Science 2200

Unit 1: Ecosystems: Diversity in ecosystems and change and stability in ecosystems

Sustainability

Whenever possible these questions relating to sustainability should be addressed in relation to the major industries of this province. Fisheries and aquaculture are examples of major industries in Newfoundland where there has been a shift to include **sustainable aquaculture practices** for salmonid and mussel farming, and to actively manage our fisheries through sustainable methods.

Suggested Teaching and Learning Strategies:

- Use Canada's Sustainable Fish and Seafood Resource to define sustainability and its applications to fisheries and aquaculture in Newfoundland. The teacher could also use the General Aquaculture Presentation (sustainability section) Resource
- Split the class into 4 or 5 groups and each group has to do a presentation on one of the species that the provincial government has identified as key species for aquaculture in Newfoundland, plus one group for alternate species. Using links under the species tab at http://www.naia.ca/ and http://www.fishaq.gov.nl.ca/aquaculture/pdf/aquasite.pdf Also use the Location of Aquaculture Sites Resource. The presentation should include a brief description of the species, its life cycle, where and how is it cultured in Newfoundland, what products are made and any ongoing research that is being done in the province.
- Using the lesson plan from the Ocean Market procedure http://smithsonianeducation.org/educators/lesson_plans/ocean/acrobat/market.pdf and Ocean Market Activity, the students can travel to a local super market or discuss what seafood products are available in the seafood, frozen food, canned and bottled sections. Record what seafood species the products include, whether it was from the wild fishery or grown through aquaculture, the country of origin of the product, and an estimate of the processing/packaging/marketing required.

Additional Resources

http://www.dfo-mpo.gc.ca/aquaculture/aquaculture-eng.htm

http://www.fao.org/fishery/en

http://www.fishbase.org/search.php

http://www.fishaq.gov.nl.ca/aquaculture/pdf/aquasite.pdf

Energy Flow and the Plankton Cycle

Energy availability affects the total mass of organisms in an ecosystem. A good example is the energy flow that passes through the ecosystem on a mussel farm, as well as in the wild. The energy from the sun is converted by phytoplankton to oxygen and nutrients in the water column (photosynthesis process). This phytoplankton is consumed by higher zooplankton in the water column and both phytoplankton and zooplankton are filter fed by larval and adult mussels. Mussels use the nutrients to grow, lay down shell and develop gonads to reproduce. When conditions are right and the gonads are mature, male and female mussels release their sperm and eggs into the water through broadcast spawning. In the water the gametes meet and fertilize into a trocophore and go through the different larval planktonic floating and swimming stages. Once larvae metamorphose they settle onto the ocean bottom, onto hard surfaces (e.g. rocks) or onto farm collector lines that have been put into the water to collect the mussel seed/spat. Fecal matter that mussels create, as well as waste produced from plankton die off, produces bacteria, gas molecules and nutrients that the phytoplankton can reuse during photosynthesis, and the cycle continues.

An issue that faces mussel farmers with respect to plankton is the risk of toxic algae blooming on a mussel farm and contaminating the mussels. The mussels are not harmed by the toxic algae because their physiology is not affected by the chemicals. But the toxins are present in the meats and if a human, bird or other animals eat the meats, they may be affected by the toxins. There are 3 common toxins that can cause gastrointestinal reactions, numbness and in severe cases, death. But mussels and the water they are grown in are carefully monitored to regularly check for toxins and to ensure that all farmed mussel products are safe for consumption. However, if you collect wild mussels from a beach, you cannot always be sure that they are safe to eat, as only select public beaches are monitored in NL.

- Use Handbook of Mussel Farm Site Monitoring and Enhancing Seed Production Resource, as well as the Newfoundland Plankton Resource to help identify plankton. The students can also complete the information for the Energy Flow of a Mussel Farm Activity to identify the major stages in the life cycle and production cycle for farmed mussels. The Oceanography and Planktology Presentation (planktology section) Resource can also be used at the teacher's discretion.
- Make a home made plankton net using the Plankton Net Activity with the plankton net(s) take a field trip to a beach or wharf to take a plankton sample. This can be done by casting out the plankton net from the shore or wharf, using a bamboo pole or a fly fishing

rod and reel. The Handbook of Mussel Farm Site Monitoring and Enhancing Seed Production Resource also provides additional information on how to do vertical or horizontal plankton tows.

- Then use a homemade viewer made using Plankton Viewer Activity to look at the plankton samples and try to identify some of the different things found in the sample. Discuss with the students why different colour backgrounds on the petri dish (or microscope, as discussed next) make it easier to see some plankton than others. The samples can be further looked at back at school using a microscope; again the Handbook of Mussel Farm Site Monitoring and Enhancing Seed Production Resource provides details on using a microscope and how to measure the size of plankton using a microscope micrometer unit.
- To further this activity, students can also make a tidal pool viewer using the Aquascope Activity http://www.montereybayaquarium.org/PDF_files/activities/aquarium_aquascope.pdf to look at some of the larger zooplankton that is easily seen with the naked eye in tidal pools while out collecting plankton samples.
- Have students break into groups; each will study a different toxic algae and present information on it. This can include: what conditions are needed for a bloom, some of the biological characteristics, the toxins and the effects they can have if consumed by people or other animals, when and if there have been an outbreak in Newfoundland, Canada and elsewhere. They can also look at what regulations are used to keep consumers safe and mussel farmers in year-round business producing healthy and safe products. Information can be found in Toxic Algae and Biotoxin Presentation Resource, as well as http://www.atl.ec.gc.ca/epb/sfish/cssp.html and http://www.shellfishquality.ca/Safety/CSSP.htm
- Incorporate plankton net, plankton view activities and lab microscopy into a plankton retrieving field trip.

Suggested Assessment and Evaluation Strategies

In the presentation there should be a definition of sustainability and information about the selected Newfoundland aquaculture species.

From the supermarket activity about products that are available in the seafood sections, get the students to present a visual display (chart or diagram) of the number of products that were from the wild fishery and/or aquaculture, where they came from and any trends that they noticed.

Quiz the students on the energy flow on a mussel farm. Students can also complete questions similar to the fill in blanks in the activity sheet, or they might reproduce a drawing of the mussel production/life cycle.

Do a lab write up, including drawings and names of some of the organisms seen using the 3 different homemade viewers (clear, white, black) and the procedures taken to collect the plankton samples with the homemade net.

Evaluate the group presentations on the different toxic algae that are common to the mussel farming industry. Discuss the safety and monitoring done to ensure consumer safety.

Additional Resources

http://www.algaebase.org/

http://www.inspection.gc.ca/english/fssa/concen/cause/pspe.shtml