

# **Grade 9 Science**

Sustainable Ecosystems

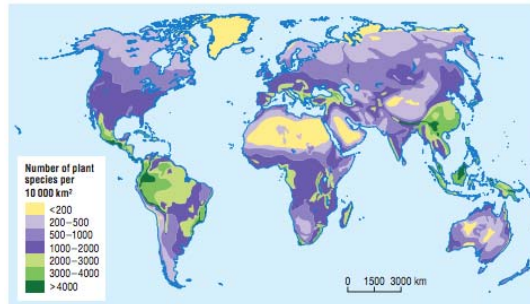
Class 8

## **Succession**

- The process of establishing and replacing a community following a disturbance (volcanic eruption, forest fire, etc.)
  - Primary – succession on newly exposed ground
  - Secondary – succession in a partially disturbed ecosystem
- Small hardy plants grow first, the shrubs and small trees and finally large trees

# Biodiversity

- **Biodiversity** – the variety of life found in an area
  - Measured by counting species richness (the number of species in an ecosystem)
  - Species richness is higher closer to the equator



## Extinction

- **Extinction** – refers to a species that has died out, no longer found on earth
  - Is a natural process
  - Human activity increased the rate of species extinction



**Figure 3** The (a) giant moa and (b) Stellar's sea cow became extinct shortly after humans colonized their ecosystems.

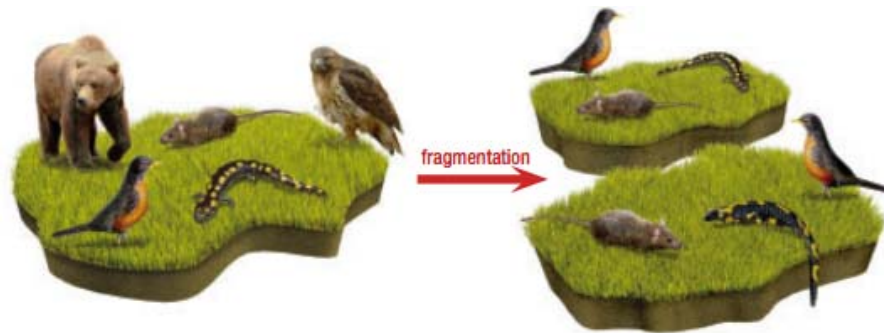
- **Extirpated** – A species that no longer exists in a specific area
- **Endangered** – A species facing imminent extirpation or extinction
- **Threatened** – Species is likely to be endangered if current trends and conditions continue
- **Special Concern** – May become threatened or endangered due to a variety of factors

**Table 1** Examples of Canadian Extinct Species and Species at Risk











Classification	Number of Canadian species (2008)	Examples
extinct	13	<ul style="list-style-type: none"> <li>• great auk</li> <li>• passenger pigeon</li> <li>• sea mink</li> </ul>
extirpated	23	<ul style="list-style-type: none"> <li>• paddlefish (from all of Canada)</li> <li>• Atlantic walrus (from the Northwest Atlantic)</li> </ul>
endangered	238	<ul style="list-style-type: none"> <li>• barn owl (in some regions)</li> <li>• swift fox</li> <li>• northern cricket frog</li> </ul>
threatened	146	<ul style="list-style-type: none"> <li>• humpback whale</li> <li>• wood bison</li> <li>• Kentucky coffee tree</li> </ul>
special concern	157	<ul style="list-style-type: none"> <li>• polar bear</li> <li>• red-headed woodpecker</li> <li>• Atlantic cod</li> </ul>

# Habitat Loss and Fragmentation

- Most of Canada's land is being converted into farmland and urban developments
- Fragmentation – dividing up a region into smaller fragments
  - Species with large home ranges cannot survive



**Table 1** Factors that Improve the Sustainability of Habitat Fragments

Factor	Poorer option	Better option	Explanation
size			Large blocks support larger and more stable populations and communities.
number			One large area is better than an equal area composed of many smaller areas because there is less outside influence.
proximity			The closer ecosystem fragments are to each other, the greater the chance populations will be able to use the entire area.
connectedness			Interconnected areas provide wildlife corridors and permit migration between larger blocks.
integrity			Access by roads and trails can increase pollution, hunting, and fishing.

# Introduction of Non-Native Species

- Most non-native species cannot survive because they do live in the same tolerance range
- **Invasive Species** – a non-native species that thrives and competes with the native species
  - Carp
  - European earwig
  - Starlings



- Ex: Zebra Mussels
  - History: Introduced to Lake Ontario in 1988; attached to the ballast water in ships
  - Ecological Problems: Clog water pipes, foul beaches, kill native clams, disrupt lake ecosystems
  - Economic Problems: Threaten commercial and recreational fishing; hundreds of millions of dollars have been spent to repair damage



# Controlling Invasive Species

- Chemical control – pesticides reduce crop damage but carry environmental risks
  - May kill native species and cause pollution
- Mechanical control – physical barriers to trap invasive species
- Biological control – intentionally introduce another organism to control the population of the invasive species

## Pollution

- **Acid Precipitation** – sulfur dioxide and nitrogen oxides are released into the air from the burning of fossil fuels and combine with water to form acids
  - Acidifies rivers and lakes
  - Damages soil
  - Causes respiratory problems
  - Damages buildings and cars





- **Oil Spills** – oil under the ocean is toxic and difficult to clean up
  - Forms large slicks on the ocean, beach and seabeds
  - Affects birds
- How to clean up an oil spill:
  - Skimming
  - Bioremediation – using bacteria that can breakdown the oil
  - Burning to prevent oil from sinking
  - Detergents to make the oil into small droplets however it can disperse and get ingested more easily



- **Plastics** – plastics are not biodegradable however they can be mechanically broken down into smaller pieces
  - Animals mistaken the plastic for food – blocks the digestive system
  - Traps animals
  - Massive mats of floating trash forms in the ocean
  - Manufacturing of plastics uses fossil fuel which causes air pollution



# Soil

- **Agroecosystem** – agricultural ecosystem
  - Crops grow and incorporate nutrients into their tissue but when farmers harvest the crops, the nutrients are also removed
  - Eventually soil is depleted of nutrients
- **Fertilizers** – used to replenish the nutrients in the soil
  - Natural fertilizers: human and animal waste
  - Synthetic fertilizers: manufactured chemically



## Impact of Fertilizers

	Synthetic fertilizers	Natural fertilizers
examples	ammonia, synthetic urea, potash, potassium, commercial chemical fertilizers	animal manure, sludge, plant materials such as seaweed and compost, blood meal, bone meal, wood ashes
advantages	<ul style="list-style-type: none"><li>• nutrients are released quickly</li><li>• amounts of nutrients can be precisely measured</li><li>• relatively easy to apply</li></ul>	<ul style="list-style-type: none"><li>• less danger of overfertilizing</li><li>• release nutrients slowly</li><li>• can improve soil structure</li><li>• benefit soil micro-organisms and nutrient cycling</li></ul>
disadvantages	<ul style="list-style-type: none"><li>• production is energy intensive</li><li>• cause water pollution</li><li>• nutrients lost from soil through leaching</li><li>• can cause an imbalance in soil chemistry and upset the balance of soil micro-organisms</li></ul>	<ul style="list-style-type: none"><li>• low concentrations of nutrients</li><li>• release of nutrients may be slower than desired</li><li>• not easy to measure the quantity of nutrients</li><li>• may be more difficult to apply</li></ul>



# Alternative Farming Practices

- **No-tillage** – farmers leave the ground undisturbed after the crop is harvested
  - Retains soil nutrients, reduces soil compaction and water loss, improves soil quality
- **Crop Rotation** – grow soybeans, corn and wheat in a three-year rotation to reduce pesticide use
- **Crops for Conditions** – grow heat-resistant, drought-resistant plants in dry areas

# Pests and Pesticides

- Pests – Organisms that might compete with or damage crop species
  - Ex: Weeds, mosquitos, mice
  - In nature, there are no pests
- Pesticides – a substance used to kill a pest
  - Differ in their persistence
  - Broad-spectrum pesticide – toxic to a wide range of species (ex: DDT)
  - Narrow-spectrum pesticide – toxic to a limited number of species (ex: Bt, kills only caterpillars)

# Issues with Pesticides



1. Kills non-target species
  - Affects food-chain
  - 1955, DDT sprayed in Borneo to control mosquitos but it also killed wasps that ate thatch-eating caterpillars
  - DDT also killed cockroaches → lizards → cats → increase in diseases due to overpopulation of rats

2. Bioaccumulation – pesticides can accumulate in the tissue of individuals as they eat food sprayed with pesticides

- Toxins are passed to successive trophic levels and become more concentrated higher up in the food web in a process called biomagnification



# Pesticide Resistance

- Pest develop resistance to the pesticide
- Pests that develop resistance are more likely to reproduce and pass on their resistance to the offspring
- Weeds and insects are most likely to develop resistance because they reproduce frequently
- Farmers need to use a higher concentration to have the same effect

# Organic Farming

- Does not use synthetic pesticides or fertilizers
- Suffer crop losses to naturally occurring pests so usually organic food is more expensive in order to compensate the loss

**Table 1** Techniques Used by Organic Farmers

Method	Description
biological control	<ul style="list-style-type: none"><li>• Predatory insects, mites, and disease-causing micro-organisms prey on and infect prey species.</li><li>• Examples include parasitic wasps and ladybird beetles (ladybugs).</li></ul>
altered timing	<ul style="list-style-type: none"><li>• Better timing of planting and harvesting can avoid peak pest populations.</li></ul>
crop rotation and mixed planting	<ul style="list-style-type: none"><li>• When farmers do not grow monocultures in the same location year after year, pest populations do not have the same opportunities to establish and prosper.</li></ul>
baiting pest	<ul style="list-style-type: none"><li>• Pheromone baits can be used to confuse some mating insects.</li></ul>

# Greener Strategies

**Table 2** Examples of How Some Cities Are Working to Reduce Their Ecological Footprint

Community action	Benefits
use community composting programs to collect food and yard wastes	<ul style="list-style-type: none"><li>• reduces need for landfills</li><li>• produces valuable fertilizer</li></ul>
use light-emitting diodes (LEDs) in traffic lights	<ul style="list-style-type: none"><li>• reduces energy consumption</li><li>• saves on bulb replacement costs</li></ul>
promote green roofs on flat-topped commercial buildings	<ul style="list-style-type: none"><li>• improves air quality</li><li>• reduces building heating and cooling costs</li></ul>
enhance and promote public transit	<ul style="list-style-type: none"><li>• reduces air pollution and energy costs</li></ul>
ban the cosmetic use of pesticides	<ul style="list-style-type: none"><li>• reduces air and water pollution</li><li>• reduces health risks associated with exposure to pesticides</li></ul>
enhance green spaces within cities	<ul style="list-style-type: none"><li>• improves air quality</li><li>• encourages participation in healthy outdoor activities</li></ul>
promote shop locally campaigns	<ul style="list-style-type: none"><li>• reduces transportation costs</li></ul>