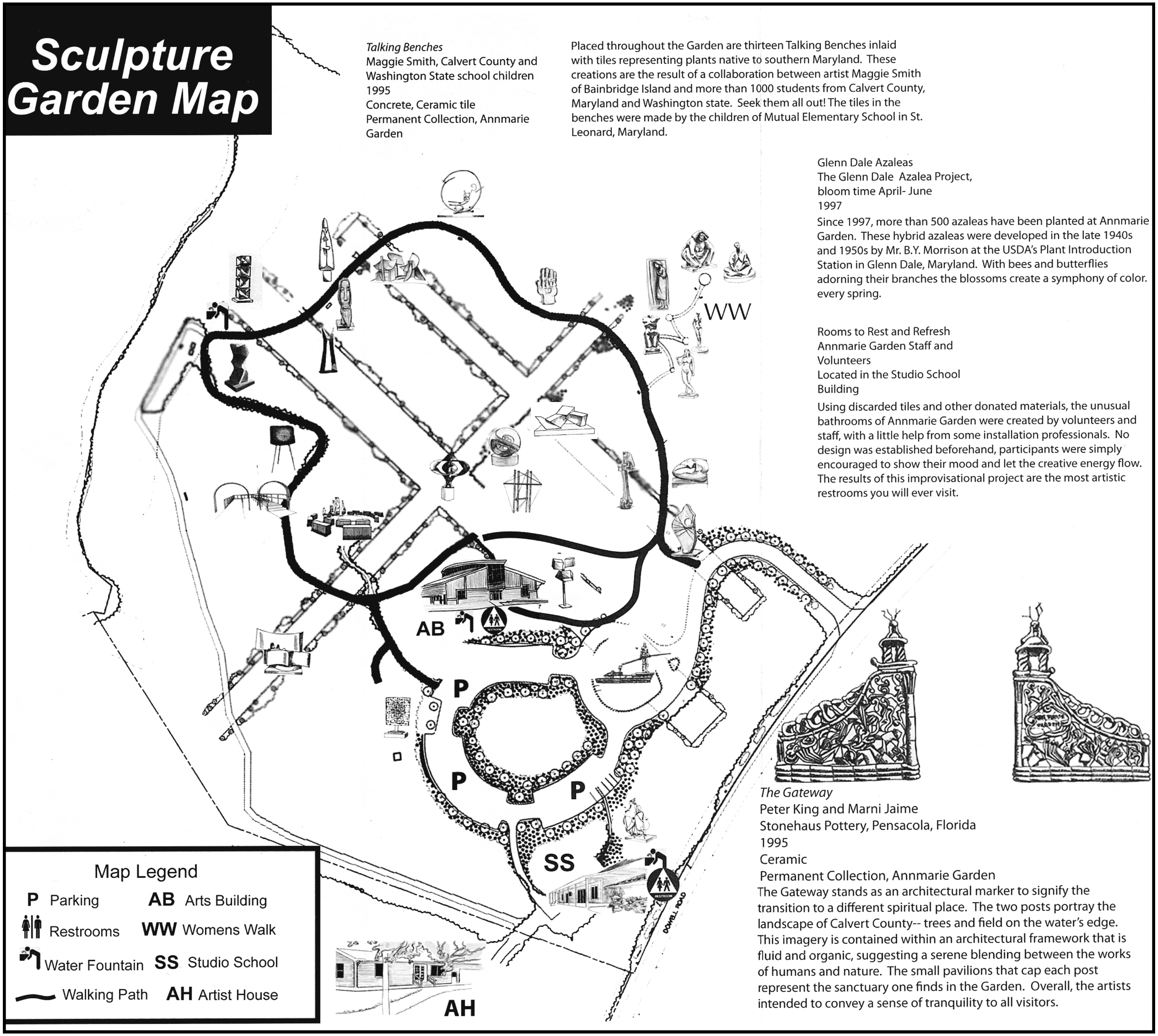
2. Music & Story:

- **'The Bard of the Chesapeake,' Tom Wisner,** was lost to us in 2010 but his extraordinary musical legacy lives on and is available from **Smithsonian Folkways Records** at: **http://www.folkways.si.edu/tom-wisner-bard-chesapeake/american-folk-childrens/music/article/smithsonian.** Additional material on Tom and his work is available at **CHESTORY** at **http://chears.org/chestory/cd.htm**.

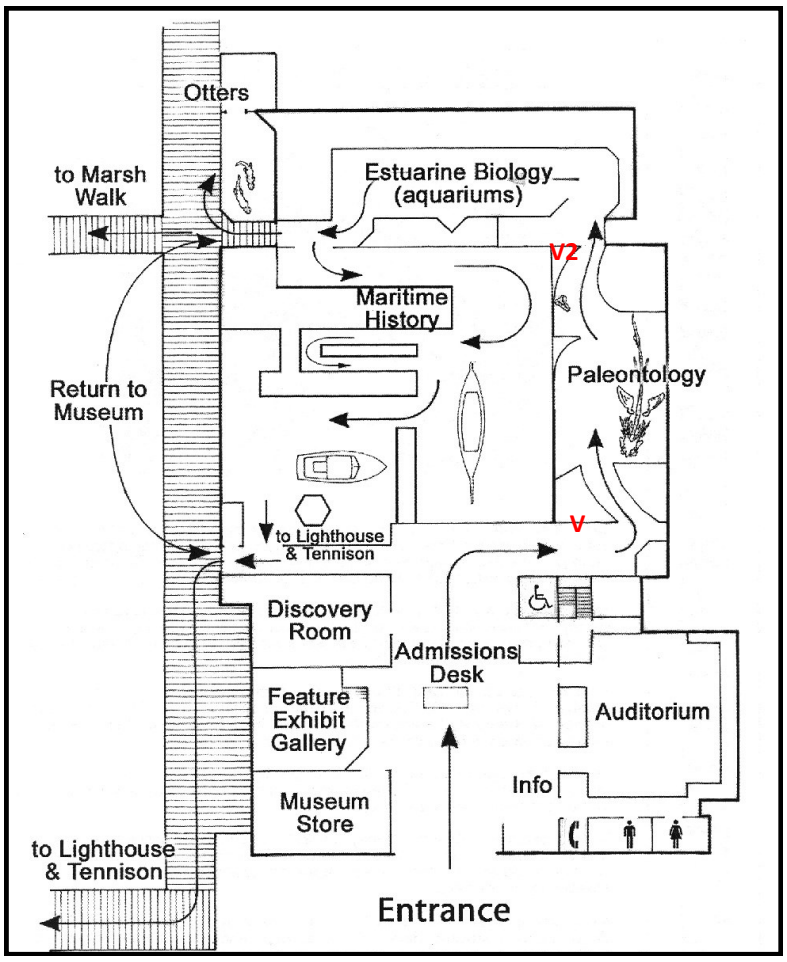
3. Internet Resources:

- The Chesapeake Bay Gateways (**https://www.nps.gov/chba/planyourvisit/chesapeake-gateways.htm**) Access to informative and educational sites around the Bay.
- Geological History of the Mid-Atlantic States: **https://csmgeo.csm.jmu.edu/geollab/vageol/vahist/index.htm**l Excellent!
- EPA's Chesapeake Bay Program website (**www.chesapeakebay.net**) has lots of data, maps and publications for downloading.
- The Chesapeake Quarterly (**www.chesapeakequarterly.net/**) A great resource.
- The Chesapeake Quarterly issue on Sea Level Rise and the Bay: **http://www.chesapeakequarterly.net/sealevel/index.php**
- Great film about sea level rise in the Chesapeake Bay ***('High Tide In Dorchester County')*** and local response to same may be viewed at: **http://hightidedorchester.org/** and **https://www.youtube.com/watch?v=va6BwulHM-c.**
- Introduction to an Ecosystem 2000: **http://www.chesapeakebay.net/content/publications/cbp_13039.pdf** A very readable and informative document that encapsulates much of the core ecological science for the Bay in one short document.
- Chesapeake Eco-Check (**ian.umces.edu/ecocheck/report-cards/chesapeakebay**) is an informative, fast way to get the straight scoop on how the Bay and its tributaries are fairing on a year-to-year basis. Very good materials for download.
- **Bay, Plain and Piedmont** – (**www.chesapeakebay.net/content/publications/cbp_19653.pdf**) Does a remarkable job of summarizing the history of the Bay Region from deep geological time to the present day. ***Highly Recommended.***
- Videos produced by MPT that look at Bay watermen and the challenges they face and the famous Skipjack oyster boats and a famous Skipjack captain, the late Art Daniels.
    - 'Another Dawn: Tilghman In Transition': **http://video.mpt.tv/video/2365232114/**
    - 'Growing Up on Tilghman': **http://video.mpt.tv/video/2365233869/**
    - The Skipjacks: **https://video.mpt.tv/video/mpt-specials-the-skipjacks/**
    - Water's Edge: Black Watermen of the Chesapeake: **https://www.pbs.org/video/waters-edge-black-watermen-of-the-chesapeake-lo9iwq/**

Annmarie Gardens Map

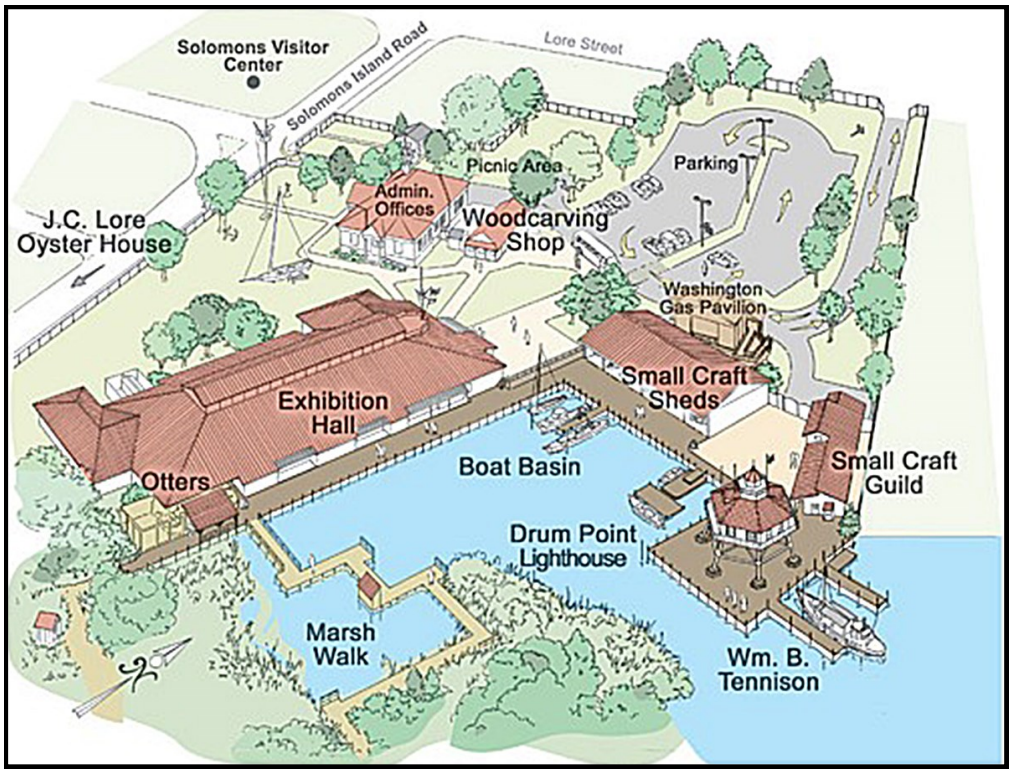


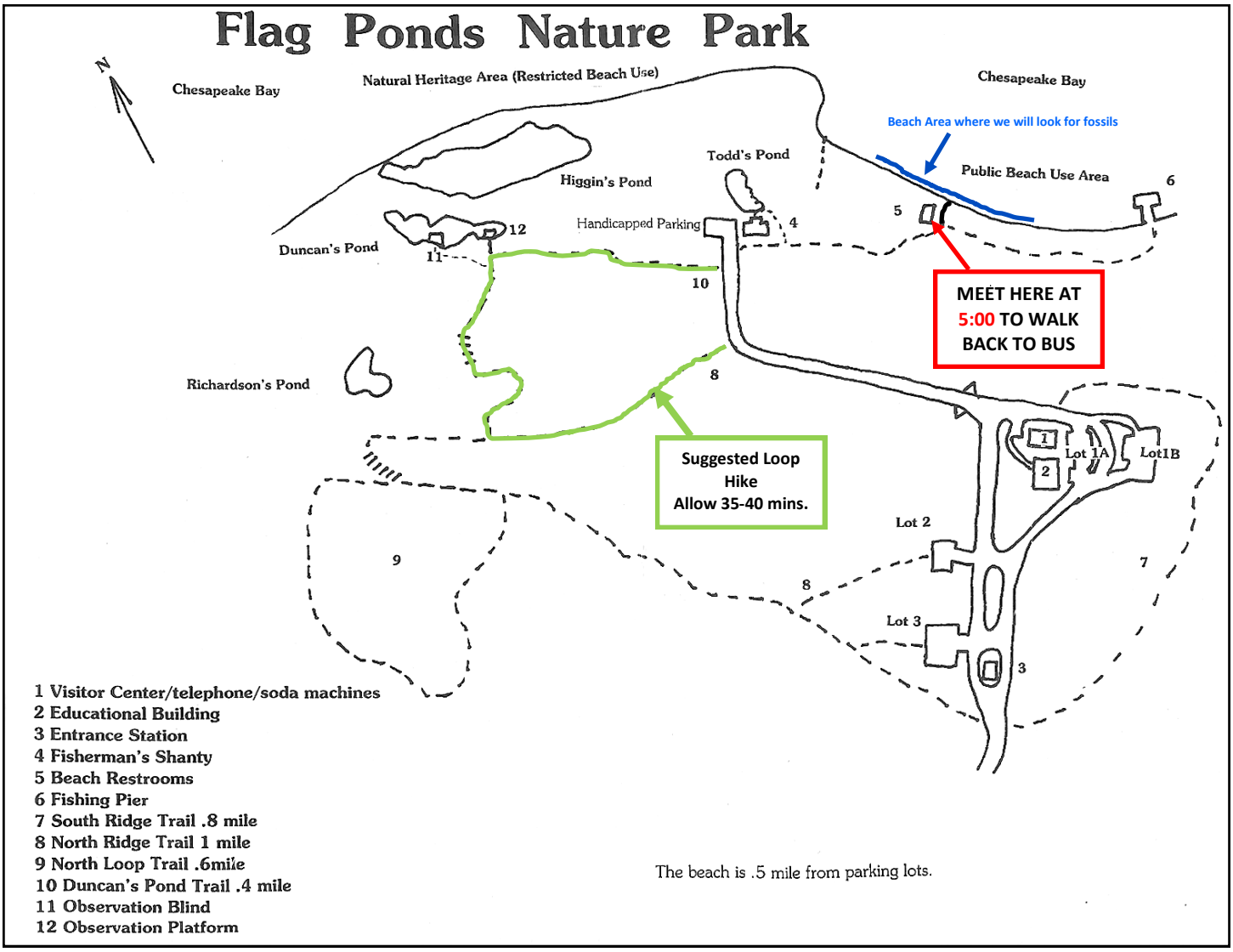
Calvert Marine Museum Maps

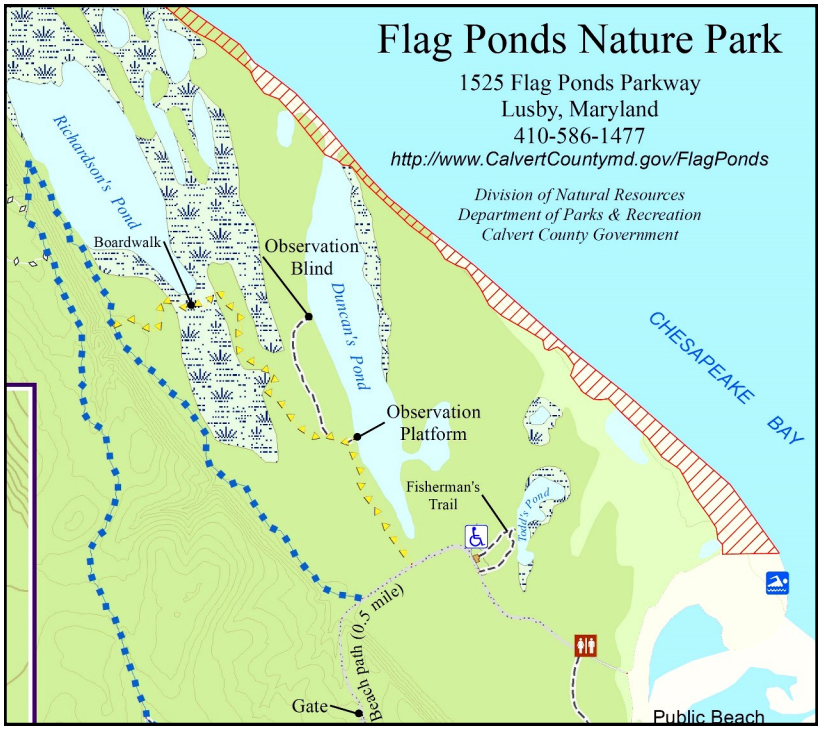


The map to the left shows the general layout of the museum interior and the normal path through the museum (although you can start anywhere you wish). While some exhibits may appear to hold little interest for you, I suggest looking at them all—you might be pleasantly surprised. I will recommend that you make a point of seeing the short video about the formation of the Calvert Cliffs that is located just inside the entrance to the 'Treasures From the Cliffs' exhibit Hall (See V on the map) and also the short video jus to the left of the entrance of the Estuarine Biology Exhibits (V2 on map).

If you want to get a first hand look at what lives in the marshy shallows, visit the Marsh Interpretive Boardwalk behind the museum. Take a moment to look at the boats in the Small Craft Shed especially the Log-Built hulls. A self-guided tour of the Lighthouse is always entertaining but PLEASE BE CAREFUL ascending and descending the ladder to the upper deck. **I will be taking a 35 minute walk through the museum offering interpretation as I go 5 minutes after arrival if you would like to join me.**







Rest Rooms are located at #'s 1 & 5 on map above.

You may hike the loop (North Ridge trail to Duncan's Pond trail) from #8 to #11/12 to #10 and then join the group on the beach if you wish. Allow 35-40 minutes for the loop.

Those wishing to walk back as a group should reassemble near rest rooms (#5) at 5:00 PM for 15-minute walk back to the bus. Please watch the time and be on board or near the bus by 5:20. The bus will be departing for DC at 5:30.