**Watersheds: Introduction to Estuaries**

**Earth Science**

 Eventually, all of the water that is contained in, and that moves through, a watershed reaches an end point. In rare cases, this ending point is a lake or salt flat in the middle of an inland basin (such as the Great Salt Lake in Utah), but usually the water that moves through a watershed reaches the ocean. This is certainly the case for watersheds in Maine.

 Please open the following link: <https://archive.epa.gov/water/test/web/html/nutrients.html>

It is a helpful EPA site about estuaries.

**What is an estuary?**

 Use the information that is provided in this website to answer these questions:

Describe what an estuary is, in one sentence.

What does the statement “An estuary is a place of transition” mean?

Think about one estuary that you have seen or visited in Maine. What did it look like?

What did it smell like?

What kinds of animals and plants live there?

Do tides impact estuaries?

**Why are estuaries important?**

 Find some information that explains why estuaries are important, and then take a moment to read the information that has been provided below.

“Estuaries can be described in terms of the ecological functions they perform and the societal benefits they offer. Some functions and benefits, such as wildlife habitat and recreation/tourism, are closely related. These functions include:

**Shoreline Anchoring** - The accretion of peat and sediment in the estuary maintains estuary elevation as sea level rises, and buffers the upland shoreline against the erosive action of open water waves and currents.

**Storm Surge Protection** - The resistance to water flow presented by estuary vegetation slows the movement of water over the estuary and reduces erosion from storms. The estuary vegetation also encourages the deposit of sediments suspended in the water column onto the surface of the estuary.

**Water Quality Maintenance** - Pollutants often enter aquatic systems attached to sediment particles. Many of these particles are deposited on the estuary, limiting their movement to other ecosystems. Nutrients in the water are taken up by the vegetation, buffering the discharges of these nutrients into shallow coastal waters where they might encourage blooms of nuisance algae. Other pollutants may bind with estuary soil particles and become unavailable for uptake by plants or animals.

**Wildlife, Finfish, and Shellfish Habitat** - The rapid growth rates of salt marsh grasses form the base of a highly productive food web. A diverse animal community, including many species of birds, finfish, shellfish and other invertebrates, uses estuaries for food and shelter, spawning and nursery areas, and sanctuary from ever-present predators.

The link between estuary productivity and the health of the Gulf of Maine continues to be studied, but in some parts of the United States well over 50% of the productivity of the near shore marine system is tied to the adjacent estuary systems. Estuaries are important contributors to the productivity of the greater Gulf of Maine ecosystem. These ecological functions have a tremendous economic value. Two-thirds of commercial shellfish and finfish landed in the US depend on coastal wetlands for nursery and breeding habitat, or on forage fish that breed in our coastal wetlands (Gosselink et al. 1974). The estimated total income for the harvest and processing of finfish and shellfish in Maine in 1997 was $653 million, resulting in twenty-two thousand jobs (Sheehan 1999). Recreational fishing, hunting, wildlife watching, and boating in coastal wetlands also contribute significant economic value.

The bounty that once was harvested from Maine estuaries has declined significantly. Many of the tidal marsh shellfish beds in the state are closed due to poor water quality. Road and dam construction along the coast has severely altered many marshes and estuaries. Over-fishing in the near coastal waters has depleted stocks of nursery fish. The numbers of ducks and shorebirds that frequent tidal marshes are a small fraction of the tremendous flocks of migrating birds that European colonists found when they arrived in North America. Inlets that were dammed for ice ponds and for tide mills no longer contribute to the marine environment.

Human activities can negatively affect the functions, values and ecological integrity of estuaries. Freshwater tributaries can be diverted, dammed, or channeled, greatly altering the seasonal flow of fresh water and sediments to the marsh. This can affect salinity levels and alter habitat sustainability of saline-sensitive species of plants, fish, and other animals. Shorelines of tributaries and marshes may be extensively developed, as buildings, parking areas, roads and lawns replace forest and pasture. This leads to dramatic changes in the pattern and quality of freshwater runoff, including increased sediment and pollutant loads, and larger ‘pulses’ that follow rains or snow melts.”

Identify, list, and describe FOUR ways in which estuaries benefit the environment.

a.

b.

c.

d.

What is “brackish” water, and where is it found?

What is the term “productivity of the Gulf of Maine ecosystem” referring to? What is being “produced”?

**What challenges do our estuaries face?**

Return to the “About Estuaries” site and click on the link entitled “What challenges do our estuaries face?”. Read the information that has been provided, being sure to take the time to gather definitions for any terms that you are not familiar with. Answer the following questions:

Americans love living by the ocean, which explains why coastal communities in the U.S. are growing at such a fast rate. How has this growth impacted estuaries?

One by one, click on each of the “challenges” faced by estuaries, and answer the questions provided for each challenge.

**Too Many Nutrients**:

The nutrients that often pollute estuaries are chemicals such as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and an overabundance of these nutrients can lead to an overpopulation of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which is called a \_\_\_\_\_\_\_\_\_\_\_ bloom. These blooms harm plants and animals in the estuary by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , or by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

List four common sources of these nutrients:

a.

b.

c.

d.

Which two of these sources do you, as an individual, have the most power to control?

What physically moves these nutrients into the estuaries?

**Pathogens**:

What is a pathogen? List three examples.

If an estuary gets polluted by one or more pathogens, how might you learn that news?

List the 5 most common sources of the pathogens found in estuaries.

a.

b.

c.

d.

e.

**Invasive Species:**

Explain what an invasive species is.

What are four problems that invasive species can create?

a.

b.

c.

d.

So far, at least 33 different invasive plant and animal species have been found in Maine’s estuaries. One such species is the Asian Shore Crab. Do a quick search and find out why scientists are concerned about Asian Shore Crabs in Maine.

**Habitat Loss:**

Estuaries are important habitats for numerous plants and animals. How do animals use estuaries?

a.

b.

c.

d.

How do estuaries help to keep oceans clean?

What kinds of human actions are most responsible for the loss of estuary habitats?

**Changes in Water Flow**:

What human activities reduce the volume of fresh water entering estuaries and interrupt natural cycles of water flow?

How do these changes in water flow impact estuaries? Give four specific examples.

a.

b.

c.

d.

**Toxic Chemicals**:

Give two examples of toxic heavy metals, and then explain what a pesticide is.

Knowing that these toxic chemicals can be easily passed through the food chain, why is their presence in estuaries such a cause for concern?

Explain the difference between a “point” source and a “non-point” source of pollution.

Invasive Species

<http://bangordailynews.com/2013/09/28/news/down-east/um-machias-students-discover-invasive-crab-in-beals-which-poses-threat-to-maines-shoreline-ecosystem/?ref=mostReadBoxNews>

Too Many Nutrients

<http://www.gulfofmaine.org/2/resources/state-of-the-gulf-of-maine-report/eutrophication/>

Pathogens

<http://www.pressherald.com/news/maine-Beaches-water-quality-pollution.html?pagenum=full>

<http://www.cascobay.usm.maine.edu/shellfish.html>

Toxic Chemicals

<http://www.cascobay.usm.maine.edu/toxics.html>

Habitat Loss

<http://www.gulfofmaine.org/2/resources/state-of-the-gulf-of-maine-report/coastal-development/>

Changes in Waterflow

<http://www.seaweb.org/resources/briefings/dams.php>

<http://www.suffolk.edu/news/6233.php#.ViTj1dYe5UE>

Stormwater issues,

<http://bangordailynews.com/2012/05/04/news/portland/portlands-bottomless-pit-the-hefty-price-tag-of-keeping-sewage-out-of-our-water/>