# Chapter 2.1
# A Brief History of Maryland's Coastal Bays

From: Hall, M. J. Casey and D. Wells. A Brief History of Maryland's Coastal Bays. In: Maryland's Coastal Bays: Ecosystem Health Assessment.

Updated timeline and revised narrative authored by:

Catherine Wazniak
Maryland Department of Natural Resources, Tidewater Ecosystem Assessment, Annapolis, MD 21401

Roman Jesien
Maryland Coastal Bays Program, Berlin, MD 21801

**Abstract**
From the early native Americans who hunted and fished the creeks and began to farm the lands, to the Europeans who settled later, to pirates and smugglers looking for hideouts among the perplexing coves and thick marshes, to most recently, the retirees and vacationers in search of more genteel escapes, Maryland's Coastal Bays have beckoned with abundant natural scenery and resources. The human population has gradually risen and, along with natural fluctuations, has promoted change as a common theme within the Coastal Bays ecosystem. Storms come and go, battering the islands and blasting inlets for Atlantic waters, which, if not stabilized, are soon closed by sandy sediments. Stocks of fish and shellfish fluctuate, forcing the waterman and recreational angler alike to be flexible. Other natural factors also constantly change. Eelgrass thrived prior to 1930, only to be reduced by a mysterious wasting disease and then returned years later. Shorelines crumble under the unrelenting force of wind and wave, often returning as shoals far from their origin. Algal populations, microscopic cells drifting unnoticed most of the time, can swell in blooms so massive as to change the clarity and color of the water in every direction. As these communities move through this century, changes in the ecosystem both natural and, more increasingly, human-caused will shape the future of the Coastal Bays.

## Pre-History: the Pleistocene Epoch

The Maryland Coastal Bays are located on the Atlantic margin of the Delmarva Peninsula, which lies entirely within the Atlantic Coastal Plain Province. The Delmarva Peninsula was formed over the last 5 to 10 million years. During the late Miocene and early Pliocene Epochs, extensive gravel sheets were deposited over a large area of the coastal plain, forming the general outline for the present day configuration of New Jersey, the Delmarva Peninsula and Maryland's western shore (Owens and Denny, 1979). Through the multiple glaciations of the Pleistocene Epoch, the Delmarva Peninsula continued to take on its present-day shape. During sea level low stands, the ancestral Delaware and Susquehanna Rivers deposited large volumes of sandy sediments on the Atlantic shelf. These sediments were transported and deposited onto the coastal margins of the Peninsula during the ensuing sea level rise or transgression. These transgression deposits are evident today. Based on geomorphic features and subsurface data, Demarest and Leatherman (1985) identified and mapped five distinct linear physiographic

features along the Delmarva Atlantic shore. They attributed each of these features to a distinct sea level high stand ranging in age from over one million years to 60,000 years. The last (and youngest) feature corresponds to the present-day mainland shoreline along Sinepuxent and Chincoteague Bays.

At the height of the last glacial period of the Pleistocene epoch, roughly 18,000 years ago, sea level was 120 meters below present level (Pielou, 1991). As a result, the continental shelf was exposed, with Maryland's Atlantic coastline located approximately 97 kilometers east of present location. Global temperatures began to rise around 17,000 years ago, marking the beginning of the Holocene epoch. The coastal bays started to resemble their present day configuration within the last 5,000 years when sea reached a level approximately 6 to 7 meters (~20 ft) below present mean sea level and started to flood the study area (Figure 2.1.1). Carbon 14 dates from peat and sediment data from cores collected in Chincoteague Bay and Assateague Island provide evidence of the existence of back bay or lagoonal environments, suggesting that barrier islands existed seaward of Delmarva mainland for at least the past 4,500 years (Biggs, 1970; Toscano et al., 1989), sheltering the mainland shore. Their general morphology would be controlled by wave climate, tides, sediment texture and supply as well as the antecedent topography of the exposed shelf. The northern bays (Assawoman and Isle of Wight Bays in Maryland, Rehoboth, Indian River, and Little Assawoman Bays in Delaware) were formed as the stream valleys of major drainage systems flooded (Wells, 1994; Chrzastowski, 1986). These bays are separated from the ocean by barrier islands that form adjacent to eroding headlands, a major source of sediments. Further south, one or more barrier island spits (similar to present day Assateague Island) probably existed separating Chincoteague Bay from the ocean. The barrier island spit, whether a single island or several, probably grew in a southern direction, maintained by a strong littoral transport of sediment.

**First contact: 900 – 1524 A.D**.
The first Native Americans are thought to have entered the present Maryland Coastal Bays watershed around 10,000 years ago. These first human visitors are believed to have only used the region as an intermittent hunting ground, forming no permanent settlements. True settlement was not likely to have occurred until around 900 A.D. with the beginning of maize agriculture (Rountree and Davidson, 1997). These earliest settlers built small villages of low reed huts along tributaries some distance from the bays. They gathered nuts from oak-hickory and oak-pine forests and tubers from marsh plants, known as tuckahoe. They fished for anadromous fishes (striped bass, white perch, shad) by weir in the tributaries, leaving no evidence of watercraft other than small dugout canoes. They also collected the abundant oysters, clams, and crabs from the shallows.

Native Americans of this period were organized into several localized chiefdoms, including the Pocomokes, Assateagues, and Chincoteagues. They spoke an Algonquin dialect, making them part of this large regional confederacy. They formed small settlements, but probably moved often in search of new farmland or gathering grounds. Before European contact, the population of the Coastal Bays watershed most likely never exceeded 300 permanent residents with many more occasional visitors (Hager, 1996).

**Second contact: 1524 – 1850**

The first Europeans to visit Maryland's Coastal Bays region are believed to have been the crew of Giovanni da Verrazzano in 1524. Verrazzano, sailing under the sponsorship of King Francis I of France in an attempt to find a short passage to India, explored the east coast of North America from 30° to 50° latitude (roughly modern-day North Carolina to Maine). He sent 20 of his crew ashore near the present-day Virginia-Maryland border and they explored inland to the Pocomoke Swamp, where they were forced to turn around (Truitt, 1971). Verrazzano kept a journal of his travels and his descriptions of the landscape and the natives led to the accepted theory that he was the first European to explore this area.

In 1649, the *Virginia Merchant* sailed for Jamestown, but was struck by a terrible storm. The battered ship anchored off of present-day Assateague and sent a small group ashore to explore the island. The ship was unable to return as scheduled to retrieve the party. As a result, ten of the group died of exposure on the wind-swept island. Without provisions, the remaining party consumed six of the ten dead in order to survive. Only the arrival and subsequent hospitality of a group of Native Americans saved the remaining party members. One of the exploration party, Henry Norwood, recorded the details of this expedition, including a description of how the Native Americans provided them food and shelter until an English settler escorted them first to his nearby plantation house and then back to Jamestown (Truitt, 1971).

The first European settlement of the lower Eastern Shore of Maryland occurred prior to 1649, as evidenced by the local settler who helped rescue the Norwood party. At first, present-day Worcester and Wicomico counties were part of Somerset County, named for the sister of the landowner, Cecil Calvert (then Lord Baltimore). Calvert later divided all of his land (from the Virginia line to just north of Philadelphia) into two counties, the southernmost extending from the northern border of present-day Delaware to the present-day border with Virginia and named Worcester County. However, these counties never materialized and the land was slowly parceled out over the next half-century.

The first European settlers were most likely farmers, hunters and trappers, and fishermen (Hager, 1996), not unlike their Native American predecessors. Frequent storms through the late 1700s and early 1800s opened and re-opened inlets to Sinepuxent bay north of Tingles Island. These inlets provided a brackish environment conducive to oyster establishment and consequent harvest. However, the area was geographically remote and, until railroads were established in the 19$^{th}$ century, population was generally small with few established settlements. This remoteness, as well as ready access to the ocean, led to the popularity of the Coastal Bays as a hideout for pirates in the early 1700's (including Edward Teach, a.k.a. Blackbeard). Later, Civil War draft-dodgers from both sides escaped into the forests and marshes, as did prohibition era rum-runners in the early twentieth century.

**Into the Twentieth Century: Big Changes**

<u>Demographics</u>

Following the Civil War, advances in transportation led to an increase in population growth. Post-war disillusionment led to a small-scale flight from eastern cities into more remote areas,

including those surrounding the Coastal Bays (C. Petrocci, pers. comm.). Colonel William Whittington was granted most of Assateague Island in 1702, which he subdivided into parcels for livestock grazing (Truitt, 1971). However, few of the parcels sold and most became vacant lands. Anticipation of a railroad terminal connecting Ocean City to Washington and Baltimore led to a marked increase in land speculation in the 1870's. However, the project never materialized, and many of the purchased plots in Ocean City also became vacant. Ocean City was already a popular resort destination during this period, with several hotels opened near the beaches. Ocean City did not become an incorporated municipality until 1880 and, despite relatively rapid growth throughout the early twentieth century, did not build a wastewater treatment plant until 1937.

Development proceeded through the 1900s, from small communities of watermen and farmers to booming resorts and beach access communities currently present in and leading into Ocean City. Advances in transportation certainly fueled these increases, the aforementioned railroads leading the way. In 1951, the Bay Bridge crossing the Chesapeake Bay from Annapolis to Kent Narrows opened. This bridge issued in a new era of population growth, as not only vacationers, but more permanent residents found it easier to get to and from property near the ocean (I. Fehrer, pers. comm.). This trend continued, despite a series of strong tropical storms and hurricanes through the 1950s and '60s. Development centered on Fenwick Island in Ocean City and in West Ocean City on the mainland. Largely in response to this run-away development, the State of Maryland purchased the northern part of Assateague Island and established Assateague State Park there in 1964. In 1965, the remainder of Assateague Island was designated a National Seashore to be managed by the National Park Service.

On the mainland, outside of Ocean City, development and population growth remained slow throughout the twentieth century. Agriculture was and is the mainstay of this area. The aforementioned transportation increases led to a shift from regional markets to Washington and Baltimore. Large-scale production of chickens began in the late 1960s, with the Perdue Company opening its first broiler processing plant in 1968 in nearby Salisbury. Currently, the population outside of Ocean City remains relatively low and the lifestyle "comfortably rural" (Hager, 1996). However, the disproportionate population rise in the resort communities masks this observation. In fact, the population of Worcester county has doubled from 1940 to 1996 (Table 2.1.1), a fact made more interesting in that nearly three centuries were required to attain the 1940 population (Hager, 1996).

Natural Resources

The myriad and often ephemeral fisheries of the Coastal Bays define not only the development of human communities on land, but also serve as perhaps the only record of ecological conditions during the post-Civil War period through the early twentieth century. Frequent hurricanes opened inlets in several portions of the islands, including the aforementioned Sinepuxent inlet and another at Green Run in 1868. The latter led to a lucrative oyster harvest in the Bays until its closure in 1880. Worcester county and Ocean City had money for cost sharing with the United States Army Corps of Engineers (USACE) to build an inlet in 1929. However, the stock market crash later that year caused the project to be postponed. Ironically, a hurricane came through in 1933 and created what is now the Ocean City inlet. In 1934, the USACE stabilized the inlet as it was navigable and most believed that the increased salinity would lead to

productive Eastern oyster (*Crassostrea virginica*) harvests. The inlet did have profound effects on the fauna of the Coastal Bays, as the salinity rose to that of ocean water virtually overnight. The effects on the oyster industry were not as expected – the influx of ocean water allowed predators to flourish, as well as competitors that vied for space with spat. Disease may have also contributed to the decline of oyster harvests. Three diseases are present in Coastal Bays; FSO (a higher salinity relation to MSX), Dermo, and some MSX. The combination of increased predation, fouling, disease, and over-harvesting probably led to the decline of oyster populations to the relicts of today (M. Tarnowski, pers. comm.).

The opening of the Ocean City inlet, while proving detrimental to oysters, was a boon for hard clams (*Mercenaria mercenaria*). Before the inlet, hard clams were confined to the southern portions of Chincoteague Bay where the salinity was high enough to sustain this brackish water species. Clam harvests climbed sporadically through the 1960s, when hydraulic clam dredging came to fore. Currently, clam populations are stable and harvesting effort is relatively low and restricted to non-mechanical recreational harvest.

Bay scallops (*Argopecten irradians*) also sustained a small commercial fishery in the higher salinity areas of southern Chincoteague Bay through the 1920s. New fisheries for this species were anticipated with the opening of the Ocean City inlet. However, the story of the bay scallop is a story of declining habitat, specifically the sea grass beds where they live. Eelgrass declined precipitously through the 1930s due to "wasting disease" and new scallop fisheries never materialized. Bay scallops (*Argopecten irradians*), which had occurred in most of the Coastal Bays during the early 2000s, have not been observed in Chincoteague since 2005. Some scallops still inhabit the northern bays, albeit in very low numbers.

Another popular fishery in the Coastal Bays is that for blue crabs (*Callinectes sapidus).* At times, over 100 boats come out of Chesapeake Bay for spring crab season, taking advantage of the earlier warming. Female Chesapeake crabs tend to be larger, so those watermen crabbing the early Coastal Bays crab season find it more lucrative to return to the Chesapeake. However, some usually stay on to take soft crabs, which molt synchronously in the Coastal Bays (Boynton, 1970). Catch records are available back to 1890 (summarized by Murphy, 1960). The catch was generally low in the 1800s through the early twentieth century, but then increased dramatically, with an overall haul of 3,757,300 pounds in 1950 (Murphy, 1960). Crab populations tend to fluctuate (Davis et. al., 2002) over years, as they did through the 1970s. Harvest continues to vary without trend (1980s through 2013),and average annual catches are around 1,560,000 pounds crabs (hard, soft, and peeler) per year. Like bay scallops, sea grass beds are critical habitat for blue crabs. However, there was no apparent decline in crab harvests during the period between the 1930s and early 1980s when sea grasses were absent and then recovering at low densities (UMCES, 1993). Also, in the early 1990s, the parasite *Hematodinium* was observed killing many crabs in the Coastal Bays.

Finfish have arguably the most tumultuous history among the many Coastal Bays fisheries. Watermen landed millions of pounds of bluefish (*Pomatomus saltatrix*), "fatbacks" (mullet: *Mugil cephalus*), striped bass (*Morone saxatilis*), and weakfish (*Cynoscion regalis*) from the late 1800s through the 1930s (Murphy, 1960). Large numbers of "bunkers" (menhaden: *Brevoortia tyrannus*) were also harvested, mainly for use as fertilizer (Truitt, 1971). However, with the

opening of the inlet in 1933, landings from the Coastal Bays declined mainly due to effort shifting to more lucrative offshore fisheries (UMCES, 1993). Despite a paucity of landing data, many species remained abundant in the Bays through the 1940s (M. Simpson, pers. comm.). Harvest remained low through the mid-twentieth century until 1970, when commercial landings increased dramatically. A record harvest of 103,635 pounds was landed that year, mostly bluefish, weakfish, and spot (*Leiostomus xanthurus*). This landmark year signaled subsequent increases in landings from the bays (UMCES, 1993). Still, the yields from oceanic fisheries dwarfed those from the Coastal Bays, and more emphasis has been placed on recreational fishing in recent years.

Despite the popularity of the Coastal Bays as a recreational fishing site, little historic data is available. However, anecdotal evidence thrives in the collective memories of many long-time residents. Many fisheries seem to cycle, reflecting the history of transitions in the Bays. For instance, spot were abundant in both commercial and recreational catches in the 1930s and 1940s, then were not seen for a decade or more, before returning in the 1960s (M. Simpson, pers. comm.). Shellfish fishing, excluding blue crabs, seems to follow the trends mentioned earlier for commercial fisheries. However, blue crabs have been harder to find for recreational "chicken-neckers" in recent years despite no apparent crash in commercial harvest (D. Wilson and M. Sampson, pers. comm.). This trend is reflected in decreased sales in recreational crab pots and associated gear (C. Cummins, pers. comm.). This trend may indicate a changeover in how visitors choose to recreate in the bays, as success usually requires some knowledge of where and when to crab.

Recreational fishing for summer flounder (*Paralichthys dentatus*) is of special mention. Many vacationers have historically come to the Coastal Bays to fish for flounder. This tradition continues to this day. From the late 1960s through the 1970s, flounder were the most sought after recreational fish (M. Sampson, pers. comm.). However, both anecdotal and Maryland Department of Natural Resourcestrawl data indicate that flounder have declined in recent years (see Fisheries chapter of this assessment- Chapter 7.1); B. Abele and M. Sampson, pers. comm.). With catches down, many anglers are shifting to the more productive offshore fishing grounds.

As telling as observations of sport fish abundance and catchability are, some anomalous observations may provide further evidence of the fluctuations present in the Coastal Bays. In the late 1980s, Northern puffer fish (*Sphoeroides maculatus*) were so abundant as to spawn a small-scale fishery. This boost seemed to correspond with an increase in serpulid worm populations, at times so numerous that masses of their calcareous casings were navigation hazards. In the late 1970s and into the 1980s, a spring run of monkfish (*Lophius americanus*) occurred on an annual basis (M. Sampson, pers. comm.). Maryland Department of Natural Resources Fisheries have observed them coming in the Ocean City inlet each spring to spawn in varying numbers annually since 1971, though never in large numbers. Storms, which had occurred frequently through the early 1970s, drastically declined during this time. These two examples are pure speculation, and these occurrences could be coincidental. Booms in species abundance, however ephemeral, are rarely random events. However, they serve to illustrate the nearly infinite interactions present in this ecosystem.

In summary, the natural opening and closing of inlets in the barrier island was a major force in the success or failure of early commercial and recreational fishing efforts in the Coastal Bays (Figure 2.1.2). An article featured in Maryland Fisheries journal published by the Maryland Conservation Department in March 1931 emphasizes this assertion. The article comments on the severe storm of February1920 that opened a wide, navigable inlet in what is now upper Assateague Island, stating: "The results from the opening of this inlet were almost magical. Crabs came up from the lower Chincoteague Bay and the sponge crab was found above Ocean City. The clamming industry began almost at once as a result of the salting of the water, and in five years clams were being taken by the millions. Fishermen were able to make as high as $35 a day clamming. Oysters were planted even above Ocean City and business commenced to thrive. Then the inlet began gradually to close and this was accompanied by the death of shell-fish of all kinds."

**The Twenty-first Century: What does the future hold?**

Clearly, Maryland's Coastal Bays have been the scene of tremendous change over time. But what changes may come as this century progresses? Human population is expected to climb steadily (Hager, 1996), with many more permanent residents as opposed to summer visitors (C. Cummins, pers. comm.). The changes in landscape, especially as farmland is converted to residential development in the greater watershed, will bring about added stresses to the Bays ecosystem (Hager, 1996). Proactive management of development, along with improvements in wastewater and run-off projects, will be necessary to preserve the integrity of this ecosystem. This necessity runs concurrent with the population trend, for it is precisely the opportunities afforded by this ecosystem integrity that draws people to this area. A survey of boaters strongly supports this assertion; a majority chose "good fishing", "scenic quality", or "peaceful location" as their main reasons for living near or visiting the Coastal Bays (Falk and Gerner, 2002). The Coastal Bays community, both ecological and human demographic, will certainly continue to change over time. The capacity to respond to this change over time should be preserved.

**Coastal Bays Ecological and Demographic Timeline**

*(Note: Location of inlets mentioned in the timeline are shown in Figure 2.1.2)*

1820-1844- Oyster harvest coincident with open inlet.
1837-First record of wild ponies.
1844- Inlet opened, closed 1844.
1868-Green Run inlet opened.
Lucrative oyster industry.
City of Berlin incorporated.
1874 – Hurricane.
1876-The List of Fishes of Maryland published, including Coastal Bays species.
1877- Hurricane.
1878 – Ocean City Life-Saving Station commissioned
1879- Hurricane.
1880-Green Run inlet closed. Oysters declined in Sinepuxent. Ocean City incorporated.
1881- Hurricane.

1882- 2 hurricanes.
1886- 2 hurricanes.
1894- Hurricane off shore.
1908- Submerged aquatic vegetation beds present in upper St. Martin's river.
1914-A Notes on the Fishes at Ocean City, Maryland was published in the journal *Copeia*.
1916-1787 barrels of "choice" fish harvested.
1920-Sturgeon (caviar) fishery declines.
1921-inlet opened. Improved fish and crab populations.
1928-State begins commercial landings survey of shellfish from bays.
1929-1921 inlet closed.
1930- Eelgrass "wasting disease" begins destroying grass beds.
1933 -Hurricane off shore in August. **Storm surge opens Ocean City inlet.**
1934- US Army Corps of Engineers stabilizes Ocean City inlet.
Bird nesting islands created with dredge material.
1935- West Ocean City harbor created by the US Army Corps of Engineers.
1936- Hurricane off shore.
1937- Ocean City sewage plant opens, discharging into Ocean City inlet.
1942 - Harry W. Kelley Memorial Bridge (Rt 50 Bridge) constructed.
1943- Hurricane.
1944- Hurricane and 2 tropical storms.
Fishing (croaker, spot) generally good (through the 1940s).
1948-First dredging of Sinepuxent and Isle of Wight bays.
1950-Perdue opens Showell plant.
1952- State hard clam study.
Chesapeake Bay Bridge opens
1953- Hurricane Barbara.
1955- Tropical Storm Connie.
1958- MSX (Multinucleated Sphere Unknown) oyster disease first reported.
Hey day of leased oyster beds.
1959 - Bishopville Dam built: *The dam was built as a "tumbling dam" to keep the river below open for fishing and small boat navigation.*
1960- SSO and Dermo (*Dermocystidium marinum*, aka *Labyrinthomyxa marina, Perkinsus marinus*) oyster diseases first mentioned.
Tropical Storm Brenda followed by offshore Tropical Storm Donna.
1964-Assateague State Park established.
1965-Assateague Island National Seashore established.
First Worcester County Comprehensive Land Use Plan created.
1967- Tropical Storm Doria.
1968-Ocean Pines Development established.
1969-Seagrass beds and scallops noticed during trawl surveys.
Assateague Ecological Study begins (through 1971).
State ends annual shellfish landings survey.
Ocean City sewage plant upgraded and outflow moved offshore.
1971- Tropical Storm Doria.

Large number of monkfish (*Lophius americanu*s) in spring (through the late '60's into '70's)

1972- Maryland Department of Natural Resources Fisheries Service begins routine trawl and seine surveys.

Federal Clean Water Act passed.

1973- Second span of the Chesapeake Bay Bridge opens.

1975- Seagrass and scallop declines.

1976- Areas of septic tank failure and subsequent water quality violations were identified in numerous towns in the Coastal Bays.

1980s- State Highway Administration stabilize Ocean City bridge

1980-U.S. Army Corps of Engineers identifies need to replenish sand along OC beaches.

1981-The Committee to Preserve Assateague Island held the first of many citizen led conferences focused on aquatic resources.

1982- Begin to see SAV recovery.

1983- First brown pelicans (*Pelecanus occidentalis).*

Last commercial oyster harvest.

Maryland Department of the Environment intensive surveys commence.

1985- Offshore hurricane Gloria. Hurricane Danny. Tropical Storm Henri.

Maryland bans phosphates in detergents

1986-Virginia Institute of Marine Sciences seagrass aerial surveys begin.

Observed decline in recreational flounder fishing.

1987-National Park Service begins routine water quality monitoring in Newport, Sinepuxent, and Chincoteague bays.

1988-Coordinated beach replenishment (Army, State, local) commences.

1989-Large numbers of pufferfish (*Sphoeroides maculatus*) present.

1990- Focus on Maryland's Forgotten Bays, The Citizens Agenda conference convened.

U.S. Environmental Protection Agency Environmental Mapping and Assessment Program (EMAP) begins (through 1992).

1991-Green crabs (*Carcinus maenus*) established.

1992-Washover event (nor'easter) impacts piping plover habitat.

1993-Brown Tide probable from archival samples.

MD Dept. of Natural Resources begins long-term hard clam survey (includes scallop numbers).

U.S. Environmental Protection Agency joint assessment begins (through 1996).

Maryland Department of Natural Resources Molluscan Inventory begins.

1995- Maryland Coastal Bays nominated to National Estuary Program.

1996- Japanese shore crabs (*Hemigrapsus sanguineus*) established.

All five Coastal Bays were included on Maryland's impaired water list.

Maryland Coastal Bays Program and Maryland Department of Natural Resources hold the first ever Maryland Coast Day on Assateague.

1997- Maryland Department of Natural Resources plants bay scallops.

Maryland Deptartment of Natural Resources Molluscan Inventory study completed.

U.S.Environmental Protection Agency Mid-Atlantic Integrated Assessment begins (through 1998).

Maryland Coastal Bay Program initiated.

Coastal Bays Rural Legacy Program established for land conservation.

1998- Brown Tide (*Aureococcus anophagefferens*) first detected.
Maryland Department of Natural Resources monitors for *Pfiesteria* at 29 stations.
Maryland Department of Natural Resources plants bay scallops.
Army Corps of Engineers completes the Ocean City water resources environmental impact study, the most extensive review of resources and conditions of the Coastal Bays to that date.

1999- Brown Tide blooms
Macroalgae present in large masses.
Maryland Coastal Bays Comprehensive Conservation & Management Plan published

2000- Brown Tide blooms Macroalgae.
National Coastal Assessment (continuation of EMAP) begins (through 2004).
Worcester 2000 Community Visioning workshops held.

2001- Brown Tide. Macroalgae.
Maryland Department of Natural Resources begins routine water quality monitoring at 45 stations.
Blue crab fishery management plan goes into effect.

2002- Brown Tide. Macroalgae.
Scallops found north of Ocean City inlet.
Hard clam fishery management plan goes into effect.
Exotic species survey completed.
Maryland Department of Natural Resources deploys continuous water quality monitors (Bishopville and Turville Creek).
Total Maximum Daily Loads approved for Big Mill Pond, Turville, Herring & Manklin Creeks, and the St. Martin River.
The state Critical Area Program expands to include protections to the Coastal Bays.
Horseshoe crab survey begins.
Maryland legislature passes law to include the coastal bays in the state's Critical Area.

2003 - Brown Tide.
Large masses of boring sponges present.
Total maximum daily loads approved for Newport Creek, Newport Bay and Kitts Branch.

2004- Priority areas for wetland restoration, preservation & mitigation determined.
Stream corridor assessments completed for each bay.

2005 - Continuous water quality monitor deployed at Public Landing.
Coastal Bays Aquatic Sensitive Areas Management and Education Plan completed.

2006- Worcester County produces an award winning Comprehensive Plan.
Sea level rise inundation modeling takes place.
Virginia Institute of Marine Sciences creates a shoreline inventory of natural and hardened shoreline structures.
Maryland Coastal Bays Program begins annual stream chemistry surveys.
*Dinophysis* bloom detected at Ocean City Inlet.

2007- The old Ocean City dump is cleaned-up and converted into a public kayak launch.
- *Dinophysis* blooms in Bishopville Prong.
- June 7- Newport Creek had microcystin levels of 13ppb and Trappe Creek had 29ppb (*Cyanobium* dominant).

2008 - First Coastal Bays Report Card is published

_____- Maryland Coastal Bays Program begins colonial waterbird count
- The Maryland Coastal Bays Program Policy Committee creates the 64,000-acre Newport/Chincoteague
- Land Conservation Area with a goal of protecting 20% of the area (471 acres/yr) by 2015

2009 – Worcester County updates zoning code, removing most large-lot zoning, strengthening the A-1 zone, and keeping growth around existing infrastructure.
- Maryland Coastal Bays Program begins Coastal Stewards Program with Maryland Department of Natural Resources and Assateague Island National Seashore.
–"Shifting Sands" published to highlight the cultural and environmental history and challenges in the coastal bays.
-Significant *Microcystis* bloom in Trappe Creek.

2010 – U.S. Fodd and Drug Administration confirmed presence of diarrhetic shellfish poisoning (DSP) toxins in Maryland waters for the first time (Manklin Creek bloom).
Bloom of *Pseudo-nitzchia* detected in Isle of Wight Bay

2011 - Lizard Hill sand mine reclaimed through the creation of an Atlantic White Cedar community (Bishopville area)
- Terrapin sightings are collected.
- Showell property undergoes floodplain restoration.
–Begin replenishing Skimmer Island.

2012 – Diarrhetic Shellfish Poisoning toxins found in shellfish above the U.S. Food and Drug Administration guidance levels in area that is closed to shellfishing (Bishopville Prong)

2013- The Town of Berlin spray irrigates all wastewater effluent and establishes the first stormwater utility in the county.
- Maryland Coastal Bays Program joins the Environmental Protection Agencies Climate Ready Estuaries Program.
- U.S. Environmental Protection Agency approves new total maximum daily load for the Maryland Coastal Bays.
- Bloom of *Dinophysis* in Manklin Creek.

2014 - Maryland Coastal Bays Comprehensive Conservation Management Plan updated,
-Dredging of Ocean City Inlet and new island created for colonial bird nesting.

**Acknowledgements**
Many people contributed information to this report, both in the form of hard data and personal anecdotes. Without their insights, a comprehensive understanding of the history of the Coastal Bays would not be possible. Many have been acknowledged in the text, but a full list is included here: Mitch Tarnowski, Carolyn Cummins, Dave Wilson, Charlie Petrocci, Mac Simpson, Mark Sampson, Bob Abele, Ilia Fehrer, Roman Jesien, Todd Burbage, Margaret McGinty, Carol Cain, and Cathy Wazniak. Cel Pietro was invaluable in locating and compiling source materials.

**References**

Biggs, R.B., 1970, The origin and geological history of Assateague Island, Maryland and Virginia, *in* Natural Resources Institute, University of Maryland, Oct. 1970, Assateague ecological studies, Part II: Environmental threats, Contribution #446, Chesapeake Biological Lab, Solomons, Md., p. 9-41.

Boynton, W.R. 1970. The commercial fisheries of Chincoteague Bay – Past, present, and future. In: University of Maryland Natural Resources Institute. Assateague Ecological Studies. Part I. Environmental Information. Pp. 356-388.

Chrzastowski, Michael J., 1986, Stratigraphy and geologic history of a Holocene lagoon: Rehoboth Bay and Indian River Bay, Delaware: Ph.D. dissertation, Univ. of Delaware, Wilmington, Delaware, June, 1986, 337 pp.

Davis, G.P., B.K. Davis, and J.C. Walstrum. 2002. Population dynamics and stock assessment of the blue crab (*Callinectes sapidus*), in Chesapeake Bay. Maryland Department of Natural Resources Winter Dredge Annual Report 2002, Annapolis, MD.

Demarest, J. M., and Leatherman, S. P., 1985, Mainland influence on coastal transgression: Delmarva Peninsula: Marine Geology, v. 63, p. 19-33.

Falk, J.M. and P.C. Gerner. 2002. Maryland Coastal Bays water-use assessment: understanding users' behaviors, attitudes and perceptions. Maryland Department of Natural Resources, Annapolis, MD and Delaware Sea Grant, Lewes, DE, Ref. no. DEL-SG-09-02.

Hager, P. 1996. Worcester County, MD. In: Beidler, K., P. Gant, M. Ramsay, and G. Schultz, eds. Proceedings – Delmarva's Coastal Bay watersheds: not yet up the creek. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. EPA/600/R-95/052. pp. 20-24.

Kraft, J. C., Chrzastowski, M. J., Belknap, D. F., Toscano, M. A., and Fletcher,C. F.,III, 1987, The Transgressive Barrier-Lagoon Coast of Delaware: Morphostratigraphy, sedimentary sequences and responses to relative rise in sea level. *in*: Nummedal, D., Piley, O.H., and Howard, J.D. (eds.) *Sea Level Fluctuations and Coastal Evolution.* Society of Economic Paleontologists and Mineralogists Special Publication 41, p. 129-144.

Murphy, G.J. 1960. Commercial fisheries catch of major species landed in Worcester County, Maryland. Maryland Department of Research and Education, ref. no. 60-5. Annapolis, MD.

Owens, J.P., and Denny, C.S., 1979, Upper Cenozoic deposits of the Central Delmarva Peninsula, Maryland and Delaware: U.S. Geol. Survey. Prof. Paper 1067-A, 28 pp.

Pielou, E.C. 1991. After the ice age: the return of life to glaciated North America. The University of Chicago Press, Chicago, IL.

Ralph, E.K., Michael, H.N., and Han, M.C., 1973, Radiocarbon dates and reality: M.A.S.C.A. Newsletter, Museum Applied Science Center for Archeology, Univ. of PA., vol. 9, p. 1-20.

Rountree, H.C. and T.E. Davidson. 1997. Eastern shore Indians of Virginia and Maryland. University Press of Virginia, Charlottesville, VA.

Toscano, M. A., Kerhin, R.T., York, L. L., Cronin, T. M., and Williams, S. J., 1989, Quaternary stratigraphy of the inner continental shelf of Maryland: Maryland Geological Survey Report of Investigation 50, 117 pp.

Truitt, R.V. 1971. Assateague..the place across: a saga of Assateague Island. Natural Resources Institute, University of Maryland Educational Series no. 90, College Park, MD.

UMCES and CES, Inc. 1993. Maryland's Coastal Bays: An assessment of aquatic ecosystems, pollutant loadings, and management options. Maryland Department of the Environment, Baltimore, MD.

Wells, D.V., 1994, Non-energy resources and shallow geological framework of the inner continental margin off Ocean City, Maryland. Maryland Geological Survey Coastal and Estuarine Geology Program Open File Report #16, 97 pp. 4 Plates.

**Table 2.1.1** Historical and Projected Population in the Coastal Bays Watershed

Pre-European (1600s) – around 300 Native Americans.
1600s through early 1900s – sparsely populated; mostly farmers and watermen.
1940 – 21,245
1990 – 35,028
1995 – 40,300
2000 – 47,228 (during summer months, can exceed 300,000)
2010 – 51,451
2014 – 51,675
projected 2020 – 72,117

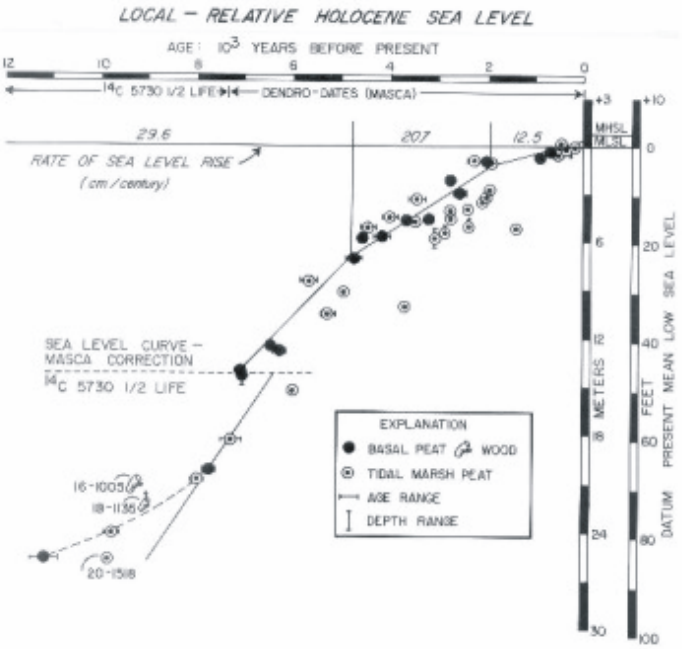


**Figure 2.1.1** Local relative sea-level rise curve for the Delaware-Maryland coastal zone based on carbon-14 dating of basal and tidal marsh peat, and wood fragments (Kraft et al, 1987; Toscano et al, 1989). MASCA corrections after Ralph et al (1973). Figure taken from Toscano et al (1989).

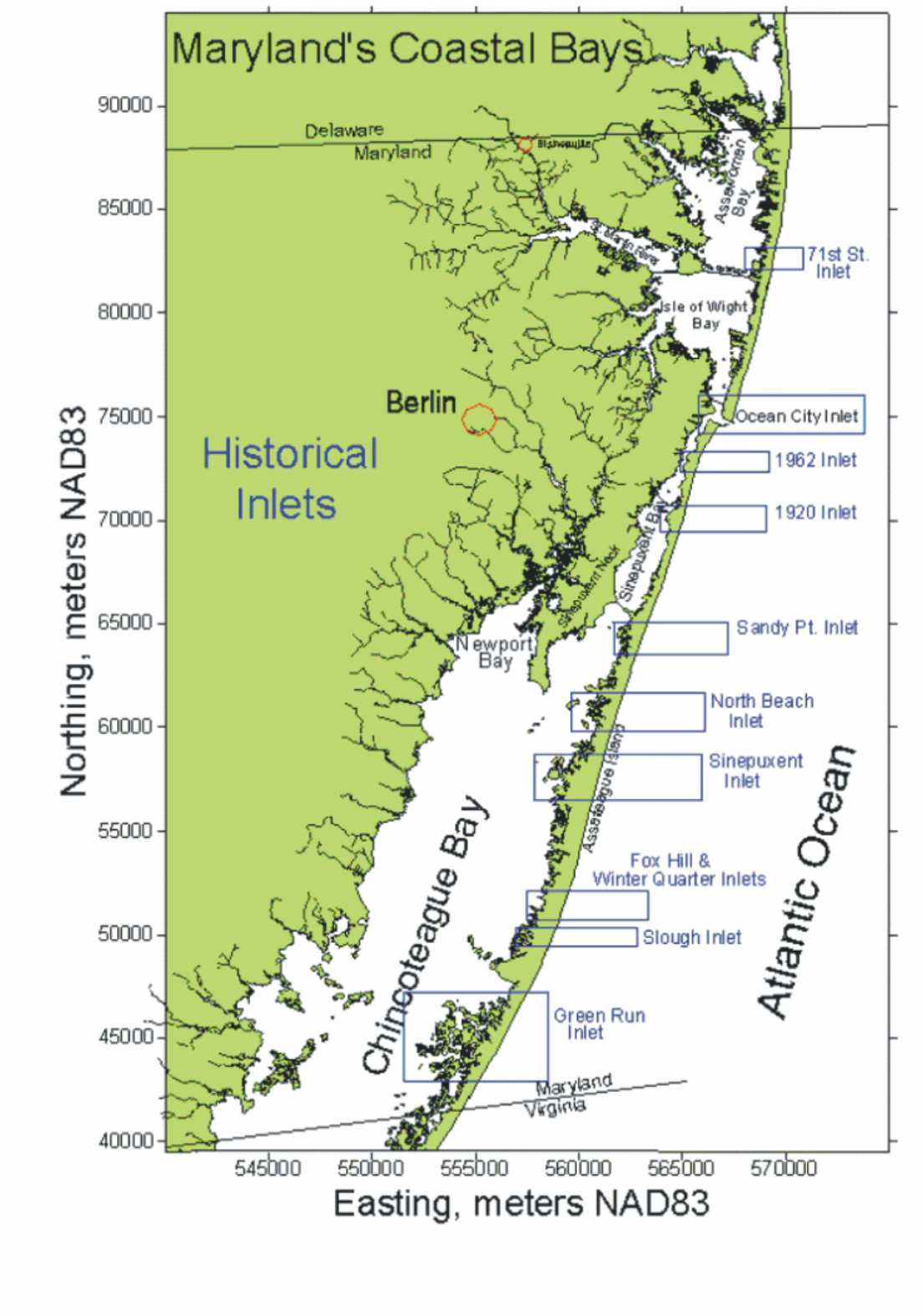


**Figure 2.1.2** Historical inlets of Maryland's Coastal Bays. These inlets are described in further detail in the timeline section of the report text.