Resource Sheet 3: Underwater, Undervalued and Under Siege

Underwater worlds are incredibly interesting to explore, whether through actual, virtual or imaginary field trips. But we do not need to wet so much as a single toe to reap the benefits of these unseen places — or to deal them a nasty blow. Let's consider how these ecosystems contribute to our daily terrestrial lives and how we could be better neighbours to our aquatic friends.

Our rivers, lakes, wetlands, estuaries and oceans are interlinked ecosystems that share energy, nutrients and inhabitants through complicated food webs. These food webs also connect through the water's thin surface to our more familiar land-based ecosystems, which means they connect to us too.

Besides food web connections, underwater ecosystems provide a number of other ecological "services," such as producing life-giving oxygen and stabilizing our planet's climate. These are described below.

Values

- **Climate and Weather Regulation:** Lakes and rivers can affect weather on local or regional levels. One main reason is that water surfaces are often dark and absorb lots of solar energy. Water itself can hold more heat than an equal volume of air, so when air temperatures are cooler than water, water bodies release heat and warm the air. On warm, sunny days, the water absorbs some of the heat to keep the air temperature cooler.

  This is called a *moderating* effect. Not surprisingly, larger water bodies, such as the Great Lakes, Lake Winnipeg, Lake Athabasca, Great Slave Lake, Great Bear Lake, large rivers, and, of course, the oceans, contain so much water that they do this on a grand scale. But the effects go way beyond simple temperature regulation. Temperature changes create currents under the surface of the water and in the winds above. Evaporation from river, lake and ocean surfaces also creates clouds of moisture that return to us as fog, rain and snow.

  While increased carbon dioxide in the atmosphere is connected to global warming, much of the Earth's carbon supply is stored in soils, terrestrial plants, undisturbed petroleum deposits and oceans. Oceans, including their bottom sediments, are by far the largest carbon *sinks* (storage areas) on the planet, making them valuable allies in our fight against climate change.

- **Oxygen Production:** Lakes, rivers and oceans have, at the base of their food chain, very tiny but very plentiful free-floating plants called *phytoplankton*. Like terrestrial plants, they give off oxygen. Since much of the planet's surface is covered by water (about 70 per cent), phytoplankton's contribution is important.

- **Food:** Fishing is not only a favourite pastime, it also puts food on the table for millions of Canadians every day. Freshwater fish, ocean fish, shellfish and some ocean plants draw humans into aquatic food chains — usually at the top. Fishing for food means jobs for thousands of Canadians and is worth over $2 billion per year to our economy.

- **Tourism:** Aquatic ecosystems provide recreational activities, including those that occur completely underwater. Scuba divers can enjoy exploring Canada's natural underwater worlds, such as the spectacular reefs near Nanaimo, B.C., but they can also dive into our historical past by exploring sunken shipwrecks — including the 22 wrecks in Ontario's Fathom Five National Marine Park.

- **Scientific Indicators:** The underwater organisms that we find living in our lakes, rivers and streams can tell us a lot about how clean the water is. Of course, what's *not* living there also tells us a lot! Scientists research which organisms they would *expect* to find in different conditions, particularly *benthic* (bottom-dwelling) invertebrates, and compare these with what they *do* find. Over time, they can see whether water quality is improving or getting worse due to human activities.

- **First Nations Values:** Water and rivers are an important source of life from food, transportation, stories, legends and a way of life for many communities. For example, most First Nations in Canada have legends that relate to water. Mishipizhiw (or Gitche-anahmi-bezheu) is an Ojibwa demigod sometimes regarded as an evil spirit of rapids and troubled waters. It is pictured as fiercely feline (the "great underwater wildcat"). Like other *Manitous*, Mishipizhiw had the power to change into various animal forms. Pictographs of Mishipizhiw can be seen at Fairy Point on Missinaibi Lake in Missinaibi Lake Provincial Park in Ontario.

Threats

- **Pollution:** Both air- and water-borne pollution from industries and automobiles ends up in our waters. Underwater creatures cannot escape these chemical pollutants; they spend every minute of their lives immersed in them. Pollution is one of the greatest threats to aquatic ecosystems and to human health because toxins are passed along the food chain — a food chain that we join when we eat fish and seafood. This is particularly important in remote Northern and traditional First Nations communities where many people draw much of their diet from contaminated aquatic food chains.

- **Eutrophication:** Eutrophication is, essentially, the over fertilization of a lake. When a lake is fed too many nutrients, such as nitrogen and phosphorus (found in fertilizers, sewage and soaps), an explosion of plant growth occurs. These plants eventually die and, as they decompose, the bacteria use up the oxygen and warm up the water. Fish that require lots of oxygen (lake trout, for example) can no longer survive.

- **Acid Precipitation:** Rain, snow and fog can become acidic when they pick up certain chemicals from the surrounding air. Although some of these acid-causing chemicals are a result of natural events such as forest fires and volcanoes, a lot flows skyward from our automobile tailpipes and industrial smokestacks. As you can imagine, precipitation that is even mildly corrosive — as acid precipitation is — can have many nasty effects on humans, ecosystems, and even fine art and architecture. Underwater ecosystems in lakes are particularly sensitive. Few underwater species can survive continued immersion in an acidified lake.

- **Dams and Diversions:** Throughout Canada, dams often prevent fish and other aquatic species from travelling to essential feeding and spawning grounds. They often result in unnaturally low water levels that can leave some species (or their eggs) high and dry.

- **Climate Change:** Water temperature is one of the key characteristics that determines "who" can live "where" in the underwater world. As the climate gets warmer, water also warms up. In freshwater systems this can mean greater evaporation, lower water levels and less available oxygen (warm water can hold less oxygen). Even small changes may mean that organisms that have adapted to the conditions over thousands of years are suddenly unable to survive. Our oceans are experiencing similar situations, except that the warmer temperatures are melting the ice caps and that is *raising* the ocean levels. Nonetheless, warmer ocean temperatures appear to be a factor in the worldwide decline of coral reefs.

- **Oil Exploration and Drilling:** The effects of oil spills on wildlife are already splashed across newspapers and television screens on a far too regular basis — and the risks of a spill increase as we extend our search for crude into underwater habitats. The Hibernia oil field off the coast of Newfoundland and Labrador is the fifth largest ever found in Canada. It is also located in one of the world's most productive fisheries habitats. A major oil spill there would be disastrous.

- **Over-exploitation:** When we harvest more fish, shellfish or plants than nature can replace, the population crashes. The tragic tale of the Atlantic cod is an example of the dangers of over-harvesting. This fish has been continuously fished on the Grand Banks by many nations and in great numbers since the 1400s. Fishing for cod within Canada's waters was closed in 1995 following a rapid population collapse.

- **Aquatic Habitat Destruction:** Another variation on the over-exploitation theme is the outright destruction of *benthic* habitats. For example, some ocean-going trawlers drag their nets along the ocean bottom, killing most of the fish and molluscs in their paths, destroying reefs, and stirring up mud that clogs the gills of other species in the area. While these fishers may be seeking only a few species, many other underwater creatures are casualties of their destructive harvesting methods.

- **Invasive Species:** Humans sometimes bring new aquatic species to an area on purpose or through carelessness. If these newcomers take hold, they often replace native species. Zebra mussels, originally from Russia, are a well-known freshwater example. Since they were first found in 1986 in Lake St. Clair (which connects Lake Huron and Lake Erie), they have rapidly spread to all the Great Lakes and beyond. They filter about one litre of water per day, removing the phytoplankton that drives the entire food web. There are now enough zebra mussels in Lake Erie to filter the entire volume of the lake once a week — and to deprive other species of a share in the food supply.

- **Shoreline Development:** What happens on the land and at the water's edge also affects underwater communities. When freshwater or ocean shorelines are disturbed, soil is added to the water. Think about trying to breathe in a dust storm. That's what underwater creatures go through in muddy waters.