

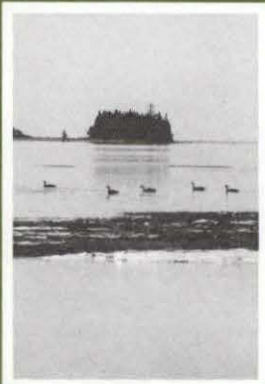
Estuaries: habitat for wildlife



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Cover photos:

1. Snow geese in a *Scirpus* marsh in the St. Lawrence estuary. Photo: A. Reed.
2. An overview of the Wallace River estuary. Photo: R.J. Hicks.
3. Canada Geese in an estuary in Prince Edward Island. Photo: R.J. Hicks.
4. Marsh in the Fraser River estuary. Photo: R. Butler.
5. The Mackenzie River estuary, near the Kendall Island Bird Sanctuary. Photo: CWS.

Everybody knows that certain types of animals can live only in the saltwater environment of the ocean, whereas other types can survive only in the fresh water of lakes and rivers. But did you know that there are a lot of fish and wildlife species that live in the areas where fresh water from rivers meets and mingles with salt water from oceans? These areas are called *estuaries*, and they provide critical habitat for species that depend upon their unique physical characteristics — such as constantly changing water levels, salt concentrations, and temperature — and biological characteristics — such as rapid plant growth — for their survival.

Where are Canada's estuaries?

Canada's best-known estuaries occur at the mouths of the Fraser, Mackenzie, and St. Lawrence rivers. Less well known estuaries are found at the mouths of rivers that empty into James, Hudson, and Ungava bays. There are also extensive areas of the ocean that have the characteristics of giant estuaries, such as the Bay of Fundy, James Bay, and the Strait of Georgia. In addition, there are thousands of smaller estuaries along Canada's three coastlines. Although not all of them are important as wildlife habitat by themselves, together they constitute a major wildlife asset for Canada that has not yet been fully appreciated.

Why do plants flourish in estuaries?

The mixing of fresh water and salt water is an important feature of estuaries. The fresh water is less dense (lighter) than seawater and therefore flows above it (see Drawing a). The flow of some large rivers is so immense that a wedge-shaped bottom layer of salt water, called a salt wedge, is pushed up the estuary along the river bottom by the force of the outgoing fresh water above it. This wedge of salt water can penetrate several kilometres from the river's mouth, carrying with it nutrients for the estuary's plant life from the ocean.

The nutrients carried in from the ocean in the river and in the salt wedge transform estuaries into very fertile areas for plant growth. In fact, estuaries are among the most biologically productive ecosystems on Earth. Studies have shown that primary productivity, or the rate at which plants convert the sun's energy by photosynthesis into food that animals can use, is higher in estuaries than in grasslands, forests, and even areas of intensive agriculture (see Drawing b).

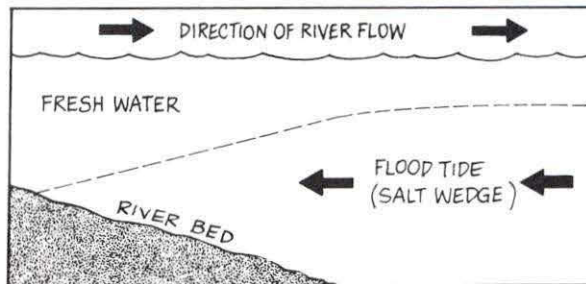
The estuarine food web

In the open ocean, microscopic algae known as phytoplankton float in the sunlit surface waters and convert the sun's energy to food energy. Phytoplankton cannot grow in the muddy water of some estuaries, however. Instead, most of the primary production in these estuaries is carried out by marsh plants, bottom-dwelling algae, and eelgrass that grow in abundance in the marshes and mudflats (the muddy land that is left uncovered at low tide) that are part of estuaries. These plants form the fuel of the estuarine *food chain*, which is the pattern in which plants are eaten by animals, which are in turn eaten by other animals, transferring food energy in the process (see Drawing c). A variety of different food chains then interconnect to form the estuarine *food web*.

Although one might guess that the next link in the food chain might be an animal feeding directly on the living algae or eelgrass, in fact this is rarely

Drawing a
A salt wedge

In estuaries, fresh water is lighter than seawater and therefore flows above it. The flow of some rivers is so immense that a wedge-shaped bottom layer of salt water is pushed up the estuary along the river bottom, carrying with it nutrients for the estuary's plant life.



Canada's estuaries

Thousands of estuaries are found along Canada's three coastlines. The map identifies some of the estuaries that are discussed in this brochure.

Important estuaries

1. Fraser estuary
2. Mackenzie estuary
3. St. Lawrence estuary

Places with lesser known estuaries

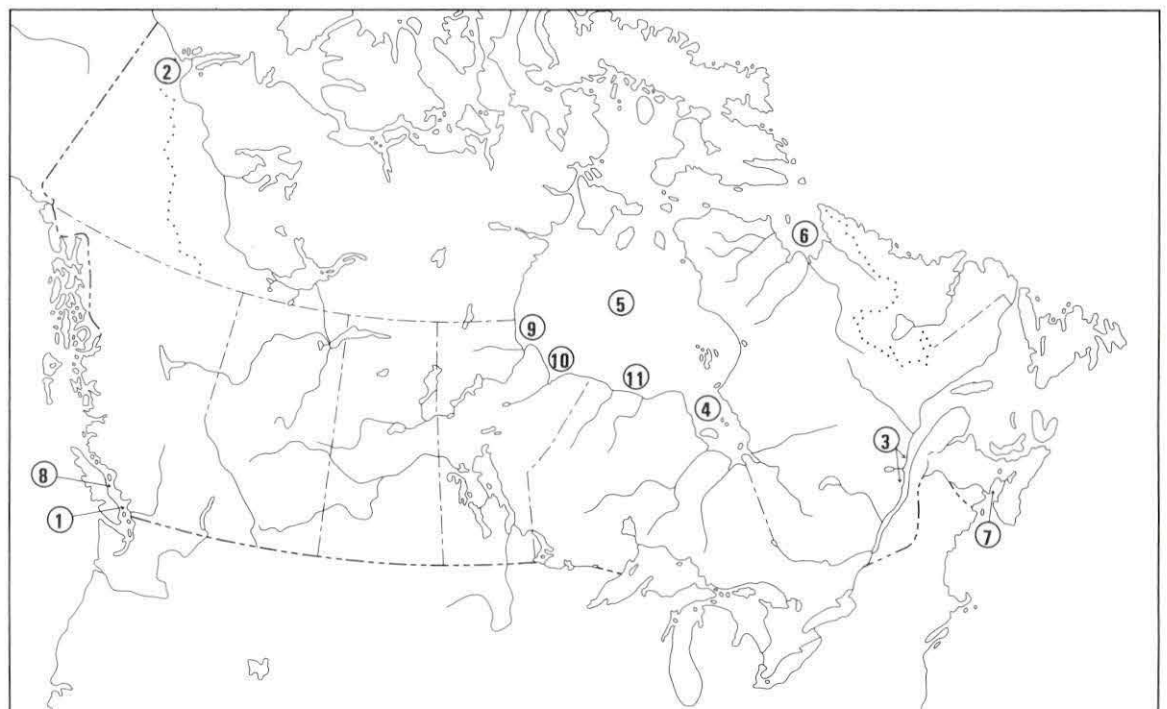
4. James Bay
5. Hudson Bay
6. Ungava Bay

Areas of the ocean that have the characteristics of giant estuaries

4. James Bay
7. Bay of Fundy
8. Strait of Georgia

Some estuaries where belugas moult

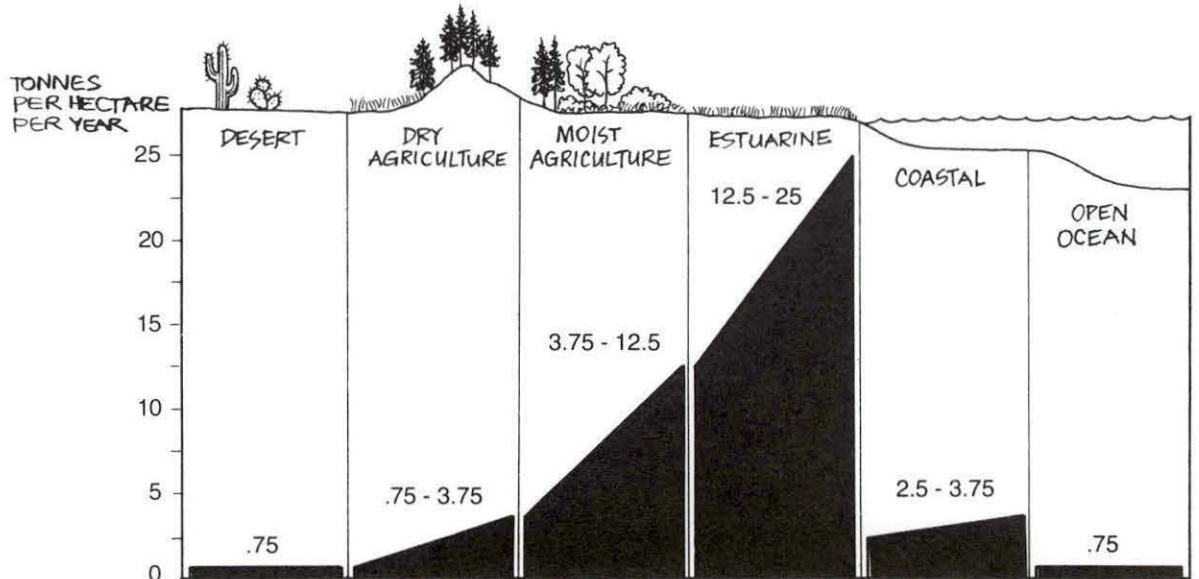
2. Mackenzie estuary
9. Churchill-Seal estuary
10. Nelson estuary
11. Winisk-Severn estuary



Drawing b

Productive ecosystems

Estuaries are among the most biologically productive ecosystems on Earth. The drawing shows how much more plant material grows in estuaries in a given time period (up to 25 tonnes per hectare per year) than in other habitats.



the case in estuaries. There are only a few conspicuous herbivores, or plant eaters, found in estuaries, and they are mainly waterfowl — like the Brant, a goose found in estuaries on all three coasts of Canada, which feeds on eelgrass, certain species of ducks that eat the seeds of the marsh plants, and the thousands of snow geese that gather in the Fraser and St. Lawrence river estuaries each autumn to feed on bulrushes and sedges.

So what follows estuarine plants in the food chain? What happens is that the estuarine plants die at the end of the growing season and decay gradually through fall and winter. The next step in the food chain is a rich assortment of microscopic fungi, bacteria, protozoa, and other microorganisms, which coat the dead plant material, called *detritus* (like a pile of rotting leaves or a compost heap). Small invertebrates, such as worms, snails, clams, oysters, and shrimp, are the next step in the food chain, feeding on this detritus. These invertebrates are then eaten by fish, amphibians, and birds, which in turn are eaten by larger fish, birds, and mammals.

Evidence of the estuarine food chain can be seen during a visit to any estuary. Bufflehead are often seen diving in shallow water to find snails

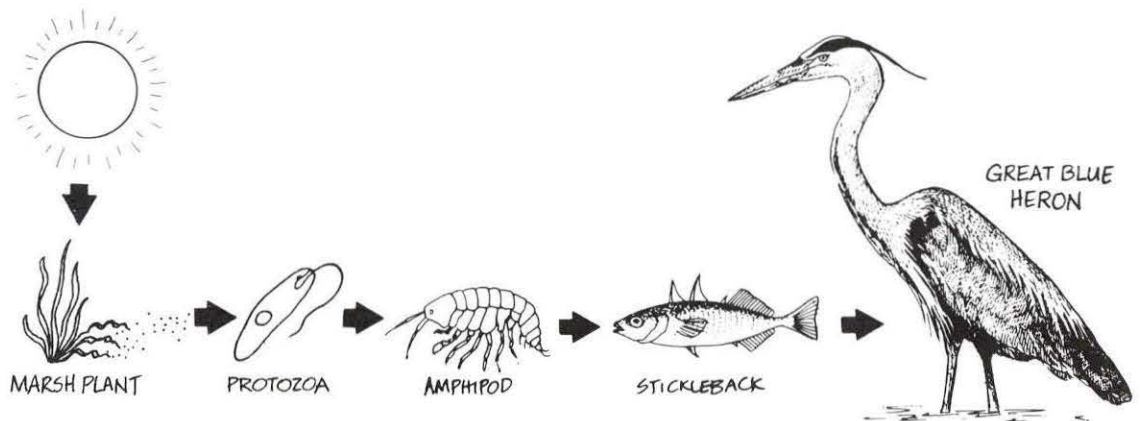
and other invertebrates living in soft estuarine sediments. In the Bay of Fundy and at the mouth of the Fraser River, shorebirds gather in flocks exceeding 100 000 birds to probe the mudflats with long bills in search of small invertebrates. Common Mergansers and Great Blue Herons find Pacific and Atlantic estuaries especially attractive places to catch small fish. Sandpipers fall prey to Peregrine Falcons that hunt along estuarine beaches, and dead fish, birds, and mammals are scavenged by Bald Eagles.

The estuarine food chain would quickly fall apart without the tides. As the bacteria and other microorganisms feed on the decaying plants, they use up much of the available oxygen in the water. This oxygen depletion would make it difficult for the estuarine invertebrates and fish to breathe, and they would eventually suffocate. However, regular incoming tides, occurring about every 12 hours, replenish the supply of oxygen for the animals that feed in the estuaries, and the outgoing tides carry away their wastes, to be used elsewhere in the estuary and nearby ocean.

Drawing c

A food web

The basis of this estuarine food web is conversion of the sun's energy to food energy by marsh plants. When the plants die and decay at the end of the growing season, protozoa and other microorganisms coat the dead plant material. Small invertebrates, which feed on this detritus, are themselves eaten by fish, which in turn may be eaten by birds and mammals.



Plants in estuaries: nature's water garden

Only certain types of plants can flourish in the physical conditions peculiar to estuaries, and each of these plants can grow in only certain parts of the estuary.

One factor influencing the growth and distribution of plants in an estuary is its salinity, or the amount of salt in the water. Certain kinds of plants can tolerate high levels of salt, getting rid of the salt they take up by releasing it through special salt pores on their leaf surfaces. Other plants do not like even a moderate amount of salt and can grow only in areas of the estuary where seawater cannot reach. In between are plants that can tolerate moderate amounts of salt and hence can survive in *brackish* (or slightly salty) areas of the estuary.

A second factor influencing the growth of plants in an estuary is the amount of flooding. The longer and deeper an area is flooded with water, the less oxygen is available in the soil. As plant roots need oxygen to grow and survive, the plants that grow in areas that are usually under water need to be adapted to an oxygen shortage, some of them transporting oxygen from special storage cells in their leaves and stems to their roots.

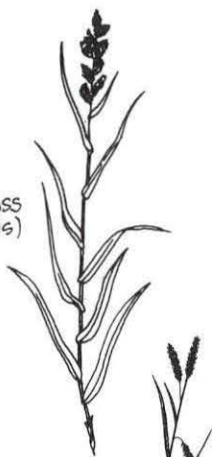
One marine plant that flourishes in estuaries is eelgrass. This plant can tolerate only brief exposure to air and therefore grows in large submerged beds near and below the lowest tide level. It is especially important as food for American Wigeon and Brant. Plants that grow on land covered by seawater for brief periods each day include salt-tolerant species such as the saltworts and saltgrasses on all three coasts, cordgrasses on the Atlantic coast, and alkali grasses in the Arctic. Plants such as the sedge and bulrush predominate in brackish areas of many estuaries, where they are covered by water for a few minutes to many hours each day. Areas that are covered with fresh water support the cattail in profusion.

In fall and winter, most plants in all parts of the estuary decay and become detritus. Some plants, such as algae, have a much shorter life cycle, lasting only a matter of days or weeks, and these continue to grow and decay even in extremely cold weather.

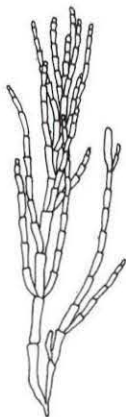
Animals in estuaries: nature's smorgasbord

Few animals can live their entire lives in estuaries. However, estuaries are critical habitat for certain wild animals at some stage of their lives. The few estuarine animal species that have adapted to the characteristically changeable conditions of salinity, temperature, and water level found in these tidal areas grow and multiply rapidly. Many other species, such as spawning whitefish and migrating sandpipers, move en masse into estuaries at specific times of the year. In turn, the survival of predators, even those that rarely visit estuaries, depends on populations of fish and birds that use these coastal ecosystems at key times in their life cycles.

SALTGRASS
(*Distichlis*)



LYNGBYEI'S
SEDGE
(*Carex*
lyngbyei)



SALTWORT
(*Salicornia*)

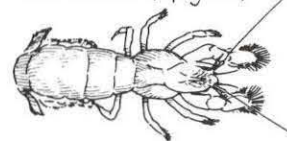


LUGWORM
(*Arenicola*)



EDIBLE BLUE
MUSSEL
(*Mytilus*)

MUD SHRIMP (*Upogebia*)



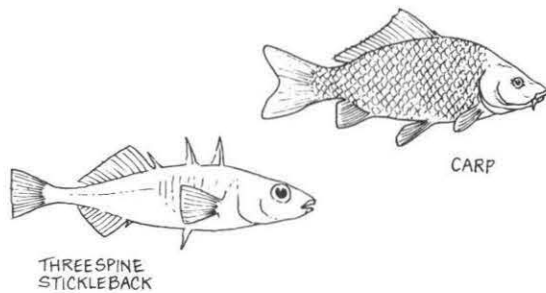
Invertebrates

Mudflats, despite their desolate appearance, teem with invertebrates that burrow into the mud for protection from predators and the elements. A variety of invertebrates, including mussels, clams, snails, amphipods (a group of small crustaceans), segmented worms, and lugworms, feast on detritus and each other in the mudflats and fall prey to a myriad of fish and birds. For example, over 11 000 amphipods have been recorded in one square metre of mud in the Bay of Fundy during the southward migration of the Semipalmated Sandpiper. These amphipods provide the necessary fuel for a million or more sandpipers to complete the nonstop flight of about 4000 km from the Bay of Fundy to Suriname in South America.

Sandy and rocky estuaries, which are often exposed to strong waves or currents, contain fewer (and different) invertebrates than mudflats. Birds that feed in these habitats, like the Black Turnstone and Surf Scoter, have evolved a variety of different beak shapes and lengths to probe for and handle particular kinds of invertebrates, and they are adept at digging or tugging invertebrates from their homes.

Fish

Estuaries play essential roles in the life history of many fish species. Arctic estuaries are important nurseries for whitefish and ciscoes, whereas Atlantic estuaries are important to salmon, eel, herring, smelt, and sturgeon. On the Pacific coast, the Fraser River estuary provides important rearing and feeding habitats for juvenile chum and chinook salmon, the brackish water of the estuary giving the juvenile salmon time to gradually adjust to salt-water conditions before they migrate to the ocean.



Fish that can tolerate changes in temperature and salinity frequent brackish and freshwater marshes in estuaries. These include important prey species for birds, such as the threespine stickleback and sculpins. Some species of fish that cannot tolerate large changes in salinity occupy eelgrass beds, where salinity is more constant. On the Pacific coast, gunnels and seaperch move into eelgrass beds in spring and summer, where they are eaten by cormorants, gulls, and herons.

Birds

Estuaries on the Arctic and Atlantic coasts are particularly important places for nesting birds, whereas Pacific coast estuaries are very important for birds in winter. Estuaries on all three coasts provide essential resting and feeding habitat for migrating birds.



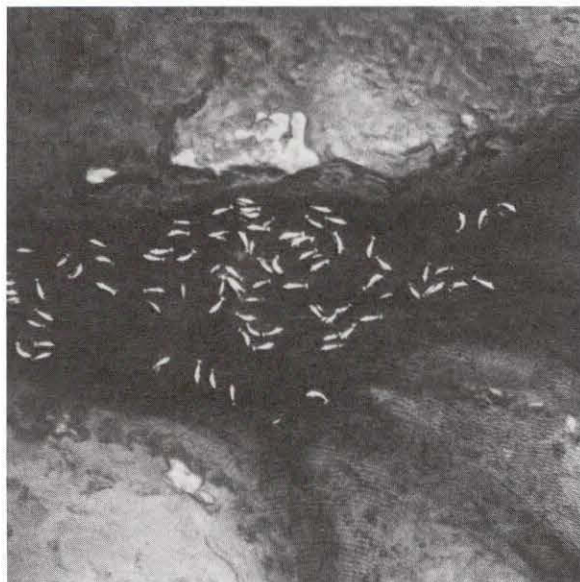
WESTERN SANDPIPER

Tens of thousands of water birds moult their feathers in or near northern estuaries before migrating south for the winter. Southern estuaries, such as in the St. Lawrence and Fraser rivers, support hundreds of thousands of migrants. Over 50 000 water birds spend the winter in the St. Lawrence River estuary, and more than 250 000 do so in the Fraser River estuary.

The abundant food supplies in estuaries allow some species of migratory birds to travel from Canada to such faraway places as Great Britain, Argentina, and Senegal. Without the critical habitats provided by estuaries, some species of migrating birds would probably disappear.

Belugas gather in large numbers within certain river estuaries during the summer ice-free season. Some individuals are known to return to the same estuaries year after year.

Photo: Department of Fisheries and Oceans.



Mammals

Estuaries are also important to some aquatic mammals. Beluga whales, for example, enter estuaries in the summer to moult their skin, which is 100 times thicker than human skin. They swim into shallow areas of small streams, rub themselves on the muddy or rocky bottom, shed their dead skin with the aid of warm freshwater currents, and grow a new one. At least 25 000 belugas moult in the Mackenzie, Nelson, Churchill-Seal, and Winisk-Severn estuaries. On the Pacific coast, killer whales gather in the Tsitika River estuary to rub against the smooth rocks.

California and Steller's sea lions and harbour seals gather in some Pacific estuaries when fish enter the rivers to spawn in spring, and killer whales follow salmon into estuaries in summer. In the St. Lawrence River estuary, several large species of whales, including the largest, the blue whale, spend the summer feeding on the abundant fish and invertebrates found there.

A threatened resource

Many of our estuaries are under increasing pressure from human development. Damming of rivers for the production of hydroelectricity, for example, has almost destroyed many estuaries by altering the flow of the rivers to accommodate demand for electricity. Many estuaries in southern Canada have been diked for farmland, industry, and housing, eliminating marshlands and intertidal mudflats. Although northern estuaries are relatively untouched by humans, oil exploration and proposed hydroelectric projects pose new threats. Global warming, which causes a rise in sea level, also threatens all estuaries.

Pollution is destroying the fish and wildlife that inhabit our estuaries. Pollutants dumped into rivers can bind to sediment particles, which are then eaten by invertebrates, fish, birds, and, eventually, people. Even small amounts of pollutants can harm life in the estuary, if they are the types of substances that concentrate in animal tissues. PCBs, dioxins, furans, and heavy metals from industry have been found in eggs from herons using the St. Lawrence and Fraser river estuaries, and industrial pollutants are thought to have reduced beluga populations in the St. Lawrence River estuary. Plastic debris has been found in estuaries, where it often entangles wildlife or is mistaken for food and eaten, causing starvation.

Pollution is destroying the fish and wildlife that inhabit our estuaries. Here, a gull has become entangled in a plastic six-pack ring near the Bay of Fundy.



What can you do to help preserve our estuaries?

All Canadians can become actively involved in the protection and conservation of estuaries. Make sure that you dispose of toxic household products properly: never dump them down the toilet, sink, or storm drain, as they may eventually end up in estuaries, where they can harm aquatic life. Instead, contact your municipal or provincial environment department for information on how to properly dispose of the products. As well, as a tourist, use reusable containers, stow your trash when you boat and dispose of or recycle it ashore, and never throw your garbage overboard. If you live near an estuary, undertake a cleanup project along its river banks. Watch out for suspicious-looking discharges from industries and fish kills. Get involved with environmental groups that support the preservation of clean estuaries. Read and learn more about estuaries, and share your new knowledge of estuaries with your friends and neighbours!

Reading list

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The Canadian Wildlife Service

The Canadian Wildlife Service of Environment Canada handles wildlife matters that are the responsibility of the Canadian government. These include protection and management of migratory birds as well as nationally significant wildlife habitat. Other responsibilities are endangered species, control of international trade in endangered species, and research on wildlife issues of national importance. The service cooperates with the provinces, territories, Canadian Parks Service, and other federal agencies in wildlife research and management.

For more information about the Canadian Wildlife Service or its other publications, please write to:

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Environmental Citizenship
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The goal of the Environment Citizenship campaign is to help Canadians learn about their responsibility to protect the environment and to encourage them to take action towards that end.

Canada

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