FISH CREEK ESTUARY ED-VENTURE ON-THE-WATER CURRICULUM

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Program Length: 2.5 hours
Audience: Participants ages 12 years and above

Equipment Needed: Photos and support materials shown in this curriculum to demonstrate historic and environmental key concepts are kept in the Estuary Ed-Venture materials box or they may be copied from this curriculum. Please see Estuary Ed-Venture Safety Manual for complete program safety protocols.

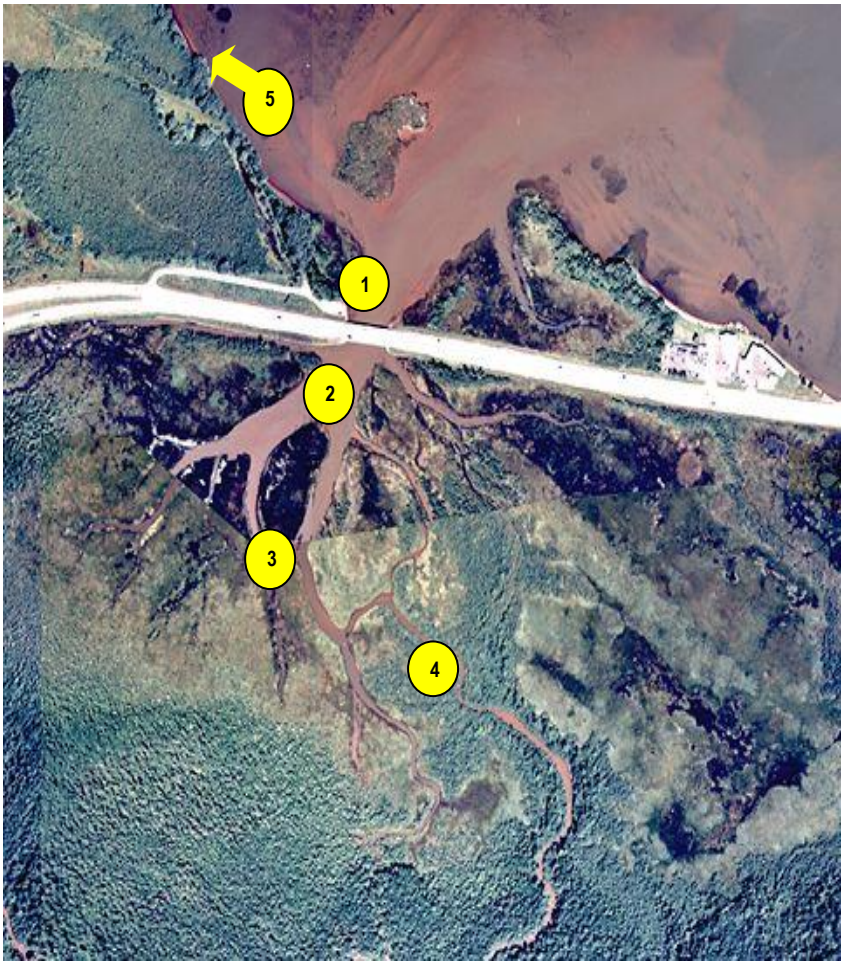
Pre-Program Check-- Participants must:

***Have submitted a signed waiver and health form. Review health forms for any important health issues to be aware of during the program**

***Wear closed toed shoes due to the presence of sharp objects in the water**

Pre-Program Preparation

Participants should receive a Pre-Trip Packet including: 1) Trip Confirmation letter, 2) Estuary Ed-Venture Reservation Form, 3) UWEX Estuary Ed-Venture Waiver and Health forms, 4) Optional: Map of the program meeting place at Long Bridge Boat Landing. Kayaks should be reserved through UW-Extension Office master calendar AND via a UW-Extension Estuary Ed-Venture Reservation Form.



About This Curriculum

This curriculum is designed to teach participants about the ecology, history, and cultural importance of Lake Superior's freshwater estuaries and issues that affect their sustainability.

The teaching locations and topics suggested here provide the "backbone" of topics that can linked together to build this awareness. Because this is an "ed-venture" program, other focus areas can be added between these stops depending on the program's focus including water quality and aquatic invertebrate sampling, botany, and birding.

Suggested Teaching Locations Cited In This Curriculum:

1 Long Bridge Landing
2 Mouth of Fish Creek Estuary
3 Sand Beach Stopping Place
4 Old Beaver Dam Turnaround
5 Whittlesey Creek Estuary

1 Program Start: Long Bridge Boat Landing

A. Program Welcome and Overview

Leaders introduce themselves and ask participants to share who they are and their interests. This allows leaders to tailor the program to cover participant's interests when possible.

B. Introduction to Fish Creek "Slough", a Lake Superior freshwater estuary

This section can be delivered at the landing or under the US 2 bridge to avoid highway noise. It can precede kayak paddling orientation, depending on the group. Key discussion points:

- **What other "estuaries" do students/participants know about?** Examples include saltwater estuaries including Tampa Bay, Chesapeake Bay, San Francisco Bay, etc.

- **What is an estuary and why are they important?**
  Estuaries are wetlands areas where a freshwater river draining a watershed mixes and with saltwater from the ocean. Tides are the force that drives salt water up into an estuary. Estuaries have unique water chemistry including salinity, connectivity, and temperature that is different from the river or seawater. Introduce the concept that there are also freshwater estuaries along the Great Lakes!

  Estuaries provide important environmental services including serving as a:
  - filter for sedimentation and pollution
  - a buffer to slow flooding and erosion
  - nursery areas for fish, birds, and wildlife as well as resting areas for migrating wildlife
  - recreation areas and community resources

- **What is a <u>freshwater</u> estuary and how is it different from other Great Lakes coastal wetlands?** Use a Great Lakes estuary photo, such as the Sand Bay Estuary photo, to demonstrate the following characteristics of freshwater estuaries:

  Sand River Freshwater Estuary

  Freshwater estuaries have 4 characteristics:

  1) A <u>freshwater river</u> that flows into a Great Lake, in this case Lake Superior. Freshwater rivers drain watersheds and have unique water quality different from Lake Superior.

     The Fish Creek Watershed is 157 square miles in size. The watershed has been affected by the removal of forest cover that began in the late 1800's. Today over half of the watershed is in pasture/grassland in the upstream areas of the watershed. This land use change has contributed to stream bank erosion and increased the frequency and peaks of flood events. Fish Creek is a major contributor to sedimentation and non-point pollution into Chequamegon Bay.

  2) There is a <u>Great Lake</u>, in this case Lake Superior. These are great freshwater inland seas with their own unique water chemistry, temperature, and connectivity.

  3) <u>There is a shallow coastal wetland</u> (a "mixing bowl") where water from a freshwater river draining the land mixes and mingles with water from a Great Lake in a shallow coastal wetland. The estuary has unique water chemistry from both the river and the Lake. Compare this to saline estuaries. Explain the role of glaciers in creating freshwater estuaries:

Freshwater estuaries are a gift of the glaciers. Since the last glaciers retreated from this area about 10,000 years, ago, the earth's crust has been relieved of the great weight of the ice and has been slowly springing back. This decompression of the earth's crust is called "isostatic rebound". The northeastern part of the Lake Superior Basin in Canada is rebounding faster (because the ice more recently left this area). This is causing the Basin to "tip" and Lake Superior's water to spill toward its southern shore and "flood' the mouths of some rivers, creating shallow wetland areas along the Lake's shoreline. These are called "drowned" river mouths. Freshwater estuaries form at the junction of a "drowned" river mouth and a Great Lake.

4) There is a force to mix Lake and river water (a "mixmaster") within the estuary. Explain how the seiche (the flow of Lake water into the estuary caused by barometric pressure changes and "wind tides") is the power forces Lake Superior waters upstream into the estuary. This creates constant mixing of river and lake water within the estuary.

   Compare Lake Superior's seiche and its influence in "pushing" lake water upstream into the Fish Creek Estuary to how saline estuaries are influenced by lunar caused tides that push sea water into a saltwater estuary, noting that lunar tides on Lake Superior are minimal. Show aerial map of Fish Creek and explain how its finger like channels are actually old river channels of Fish Creek. The seiche coming in from Lake Superior, esp. through a constriction of Long Bridge, has a back and forth-like sawing like action that keeps these old channels from filling with sediment. Note: Prior to trip departure put a "seiche stick" into shore at the water's mark. Compare water level fluctuation at the program's end.

5) Presence of a bay-mouth bar. This feature is caused by the deposition of sand and sediments caused by shoreline currents. Bay-mouth bars periodically will form and obstruct the mouth of an estuary, reducing the seiche effect within the estuary. Challenge the students/participants to determine if the Fish Creek Estuary has a bay-mouth bar and where it is located.

   US Hwy. 2 was constructed on top of the Fish Creek baymouth bar. Because of the highway, the normal water exchange between the Fish Creek Estuary and Lake Superior has been restricted to two places: Long and Short Bridges. This creates more dramatic seiche events at these entry points into the estuary. Wisconsin Point, at the mouth of St. Louis River Estuary between Superior WI and Duluth Minnesota, is the world's longest freshwater bay-mouth bar.

Estuaries are very dynamic eco-systems as water levels fluctuate on a daily basis due the seiche and storm events, on a seasonal basis due to seasonal precipitation, and over an annual basis due to extended dry or wet periods. Plants and animals living here must be adapted to change. During wet periods, aquatic plants within the estuary expand influence and shrubs and trees are pushed back to drier ground. During dry periods, woody plants encroach into the estuary.

C. Kayak, PFD, and paddling orientation – see Estuary Ed-Ventures Water Safety Manual for complete safety protocols. Leaders should demonstrate/discuss the following.

- PFD's are worn and properly adjusted
- Paddling practice
- Safe kayak entry and exit procedures
- Emergency procedures

D. Leaving Long Bridge Boat Landing-on the water

Prior to departure: Set the "seiche stick" (a stick pushed into the shore at the water's edge) and explain how this will be used to monitor the fluctuation in water levels.

Assist participants to safely load into their kayaks. Ask them to practice their paddling strokes in the sheltered areas across from the landing and stay downstream from the US 2 bridge until the entire group is on the water.

Once the group is assembled on the water, paddle under Long Bridge pointing out the barn swallow nests clinging to the bridge and their beneficial role in eating mosquitos and other flying insects.

Once under the bridge, raft up as a group and evaluate if anyone is having paddling difficulties. If there is time for exploration, ask the group to think back about how the Fish Creek Estuary has finger-like old river channels. Challenge them to find the active Fish Creek River channel. After passing under Long Bridge, channels to the right are old river channels and are dead-ends. They are interesting to explore and provide teachable examples of the "nursery function" of a freshwater estuary. In these areas, the water becomes shallow, warm, and calmer providing habitat for nesting waterfowl and nursery areas for fish.

The main channel is to the left of the sand island upstream from Long Bridge. Any smaller "tributaries" on the extreme left side of the main channel are also dead ends. This is a great stretch to allow participants to practice their paddling and enjoy the estuarine environment.

E. Historic importance of Fish Creek Estuary

2 Mouth of Fish Creek Estuary- Native American Connections-Fur Trade Era

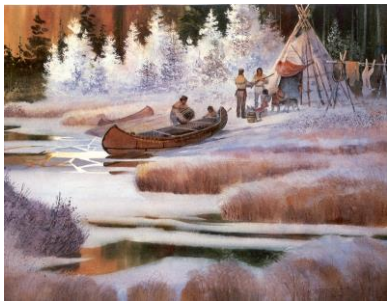
Native American Connections:

Wild Rice Harvesting

The mouth of Fish Creek is a very important location historically and culturally. Prior to arrival by Europeans, the original mouth of the Fish Creek Estuary (note: the original mouth of Fish Creek is located east of Long Bridge. The construction of US 2 changed the mouth to the current location at Long Bridge) was the location of major Ojibwe villages. Explore with participants what advantages a village location on the mouth of an estuary would have including: sources of food (plants like wild rice, fish, wildlife and waterfowl), water, medicines; and it would serve as a "water highway" for travel. Tell the story of how the Ojibwe people migrated westward to find the "place where food grows on the water" or "manoomin" (wild rice). Explain how wild rice once grew in the Fish Creek Estuary and its importance to Native people in the past and today. (show the photo of Native man ricing)

Fur Trade Era (1658-1840):

The mouth of the Fish Creek Estuary was also pivotal in bringing European people to this area. In 1658, two French "woods runners" (traders who were not licensed by the French government who then controlled this territory) named Radisson and Groseillers landed at the mouth of Fish Creek. Some say they were led there by the Ojibwe guides, others say that they were seeking the mythological Northwest Passage-- an easy route across the North American continent that was being sought to find a quick way to the riches of the Orient. They found something here that was a valuable as gold. We call it "fuzzy gold" or beaver. In Europe, it was the fashion, and in some places the law, for gentlemen to wear beaver felt top hats. Populations of beaver in Europe were depleted. Finding beaver so plentiful here meant big money for European fur traders. (Display props of beaver pelt and beaver hat or laminated images of them. Briefly explain how beaver pelts were made into felt top hats)



Voyageurs traded with Native people for furs

Radisson and Groseillers travelled as far as 60 miles south to Lac Courts Oreilles, overwintered, and traded with the Native people for beaver. They amassed a canoe load of beaver furs, some say worth about $400,000 in

today's money. They paddled back to Quebec Canada to meet with the Governor of New France who was in charge of this area to seek his permission to trade. He promptly confiscated their furs because they had traded without his permission. Raddison and Grosilliers travelled to France to appeal their case to the King that they should keep their furs and become licensed to trade in this area. When the French King refused to help them secure permission to trade in the Lake Superior region, they went to the King of England who saw the opportunity to get on up on his rival the King of France. The English King promptly gave Raddison and Grosilliers money and ships to trade for beaver among the Native people. They started a new fur trade company that still exists today. It is the Hudson Bay Company. Many people know of the great rivalry between England and France that continues today. Much of this was fueled during the fur trade era and at least part of the roots of this rivalry is due to what happened here at the mouth of Fish Creek.

The fur trade was BIG BUSINESS in this area from the late 1600's through 1840's. Voyageurs working for fur trade companies traded European manufactured "trade goods" (metal items, blankets, flints, rifles, cloth, etc.) for Native harvested beaver pelts. (if there is time and interest, more can explained about how the fur trade era and its impact on the region.)

3 Sand Beach Stopping Place- Logging Era

A good stopping place to regroup and wait for slower paddlers is at the large sand beach at the south end of the main channel. Have the students/participants beach their kayaks, but stay in their boats. An educator can exit their kayak to discuss the impact of logging on Fish Creek.

Logging Era: By the mid-1800's there was a big demand for wood to build homes and buildings. This area had large white pine forests that were considered "inexhaustible". White pine floats and rivers like Fish Creek were used to flush logs downstream to mills located on Lake Superior's shore. (show old photo of the Fish Creek choked with logs). During the winter, pine logs were decked near the river. In the spring, Fish Creek was dammed up upstream creating a large back up of water. The logs were rolled into the dammed up area and then the dam was released, flushing the logs downstream to Lake Superior sawmills along its shoreline (show Bigelow Mill on Lake Superior's shore in Washburn).

Fish Creek log drive, 1872

Bigelow Sawmill on Lake Superior

The logs worked like bulldozers and rammed into the river's banks. In some places this caused the river's course to be altered and created stream bank erosion. Note: During low water what appears to be remnants of these old logs can be seen sticking out of the steam bank near this stopping point.

The area has a thick deposit of red clay and below that, coarse sand. Erosion cuts through the red clay layer, adding fine red clay sedimentation. Once the clay layer is cut through, the sand layer is highly erodible and is quickly washed into waterways and into the Lake. Fish Creek deposits estimated 1-2 dump truck loads per day of eroded sand into Chequamegon Bay.

Sand Beach to the Entrance of Fish Creek

Paddling on, this short section is a great place to see and comment on a variety of wetland plant species, including invasive Purple Loosestrife, Water Hemlock (poisonous), Great Angelica, and Water Parsnip. The entrance to Fish Creek will be on the left, but the main channel appears to continue straight ahead. These channels are dead ends but offer interesting side trips and opportunities to see more secretive birds. Ask participants which way they think is the main channel of Fish Creek. Encourage them to observe water currents, water temperature, etc. There is a deep hole right at the entrance to Fish Creek and a large sandbar caused by the eddy. This is a great clue on the location of the main river channel.

Paddling up Fish Creek

The first obstacle encountered will be the "elbow", an old beaver dam that stretches part way across the river. Depending on water levels, it may be possible to paddle over the old structure. However, the best course is to bear left around the old dam and then paddle immediately right to make the river's bend.

Watch for teachable moments along the river. There are a number of urban and invasive species. Lots of beaver sign. Sometimes birds, ducks, and other mammals can be seen as well as rare native plants like Purple Gentian.

4 Beaver Dam Turn Around-Early Farming

Fish Creek continues upstream for many miles, but our trips usually turn around at the first beaver dam (approx. ½ mile upstream). Note: in high water years this beaver dam may not be visible, so find a suitable spot to raft up. The current will be swifter here.

The "Cutover"

Early Farming: Once the white pine was cut, the hardwoods were logged off. This region was called the "cutover" (show old photo of the cutover) and devastating fires burned the land. The old saying is that the "plow follows the axe" and the large cutover areas were sold to immigrants who sought to farm this area. (show the photo of rooting out stumps, photo of hay field). Some wetland areas were drained to promote agriculture, such as portions of Whittlesey Creek Estuary watershed which we'll discuss later.

Clearing the land of stumps

The soils in most locations were forest soils, and not good for agriculture. Many early farms were abandoned. However, the removal of the protective forest canopy from logging and early farming eras, set that stage for the erosion and flooding problems Fish Creek still has today.

The sand that was deposited at this stopping place was caused by erosion upstream that began when the protective forest canopy was clear cut in the late 1800's, and increased as land was converted to agriculture (Fitzpatrick, 1999). Paddlers can tap their paddles on the stream bottom to feel the coarse sand bottom.

Converting wetlands to hay production

Discuss the impact of the cutover and fires following, the emergence of farming, and the impact of these land uses on erosion, and especially in wetland areas. Ask participants what other impacts erosion might have on a freshwater estuary (examples: loss of fish spawning areas, degraded water quality).

This is a great place to talk about the issue of erosion and the role of course woody debris in the river. Other topics include the role of tag alder which provides shade, prevents stream bank erosion, and is a nitrogen "fixing" plant that improves the soil. Black ash trees are found this section of the river and offer opportunities to talk about how this species was used by Native Americans.

If possible have a staff member lead the group downstream. Ask paddlers to keep extra distance between boats since they will be going downstream faster than they paddled upstream. Warn them that that if they find themselves being swept into the bushes, to gently push themselves away. They should not get out of their boats. Ask the group to raft up at the entrance of Fish Creek and the estuary.

Return to Long Bridge Boat Landing

Once the group has re-grouped at the confluence of Fish Creek and the estuary, it is a great time to just let the group enjoy paddling and making observations on their way back to the boat landing.

If there is not enough time to paddle into Lake Superior to the Whittlesey Creek Estuary, ask participants to pull into the Long Bridge Boat Landing and safely exit their kayaks. Ask them to remove all items from their kayaks, bring their kayaks up toward the kayak trailer, and take off their PFD's, and put them and their paddles into the trailer's storage compartment.

Do not allow participants to load the kayaks on the trailer unless supervised. **CAUTION: DO NOT LOAD KAYAKS ON THE TRAILER UNLESS IT IS SECURELY ATTACHED TO A TOW VEHICLE. THIS TRAILER WILL TIP BACKWARDS IF NOT SECURED.**

Program Conclusion

Give a review of what was observed. Don't forget to check where the water level is on the seiche stick! This is a great opportunity to share the progress that has happened to establish a Lake Superior National Estuarine Research Reserve (LSNERR) on the St. Louis River in Superior and how this designation will benefit all Great Lakes freshwater estuaries. Thank program participants. Conduct a formal evaluation, if desired. Double check to make sure all equipment is accounted for.

OPTIONAL: Paddling into Lake Superior to Whittlesey Creek Estuary

Depending on wind conditions, paddling skills, and time; leaders may offer a trip extension into Lake Superior and on to Whittlesey Creek National Wildlife Refuge. It is about an additional 20 minute paddle to Whittlesey Creek from the Long Bridge Landing.

At the mouth of Fish Creek discuss the impact of erosion on the estuary since the sand deposition will be very evident. The large sand island at the mouth of Fish Creek was formed from this deposition.

Paddle between the sheltered waterway between the shore and sand island at the mouth of Fish Creek, before emerging into open waters to follow the coast to Whittlesey Creek. NOTE: Due to the shallow water, if it is windy this section of the trip can be very choppy and with participants will get wet. Use discretion!

Watch for ducks, eagles, and shorebirds en route.

5 Whittlesey Creek Estuary

Unless water levels are very high, land the kayaks is on the large sand beach before reaching the mouth the Whittlesey Creek Estuary. Walk to the estuary from here because it's impossible to paddle into the estuary due to its shallow water. If water levels are high, it may be possible to paddle up Whittlesey Creek for a short distance.

This is another example of a freshwater estuary, however this estuary was altered. Show the aerial map of Whittlesey and compare to an aerial photo of Sand River and/or Fish Creek. Ask for ideas of what happened here.

Channelized mouth of Whittlesey Creek Estuary (note the old river channels still visible)

In the 1950's, the Army Corps of Engineering channelized Whittlesey Creek to speed the run-off of water from area farm fields. The project increased the amount of erosion going into this estuary, Unlike Fish Creek, the old river channel fingers were not able to be refreshed from water outflow and became clogged with sediment. Explain that since the US Fish and Wildlife Service established the Whittlesey Creek National

Wildlife Refuge, they have been working with property owners within the watershed to help prevent erosion. Naturally, this estuary is beginning to re-establish delta-like projections into Lake Superior. Use the map to point out the old river channels that were once part of the Whittlesey Creek Estuary.

NOTE: Sometimes it is surprising to find little or no water in the Whittlesey Creek bed. This has occurred when natural obstructions like logs have fallen in the river, slowing the rate of flow and diverting it from the artificial channel into one of the estuaries old river channels. This is a teachable moment to explain how coarse woody debris and other natural obstructions are gradually changing the Whittlesey Creek Estuary's from an artificially straightened channel into one that is more natural. If this situation happens, encourage students/participants walk around the mouth to find the new Whittlesey Creek outflow with their feet! The creek water will be much colder than the Lake Superior water in this shallow bay.

Unlike Fish Creek, Whittlesey's waters are extremely cold (40-degrees) because this creek is almost entirely ground water fed by water from deep within the Bayfield Peninsula. By walking around the mouth of the estuary, students/participants will be able to detect changes in water temperature suggesting where Whittlesey is outflowing into Lake Superior.

The cold waters of this estuary make one of the locations for establishment of the coaster brook trout, a native species of trout that has almost all but disappeared.

Paddle Back to Long Bridge Boat Landing

Program Conclusion—see above 4

For more information contact:
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