

# ALL ABOUT ESTUARIES

## *in North Carolina*

ADAPTED FROM THE ORIGINAL ARTICLE BY [WAVERLY HARRELL](#) AND [JENNIFER GODWIN-WYER](#)

Estuaries are places near the coast where freshwater and saltwater mix. Influenced by ocean forces yet partly sheltered from them, estuaries have unique and fascinating ecologies. This article explains what estuaries are, their geology and role in the larger ecosystem, and the ways in which they are currently threatened.

## WHAT IS AN ESTUARY?

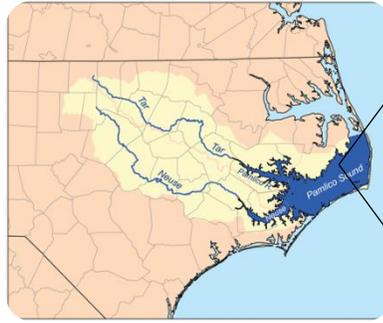
The definition of an estuary varies as each estuary is unique in its own way. The simplest definition of an estuary is any place where freshwater joins and mixes with saltwater. But more typically, an estuary is defined as a partially enclosed coastal body of water, having an open connection with the ocean (for example, via a river), where freshwater from inland is mixed with saltwater from the sea. Estuaries typically occupy coastal areas where effects from the ocean are reduced but



still influential. Forces like tides, waves, and major storms from the sea play a vital role in an estuary's development and morphology as they provide energy to help mix the fresh and salt waters and distribute sediments. This mixing creates a brackish (slightly salty) environment where the salinity in the water is between 0.5 and 30 grams of salt per liter, or 0.5 to 30 parts per thousand (ppt or ‰).

Estuaries contain salt water and fresh water in different proportions over the length of the estuary and over the course of the day, with more salt water during high tide and less at low tide. Because they are shallow (in North Carolina, less than thirty feet deep), sunlight penetrates the water, allowing plants to grow. The rivers that feed the estuaries deposit sediments rich in nutrients, which settle onto the sand and mud of the estuary floor. These conditions create unique habitats for both plants and animals, and provide an environment for biological diversity in species (of fish, shrimp, crabs, clams and oysters) that are able to adapt to the brackish conditions. Estuaries are also good nurseries as they provide a place for these species to hatch and grow before they migrate to the sea to live out their adult lives.

The largest North Carolina estuary is Pamlico Sound. Water drains into this system from eastern North Carolina and southeastern Virginia, from the Chowan, Roanoke, Pasquotank, Pamlico, and Neuse Rivers, from marshes, swamps, forests, and grasslands.



## WHY ESTUARIES ARE IMPORTANT?

Estuaries help control erosion and reduce flooding of the mainland. Sand bars buffer the impact of waves, while plants and shellfish beds anchor the shore against tides. Swamps and marshes take the initial impact of high winds moving in from the ocean, soak up heavy rain and storm surges, and release the extra water gradually into rivers and groundwater supplies.

Estuaries are a type of environmental filter as plants and animals in estuaries filter pollutants out of the water. Particles in the water are either removed by chemical processes or by the feeding of estuarine animals and bacteria. Some examples of filtration include:

- 1) Salt marsh plants trap some of the chemicals and pathogens carried by rivers and move them into soils where they can be neutralized.
- 2) Oysters filter impurities out of water as they eat, collecting the contaminants in their bodies. One oyster can filter twenty–five gallons of water per day.
- 3) Bacteria eat organic matter found in the sediment and in turn release carbon dioxide, hydrogen sulfate and methane into the atmosphere preventing these gases from being excessively stored up in the estuary.

However, toxins and other pollutants can accumulate in estuaries causing many environmental and health problems. (This is discussed more below in “Threats to the estuarine system.”)

Three quarters of the fish caught commercially (meaning those caught and sold for profit) in the United States live in estuaries, meaning that on average, estuaries produce more food per acre than our most productive farmland. About thirty commercial fishing species live in North Carolina estuaries. Commercial fishing is important to the national economy and food supply. And of course, beaches lie along the estuaries of North Carolina – beaches where many of us go every summer to lie in the sun, swim, surf, boat, and fish. Tourists come from across the state and from other parts of the country, and tourism supplies much-needed jobs on the North Carolina coast.

## FISH AND WILDLIFE

Although estuaries create unusual and changeable habitats, many plants and animals have adapted to the brackish conditions there. More than 150 species of fish and invertebrates live in North Carolina estuaries. Some species use different habitats within the estuarine system during

different stages of their life cycles. As in any ecosystem, the plants and animals in an estuary are richly interconnected, and every species depends on several other species to survive.



Oysters and clams attach to gravel and old shells on the shoreline, forming spiky oyster beds that help protect the land from erosion. Blue and stone crabs and grass shrimp hatch in the oyster beds and begin to grow there, eating phytoplankton. The environment these species grow in are also protected from the ocean currents. Black sea bass and flounder forage for food among the oysters.

Swamps and marshes along the edges of the coast provide feeding grounds and shelter for many adult fish and shellfish. Cypress, tupelo, and swamp maple trees grow in swamp forests, whereas grasses such as black needlerush and cordgrasses predominate in salt marshes. Freshwater marshes support cattails, bullrushes, and reeds. River herring spawn in the swamps, while adult river herring, Atlantic menhaden, and bluefish live in the open water.

Underwater plants cover about 200,000 acres on the coast of North Carolina. Submerged plants produce oxygen and nutrients used by animal species. Spotted sea trout, red drum fish, and pink shrimp spend their early lives among the underwater plants, and predators such as flounder and rays hunt there. Bay scallops attach to the blades of plants. Spots, croakers, mullets, and sturgeon feed on algae and tiny animals on the soft floor of the estuary. Flounder, shrimp, and kingfish hatch there, and clams and worms burrow into the mud and sand.



Migratory birds, including tundra swans, sea ducks, and snow geese, winter along the estuary. Egrets and herons fish in the salt marshes. Loggerhead sea turtles hatch on the beach and head out to Pamlico Sound to feed.

## **GEOLOGY**

North Carolina estuarine environments were formed over many tens of thousands of years as sediment from the erosion of the land and mountains were carried to the coastline by rivers and wind, and sediment that was eroded and deposited during rising and falling sea levels accumulated.

Moving from a location, such as Charlotte, NC towards the coastal plains of eastern North Carolina you will notice a change in the landscape and terrain. The land will become closer to sea

level, and you will notice that it is much flatter compared to the Piedmont Region which is full of rolling hills. You will also notice the increased number of small bodies of water such as lakes, ponds and rivers. Marshes and swamps will be rich with wildlife both in and out of the water. The air will likely smell slightly “salty”, too! You’re getting closer to the ocean!

## THREATS TO THE ESTUARINE SYSTEM

As land is developed for human habitation and use, things such as roads, bridges, culverts, sewage systems, pipelines, and dams change the flow of water through the ecosystem. Whereas wetlands soak up water like a sponge and settle contaminants in the ground, asphalt and concrete deflect water so that it runs off with all its contaminants directly into the rivers, estuaries, and the sea.

Dredging (digging out mud to make it deeper) of channels to allow large boats to pass through or dock damages plants and oyster beds and stirs up sediment that clouds the estuary water, and increases sediment deposition in the estuary creating a situation where more dredging has to occur to remove the accumulation. When sediment is suspended throughout the water, fishes’ gills



can become clogged, contaminants previously settled in the soil are taken in by fish, and predators have a hard time seeing their prey. Fishing gear that digs into the floor of the estuary or channels cut for irrigation or flood control also increase water turbidity (the cloudiness of water).

Although this may seem counterintuitive, estuaries can suffer from an excess of nutrients. Sewage treatment plants, septic systems, polluted air, and fertilizers deposit nutrients such as nitrogen and phosphorus in rivers and ultimately in estuaries. High levels of these nutrients can create large growths of algae called algal blooms. Algal blooms block the passage of sunlight through the water, reducing the growth of other plants. When the algae is alive, it produces oxygen, but once it dies its decomposition consumes oxygen. As oxygen levels drop, fish and invertebrates suffocate. Excess toxins can cause an overgrowth of plants in an estuary that can suffocate the environment by taking out too much oxygen, which in turn kills fish and other species through asphyxiation (suffocating).

Recall that estuaries are an extremely important part of our world. We need estuaries to prevent shoreline erosion, buffer the impact of storms, filter and neutralize contaminants, and produce fish and shellfish to feed ourselves and our livestock. We must ensure that we do our part to protect such important ecosystems in our world!

## **WHILE YOU READ QUESTIONS:**

- 1) What are estuaries?
- 2) How/why do shallow estuary waters create unique habitats for organisms living here?
- 3) How does the salinity in water change as you move from inland areas out towards to ocean? Be sure to include the phrase "brackish waters" in your response.
- 4) List 4 ways estuaries provide protection for inland areas.
- 5) How does dredging impact fish living in an estuary?
- 6) How could too many nutrients impact the natural balance in an estuary?
- 7) List and describe 3 ways the land/terrain change as we move from Charlotte, NC to the coastal plains of North Carolina.
- 8) List 4 ways estuaries provide protection for inland areas.
- 9) List 5 factors that can change the flow of water through an ecosystem:
- 10) List and describe 4 reasons estuaries are important for both wildlife and human activity.