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The Engineering Explorations Newsletter

Harmonics

What is ocean engineering?

Have you ever been to the ocean? Played on the beach? Gathered shells in a bucket? How big do you think the ocean is? How important is it in your life?

If you could fly higher than the birds, out into space and turn back to look back at the Earth, you would see a blue planet. Nearly 75% of the surface is covered in water; water in rivers, in lakes, in ponds, in streams, but mostly, water in oceans. Oceans are massive bodies of salt water which separate continents; they contain 97.5% of all the water on the planet.

If you live near the ocean, you've probably heard Elders tell stories of the tides and the creatures that live in the water. For many nations, the ocean was here first; the land, the plants, the animals, the people all came later. You will know how important the ocean is to your community and people. Even though you cannot drink the water, it brings food, provides transport, and supports local economies. You may not know that the ocean is important to everyone, no matter where they live. The ocean produces oxygen for us to breathe, stores carbon dioxide, and generates power. In the northern hemisphere, between the Equator and 30°N the ocean actually carries more heat than the air.

As important as the ocean (and all water) is to human beings, it is essentially a foreign environment for us. We cannot live in or travel on water for very long without the help of technology. And so, for thousands and thousands of years, we have been ocean engineers. Ocean engineering is all about respecting, harnessing and working with the power of the ocean.

Today's ocean engineers take their knowledge of math and science and apply it to the analysis, design, construction, and management of systems that operate in the ocean environment. Ocean engineers may work to protect beaches by developing ways prevent coastal erosion. They build ports and harbours, ships and submarines. They study ways to convert wave and tidal motion into electrical power. Ocean engineers also develop protection systems like tsunami detection buoys which can warn people about dangerous ocean conditions before they reach shore.

Ocean engineering also has a long history in Aboriginal nations from coast to coast to coast. In the west, the construction of huge ocean-going canoes allowed for trade and whale hunting. In the north, the development of specialized harpoons fed many villages. In the east, the knowledge of fisheries gained over generations is being used to understand fish populations today. As an ocean engineer you could contribute to this proud tradition by combining western and native knowledge about the ocean for the benefit of your community.

Native Engineers & Scientists

A place to meet people from your community.

Name: Justine Saunders
Nation: Maori
School(s) Attended: University of Auckland
Degree (s): B.Sc., M.Sc.
Job Title: Ph.D. Candidate Marine Science
Favorite thing about your job or school:
The marine research facilities are fantastic.

Justine Saunders always loved solving puzzles and had a strong connection to nature, but never really knew where life would lead her. Luckily, she had teachers who believed in her and a good understanding of herself, "I was happy to take it one crossroad at a time and see how the path developed. Currently, I'm a marine scientist and loving every minute of it, but I have no delusions that I will always feel this way. The best thing for me is to recognize where I am, where I'd like to head, to go with the flow and to accept change wherever it is necessary."

Justine is working while finishing her Ph.D. in Marine Science. While conducting her research she got to go scuba diving, collect miniature animals that live amongst algal plants, identify them under a microscope and conduct statistical analyses of her findings. Right now, she is writing her thesis while based at a marine research station in a small fishing village north of Auckland, New Zealand, "It's a place that inspires me with its views of the ocean and open space."

As a person who has spent lots of time in university, Justine knows first-hand how challenging it can be for Native students to leave home to go to school. She found the key to success in balancing her time between school work and extra curricular activities. She also used her experience to encourage other Aboriginal students, "I was tutoring an undergraduate class of Maori and Pacific Islanders in Biology. … Many of these students had come from small rural schools of less than 100 pupils. They were often the only person from their school to make it to University, so they had no friends, and had to adjust to a large campus full of thousands of students. It was a great source of pride when they all passed their exams. They wrote a little rap song for me. I cried."

The success of her students was probably inspired by the way Justine views science, "[It] is simply a method of logically approaching a problem and working out an answer or solution. It's not that different from how our ancestors figured out the medicinal properties of plants, for example, or monitored the change in a population of fish throughout the year. It's how that knowledge is applied that differs culturally. Asking questions about our environment and finding solutions to those questions is central to the growth and survival of any nation or tribe."

They were probably also inspired by the way she lives her life, "I love designing and making clothes, writing poetry, running and doing marital arts. We're all multi-dimensional people. Just because someone is a scientist doesn't mean that they're not also a musician, or an athlete, or a parent, or an artist. Don't be afraid that if you take a certain course in life other options will be closed to you. We all have a brain, a body and a spirit – they all need to be expressed."

Possibly the hardest thing is to decide whether you want to take a particular path, or subject, or course of action. Imagine where it might lead you. If you don't know ask advice from as many different people as possible. Once you have made your decision, embrace it with passion, put aside any fears and don't make any excuses; the rest will be easy. Negatives like 'can't' should not be a part of your vocabulary."

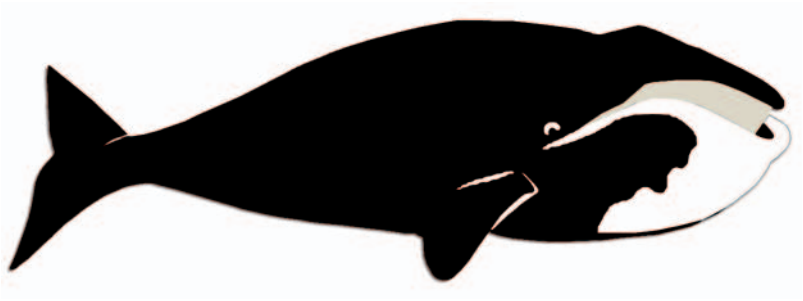
Along with her career and PhD writing Justine recently got married. She is living with her husband, Matthew, in New Zealand and they will soon be moving to the United Kingdom.

Arviq, the bowhead whale

About 400 years ago, the cold waters of the Arctic were home to thousands and thousands of Bowhead whales. They would migrate with the seasons and the ice: living at the southern edge of the ice sheet in winter, moving north with the break up in spring and swimming back south again as the weather got colder in fall.

For as long as anyone can remember, the bowhead was a primary source of food, clothing and building materials for the Inuit and other northern peoples. The whale's blubber, called *muktuk*, was an excellent source of food energy which could last through the winter. Each animal is so big (in excess of 20 meters and 60 tonnes as adults) that most villages only needed one or two whales a year to meet all their needs, so the animal population prospered along with the people who hunted it.

Things changed remarkably quickly for the bowhead and Inuit with the beginnings of European commercial whaling in the Arctic about 400 years ago. By the early 1900s bowheads were nearly extinct. There were so few whales left that the Inuit mostly gave up the traditional hunt, even though the Canadian government only put a stop to all whale hunting in 1979. Since then, everyone has been wondering if and when whale populations would recover.



The English name for Arviq is bowhead whale. Some people think it got its English name from the shape of its jaw which looks like a hunter's bow. Other people think it was named because its head looks like the bow of a ship.

Whales are hard to count because they spend so much time under water. Bowhead whales are even harder to count because they spend a lot of time hidden under the ice. No one knows for sure how many Bowhead whales there are today. Until recently, the best guesses said that there were about 700 bowhead in the eastern Arctic, and 7500 to 8000 in the western part.

In the late 1990s, the Nunavut Wildlife Management Board (NWMB) worked with Inuit Elders in 18 Nunavut communities to gather together Inuit knowledge of the bowhead whale for future generations. At that time, the Elders, who have lived near the whales their entire lives, said that there were significantly more bowheads than when they were very young.

To allow the population to recover, a conservation strategy was developed for eastern Arctic Bowheads by Fisheries and Oceans Canada in close cooperation with the (NWMB) and the World Wildlife Fund (WWF). This strategy allows for one bowhead to be hunted by the Inuit every 2 to 3 years. Four hunts have been held since 1998; a fifth will be held in 2005.

Recently there has been some good news regarding bowheads. An ongoing, 3-year study by Fisheries and Oceans Canada, has confirmed what Inuit Elders knew; there are more bowhead in eastern Arctic waters than we can easily see. The population is now estimated in the low thousands. While the population is nowhere near its estimated historic levels of 12-15 thousand, conservation efforts which allow for the traditional hunt seem to be working.

Sources:
Fisheries and Oceans Canada, http://www.dfo-mpo.gc.ca/species-especes/species/species_bowheadWhale_eastArtic_e.asp
Inuit Bowhead Knowledge Study, Nunavut Wildife Management Board, http://www.nwmb.com/english/
Nunatsiaq News, http://www.nunatsiaq.com

Community Profile

Anacla, BC

The West coast of Vancouver Island is one of the most beautiful places in the world. Long stretches of open beach lie between the Pacific Ocean and old growth forests of red and yellow cedar. It has been home for many Aboriginal peoples since time began, including the people of the Huu-Ay-Aht First Nation.

The Huu-Ay-Aht First Nation lies on Pachena Bay in the village of Anacla. It is just southeast of Bamfield, BC, and about 125km northwest of Victoria. Nearly 600 people from 130 families live in the community. The Huu-Ay-Aht people are very committed to solving problems which affect community development and quality of life. They are working with forestry giant MacMillan Bloedel Inc., to harvest local cedars in a manner which will heal the Sarita River, the Nation's traditional source of salmon. They are partners in Quu'as West Coast Trail Society along with Parks Canada and other coastal First Nations. They are also working with researchers at the University of Victoria to bring alternate energy sources to the community.

One of the most important stories told by Huu-Ay-Aht Elders is about the day the earth moved violently, and a great wave arrived on their shores, sweeping away the entire village and leaving just one person behind in the rubble. Scientists can now trace this story back to a magnitude 9.0 earthquake that occurred on the Cascadia subduction zone somewhere off the coast on the night of January 26, 1700. The resulting tsunami not only wiped out villages on the west coast of Vancouver Island and Washington State, but was big enough to travel all the way to Japan, where 2.5 meter waves washed over fishing villages about 9 hours after the quake was felt.

Anacla is named after the surviving member of the Huu-Ay-Aht Nation, Anacla-aq-sop, It is still completely exposed to the open ocean and the threat of tsunami. Since 1999, the community has been working to relocate in the same area but further back from the shore on higher ground.

While tsunamis are relatively rare, the Boxing Day 2004 wave in southeast Asia which killed close to 300,000 people, has underlined just how devastating one wave can be. The Cascadia subduction zone, where the Juan de Fuca plate is slowing sinking under the North American plate, is still a prime location for earthquakes and subsequent tsunamis. In 1964, an 9.2 magnitude earthquake on the fault line up near Alaska caused a tsunami which damaged the area around Anacla and nearby Port Alberni. Computer models show that a similar earthquake could send waves between 3 and 10 meters high crashing into Vancouver Island's coastal communities, as little as 20 minutes after the quake.

The Governments of Canada and BC have recently set aside $1.85 million for emergency preparedness of coastal communities; $500,000 specifically for First Nations communities. Their focus is providing enough warning for people to get to higher ground before a tsunami hits, to avoid loss of life. The Huu-Ay-Aht want to move their entire village to higher ground now, to avoid loss completely.

Along with the residents of Anacla, about 4,500-5,000 other Aboriginal people on Vancouver Island live in communities which are exposed to open water.

Source:
CBC BC, http://www.vancouver.cbc.ca/regional/servlet/View?filename+bc_tsunami-bc-20050125
Ha-Shilth-Sa Newspaper, February 10, 2005, http://www.nuuchahnulth.org/hashilth.htm
Huu-Ay-Aht First Nation http://www.huuayaht.ca
New York Times, http://www.nytimes.com/2005/01/04/science/04wave.html?ex=1110690000&en=7357b8d557bdf329&ei=5070&pagewanted=3
Turtle Island News, http://www.turtleisland.org/discussion/viewtopic.php?t=3086&view=previous

Fun facts and things to think about

The highest tides in the world are at the Bay of Fundy, which separates New Brunswick from Nova Scotia. At some times of the year the difference between high and low tide is 53 feet 6 inches, the equivalent of a three-story building. Engineers have harnessed the power of these tides to produce electricity at the Annapolis Tidal Generating Station

Annapolis is one of only 3 tidal power plants in the world. The other two are located in the estuary of La Rance near St. Malo, France and at Kislaya Guba on the White Sea in Russia.

Annapolis generates 30 million kilowatt hours per year - enough to power 4,000 homes.

Sources:
Nova Scotia Power
http://www.nspower.ca/AboutUs/OurBusiness/PowerProduction/HowWeGeneratePower/TidalPower.html
Ocean Planet

We ourselves feel that what we are doing is just a drop in the ocean. But the ocean would be less because of that missing drop.
- Mother Teresa of Calcutta

Did you know…
… an average electric eel can generate from 350 to 650 volts of electricity? The voltage increases as it grows, until it reaches about 3 feet (1 m) in length, then only its amperage (or current) increases. About 80% of an electric eel's body is tail. In a full grown animal, the tail contains 5,000 to 6,000 electroplaques which act a bit like cells in a dry battery. While each electroplaque produces only a small voltage, they are arranged in series and so can combine to produce a pretty large jolt. At full strength, an adult eel gives off about five times the voltage that comes out of a wall socket: enough to injure or even kill a human.
Sources: NOAA
http://www.nefsc.noaa.gov/faq/fishfaq2b1.html#q13
Hypertext
http://hypertextt

Bowhead whales are "engineered" to survive in the extremely cold water of the Arctic ocean. The bones in their skulls are thick enough to break ice from below to create breathing holes, and their blubber is so thick it provides enough insulation to survive submersion in liquid nitrogen (–196°C).
Source: http://www.tapirisat.ca/environment/wildlife-bowhead.php

Wood from the ocean

The animals, fish and plants of the ocean are a rich source of food, clothing and tools for millions of people all over the world. Would you ever consider the ocean as a source for wood? Well, for the Unangan people of the Aleutian Islands, it is.

The Aleutian Islands lie in the northern Pacific between Alaska and Russia, a place where it is too cold for trees to grow. The Unangan people who live there, however, use wood to build framing for their winter homes, called ulax. Their suppliers are the forests of northwestern North America and the currents of the Pacific Ocean.

Ocean water is constantly moving, flowing from one place to another. The way it flows is determined by wind, water temperature and salt content, the topography of the ocean floor, and the Earth's rotation. Surface currents are largely caused by Earth's prevailing winds which, in the northern hemisphere, blow from the northeast. Over the northern Atlantic and northern Pacific oceans, these winds help to push currents in a generally clockwise fashion. Sometimes, however, smaller currents can rotate in a different direction.

In the northern Pacific a huge circular current, or gyre, occupies the open ocean. It flows between North America (in the east) and Asia (in the west), between 15 degrees north and 45 degrees north . When the water approaches North American (around the

Canada-US border), some of it gets deflected south towards California, and some of it gets deflected north, towards Alaska. This water becomes the Alaska current.

The Alaska current is a counter clockwise gyre that is trapped between the coast of North America and the North Pacific Current. It flows up the heavily forested northwest coast of British Colombia. Any trees, branches and logs in the water get caught up in its flow go along for the ride. When it reaches the southern coast of Alaska, the current turns west heading along the coast and out to sea past the Aleutian Islands. Smaller currents caused when water flow is interrupted by the islands deflect parts of the Alaska current and whatever it is carrying. It is these water flows which finally bring BC wood into island coves and bays, where it lands on the beach and is collected by the Unangan people.

Sources:
Unangan history
http://www.nps.gov/aleu/UnanganHistoryAndCulture.htm
Ocean Planet
http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_currents_1.html
Whirlpools in Your Bathtub

http://www.oceansonline.com/ocean_currents.htm

All about us

Native Access provides culturally relevant learning opportunities in science, math, engineering and technology to Aboriginal students and their teachers across Canada.

Established in 1993, the projects ultimate goal was to increase the representation of Aboriginal peoples among the the ranks of practicing engineers and scientists in Canada.

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