Huron County Nature Center Wilderness Arboretum

Mapping Ancient Shoreline Ridges Using GPS Technology

Lesson Plan **Level: High School**

Developed by Bob Tallman with funding support, in part, from the Huron County Nature Center

Program Description: Students will observe the ancient shoreline ridges that exist in the Huron County Nature Center Wilderness Arboretum.

MEAP Benchmarks:

SCI. I 1. High School. Benchmark 1: Generate scientific questions about the world based on observations.
SCI.V 1. High School. Benchmark 1: Explain the surface features of the Great Lakes region using Ice Age theory.
SCI. I. 1. High School. Benchmark 3: Use tools and equipment appropriate to Scientific Investigation.
SCI. I. 1. High School. Benchmark 4: Use metric measurement devices to provide consistency in an investigation.

Overview:

As students walk along the Handicapped Trail from the pavilion and moving clockwise, they will walk up, over, and down a series of sand ridges. Since the area is now forested with midtolerant trees (red oak, red pine) and shade plants (huckleberries and bracken fern), students may not realize that in ancient times, the lakes that occupied what we now call the Lake Huron basin, extended to these ridges. Long after the glaciers receded, Ancient lakes (Algonquin, Stanley, and Nipissing) covered this area. The Ancient shoreline ridges were formed by the pounding waves during spring and summer and by the sheets of ice that pushed ashore during the spring meltdown bulldozing the sand into ridges that marked the edge of the lake.

Time Needed: Several hours depending on how many features each group takes GPS readings on.

Key Concepts

- Elevated sand ridges in the HCNC are stopping (climaxing) succession at the midtolderant tree community with oak, huckleberry, and bracken fern.
- Ancient lake pools are usually a succession community behind the succession community of the shoreline ridge.
- Waves move the sand from the lake bottom to the shoreline.
- When the depth of the lake water changes, the shoreline ridges are left behind, marking a time when lake water levels were higher.

Preparation

Students should already know how to initialize and use the GPS Units.

Talk with the students about the fragile nature of the vegetation in this sandy environment. Encourage them to watch where they step and protect the plants that are needed for the animals in the habitat to survive.

Background

Glaciers receded from this area about 11,000 years ago. Lake Algonquin, at about 605 feet above sea level, existed until about 8000 years ago. Lake Stanley, at about 180 feet above sea level, left what is now Saginaw Bay completely dry until about 5000 years ago. Then Lake Nipissing covered the area to 605 feet above sea level until about 2800 years ago. The average height of Lake Huron in modern times is 581 feet above sea level. This is why this area is a Nature Center, and not beach, in sight of the lake.

Most of the ancient Lake Nipissiang lake bed is the flat Saginaw farmland today. An example of the high water level is on the west side of Gagetown. The town sits on the old high ground with the flat lake bed to the west.

During the time of the shoreline ridge formation, winds coming from the north or northwest would have generated fetches with the most force in the Huron County Nature Center area. Ice flows in the spring being blown off the lake were driven by the wind onto the shore with tremendous force. The force drove the sand up off the beach into piles or windrows. The sand in the ridges is, therefore, removed from the action of the waves that would take it back out to form sand bars or down the shore with shoreline currents.

These same strong winds in the summer would cause a piling up of water containing more sand. The excess water would either return as an undertow forming sandbars with its sand or move sideways as a shoreline current increasing the new sand on the shoreline.

The shoreline currents always flow to the left of the curl of the wave crashing. In physics it is often referred to as the "right hand rule" because if one takes this right hand fingers into the shape of a wave, the right thumb points left similar to the shoreline currents. With a build-up of water and a loss of energy, the shoreline current turns and goes back under the waves in what is often called a rip current. Rip currents may be located by looking for breaks in offshore sand bars.

Shoreline currents, driven by strong winds, may bring enough sand at an angle to trap water in a pool. Lake pools vary tremendously in size. A small ancient lake pool is between the Handicapped Trail and the first shoreline ridge (as the Handicapped Trail is walked clockwise.) Ancient lake pools can be identified as a circle or oval area with plant species from an earlier succession stage. This lake pool becomes obvious with its aspen, white birch and red maple rather than the oaks and bracken fern of the surrounding area. Many lake pools retain water and are marshland. Some lake pools dry out and continue the succession. The largest lake pool is north of the Handicapped Trail loop with the extension walkway going out onto the ancient lake pool. This still contains water. The oak leaves lining the bottom help to retain water like a pool liner. Oak leaves have tannic acid that preserves them and slows down the rotting process. If the lake pool is close to the water table, the pool will maintain its level without a "pool liner."

Once a water level has dropped, the process would start again to form another shoreline and shoreline ridge. As it did, the wind blowing down

between the old and new shoreline ridges would pick up sand from the dry sand bars and deposit the sand into a sand dune.

The variables that influenced the ancient formations are the same today: strength of the wind, direction of the fetch, temperature, temperature change in a time period, and water level.

The water of Lake Nipissing remained constant while the excess water emptied by way of the Ottawa River through Canada. Once the Detroit River began to develop, the water level began to drop again. It was during this time that new shoreline ridges developed with the receding water. The receding water went down in punctuated manner rather than at a gradual rate. This meant that there were variables slowing down and speeding up the receding water at different times. This caused the shoreline ridges we see at the Huron County Nature Center to be different distances apart.

For more information on waves, rip tides, and shoreline ridges, consult

Http://science.howstuffworks.com.

Definitions

Shoreline: the line where lake water meets land.

Beach: the stretch of land between the shoreline and the vegetation on land. It may be sandy or rocky.

Fetch: the direction of the wind across a body of water or land.

Undertow: a bottom current that regularly returns water that the waves have pile onto the shore back under the waves. This produces offshore sand bars. Lakeshore currents are usually not present at the same time and place as undertows.

Lakeshore current: the movement of water to the left of the wave along the shoreline.

Rip current: the rapid return of water at the end of a long lakeshore current. It is located at the end of sandbars.

Lake pool: a trapped pool of water separated by sand from the rest of the lake. Lake pools can be inhabited with their own community of organisms.

Sand dune: a rectangular pile of sand formed by wind blowing loose sand from the beach toward the vegetation. The sand blows up and over the dune dropping on the other side as the wind slows.

At the Nature Center: Procedure for identifying shoreline ridges

- Teacher moves the class from the pavilion north on the Handicap accessible Trail to the first shoreline ridge. With the woods covering the area, students may have difficulty understanding where the shoreline ridge is located.
- Have male students (being careful of the vegetation) form a line along the top of the ridge standing an arm span apart.
- Have the female students (being careful of the vegetation) form a line at the base of the ridge standing an arm span apart.
- Teacher would discuss how the waves once came at the area where the female students are standing and piled the sand to make the ridge.
- Once the ridge began to form, ice and wind would increase the size of the shoreline ridge.
- Students would return to the trail by walking single file back the way they came. They should not run down the side of the ridge

Procedure for measuring and mapping shoreline ridges

- Student groups should initalize GPS units in the HCNC parking lot. All students should find the locations of the entrance, exit, and the pavilion to be sure all GPS units are working correctly, and to insure that the students are reading accurate data.
- The number of features, and which features each group will measure should be determined before they begin.

- When the class reaches the first ridge, have the students do the activity above to help them identify what a shoreline ridge is and how many readings they will need to take and record.
- Shoreline ridges will require at least two sets of coordinates with the line from one set to the next lying in a straight line. Students should record coordinate and elevations.
- The student groups should then measure some lake pools recording both coordinates and elevations.
- The sand dunes are found by taking the east trails. The sand dune with the highest elevation has an observation point on top of it.

Post Trip Activity

- Back in the classroom, student groups download their GPS information into a computer and print out the data. Using this information and the background from the instructor, students should create questions similar to those at the end of this lesson plan and answer them.

Students should be evaluated on their data collection and interpretation as well as on the questions.

Lead Students to develop and answer questions similar to the following.

1. How can an ancient lake shoreline ridge be located?
2. How can a sand dune be identified?
3. What is the difference between an ancient lake shoreline ridge and a sand dune?
4. What is a beach pool?
5. How can you identify an ancient beach pool?
6. If the ridges in the HCNC are ancient shoreline ridge, where did the water go?
7. Why are there different shoreline ridges through the nature center?
8. Why are the shoreline ridges at different distances from each other throughout the Nature Center?
9. Is it possible to locate the high water shoreline of Lake Algonquin and of Lake Nipissing?
10. Which shoreline ridges represented the coldest climates?
11. Which shoreline ridges show the greatest lake elevation drop?
12. Which shoreline ridge represented the longest period of time at that lake level?