Great Lakes Outreach Program

Life Systems: Grade Seven
Interactions within Ecosystems

Lessons for the Ministry of Education and Training
The Ontario Curriculum, Science and Technology

Image © GLIN

Featuring 4 local fishes: Atlantic salmon, redside dace, eastern sand darter and American eel
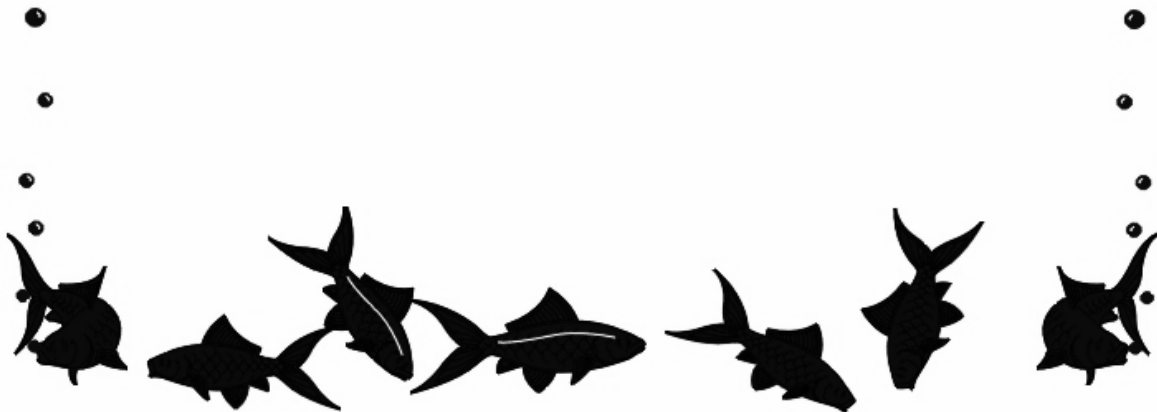
Ontario

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Curriculum Guide
Life Systems: Grade 7
Interactions within Ecosystems

Grade   7

Subjects   Environmental science, language, and art

Goals   The study of ecosystems is an introduction to the study of ecology and involves investigation of the complex interactions between all types of organisms and their environment. Students will learn that ecosystems consist of communities of plants and animals that are dependent on each other as well as the non-living parts of the environment. In investigating ecosystems, students will develop research and critical thinking skills while investigating the long-term effects of losing natural habitats, natural resources and biodiversity. Students will learn how sustainable management protects species and their habitats in Canada, and how individuals can contribute to these conservation efforts.

Basic Concepts

Students will:

❑ Understand the importance of biodiversity.

❑ Identify factors affecting the balance of an ecosystem.

❑ Understand the effects of human activities on aquatic ecosystems by investigating four local fishes at risk: Atlantic salmon (extirpated), redside dace (endangered), eastern sand darter (threatened) and American eel (special concern)

❑ Study conservation efforts of government agencies, action groups and local communities.

Teacher Guide
Lesson One
"Imagine a World Without Fishes"
Class time: 30 min

Basic Concept: Understanding the importance of maintaining biodiversity by identifying factors affecting the balance of an ecosystem.

Keywords: biodiversity, extinct, habitat, natural resource, species

Materials: Student worksheet, "**A World Without Fish: What Would it Look Like?**"
Student worksheet, "**Imagine a World Without Fishes**"
Student handout, "**Atlantic Salmon story"**

Student Activity

This activity can be done as a class discussion. It is designed to get students to think about ecosystem dynamics, how organisms within ecosystems are dependent on each other, and how removing species from food webs has detrimental effects on the environment and humans. Vocabulary words are italicized and are found in the glossary (**Appendix 2**).

Imagine a World Without Fish…

Pick one of the four species of fish from Ontario (redside dace, Atlantic salmon, eastern sand darter, or American eel). Pick a species to use as an example, i.e. redside dace by referring to **Appendix 1** for species information.

1.   What are the *basic needs* of living things (what do living things need to survive)?
    a. **Food** (redside dace eats insects)
    b. **Water** (redside dace needs water for breathing and living in)
    c. **Oxygen** (redside dace breathes oxygen dissolved in water)
    d. **Shelter** (redside dace hides under logs and lays eggs in other fishes' nests)
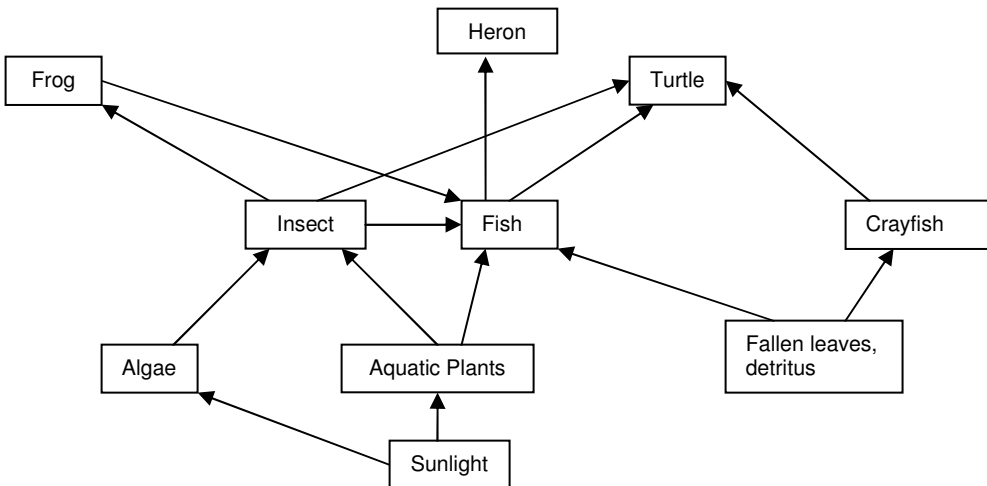   e. **Habitat** (redside dace lives in cool, shady streams)

Use *habitat* as a lead-in to define *ecosystem*. A habitat is the place where an organism naturally lives and grows. An ecosystem is all of the interacting parts of a biological community, including biotic and abiotic factors. For example, a stream is both a habitat (for the redside dace) and an ecosystem (for other organisms).

2.   What does an ecosystem need to be balanced and healthy?
    a. *Abiotic* (non-living) factors:
        i. Soil   iii. Water
        ii. Air   iv. Nutrients
3.   *Biotic* (living) factors:
    a. Plants   iii. Fungi
    b. Animals   iv. Micro-organisms

Ecosystems need producers, *consumers and decomposers to* function properly. Introduce the idea of a food web, with producers at the bottom, and different consumers (*omnivores, carnivores, herbivores*) above. An organism may be eaten by more than one thing, and may eat more than one thing, hence, a web.

Create a food web on the board using a stream ecosystem. Include several fish at different consumer levels (i.e. herbivore – plant eater, omnivore – meat/plant eater, carnivore – meat eater).

Example:

Heron

Frog   Turtle

Insect   Fish   Crayfish

Algae   Aquatic Plants   Fallen leaves, detritus

Sunlight

3.   Now, what if a small town developed near the stream? What would the effects on the ecosystem be?
  - People could catch fish for food.
  - People could use water from the stream.
  - People could build houses near the stream.
The stream could still be healthy at this point if people lived in **balance** with the ecosystem and didn't disrupt it too much.

What if a city was built near the stream, or a shopping mall was built over top of part of the stream?
 - Disruption to the area would destroy habitats and kill many species including fish. This would reduce the biodiversity and balance of the ecosystem, and have many negative effects:
      - *Siltation*
      - Erosion
      - *Pollution*
      - Over-fishing
      - Logging/paving
      - Increased water temperature and disrupted flow
      - Flooding (especially around wetlands)
      - *Extirpation*

4.   If these things caused fish to disappear, what would happen? Use the following handouts to encourage students to brainstorm the potential effects of losing fishes in the world.

Student Worksheet
A World Without Fish: What Would it Look Like?

Effects on Ecosystems	Effects on Humans
Example: Prey species (like insects) would become overpopulated. _____ _____ _____ _____ _____ _____ _____ _____	Example: Loss of an important food source for people. _____ _____ _____ _____ _____ _____ _____ _____

Imagine a World Without Fishes:
A Loss of Biodiversity

How are humans affected?
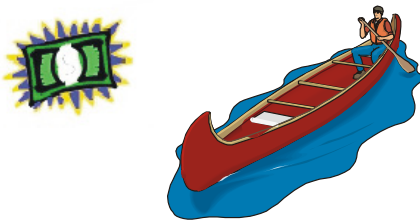
LESS
pet and aquarium trade
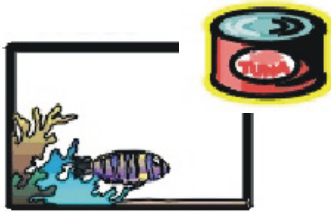
LESS
food sources for people and domestic animals (for example: livestock supplements)

LESS
fish by-product industries

LESS
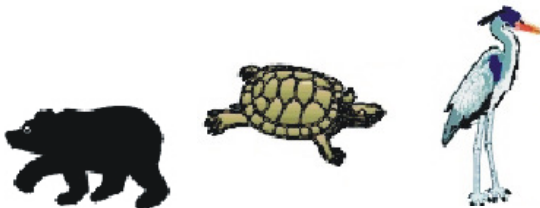jobs, trade or tourism

NO FISHES

LESS
commercial and sport fishing

Food Chains
loss of beauty and biodiversity; fewer items to eat

Missing Links
disrupted food web

wetlands & watersheds disrupted!

Fewer indicators of water pollution

Imbalanced numbers in plants & animals

How are ecosystems affected?

Student Handout
Local Example
"Atlantic Salmon Story"

### Extirpated: Atlantic Salmon Lake Ontario Population

The Atlantic salmon of Lake Ontario were an important part of the diet of Aboriginal people residing around Lake Ontario. European settlers arrived in the late 1700's and the Atlantic salmon were so plentiful that they were able to harvest salmon by the barrel. Historians have suggested the availability of Atlantic salmon encouraged settlement of the interior of Canada. Later, commercial and recreational fisheries for Atlantic salmon developed on Lake Ontario. The commercial fisheries supported thousands of fishermen.

Pressure from these fisheries, plus serious environmental degradation caused ecological changes in Lake Ontario. In the late 1700's and onwards large areas of land were cleared for agriculture increasing water temperatures and erosion and decreasing the availability of spawning and nursery habitats. Dams and mills also served as barriers that even the legendary "leaping" salmon couldn't move over during their annual migrations. Habitat destruction lead to changes in Lake Ontario's fish community. The traditional prey of Atlantic salmon, lake herring, was being replaced by alewife and rainbow smelt.

Lake Ontario's Atlantic salmon were officially declared extirpated in 1896. Atlantic Salmon were one of the first species in Canada to disappear as a result of human activity.

Several unsuccessful reintroduction attempts have been made.

Recently stream stewardship has gained momentum and many tributaries of Lake Ontario are on the way to recovery thanks to the efforts of local landowners and conservationists. The Lake Ontario Atlantic Salmon Recovery Team hopes to have a self sustaining population of Atlantic salmon in Lake Ontario by 2020. For more information visit www.atlanticsalmonontario.ca .
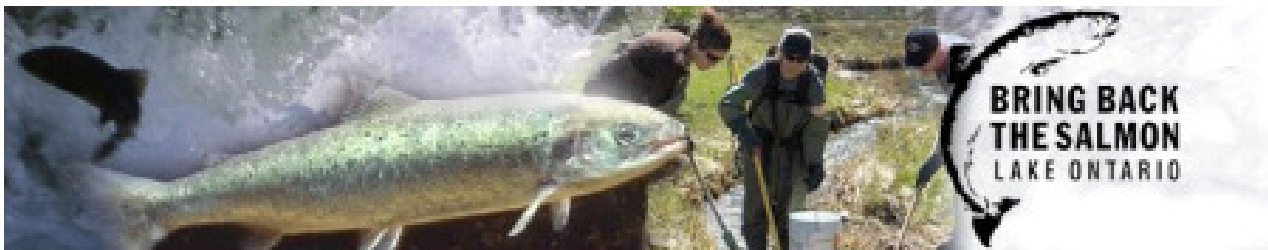
Teacher Guide
Lesson Two
Local Fishes Display!
Class time: Over 1 week (5 x 30 minutes)

Basic Concept:
- Understand how human activities impact on aquatic ecosystems by investigating four local fishes at risk: Atlantic salmon (extirpated), redside dace (endangered), eastern sand darter (threatened) and American eel (special concern).
- Study the conservation efforts of government agencies, action groups and local communities.
- Students will practice research and writing skills, and will need to create a simple population graph and make predictions based on the data.

Keywords:
biodiversity, captive breeding, conservation, ecosystem, endangered, environment, extirpated, habitat, habitat rehabilitation, pollution, sustainable management, species, threatened, watershed

Materials:
Research medium (internet, library), computers, printer, disk or hard-drive file, paper, pen, cardboard/poster board, markers, rulers, scissors, glue and various other creative materials to be used for mural construction.

Teacher Instructions

To understand how human activities impact aquatic ecosystems and the biodiversity of Canada's wildlife, we suggest that your students research a watershed that is local to them. The Rouge River is an example of a watershed in Southern Ontario. Define **watershed** if the students are not already familiar with this term. See **Glossary (Appendix 2).**

A- Display Mural:

1. As a class, students will design a display (informative mural) of different fish species in their local watershed. Divide the students into four groups. Designate one of the four fish species highlighted in this package to each group (redside dace, Atlantic salmon, eastern sand darter and American eel). Each group should research the following topics on their species:

➢ BIOLOGY (i.e. body shape and movement, reproductive habits, etc.)
➢ NEEDS AND HABITAT (i.e. diet, type of water required: moving/still, cool/warm, gravely bottom, etc.)
➢ HUMAN ACTIVITIES THREATENING THE FISH (i.e. road salting, fertilizers, etc.)
➢ WHAT HUMANS ARE DOING TO HELP PROTECT THE FISH AND ITS HABITAT
➢ WHAT **YOU** (STUDENTS) CAN DO TO KEEP RIVERS & STREAMS CLEAN

For information on these topics you may refer to the Local Fish Fact Sheet (Appendix 1). A useful start for the students' research is http://www.ontariostreams.on.ca/RSD/. Other useful references are listed on page 15 and in Appendix III.

2. Each group will compose a written summary outlining the above topics, along with pictures, maps, graphs, drawings, paintings, collages or other types of art suitable for the mural.

Obtain one large piece of cardboard and four smaller pieces (1/4 the size of your large piece) of cardboard.
Give each group of students a smaller piece of board to design their own separate display (summary & other visual material) that will, together with the other groups, be placed on the larger board to create the class mural.
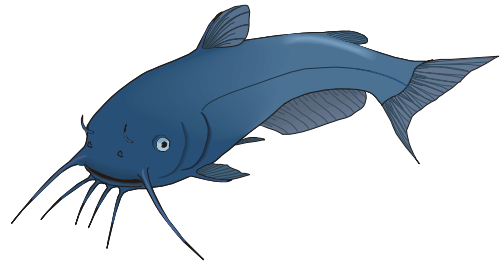
B- Individual Opinion Report:

1. Each student will also compose a follow-up report describing their personal views on the decline of Canada's biodiversity. They should be encouraged to look at the other three groups' displays to appreciate that there are many local species in danger. The following questions can be addressed in their report:

- ➢ What is biodiversity?
- ➢ Are we as individuals or as a country contributing to the effective protection and conservation of our wildlife and environment?
- ➢ How will protecting one species, such as the American eel, make a difference?
- ➢ Encourage students to practice supporting their arguments with scientific data by including a graph or chart of population data in their report. American eel population data can be found in **Appendix 3**. Are population numbers declining? At what rate? What can you infer about the future of this species by your data (i.e. will it become extinct if the trend continues)?
- ➢ How do you feel about conserving biodiversity—do you think it's important? Why?
- ➢ How can individuals contribute to conservation efforts -- will it make a difference?

2. Some helpful references include:

- ➢ **Local Fish Fact Sheet (Appendix 1)**
- ➢ www.dfo-mpo.gc.ca/species-especes/species/species_easternSandDarter_e.asp
- ➢ www.dfo-mpo.gc.ca/zone/underwater_sousmarin/american_eel/eel-anguille_e.htm
- ➢ http://www.ontariostreams.on.ca/RSD/
- ➢ http://www.speciesatrisk.gc.ca
- ➢ http://www.cosewic.gc.ca
- ➢ http://www.mnr.gov.on.ca/MNR/nhic/nhic.cfm
- ➢ http://www.rougepark.com/search.php
- ➢ http://www.atlanticsalmonontario.ca
- ➢ http://www.cosewic.gc.ca/
- ➢ http://www.speciesatrisk.gc.ca/Species/English/Default.cfm

Appendix I
Local Fish Fact Sheet

American Fisheries Society

Redside Dace (minnow)
Endangered

This minnow is a great neighbour to have because it eats flying insects including mosquitoes!! The redside dace is a <u>carnivore</u>.

Scientific Name: *Clinostomus elongatus*

Characteristics:

- Body Length: between 7.5-11 cm.
- Lifespan: 4 years
- A red band along the side (hence its name); the red colour is brighter in males than on females and intensifies during **spawning**, in May.
- A large upturned mouth to catch flying insects; can jump up to 10cm out of the water to catch its food!

Distribution:

- In Canada, isolated populations in Southern Ontario.

Habitat:

- Prefer clear, cool (16℃ - 24℃), shallow, flowing streams with gravel/stony bottom.
- Use rocks and fallen debris as shelter (need vegetated shorelines).
- Very sensitive to cloudy/polluted waters; this fish is an early indicator of water pollution.

Threats:

- The main factors that have affected redside dace populations are destruction and degradation of habitat through **siltation**; removal of shoreline vegetation (like trees); urban development, decreases in water quality; and introduction of foreign aquatic species.
- Redside dace are vulnerable to increases in water temperature and cloudy water, both of which are made worse with urban development (cities, farms, factories, dams, roads, and pollution).
- An estimated 50%-90% decline in native Canadian range led to this species being designated an "**Endangered**" species by **COSEWIC** and "**Threatened**" by **COSSARO** (provincial authority) respectively.

Atlantic Salmon
Extirpated

Atlantic salmon disappeared from Lake Ontario more than 100 years ago. People have worked hard to improve <u>habitat</u> for Atlantic salmon. Work is now underway to reintroduce these fish to Lake Ontario.

© J E Swedberg

Scientific Name: *Salmo salar*

Characteristics:

- Sleek, powerful body enables fast movement. The skin of adults is silvery-blue.
- A very sensitive organ called the lateral line enables them to detect which direction is upstream or downstream.
- Feeds on small crustaceans and invertebrates when young; as adults they eat larger prey like squid, eels and fish. When adults return to freshwater to spawn and die (this can be a 4000km trip!), they stop eating and live off fat reserves.
- Salmon mature through a series of phases as they mature: egg → alevin → fry → parr → smolt (adapts to seawater) → adult.
- Salmon do not *need* to move to seawater; some remain landlocked their whole lives.
- Very keen sense of smell (1000x better than a dog!)

Distribution:

- Cooler waters on both sides of the Atlantic and connecting rivers.

Habitat:

- Large, cool rivers with gravely bottoms are important for young fish.
- In the ocean, they prefer temperatures between 4°C and 12°C.
- These fish will usually return to the same river they were born in to spawn.

Threats:

- Population numbers are at their lowest point in history, but may be increasing again due to conservation efforts.
- Atlantic salmon numbers have been severely reduced (they have been extirpated from the Great Lakes) due to habitat destruction, obstruction of spawning sites by dams, overfishing and pollution.
- Considered lower risk by the IUCN, and an endangered species by the U.S. Fish and Wildlife Service
- The Atlantic Salmon Federation has been instrumental in conservation efforts.

A. Dextrase

Eastern Sand Darter
Threatened

This fish burrows into the sand to <u>camouflage</u> itself and then jumps out and surprises its <u>prey</u>.

Scientific Name: *Ammocrypta pellucida*

Characteristics:

- A member of the perch family, this fish grows to between 46 and 71mm in length.
- Small, slender, translucent body with dark spots along sides. Sandy colour allows for excellent camouflage along river bottoms.
- Small mouths, their diet is mainly midge and blackfly larvae.

Distribution:

- In Canada this species is today found in Lake Erie, Lake St. Claire, and a few rivers in Quebec and south-western Ontario.

Habitat:

- Prefers sandy-bottomed water, either clear or murky, still or moving. Often buries itself in the sand to surprise prey.

Threats:

- Habitat deterioration due to siltation, chemical pollution, acid mining drainage and sandbar removal has caused this fish to decline in numbers since the early 1900's.
- Their habitat receives some protection from the Species At Risk Act, the Fisheries Act and the Ontario Lakes and Streams Improvement Act.

American Eel
Special Concern

Eels can absorb <u>oxygen</u> through their skin which allows them to travel on land for short distances.

Scientific Name: *Anguilla rostrata*

Characteristics:

- Elongate and serpentine body shape
- Thick skin secretes lots of mucous to provide protection. Scales develop at about 3 years of age.
- Top predators that help control invasive species like the goby. They will also scavenge for dead fish.

Distribution:

- Very broad range; Northeast South America to Labrador and even Southwest Greenland!

Habitat:

- American eels are catadromous, meaning they are born in saltwater, spend most of their lives in freshwater, and then return to the sea to spawn and die (compared to anadromous fish, i.e. Atlantic salmon). Their *only* breeding place in the world is the Sargasso Sea in the Atlantic Ocean. After birth, they will drift along with ocean currents and eventually migrate inland where they mature in rivers, streams and lakes for 10-25 years before returning to the ocean to spawn.

Threats:

- American eels have been harvested for human consumption since the 1600's and in recent decades accounted for a huge percentage of the fish caught in Lake Ontario.
- Numbers have dropped drastically since the 1980's; the causes are still unclear, but the following may be contributing factors:
- chemical contamination of water impairing reproductive abilities
- hydroelectric dams interfering with migratory routes
- climate change altering ocean currents
- historic overfishing of young eels

Appendix II
Glossary

Abiotic: a term applied to non-living (physical, chemical, or non-organic) things in the environment; for example air, water, the climate, and soil are abiotic.

Basic Needs: all living things have 5 basic needs: food, water, oxygen, home and a habitat.

Biodiversity: the variability among living organisms on earth, including the variability within and between species and within and between ecosystems.

Biotic: organic or living component parts that make up the environment, such as aquatic plants, fishes, birds, and frogs.

Carnivore: animals that eat only meat. Example: redside dace.

Camouflage: when an animal looks like its surrounding, thus allowing it to blend in or become hidden.

Captive Breeding: organisms breed and produce young in captivity; sometimes used to enhance wild populations.

Community: a group of organisms living together in a habitat. They have an effect on each other and are linked by a food web.

Conservation: the planned management of a natural resource or of a particular ecosystem to prevent exploitation, pollution, destruction, or neglect, and to ensure biodiversity and/or the future usability of the resource.

Ecosystem: all the interacting parts of a biological community and its environment, for example, a stream.

Endangered: any species at risk of extinction or extirpation throughout all or most of its range.

Extinct: any species that no longer exists.

Extirpated: any species that no longer exists in the wild, but exists elsewhere in captivity; any species that lives in one area but is extinct in another area

Habitat: the type of place where a plant or animal naturally lives or grows, for example, a streamside pool of water.

Habitat Rehabilitation: an attempt to restore a degraded habitat to its natural state; as it was prior to disturbance.

Habitat Stewardship: voluntary actions that individuals take to care for the environment. Citizen involvement includes monitoring and conserving wildlife species and their habitats, and to protect and improve the quality of all natural resources.

Invertebrate: an animal, such as an insect or mollusc, which lacks a backbone or spinal column.

Natural Resource: naturally occurring exploitable material, for example, trees.

Niche: the role or characteristic activity that is undertaken by an organism in an ecosystem; one organism may fill several different niches.

Organism: any type of living creature.

Pollution: a collective term for different types of harmful materials that are released into the environment through human activities.

Population: all the organisms that constitute a specific group or occur in a specified habitat.

Recovery Team: In Canada, a multi-disciplinary group of biologists and experts working to help populations of endangered species by saving habitat, breeding programs and public awareness programs.

Siltation: to choke, fill, cover, or obstruct with silt or mud.

Spawning: the act of mating by fishes, often involving the release of eggs and sperm (milt), to fertilize the eggs.

Special Concern/Vulnerable: any species that is sensitive to human activities or natural events, but does not include extirpated, endangered or threatened species.

Species: a narrow classification grouping for organisms; e.g. *Clinostomus elongatus*, where *elontagus* is the species name

Sustainable Management: meeting the needs of the present yet sustaining growth for the future.

Threatened: any species that is at risk of becoming endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Water Cycle: the patterns and processes of global water distribution. It is a closed system that circulates water through the biosphere. The water cycle consists of evaporation, transpiration, condensation, and precipitation.

Watershed: the geographic region draining into a river, river system, lake or other body of water.

Wetland: is a term used to describe areas, which are neither fully terrestrial nor fully aquatic. They include marshes, swamps, peatlands (including bogs and fens), flood meadows, lakes and ponds, rivers and streams, estuaries and other coastal waters. These areas range in character from the majestic cypress swamps to shallow depressions, which hold water at most only a few weeks out of the year.

Appendix III
American Eel Population Data

American eels were counted as they ascended a fish ladder in Cornwall Ontario. Numbers are per day over a 31-day period. No data are available for 1996.
Source: http://www.mnr.gov.on.ca/en/Business/SORR/2ColumnSubPage/EELPAGE.html.

Year	# of Eels	Year	# of Eels
1974	8000	1992	500
1976	11000	1994	1000
1978	17000	1996	-
1980	9000	1998	57
1982	27500	2000	54
1984	15000	2002	55
1986	5500	2004	0
1988	5500	2005	228
1990	3000		

Appendix IV:
References

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www.atlanticsalmonontario.ca

http://www.4j.lane.edu/partners/eweb/ttr/curriculum/watershd.html

http://www.cosewic.gc.ca/

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http://www.ramsar.org/about_infopack_1e.htm

http://www.redsidedace.com

http://www.speciesatrisk.gc.ca/Species/English/Default.cfm

http://www.wri.org/biodiv/b03-gbs.html