MANITOBA ENVIROTHON

WILDLIFE ECOLOGY

REGIONAL RESOURCES

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INTRODUCTION TO WILDLIFE

Wildlife is defined as animals that are undomesticated and most commonly free-living. They include more than just the mammals and birds living in a wilderness area. Every form of virus, soil organisms, insect, no matter where it lives, is a wild species. The basic habitat needs of food, water, cover, and space are essential to maintaining healthy populations of diverse species in their respective ecosystems. Maintaining a healthy, biodiverse environment is the key to species survival. Biodiversity means the variety of life on Earth. It is most commonly measured as the variety within a species (known as genetic diversity), the variety between species, and the variety of ecosystems. Education and good management practices are needed to ensure a future in maintaining healthy, biodiverse ecosystem.

Canada and Manitoba in particular, has a vast abundance of wildlife resources. The diversity of habitat types has paved the way for diverse ecosystems. The commercial, game, aesthetic, ethical, scientific and ecological values of wildlife have captivated everyone's interest in these organisms and their naturally associated environments.

ECOLOGY

Ecology is the study of the inter-relationships among and between organisms (including wildlife) and all the aspects (living and non-living) of the environment. Organisms compete with other individuals for food and other resources. They also prey upon others, parasitize them, provide them food, and change their physical and chemical environment. Interactions between species can take various forms. **Neutral interactions** will have no effect on individuals or populations. **Positive interactions** will benefit either individuals or populations. These interactions are known as *mutualism* (+/+). In some situations the relationships are one sided where one group or species or individual is benefited while the other is neither benefited nor harmed. This is known as *commensalism* (+/0). An example of a commensalism is between trees and epiphytes, small plants that grow on the branches of trees. *Amensalism* (-/0) refers to a relationship where one population or individual is negatively affected while the other remains unaffected. *Predation* and *parasitism* (+/-) are two other relationships in which one group is positively affected while the other is negatively affected. Predation involves the killing and consumption of the prey whereas parasitism is an interaction where on (usually small) organism lives on or in another (the host) from which it obtains nutrients. Relationships between populations or species can also have a negative effect on both parties. **Inter**specific competition represents a negative interaction between two **different** species. **Intra**specific competition represents a negative interaction between two individuals of the **same** species.

Ecosystem – a community of living things interacting with each other and the physical environment. An ecosystem can be a planet, the boreal forest, a stand of trees, a lake, or a fallen log.

Organism – any living individual system (e.g. animal, fungus, microorganism, plant, etc.)

Population – a group of organisms, all of the same species, that live in a particular area

Community – any group of populations of different organisms that are found living together in a particular environment. The organisms interact and give the community a structure.

HABITAT

All living things have basic habitat needs, four of which are: food, water, cover, and space. When these needs or habitat factors are in good supply, they contribute to the well-being of wildlife. A short supply of any factor that will limit the number and distribution of wildlife and is called a limiting factor. An animal's habitat must provide these basic needs in the proper 'arrangement', which is known as the fifth basic habitat need. Each species of animal has its own habitat requirements.

Food – all animals need food to meet their energy needs: to grow, reproduce, escape predators, and survive chilling winters or long migrations. Each species selects particular foods from the foods that are present in its environment. Some species are more specific about their food selection than others.

Cover – many animals need shelter or cover to hide in, to raise young, and to protect them from harsh conditions. Dense vegetation is the most common kind of cover, but cover may also include rock piles, burrows in the ground, holes in logs, or bodies of water. Some small animals such as beaver and muskrats, build their own cover in the form of houses.

Water – all animals need water. Many wildlife species get enough water from the food they eat, such as succulent plants, but some also need to drink water.

Space – animals need space to survive. Overcrowding leads to severe competition for food and breeding sites, and eventually to malnutrition and rapid spread of parasites. Most animals are territorial to some extent; that is, they will occupy specific sites sometimes known as their home range. Their territoriality tends to ensure spacing and prevent overcrowding. Because of the need for space, a given area will only support so many animals. Many species have very particular needs for breeding sites. Dense forest cover is needed by moose to conceal newborn calves and by tree-nesting birds to hide their nests. Bald eagles need large old trees to support their bulky nests and these trees must be near the shorelines where they feed. Hole-nesting birds need snags and old trees in which to excavate nests, falcons need cliff ledges, and seabirds that nest in colonies need secluded islands. Some mammals, like foxes, wolves and bears, need particular soil conditions for digging their maternity dens.

Arrangement – the arrangement of food, cover, water and space is important in determining the numbers and distribution of wildlife. For many species of wildlife, the best arrangement is in small blocks that produce edges. For other species, they need large tracks of land that are undistributed by any development for survival.

Carrying capacity

Every region has a limited amount of resources. Due to its limit in resources, it can only support so many animals. The number of animals that an area can support without damage to the habitat or animals is called the carrying capacity. The uppermost limit on the size of a population is often determined by the availability of food. For example, the growth of plants depends on the supply of nutrients and solar energy. The quantity of plant material produced determines, in turn, the maximum possible population of herbivores. The number of these animals will then set a limit to the number of carnivores. Food is not the only limiting factor on the growth of a population and so the maximum size of the population may never be reached. For example, there may be enough food to sustain thousands of birds in a region but not enough nesting sites.

Some animals can increase in numbers very quickly and may exceed their carrying capacity temporarily. This results in severe decrease in resources, environmental deterioration, social stress, increased competition for food and possible starvation, and greater exposure to parasites (leading to increased disease), predation, poor reproductive success, and damage to the habitat. For example, multiplying muskrats can very quickly eat all the vegetation in a marsh and then die out. The few individuals that were able to find food while it was scarce will then represent the surviving population. The vegetation will recover and the population will increase again.

Most animals are food (prey) for other animals, and when their population increases, so does the number of predators. Once the prey population has been reduced, there may be less food for some predators; their numbers will decline and a balance may again be restored. An example of this 'cyclic population' is the relationship between the snowshoe hare and the lynx. Lynx, because of their large well-furred feet, are physically adapted to pursuing snowshoe hare and selectively feed on them. Both populations follow a ten-year cycle of boom and bust. The cycle of lynx follows that of the snowshoe hare by one or two years. For example, when snowshoe hare numbers reach their 'low', the lynx population responds with a lower survival rate of young and a lower reproductive rate in females because of the reduced food source.

Population dynamics

A population is a group of animals of the same species that occupy a particular area. Dynamics refers to motion or change from within. Population dynamics means the changes that occur in a population over time. The study of population dynamics helps explain why wildlife populations must be managed and how. Two major factors affect the population dynamics of wildlife - the birth rate and the death rate.

Birth Rate:
Generally, the smaller species of wildlife have higher birth rates than the larger species. The most important factors that affect the birth rate are:

- Age at which breeding begins
- Number of births per year for each breeding female (how many times each year young are born)
- Number of young born per litter

Death Rate:
The smaller species of wildlife have higher death rates than the larger species (in general). The principal factors affecting the death rate of wildlife:

- Availability of food
- Predation and cover
- Weather
- Pathogens and disease
- Human activities

BASIC GROUPS OF WILDLIFE

Wildlife includes all non-domesticated animals within a region. Animals are multicellular, eukaryotic species that ingest other organisms or their products for sustenance (heterotrophs). They include species that range from small multicellular copepods to the large bison that roam the prairies. There are 35 known phyla, or groups of animals, that are currently found on earth. Below is a brief listing of some common phyla and their distinguishing characteristics.

Orange sea sponge (*Porifera*)

Porifera – have the most simple cellular organization of animals and a system of pores, with collar cells, through which water passes and they obtain nutrients from this filter feeding. **e.g.** sponges

Different types of coral (*Cnidaria*)

Cnidaria – have tissue level organization but no true organs and a gastrovascular cavity that serves as both the mouth and anus. They also have tentacles surrounding this opening, often containing nematocysts (for hunting and predator defence). Cnidarians have two basic body forms, the medusa, like sea jellies, and the polyp, like corals. **e.g.** corals, sea anemones, sea jellies, and hydra

Snail (*Mollusca*)

Mollusca – large diverse group of animals (over 50 000 species) that have soft bodies with a 'head' and 'foot' region. Often they have a hard exoskeleton made from calcium carbonate, secreted by their mantle. **e.g.** clams, snails, slugs, squid, and octopus

Sea flatworm (*Platyhelminthes*)

Platyhelminthes – also known as flatworms, they are unsegmented, bilaterally symmetrical worms. They have many species' in this group that are parasitic. They have no respiratory or circulatory systems as they perform these functions through their body wall. **e.g.** tapeworms, flukes

Nematoda – also known as round worms, nematodes are worm-like species that are surrounded by a strong, flexible layer called a cuticle. It has been suggested that there may be over 500 000 species in this phylum. **e.g.** hookworms, pinworms

Annelida – segmented worms, where the segments form subdivisions in the body cavity. Each segment contains parts of many body systems including circulatory, nervous, and excretory tracts. **e.g.** earthworms, leeches, red velvet worms

Arthropoda – This phyla has more species than all the other phyla combined, with the insects (a large group of arthropods) being suggested to have over ten million species still undescribed. Arthropods are strongly segmented affecting both the external and internal structures. They have an exoskeleton made primarily of chitin. Each body segment has a pair of jointed appendages, although these appendages may be modified or even lost. They grow by molting their exoskeletons. Further, many species of arthropods have highly developed eyesight. **e.g.** insects, crustaceans (lobsters and crabs), spiders, scorpions, and centipedes.

Chordata – characterized by having a structure called a notochord (like a spinal cord) during some part of their development. They are bilaterally symmetrical and have a brain. Chordates also have a tail posterior to their anus at some point of development, a heart, complete digestive system, and a bony or cartilaginous endoskeleton. **e.g.** birds, mammals, amphibians, fish, and humans.

Nematode with bean (*Nematoda*)

Earthworm (*Annelida*)

Beetle (*Arthropoda*)

Lionfish (*Chordata*)

WILDLIFE ANATOMY AND IDENTIFICATION

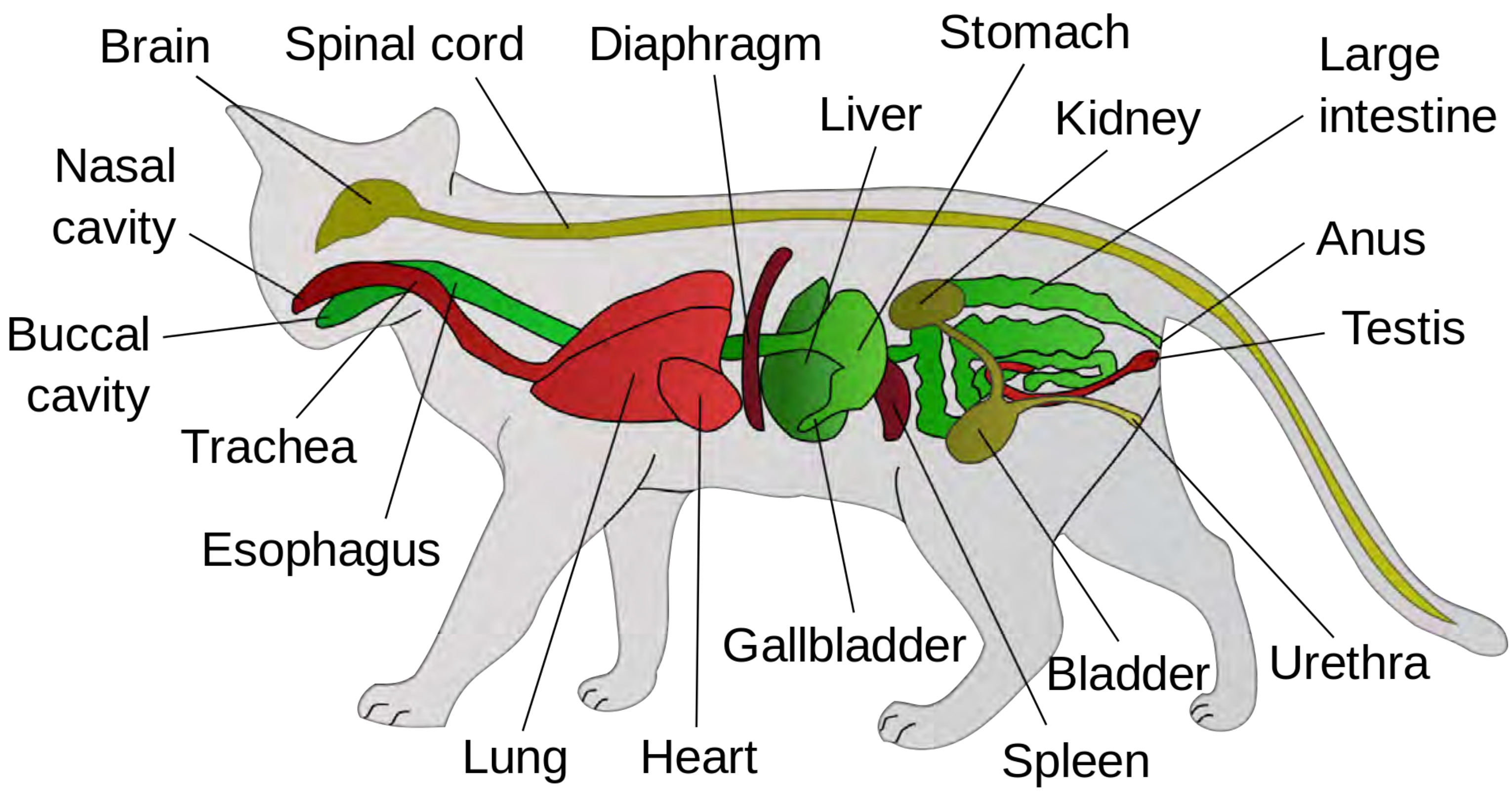
A broad understanding of basic anatomy and identification of wildlife is key when trying to understand their behaviour, abundance, diversity, as well as making management decisions within a region.

BASIC ANATOMY

Mammals are a group of vertebrate species that share a number of characteristic features. They are endothermic homeotherms, meaning they remain at a near constant temperature (most of the time, excluding during torpor or hibernation) with the capacity for internal temperature control. Mammals also have hair at least at some point in their lives. This hair often aids in the control of internal temperature. Mammals also possess mammary glands that they use for nourishing their young. With a few exceptions, they give birth to live young. A few other characteristics define mammals, including a middle ear with three bones, the lower jaw is made from a single bone, and a single muscular diaphragm which splits the body cavity into two sections. The skeleton of a mammal is split into three sections, the cranium (including the skull), axial skeleton (including the vertebrae, spinal column, and rib cage), and the appendicular skeleton (including the girdles and limbs).

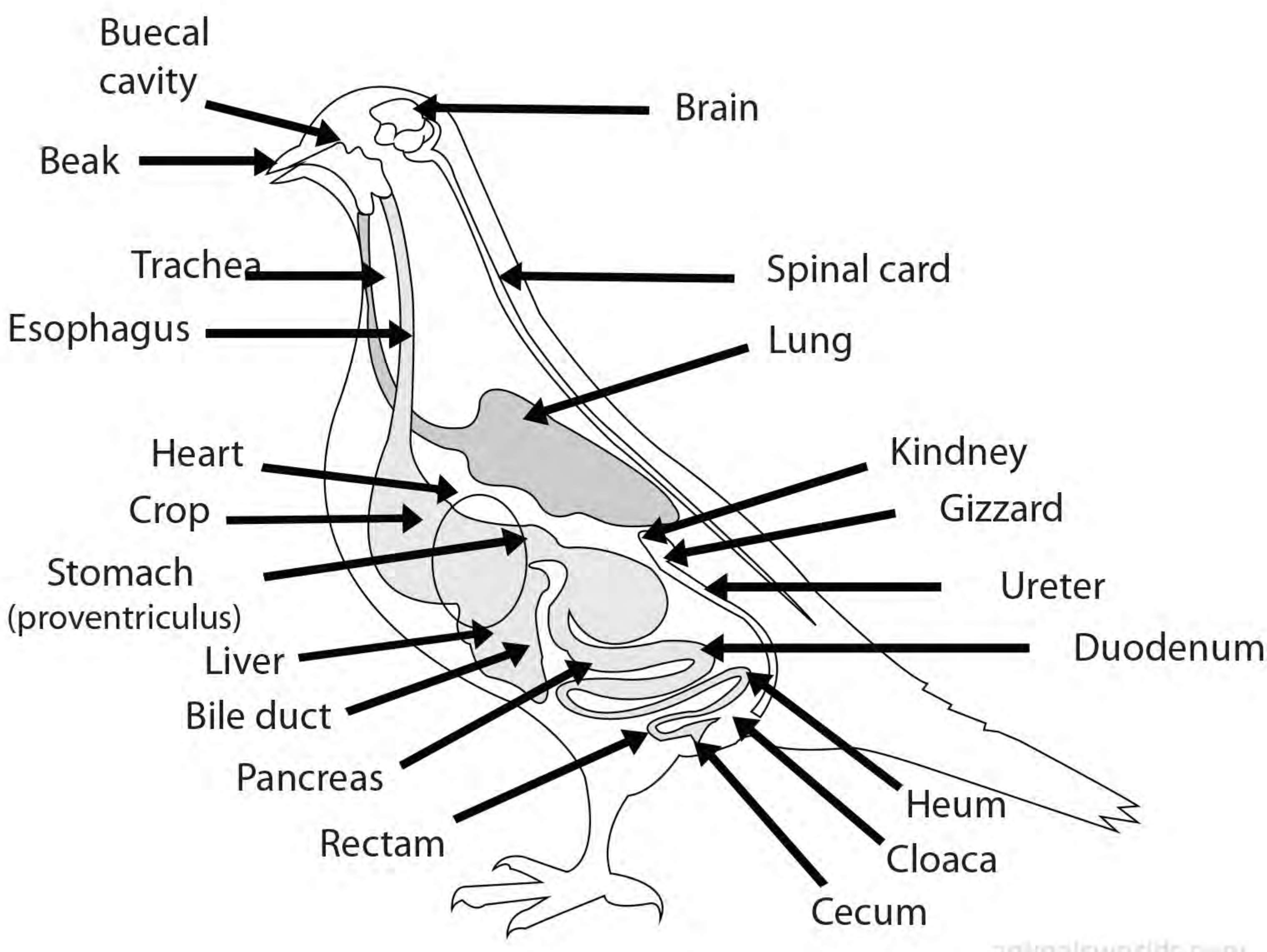
Mammals vary in their mode of locomotion. Most move quadrupedally, using all four limbs, although there are a few exceptions to this like humans who can walk upright. Mammals can be **cursorial** (having limbs adapted for running), spending much of their time running to escape predators, catch prey, or possibly migrating (e.g. pronghorns). They could also be **ambulatory** (having limbs adapted for walking), spending most of their time walking (e.g. bears). How the mammal contacts the ground also varies based on the species'. **Digitigrades** run on one or more toes (e.g. carnivores). **Unguligrades** use their fingernails or hooves to contact the ground (e.g. deer and cattle). If an animal is **plantigrade**, the ankles to the tips of the toes are imprinted (e.g. rabbits, raccoons, and skunks). Bats are a unique as they are the only mammal to truly fly.

The mammalian body has **11 main organ systems**. Each organ system uses various organs to perform its main functions. Below is a diagram and description of all major organs within a mammal and all 11 organ systems are outline below, followed by a brief description of some of their major organs.



Organ system	Main components	Main functions
Digestive	Mouth, pharynx, esophagus, stomach, intestines, liver, pancreas, anus	Food processing (ingestion, digestion, absorption, elimination)
Circulatory	Heart, blood vessels, blood	Internal distribution of materials
Respiratory	Lungs, trachea, other breathing tubes	Gas exchange (uptake of oxygen, disposal of carbon dioxide)
Immune and Lymphatic	Bone marrow, lymph nodes, thymus, spleen, lymph vessels, white blood cells	Body defence (fighting infections, pathogens, disease)
Excretory	Kidneys, ureters, urinary bladder, urethra	Disposal of wastes and maintenance of osmotic balance of blood
Endocrine	Pituitary, thyroid, pancreas	Coordination of body activities
Reproductive	Ovaries, testes, and associated organs	Reproduction
Nervous	Brain, spinal cord, nerves, sensory organs	Coordination of body activities
Integumentary	Skin and its derivatives (e.g. hair, claws, skin glands)	Protection against mechanical injury, infection, drying out, thermoregulation
Skelatal	Skeleton (bones, tendons, ligaments, cartilage)	Body support, protection, movement
Muscular	Skeletal muscles	Movement, locomotion

Birds, also known as Aves (their class), are feathered, winged, bipedal, endothermic vertebrate animals. There around 10 000 living species of birds. They range in size from the bee hummingbird (0.05 m long) to the ostrich (2.75 m long). They are characterized by their feathers, a beak that lacks teeth, laying hard-shelled eggs, high metabolic rate, and a lightweight but strong skeleton.

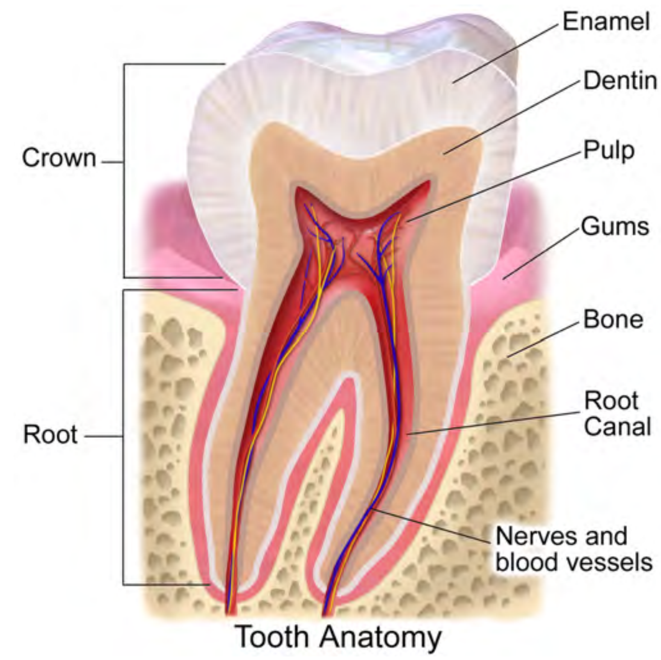


Many of the organs are similar between birds and mammals, including the **heart**, **liver**, **brain**, **spinal cord**, **kidneys**, and **intestine**. Birds also have **crops**, **gizzards** (both part of the digestive system) as well as a **cecum**.

SKULLS AND TEETH

Skulls and teeth are important tools we can use not only to identify the species of specimen in the field but also can give us insights into the life of the animal, what it eats, how it forages, or even special adaptations to its environment.

Birds, reptiles, fish, and amphibians have **homodont** teeth (if teeth are present), meaning all the teeth are the same relative shape and morphology. Mammals are unique in the fact that they have **heterodont** teeth, meaning many teeth are different, including incisors, canines, premolars, and molars. They suggest that the animal has some level of hunting and/or feeding specialization. Differences in the structure of mammalian teeth give some clues to the foraging activities of the species.



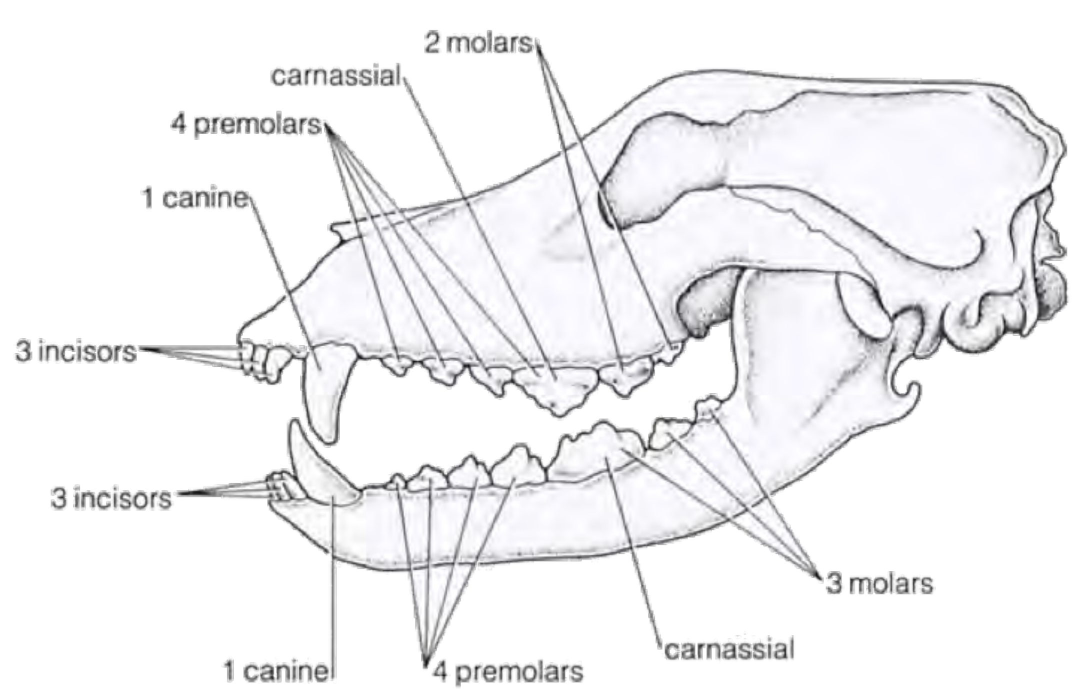
To the right is an image of the basic structure of a mammalian tooth. As the cementum layer is added annually in most species of mammals, analyzing teeth can also provide the age of the individual.

Dental formula

The number of different tooth types found in a skull can be expressed using the dental formula. It can then be used to identify a skull. To find the dental formula of an individual skull you must identify the number of teeth of each type (incisors, canine, premolars, and molars) on the top and bottom of one HALF of the skull (either left side or right side). Upper numbers in the fraction are for the upper teeth; lower numbers in the fraction are for the lower teeth. The "2" in the front of the formula indicates that this arrangement of teeth is the same for both sides of the mouth.

I – Incisors, C – Canines, P – Premolars, M- Molars

For example in a dog skull,



$$2\left(I\frac{upper\ teeth}{lower\ teeth}\ C\frac{upper}{lower}\ P\frac{upper}{lower}\ M\frac{upper}{lower}\right)$$

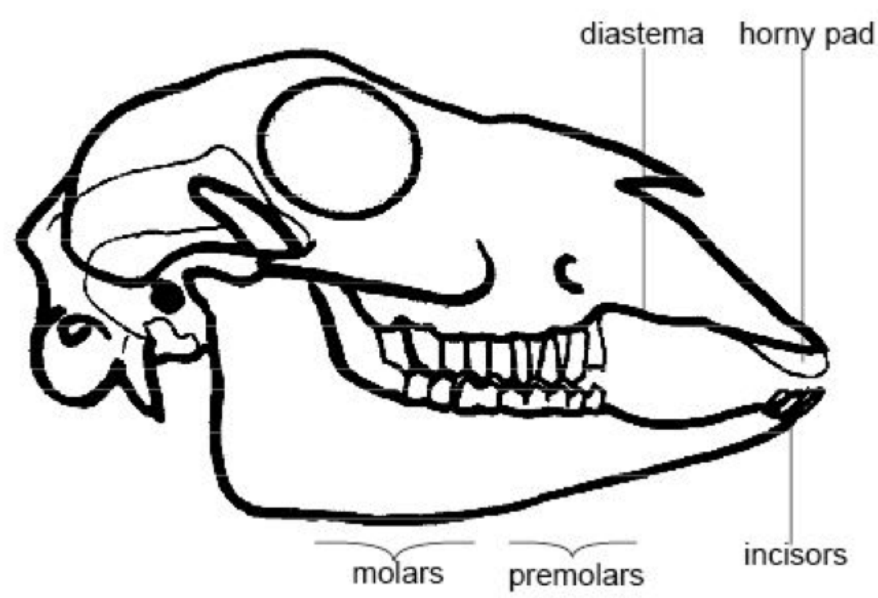
The calculation of the total dental formula involves the addition of the number of all the upper teeth plus the combination of all of the lower teeth. This is then multiplied by two (to account for the two sides of the skull) to calculate the total number of teeth in the skull. The dental formula of the individual is then reported as below:

$$2\left(I\frac{3}{3}+C\frac{1}{1}+P\frac{4}{4}+M\frac{2}{3}\right)$$

$$2\left(\frac{3+1+4+2}{3+1+4+3}\right)=2\left(\frac{10}{11}\right)=2(21)=42$$

(3/3, 1/1, 4/4, 2/3) = 42

A second example of a sheep's skull,

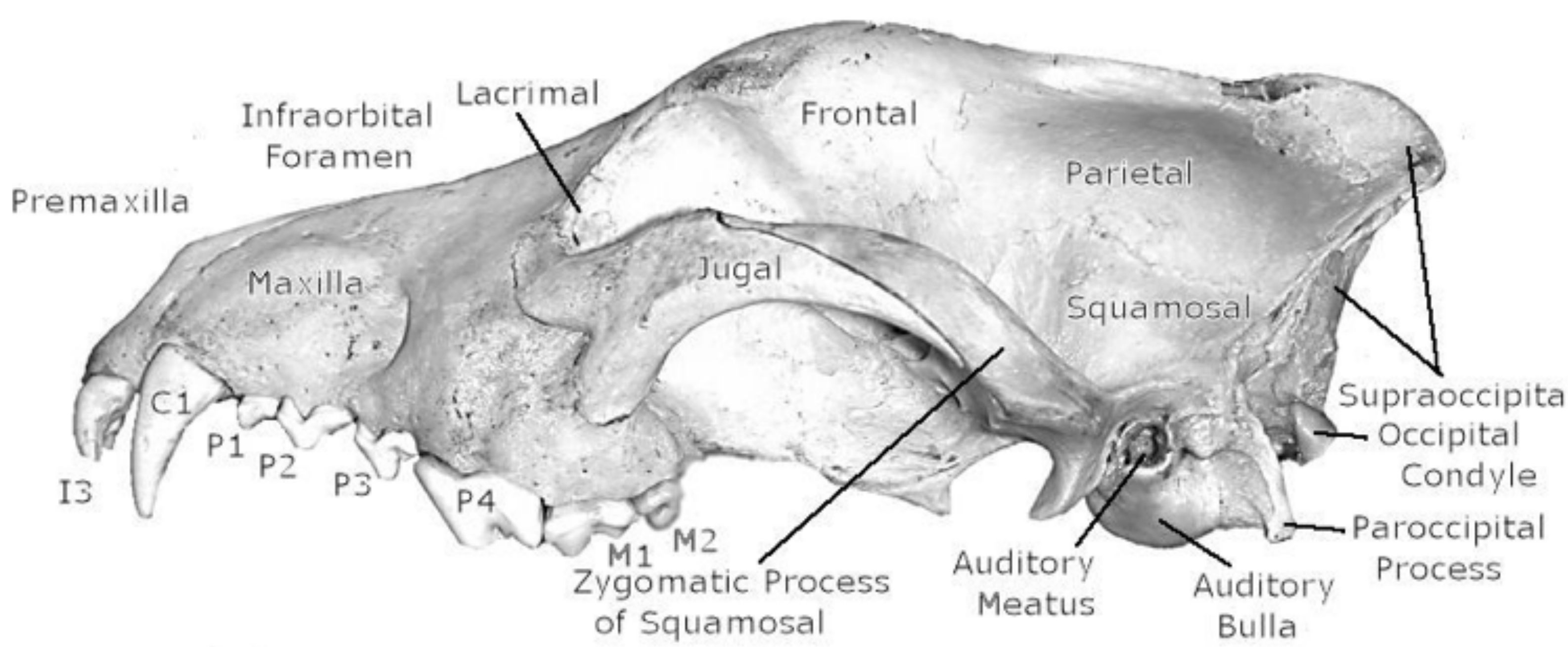


$$2\left(I\frac{0}{4}+C\frac{0}{0}+P\frac{3}{3}+M\frac{3}{3}\right)$$

So, the dental formula for a sheep would be (0/4, 0/0, 3/3, 3/3) = 32

Mammal Skulls

The identification of a skull (animal species) can be determined by several methods. The use of a **dichotomous key** allows a person, through a series of questions, to identify an organism to species by process of elimination. Other measurements of the skull can be taken to help in this process. Common measurements include *Condylo-basal length* (from the **occipital condyle** to the furthest edge of the **premaxilla**) for the length of the skull, *zygomatic breath* (greatest distance between the outer edges of the **zygomatic arches)** for the width of the skull, and *nasal length* (distance from the edge of the **premaxilla** to end of the **nasal bone**) for the length of the nose.



In combination with the structure of the teeth, a mammal skull can tell you a lot about the diet and lifestyle of its owner. Above is a picture of a canid (carnivore) skull. Below are diagrams of some basic mammal skulls from major mammalian groups.

Beaver (Rodent) skull

Bat skull (note reduced incisors)

Shrew (Insectivore) skull

Beluga (cetacean) skull

Snowshoe hare (Lagomorph) skull

Moose (Artiodactyla) skull

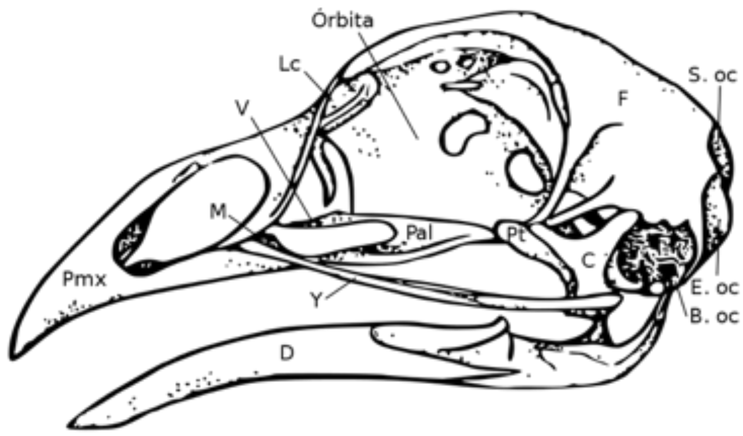
Bird Skulls

The beak of a bird is an extension of its skull and is designed for feeding. Some beaks have evolved to specialize in feeding specific items. A duck, hawk, hummingbird and sparrow are all birds, but their beaks are very different due to their different diet. A duck has a wide flattened "bill" used for eating aquatic plants and mosses. A hawk has a sharp hooked beak used in tearing flesh from its prey or carrion.

Duck Skull

Hawk Skull

A hummingbird uses its long narrow beak to lap nectar from flowers and a sparrow has a small powerful beak used for picking berries and cracking seeds. As you can see, a bird's beak can tell you a lot about not only the diet, but also the lifestyle of its owner.



Crane Skull

Hummingbird Skull

Horns and Antlers

Horns or antlers found on a skull bear evidence of how an animal communicated, defended its self, and possibly the animals' sex. Animals can protect themselves or attack other animals by goring them with their horns or antlers. Bighorn sheep, muskox and deer use their horns or antlers for establishing territory and winning mates. **Horns** are permanent structures that grow year after year. Depending on the species, both male and female bovid animals (cattle, gazelle, antelope, etc.) can have horns. **Antlers**, however, are temporary. Antlers grow, develop and shed from the animal once a year. Antlers are branched and only found in the cervid family (deer, moose, elk, etc.). With the exception of the female caribou, only male cervids have antlers.

Bighorn Sheep with horns

White-tailed deer with antlers

ANIMAL ACCLIMATION AND ADAPTATION

Adaptation is any behavioural, morphological, or physiological trait that is a result of natural selection. This inherited characteristic should enhance an organism's ability to survive and reproduce in their environment. Some individuals, who often possess these adaptations, will leave more offspring than others. These individuals are considered to be more 'fit' than others because they contribute the most to the entire population's gene pool. Differences in the reproductive success of individuals come about through the process of **natural selection**. Under a specific set of environmental conditions, the individuals that survive the best or have adaptations to best survive those conditions are selected for but any individuals that either do not have adaptations to survive and reproduce in these conditions or survive worse than others will be selected against.

Acclimation is the short-term response of an individual to different or changing natural environments. For many species, this acclimation occurs each season. For example, a fish inhabiting a pond in which the water temperature changes from summer through to winter. As the winter cools in fall and winter, the tolerance for low temperatures increases, while their tolerance for high temperatures decreases and vice versa. As the water warms during the spring, the tolerance of the fish for warmer temperatures gradually increases. Although their tolerance changes with the seasons all of this shifting takes place within the adaptive limits of the fish.

BASIC NEEDS AND ADAPTATION

All wildlife need to solve a common set of problems. They must obtain oxygen, nourish themselves, excrete waste products, and move.

Abiotic factors, such as temperature, water, sunlight, wind, rocks and soil, and climate all impact an animal's ability to obtain the resources they need to live and ability to survive in the environment. The temperature of an area affects all biological processes. The availability of water within regions affects species distribution as all species need water to survive and many species live within this water. Sunlight provides the energy that plants use to grow. As the primary food source, the abundance and distribution of plants in an environment will impact the abundance, density, and diversity of wildlife in a region. Additionally, the physical structure of rocks and soil limit the distribution of plants and thus the animals that rely on them. Climate is one of the biggest abiotic driving factors that influence the distribution of wildlife on earth. Climate influences the temperature of a region, availability of water, sunlight, and wind, as well as the structure of rocks and soil. It also limits the biological process of all living organisms and thus plays a large role in dictating the diversity and abundance of wildlife.

Animals need to derive their energy from organic carbon compounds. All animals eat other organisms to stay alive. The ultimate source of these organic compounds is plants. More details about how animals obtain energy and the flow of energy through an ecosystem are discussed in Trophic Ecology.

Animals are required to obtain oxygen from their environment to stay alive. Groups of wildlife obtain this oxygen and distribute it through their bodies differently. Wildlife must take molecular oxygen (O_2) from their environment and release carbon dioxide (CO_2) back into the environment. The exchange of gases occurs on the respiratory surface. The oxygen must then be supplied to the entire body (through the circulatory system) and carbon dioxide removed. The structure of the respiratory surface depends on the size of the organism, its habitat, and its evolutionary past. Some animals, such as earthworms and some amphibians, use their entire outer skin as a respiratory organ. Gills, outfoldings of the body surface, are used by some aquatic invertebrates (e.g. sea stars, segmented worms, scallops, crayfish, etc.) as their respiratory surface. Tracheal systems are used in insects. The tracheal system is made up of air tubes that branch throughout the body. Lungs are a respiratory surface that is restricted to one location. They have a dense net of capillaries that form the main respiratory surface. They are present not only in mammals and birds, but other vertebrates, terrestrial snails, and spiders. The size and complexity of the lungs are correlated with the animal's metabolic rate. Further adaptation is seen within these basic respiration surfaces. For example, bird ventilation is much more complex than observed in mammals. The additional complexity increases the concentration of oxygen within the birds allowing them to fly at high altitudes.

An animal's size and shape are fundamental aspects of form and function that affect the way an animal interacts with its environment. Physical requirements constrain what natural selection can select for, including the size and shape of an animal. For example, physical requirements limit the size and shape of flying animals. An animal the size and shape of a mythical dragon could not generate enough lift with its wings to get off the ground. In contrast, a small hummingbird is light for its size and is well adapted to flight.

HABITAT AND SPECIALIZED ADAPTATION

Wildlife adapt themselves to the habitat in which they live. Specialized adaptation of each species to their habitat ensures their survival and continued ability to reproduce. This adaptation also allows species to survive predictable changes in their environment, such as the onset of winter or summer, or the wet or dry seasons.

Thermoregulation

Thermoregulation is the process by which animals maintain their internal temperature. Animals use different strategies to manage their "heat budgets". All of these strategies have both large benefits as well as costs associated with them.

Ectotherm – gain most of their heat from the environment. Many ectotherms regulate their body temperature through behavioural means, such as basking in the sun or seeking out shade. They include invertebrates, fishes, amphibians, lizards, snakes, and turtles.

Endotherm – use metabolic heat (from their body) to maintain or regulate their body temperature. Examples include mammals, birds, a few reptiles, some fish, and a few insect species. The maintenance of a constant body temperature is another adaptation that is seen in some animal species.

Pokilotherm – an animal whose internal body temperature varies widely. Examples include fish and invertebrates.

Homeotherm – an animal whose internal body temperature remains relatively stable. Examples include mammals and birds.

Although we generally think of all ectotherms also being pokilotherms (or 'cold-blooded') and all endotherms being homeotherms (or 'warm-blooded') there are many species that have different adaptive strategies. Many species of marine invertebrates and fish are ecotherms, gaining heat from their environment, but because their environment does not fluctuate in temperature much, their body temperature remains relatively constant, making them homeotherms. Further, some mammal species experience large variations in body temperature through the year (e.g. hibernation) despite them being endotherms.

Animals have many adaptations to assist them with thermoregulation. They include insulation (e.g. hair, feathers, blubber, etc.), circulatory adaptations (e.g. vasodilation, vasoconstriction, countercurrent heat exchanger, etc.), behavioural responses (e.g. hibernation, migration, etc.), and adjusting metabolic heat production (e.g. brown fat).

Camouflage

Camouflage is the set of methods of concealment that allows otherwise visible animals to remain unnoticed by blending in. In many animal species, young are born with dappled brown coats so that they can blend into the brush or forest. The arctic fox and snowshoe hare change into a white coat during the winter period to blend into their snowy environment. They shed this winter coat in the summer period. It is replaced by a mostly brown coat.

Mirnesis is a type of camouflage where an animal resembles something else in its environment. For example (as seen in the photo to the top right), the stick insect mimics a stick, hiding itself from predators.

Crypsis is a type of camouflage where the animal means to be hidden. Cuddlefish (as seen in the photo to the bottom right) are very good at matching the colour and texture of their environment protecting them from predators. Many species of octopuses camouflage in the environment, allowing them to capture prey more easily.

Behaviour

Each animal species has unique behaviours that allow it to survive in its habitat. Examples include different social organizations, such as flocks or herds (geese, cranes, caribou, sheep, goats, elk, muskoxen, fur seats, walrus), family groups (eagles, wolves, whales, river otters, foxes, beavers), solitary life (moose, lynx, wolverines, porcupines), and colonies (many rodents).

Other adaptive behaviours are defensive strategies. For instance, muskoxen form a tight circle around the herd's young when threatened by predators. The adults face the outside of the circle, showing only their horny brows and front hooves.

Still other adaptive behaviours include hunting methods, such as wolves' pack hunting, killer whales' and humpback whales' circles of bubbles that trap fish, and bears' use of their long claws to swipe salmon from streams.

TROPHIC ECOLOGY

Trophic ecology is the study of how energy moves through an ecosystem. All organisms must obtain energy for their growth, survival, and reproduction. The methods of obtaining these resources and the impacts of resulting interactions are all studied within trophic ecology.

Autotrophs – organisms that use inorganic sources of carbon and energy from solar radiation. Examples include plants, algae, and certain bacteria. They are also known as **PRIMARY producers**.

Heterotrophs – organisms that use organic sources of carbon by consuming other organisms or their by-products. Examples include animals, bacteria, and fungi. They are often referred to as **SECONDARY producers**.

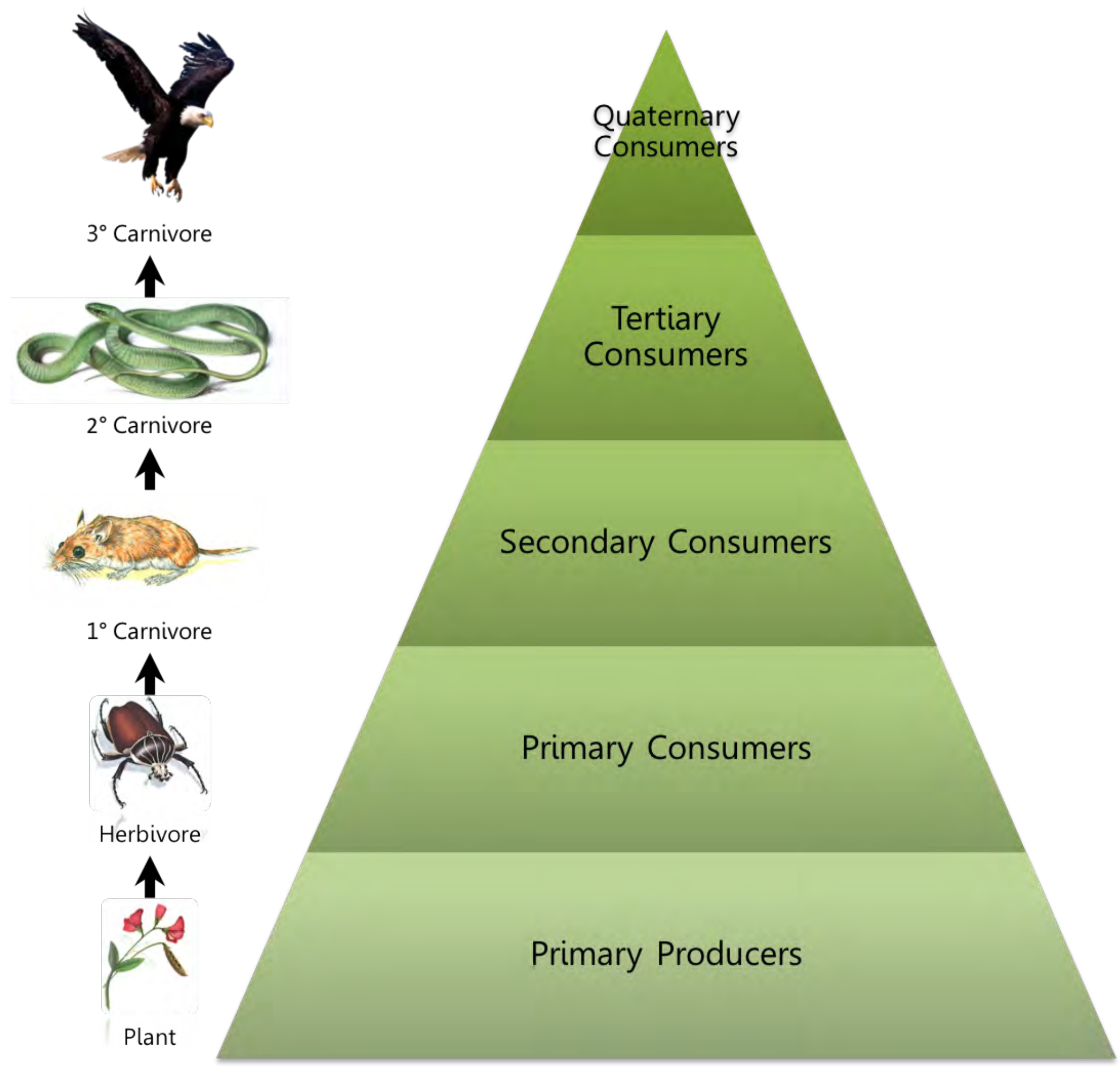
> **Consumers** – these are heterotrophs that consume other organisms
> **Decomposers** – these are heterotrophs that consume dead organic matter or waste products

Herbivores – organisms that primarily consume plant materials. They include grazers (feed on leafy material like grasses), browsers (feed on woody material), granivores (feed on seeds), and frugivores (feed on fruit).

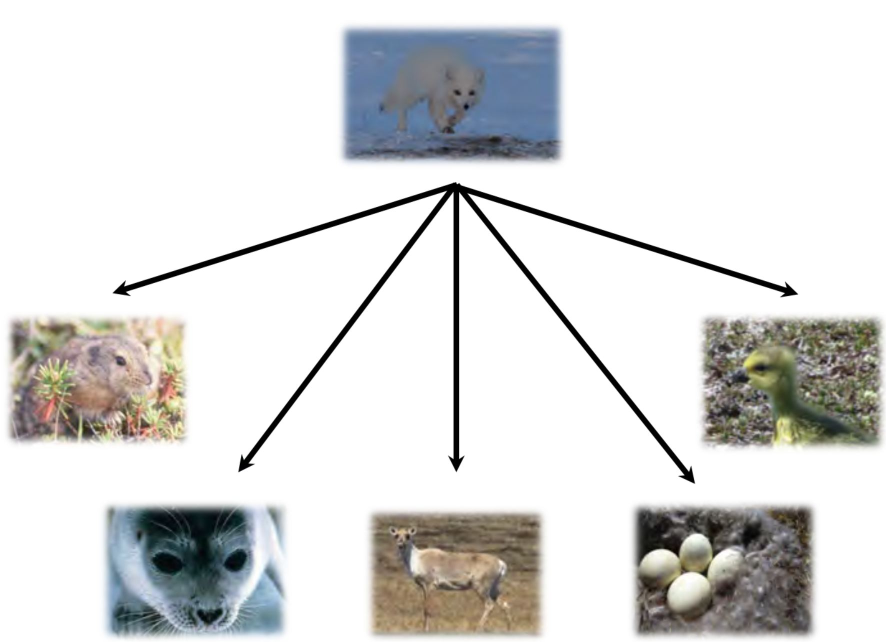
Carnivores – organisms that are 'flesh-eaters'. They consume herbivores or other carnivores. Individuals that feed directly on herbivores are considered first-level carnivores (second level consumers). Individuals that consume both herbivores and first-level carnivores can be considered second-level carnivores (third level consumers).

The trophic level is a stem in the transfer of energy, or food, within a food web or chain. There may be several trophic levels within a system, including primary producers, primary consumers, and secondary consumers. Further carnivores may form fourth and fifth levels. Primary producers are the most abundant food source and biomass (mass of organic material) available. Primary consumers, who consume primary producers, are the second most abundant group of organisms. Tertiary and quaternary consumers represent the smallest groups of organisms. The amount of energy in each a trophic level is reduced with every step up.

Many species can feed on different trophic levels. For example, the red squirrel often will consume acorns or fruits, primary producers, and so it acts as a primary consumer. However, red squirrels can also consume insects or nesting birds. When they consume these prey sources they are acting as secondary consumers.

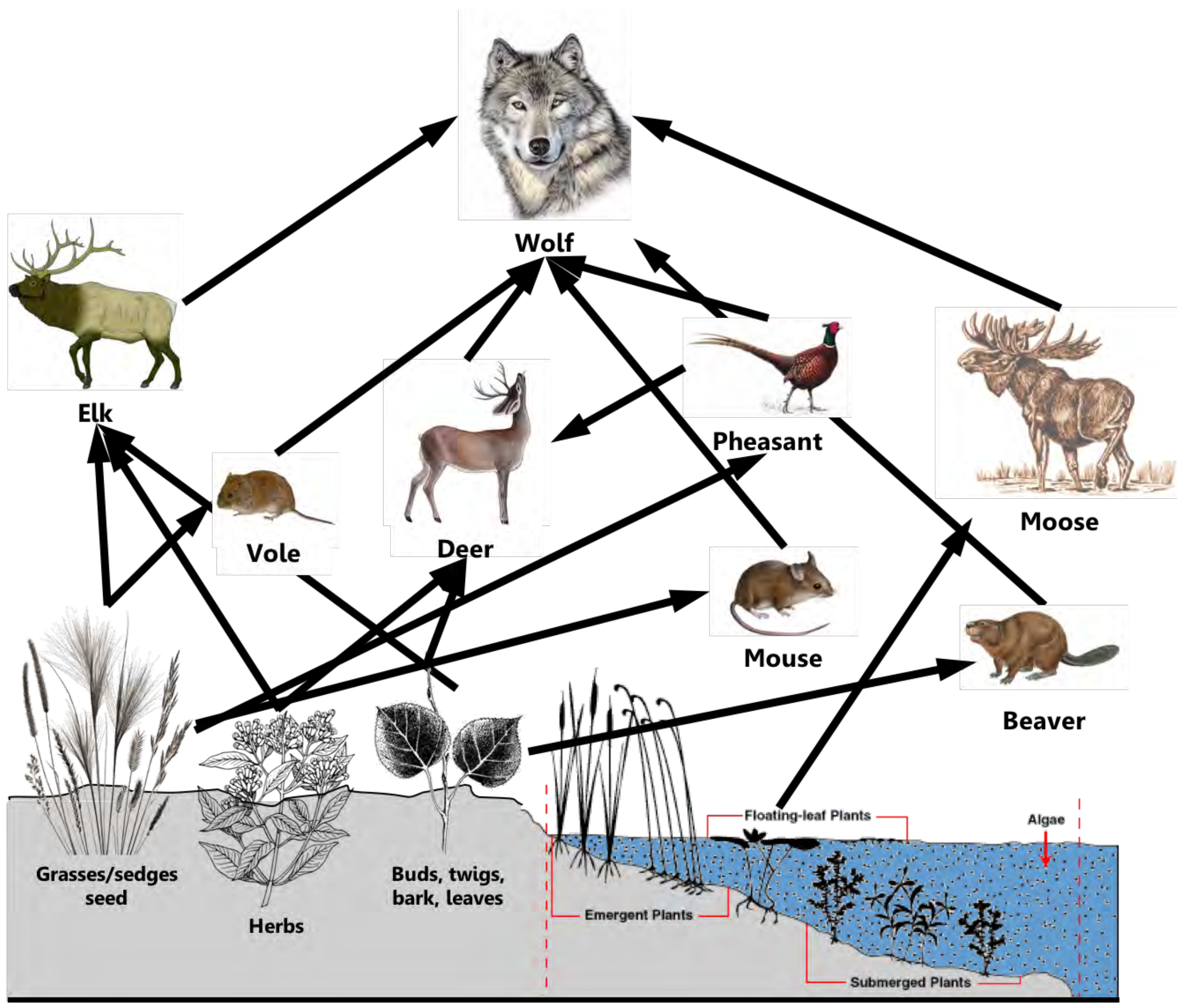


Most food webs are interconnected. Animals typically consume a varied diet and, in turn, serve as food for a variety of other species that prey on them. These interconnections are very important for the structure and diversity of an ecosystem.



For example, above is a simple food web of the diet of an arctic fox. It can consume a variety of different items that all come from different trophic levels.

The arctic fox consumes lemmings (primary consumers), caribou (primary consumers), goslings (primary consumers), as well as seals (secondary or tertiary consumers). Food webs can get much more complex. For example is a boreal forest food web:



Note that even though this food web may seem complex it is missing many species that are important including, but not limited to, insects, arachnids (spiders, ticks, mites), many species of parasites (including cestode (tapeworm), nematodes, trematodes (flatworms)), fishers, weasels, foxes, and many species of birds (especially song birds and raptors).

ECOLOGY AND WILDLIFE MANAGEMENT

Wildlife conservation and management is the protection and use of wild-animal populations and of the land necessary to support them to ensure that productivity and ecological balance are maintained in perpetuity, while social benefits are realized. Human activity has become one of the most significant influences on the abundance and well-being of wildlife.

The over exploitation, or misuse of wildlife as a resource, has a long history in Canada. Wildlife, fish, and timber were previously free for the taking for personal use, or could be converted into a monetary return. In the early 19th century this attitude had removed elk from their eastern most limits near Ontario. The bison previously numbered in the millions across the North American plains. By 1885 they were almost gone. The extinction of the previously abundant passenger pigeon was the driving force behind the passage of wildlife conservation laws. The development of national parks, such as the Banff National Park (1885), created areas that protected wildlife and provided them with areas in which they could prosper. Various treaties have been signed (e.g. Migratory Birds Convention Treaty of 1916) in hopes of protecting the remaining wildlife.

While many forms of wildlife are more abundant now than they were in 1870, a number of species have continued to decline to threatened levels or are in danger of extinction. Wetland drainage permanently removes the habitat required by many species. Pollution of rivers and estuaries renders them unfit for wildlife survival. Acid rain from industrial effluent stacks, automobiles and urban areas continue to sterilize vast tracks of land and waterways in Canada. Marine birds and mammals increasingly face the threat of offshore oil spills and general pollution of the oceans. Recent and continued changes in the climate have already started to impact wildlife populations, particularly in the Arctic.

The uses and value of wildlife to society vary. Wildlife is one part of the equation which, together with vegetation and the abiotic environment, establishes the "balance of nature", the set of complex natural processes on which human survival depends. Wildlife is a direct source of food and other products for many Canadians. The value is most apparent in northern regions, but it is also important in southern Canada. Coastal and inland commercial fishing, based on naturally reproducing populations, is an important industry. The wild fur industry provides a direct source of income for thousands, representing the highest continuing economic return of any resource in mid-northern regions. These harvest uses not only give direct economic return but, provided their management is biologically sound, also keep populations in balance with their food supply. It helps prevent overpopulation and dramatic losses from starvation and disease.

WILDLIFE MANAGEMENT TECHNIQUES

Wildlife management is the practical application of ecological principles to ensure the survival of all animals. Present wildlife management efforts focus on the conservation and continued existence of ideal numbers of wildlife. Wildlife managers use several approaches to arrive at these goals including:

1. Research: In order to exert careful control over the amount taken and methods used in the harvesting of wildlife, wildlife managers need a great deal of information about wildlife populations. Most importantly, they need an estimate of the number of animals in the hunted population, and the number taken each year.

2. Monitoring: Estimating the number of animals present is called inventory. Biologists use aerial surveys to inventory most large wildlife species. When leaves have fallen from the trees and snow is on the ground, dark animals like moose are easy to see from the air. The animals may be counted and classified on sample plots or entire winter ranges. More examples of techniques used to monitor populations are discussed in the Wildlife Research Methods Section

3. Refuges: Refuges provide safe areas for animals to live. For example, refuges provide safe areas during staging periods, restrict hunters access to staging waterfowl, eliminate the potential for hunting related accidents near urban centers and high non-consumptive resource user areas like Birds Hill Provincial Park and critical habitat areas.

4. Management Areas: Wildlife Management Areas are designated lands created within an agency's jurisdiction and in some cases, these areas are managed separately. They may be based on habitat, species, remoteness, hunting pressure or any other factor which managers feel requires a certain area to be managed separately. By breaking a larger area into smaller management areas, biologists can better gauge population levels, habitat conditions, hunting pressure, etc.

5. Seasons and bag limits (for hunting and harvesting): The ability to set seasons and bag limits is an important part of managing wildlife populations. A season, in this context, is the time period when a particular species may be hunted. Seasons and bag limits are set only after considering all factors affecting that population. If a wildlife manager feels a need to increase or decrease a particular population, seasons can be lengthened or shortened to help reach the desired number. Seasons also help protect animals during critical breeding stages.

6. Habitat management and conservation: Habitat is the combination of soil, water and plants, commonly called 'cover' in which wildlife exists. The relationships between soil, water, plants and the species of wildlife dependent on them are many and varied. Humans and their activities can cause profound and often irreversible changes to

habitat, usually to the detriment of wildlife. In order to maintain productive wildlife habitat, planning programs concerning man's use and the future of habitat components are necessary. Both short- and long-term planning for use of our land and water resources must include a recognition of the need to maintain suitable habitat if wildlife is to continue to flourish.

7. Hunting and trapping: Regulated hunting and trapping also make it possible to harvest animals when populations are at, or close to, their highest numbers over the year. Hunting and trapping remove a portion of the annual surplus before it is lost to "natural" causes. This is called the "harvestable surplus". Regulated hunting has never led to the extinction of a wildlife species or caused any species to become endangered.

8. Public Education: Public understanding, acceptance and support are essential if wildlife management programs are to be successful. This will only happen if people are educated about wildlife and its needs.

9. Compliance (Laws): The creation and enforcement of wildlife laws is an important management tool. To be effective, these laws must be flexible to cope with changes in wildlife populations, habitats and the needs of people; they must be based on biological fact and complement other management practices. For example, a hunting season is a law enforced by Conservation Officers. Wildlife managers set the season based on sound biological information and in the best interests of the wildlife species. In cases involving rare or endangered species or sensitive breeding sites, complete protection from harvesting may be required. Conservation Officers enforce laws related to sex-specific licence types, not simply to be difficult but rather to support the concept of selective harvest, a sound, beneficial wildlife management practice.

10. Cooperative, co-management or joint management agreements: Formal Agreements and joint management agreements have been used by Manitoba and other governments like First Nations and conservation organizations to manage wildlife and wildlife habitat. Examples of this are: The Waterhen Wood Bison re-introduction agreement between the Waterhen First Nation and government of Manitoba has resulted in the successful reintroduction of wood bison into Manitoba.

11. Species re-introductions: Reintroduction of wildlife species has been used where a species became extinct within Manitoba or parts of Manitoba. Successful reintroductions include the Waterhen wood bison initiative where sixteen wood bison were released to the area. There are now over 120 free roaming bison in Manitoba. Another excellent

example of this management technique is the reintroduction of elk into the Interlake region.

PROBLEM WILDLIFE

Human-wildlife conflicts can occur when people and wildlife compete for resources, whenever you're living, working or pursuing recreational activities. Wild animals in inappropriate locations can pose significant problems for or threats to humans, other animals, or the environment. They can cause serious damage to crops, livestock and property. They can create hazardous conditions for vehicular traffic. They can expose humans and pets to pathogens leading to disease and health issues. Below we will discuss some of the problem wildlife found in Manitoba and the conservation and management issues surrounding these populations.

White-tailed Deer – White-tailed deer are one of the most abundant and easily seen big game species in Manitoba. Cities and towns have many natural areas that help support these deer in an urban setting. The deer do well with abundant food, shelter, and protection from natural predators. Bylaws also prohibit the hunting of deer within city limits.

White-tailed deer can cause damage to gardens, shrubs, fruit trees, and other public and private property. They can become a treat to human health and safety when they move onto roadways and collide with vehicles. They also are suitable hosts for deer ticks, which can transmit Lyme disease to other animals, pets and humans.

Urban White-tailed Deer
© Mack Male

Managers ask people not to feed deer. Feeding the deer helps maintain artificially high populations, making the deer more susceptible to starvation and disease. Deer also become accustomed to humans and lose their fear of being around human communities. A feeding area attacks larger groups of deer that may result in more damage as well as encouraging them to travel, increasing their chance of being hit by a vehicle. Using fencing and repellents may also help people reduce the presence of deer in undesired areas.

Coyotes – Coyotes are a very common wildlife species seen throughout North America, including in Manitoba. They are well adapted to live in urban centers. They are also suitable hosts for canine distemper, rabies, canine hepatitis, the parvovirus, mange, tapeworms (*Echinococcus multilocularis*, and *Taenia* spp.), nematodes, and heartworm (*Dirofilaria immitis*). All of these pathogens can be transmitted to domestic dogs, other pets, sometimes humans and wildlife species. Coyotes can also cause damage to property, including hunting domestic livestock. They will also go through garbage and fight with pets. On rare occasions, they have been known to attack humans, especially after being fed by people in the past.

Managers try to make sure people do not feed coyotes, especially near human homes. They also try to keep garbage in proper containers. They suggest people closely supervise their children while outside and keep pets in at night. They also recommend avoiding contact with feces (of coyotes and any wild animal) and making sure your pet does as well. Coyotes are trapped using humane traps and trapping techniques annually in Manitoba.

Urban raccoons
© Andy Langager

Raccoons – Raccoons are one of the most commonly problematic wildlife species in urban areas in Manitoba. They are an extremely adaptable species that is able to live almost anywhere. To manage raccoons in the city, managers ask people to supervise their children and inspect outdoor play structures as well as covering sand play boxes as they may be used by raccoons as latrines. They ask people to not deliberately feed raccoons, or leave garbage or pet food outdoors. Protecting outdoor fishponds with metal screens or mesh is important. Block any access (no matter how small) to attics, sheds, chimneys, or other potential dens and replace old wooden roof materials. If you encounter a raccoon, make sure not to fed, disturb or handle it. Do not adopt young as pets. If you have to clean up raccoon faeces, you should use shovels, disposable rubber gloves, strong disinfectants, and masks to collect the faeces, which should then be buried or sent directly to a landfill. Raccoons serve as host to many pathogens, including rabies and canine distemper as well as many other dangerous parasites that may be transmitted to other wildlife, pets, or humans.

ENDANGERED SPECIES

Various factors, including human activities and climatic changes, have led to the reduction and alteration in animal populations. In response, government wildlife agencies and public groups have formed the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) which encourages and commissions studies on rare and endangered animals or animals of unknown status. Some of the most endangered species in North America are seen below: Vancouver Marmot, Red wolf, Pygmy Raccoon, Staghorn coral, Oahu tree snails, Giant seabass, Kemp's Ridley Sea Turtle, California Condor, and Franklin's Bumblebee

Other groups, such as the International Union for Conservation of Nature (IUCN) have taken this idea internationally, trying to monitor and report on wildlife populations worldwide. The IUCN Red List of Threatened Species is a world-renowned database of information collected over the last four decades. The IUCN Red List assesses both plants and animals and provides taxonomic, conservation status, and distribution information. The IUCN Red List sorts each species into one of the following categories:

Extinct – a species or taxon is extinct when there is no reasonable doubt that the last individual of this group has died. Exhaustive surveys of known and expected habitat during appropriate times will have failed to record the presence of this species.

Extinct in the Wild – a species is considered to be extinct in the wild when they are only known to survive in cultivation (e.g. farming), in captivity (e.g. zoo), or as a naturalized population well outside their past range. As with extinct animals, exhaustive surveys of known and expected historical habitat during appropriate times will have failed to record the presence of this species.

Critically Endangered – a species is considered to be critically endangered when all evidence indicates that its population has either: (a) been seen to be reduced by 90% or more in last 10 years or three generations, (b) its geographic range has been reduced to less than 100 km^2 and severely fragmented or less than 10 km^2, (c) population less than 250 mature individuals and continuing to decline, (d) population size of less than 50 individuals, or (e) quantitative modeling suggests the probability of extinction at least 50% in the next 10 years. It is considered to be facing an extremely high risk of extinction in the wild.

Endangered – a species is endangered when the evidence indicates that its population has either: (a) been seen to be reduced by 70% or more in last 10 years or three generations, (b) its geographic range has been reduced to less than 5000 km2 and severely fragmented or less than 500 km2, (c) population less than 2500 mature individuals and continuing to decline, (d) population size of less than 250 individuals, or (e) quantitative modeling suggests the probability of extinction at least 20% in the next 10 years. It is considered to be facing a very high risk of extinction in the wild.

Vulnerable – a species is considered vulnerable when its population meets any of the following criteria: (a) been seen to be reduced by 50% or more in last 10 years or three generations, (b) its geographic range has been reduced to less than 20 000 km^2 and severely fragmented or less than 2000 km^2, (c) population less than 10 000 mature individuals and continuing to decline, (d) population size of less than 1000 individuals, or (e) quantitative modeling suggests the probability of extinction at least 10% in the next 10 years. It is considered to be facing a high risk of extinction in the wild.

Near Threatened – a species that is near threatened is close to meeting the criteria for critically endangered, endangered or vulnerable in the near future.

Least Concern – a species is least concern when it does not meet any criteria to qualify for critically endangered, endangered, vulnerable, or near threatened. Species that are widespread or abundant are included in this category.

INVASIVE SPECIES

Invasive species are organisms, including plants, mammals, birds and crocodiles, amphibians, invertebrates, reptiles (lizards, snakes, turtles), and microorganisms that spread beyond their natural range into new locations. This expansion is often due to human activities. Invasive species are more commonplace than one might think. Kentucky bluegrass, periwinkle, lily of the valley, and dandelion are all common plant species found in our lawns and gardens but are invasive species to this region. The domestic cat is thought to have originated in Africa. The European starling came from Europe. Some species have moved within the country into areas they have been previously absent. For example, the moose is an introduced species on Newfoundland but is native to most of Canada. The house finch, native to several western provinces, is now found in a number of eastern provinces.

Alien or invasive species can be beneficial in a region but a good number are not. Sometimes the invasive species does not have the same limiting factors in their new habitat. This can lead to populations growing beyond control.

Invasive species come into Canada by any means of transport that moves them farther than they could move on their own. Sometimes they are brought in on purpose, but often they arrive unintentionally. Seafaring European explorers and settlers were the first to introduce new species to Canada. They brought cattle, goats, and other domestic animals, along with familiar crops like wheat, when they came by ship to explore and settle the New World. Without meaning to, they also introduced unwanted organisms—pests, like the Norway rat, and viruses, like deadly influenza and smallpox.

Many invasive species are transported to an area by accident. Accidental arrivals are rarely discovered until they have established themselves and have spread beyond their point of entry. For example, many unwanted invasive species arrive in ballast water, the seawater or freshwater used to stabilize large ships during travel; aquatic species are taken up along with ballast water at one port and released at the destination port. About half of the invasive shellfish species in Canada, including the highly invasive zebra mussel, as well as the invasive zooplankton, the spiny water flea, probably arrived in North America in this way.

When an invasive species enters an ecosystem, it can have an impact on the species that are present, on important habitats, or even on the ecosystem itself. Concern arises when an invasive species changes the system for the worse, by either reducing or eliminating populations of native species, or by otherwise changing the way the ecosystem works. These changes have made the invasion of alien species a major global problem. If organisms were not able to move beyond their normal ranges, each part of the world would have a unique array of plants, animals, and microorganisms. However, as species move from one area of the world to another, sometimes squeezing out the competition, different places in the world become more alike in their biology—a process called biological homogenization.

Biological homogenization is undesirable because as it takes place, ecosystems often become less stable, and valuable biodiversity, or variety of life, is lost. This variety is essential to the health of our planet; each species performs a function that contributes to global well being. The spread of invasive species, like habitat loss, is considered one of the major threats to biological diversity. Invasive species have obliterated over 110 vertebrate species around the world and have affected nearly every type of ecosystem. For example, in New Zealand, predatory European mammals such as rats, cats, and stoats have caused the extinction of nine native bird species, and they threaten many more. In Guam, the brown tree snake, an import that arrived hidden in ship cargo from New Guinea, has wiped out virtually all the island's native forest birds.

Invasive species are successful due to some advantage they have over native species. For example:

Competition: invasive species can often outcompete native species for space, water, food, and other essential resources

Predation: some invasive species cause native species to decline by being aggressive herbivores or predators.

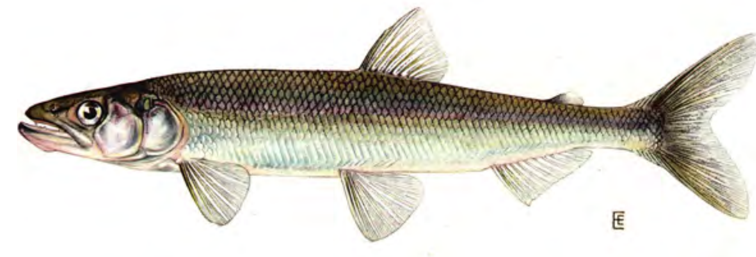
Pathogens and parasites: often invasive species bring with them novel parasites or pathogens to a region. Sometimes the invasive species is a parasite itself and can affect population dynamics

Hybridization: sometimes invasive species weaken the gene pool of the native species by interbreeding with them, a process called hybridization.

Habitat alteration: invasive species may change the structure or composition of a habitat; invasive species make it unsuitable for other native species.

There are quite a few examples of invasive species in Manitoba that are of great management concern. They include the leafy spurge, Eurasian watermilfoil, yellow flag iris, flowering rush, purple loosestrife, narrow-leaved and hybrid cattail, common carp, rainbow smelt, round goby, rusty crayfish, spiny water flea, zebra mussels, yellow starthistle, tall buttercup, lily leaf beetle, and dutch elm disease fungi.

Rainbow smelt (*Osmerus mordax*) are an elongate fish between 178-203 mm long. They are found in clear lakes, rivers, and coastal waters including Lake Winnipeg. Rainbow smelt compete with native fish species for food and other resources. They are also a source of food for other species of native fish. Affected native species include yellow perch, cisco, emerald shiner, walleye, lake erring, bloater, whitefish, lake trout, and slimy sculpin.



Rainbow smelt
© Ellen Edmonson and Hugh Chrisp

The rusty crayfish (*Orconectes rusticus*) is an aggressive species that originates in the Ohio River basin (USA), which began to spread into the northern Great Lakes regions, including Minnesota, Wisconsin, and Ontario in the 1960's. They are often spread when they are used as bait by anglers. Rusty crayfish reduce aquatic plant beds and the species that live in these environments. It has been suggested that the damage that the rusty crayfish does to the aquatic ecosystem is the equivalent to clear cutting forests. They feed heavily on aquatic plants, small fish, and water insects. Rusty crayfish are relatively new to Manitoba, being first spotted in 2007. Managers have been using information campaigns with recreational anglers to try to reduce the spread of this invasive species.

Invasive rusty crayfish
© Doug Watkinson, DFO

Emerald Ash Borer (*Agrilus planipennis*) are invasive insects originally from eastern Asia. This species consumes and destroys ash trees. It likely came to Canada from a shipment of untreated wooden packing material from Asia. Adult emerald ash borer feed on the leaves of the ash trees producing irregular shape patches with jagged edges. Eggs are then deposited in the truck and branches of trees within the bark. When the eggs hatch, the larvae burrow in the bark into the cambial layer. As the larvae feed, they create s-shaped tunnels and eventually girdle (complete removal of a strip of bark from around the entire circumference of either a branch or trunk of a woody plant) the tree.

Invasive Emerald Ash Borer
© David Cappaert/Michigan State University

Various management techniques can be used to both slow and prevent the spread of invasive species. Cooperation between different countries and their experts is key to developing programs like the Global Invasive Species Program. Canada has instituted many laws, regulations, and policies, aiming to prevent the spread of invasive species. Further education initiatives, such as with zebra mussels and spiny water flea campaigns with anglers, will further assist in preventing these invasive species to spread further. Targeted control, including physical control (i.e. physically removing the species from its environment), chemical control (i.e. pesticides, herbicides, fungicides, and other chemicals to kill invasive species), biological control (i.e. using living organisms, particularly predators, parasites, and disease are used to control the growth of invasive species populations), and integrated control (i.e. combination of all listed above).

CLIMATE CHANGE

Climate change, or the alteration and lasting change of the distribution of weather patterns over period of time, is something that the earth is now facing. Of all the ways in which human activity affects the distribution and abundance of wildlife on our planet, none is as pervasive and powerful as climate change. All species have a capability to adapt – at least to some degree – to natural stresses. Changes to climate and habitat have been occurring for eons, and with them have come changes to the diversity of species on earth. What makes current climate change unique is that, with the exception of cataclysmic events such as meteor strikes, the rate at which it is taking place is leaving species and ecosystems no time to adapt.

The direct impacts of human caused climate change have now been documented on every continent, in every ocean, and in most major taxonomic groups. One of the most studied and observed climate change responses of organisms has involved alterations of the species' phenologies (the study of periodic plant and animal life cycle events). For example, humans have been recording the flowering of cherry trees in Japan since the 1400's. Although the timing of the flowering is highly variable among years, no clear trends have been observed between 1400-1900. Since the early 1900s to 1952 the date of flowering has steadily moved earlier into the year. In the past few years, the flowering time has moved even earlier. Another study examined the calling of six frog species in Ithaca, New York. These frogs use calling as part of their mating ritual. The study found 10-13 day advancement in this calling. Further, amphibian breeding has also started 1-3 years earlier per decade of change.

The problem with these shifts in life history comes when they start to become mismatched with other events in the environment. For example, many species of songbirds rely on huge increases in insect populations (seen after the insect's successful breeding) to feed their young. Activity and reproductive cues for many species of insects are related to the ambient temperature. If the temperature continues to increase, insects may start to become active sooner and breed earlier. If the breeding time of songbirds does not change in sync with the insects (due to other drivers in their life cycle such as daylight hours) they will miss this large population boom of insects, not be able to feed their young, and their populations will suffer.

The increase in storms and unpredictable weather patterns is also expected with climate change. These extreme weather events can devastate wildlife populations as well as their habitat. This puts already vulnerable species further at risk of extinction.

Another direct impact of climate change is the loss of habitat. The decline in sea-ice extent has led to large changes and in turn trophic cascades in both the Antarctic and the Arctic ecosystems. In the Antarctic, declines in sea ice have reduced the abundance of ice algae (due to loss of habitat), leading to declines in krill (38-75% per decade since 1976). Krill is the primary food source for many species of fish, seabirds, and marine mammals. Emperor penguins have declined from 300 to 9 breeding pairs in certain portions of their range and other areas have shown a reduction by 50% of their population since 1970. Adelies penguins have seen similar declines. In contrast, open-ocean feeding penguins, such as the chinstrap and Gentoo, have increased their range. In the Arctic, invertebrate communities in Arctic lakes have shown hug species turnover (change in the community of organisms). Polar bears have suffered significant population declines. Climate change has caused a lengthening of the ice-free period, periods during which the polar bears live only on their fat reserves, as an ice shelf is essential for feeding. Further, climatic warming trends have led to a reduction in their main food source, the ringed seal.

The movement of parasites and pest species is another component of climate change. A nematode parasite has seen an increased abundance due to a shortening of its life cycle in response to warming trends. The increased abundance has had associated negative to its wild musk oxen host, decreasing their survival and ability to breed.

Increasing temperatures can also lead to both local and worldwide extinction of wildlife species. Global sea surface temperatures have risen an average of 0.1-0.2°C since 1976. El Nino events (climate pattern that increases the temperature) alongside global climate warming has led to 16% of all corals rendered extinct globally.

WILDLIFE RESEARCH METHODS

FIELD NOTES

A wildlife biologist or naturalist should always keep field notes and a journal as an essential record of activities and observations. Keeping accurate field notes and a good journal enables one or others to return to the same areas in the future and look for important ecological changes. A journal also provides a good record of one's investigations, observations, thoughts, speculations, and random musings of the field. Although certain details may not seem useful or applicable at the time, great discoveries and revelations have been made by referencing back to ones field notes.

Good field notes include quite a few things:

1. Name of observer(s)
2. Date, time, and locality of the day's observations
3. Numbered pages
4. Weather should be noted at the beginning of the day and whenever significant changes occur
5. Recent events (fires, storms, or droughts, for example)
6. Brief description of the habitat including the topography (flood plain, forest, sedge meadow, fen, etc.) and vegetation (oak-pine forest, wetland, etc.)
7. GPS location of any observation
8. Route traveled
9. Quantitative (numerical) data (for example estimates of the numbers or sizes of individual plants and animals seen, frequency of events, etc.) and other observations (e.g. other animals or plants)
10. Records of collected items (e.g. samples taken such as plant samples or fecal samples)
11. Photos taken and their location
12. Thoughts, questions, speculations, etc.

An example of a page out of a field journal:

Page 1

Name: J. Doe
Date: 22 04 2013
Time: 19:30

Location: Den E25, Wapusk National Park (near Nestor One)
Habitat: Tundra, beach ridge, fox den
Temperature: -21°C **Humidity:** 60%
GPS Coordinates: 15 473110 6473943 UTM

Data and Observations:

- Fox burrow present with fresh digging, two entrances
- Fox feces present
- Urine present
- White hair (Arctic fox) present in fox burrow
- No fox tracks present
- Ptarmigan present at den with lots of ptarmigan feces
- Large tracks (likely polar bear) present at outer edge of den
- Deep snow but some vegetation still obvious

Photos:
IMG_0986 – burrow opening
IMG_0987 – researching examining burrow opening
IMG_0988 – Ptarmigan

Collected Items:

- Fox feces collected and labeled
- White hair from burrow opening

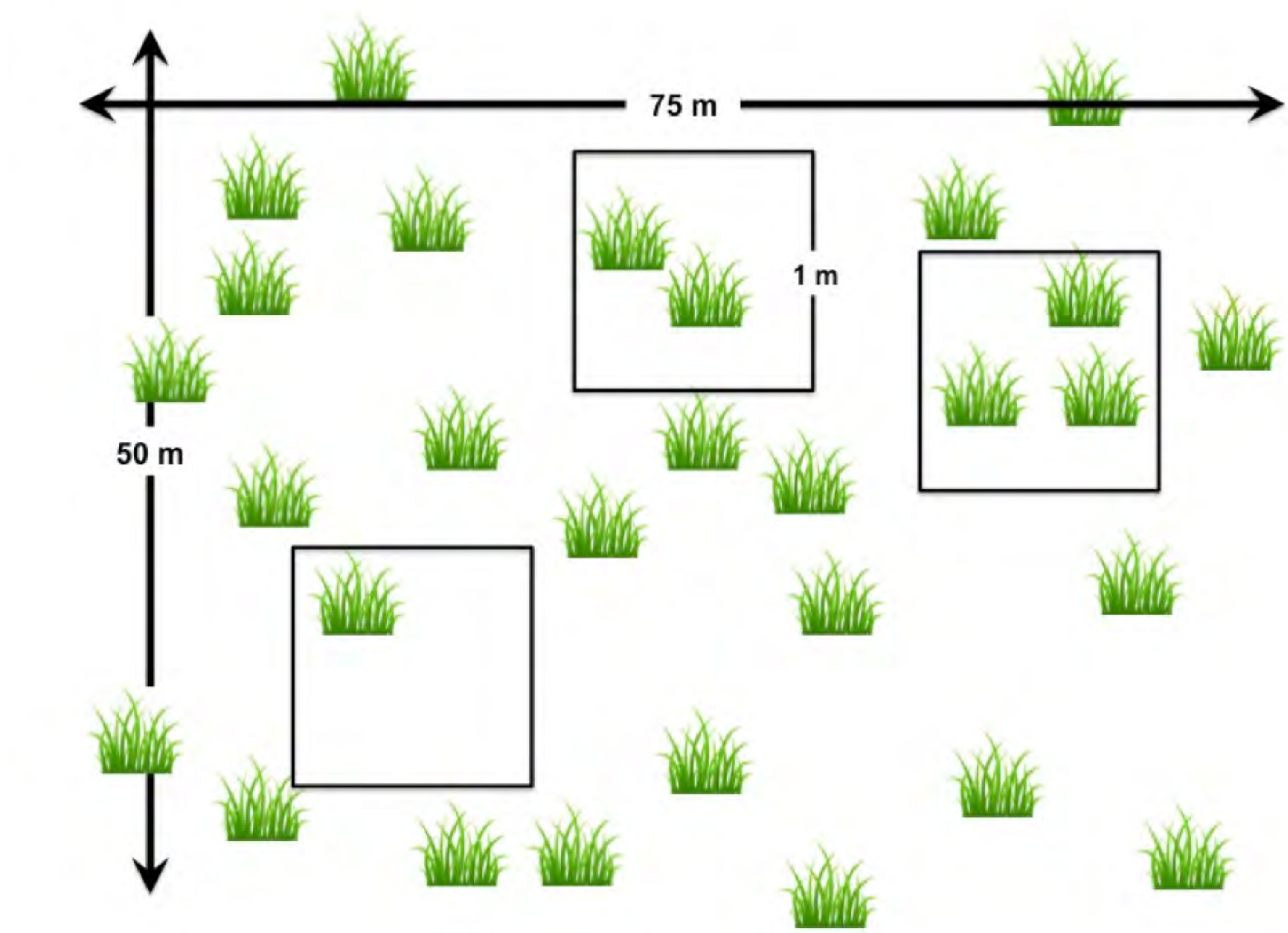
Field journals can be more detailed depending on the project. In many behavioural observation studies or mark-recapture studies, the researcher often records the mass of the animal, sex, tag number, pit tag, spine length, etc. The more detailed the field notes the easier it is to come back to them as a reference.

POPULATION MONITORING

Ecology is defined as the study of the factors that affect the distribution and abundance of organisms. Therefore, as ecologists, wildlife biologists, and managers, determining the abundance of a specific group of organisms are important. To estimate the population size a researcher can use various methods.

Complete census: this method will count all the organisms. Often this method is difficult to do, difficult to tell if you have found all of the individuals in an area, takes a large amount of time. Further, how important is it to count every individual? For this reason we use samples from a population to estimate abundance under the assumption that it is representative of the entire population.

Quadrat Sampling: in this method you define a quadrant (small area of known size) that is chosen at random and count the number of organisms in that region. The mean (average) number of organisms in each quadrant is used to estimate the entire population. This method is used when the organisms are sedentary, e.g. plants or trees.



Mean plant density (number/m^2) x total area = population size

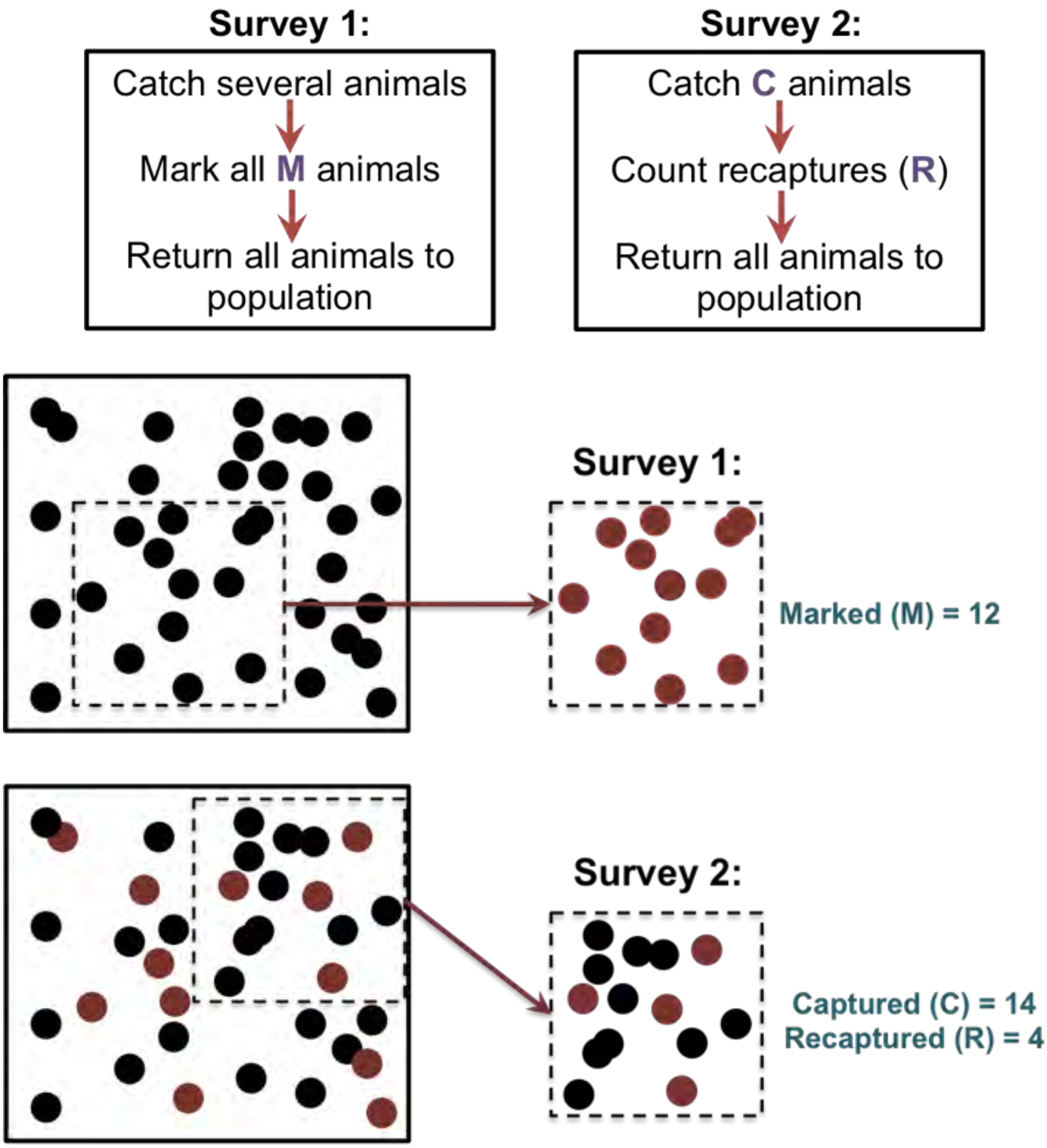
2 plants/m^2 x (50m x 75m) = 7500 plants

Many plants or animals do not distribute themselves evenly across the landscape. Due to this habitat heterogeneity (patchiness) we need to choose a sampling strategy that best captures the population and minimizes our variability of measurement. The edge effect is also something to consider when designing a sampling method. Individuals on the edge may or may not be counted, but this needs to be consistent to reduce counting errors. The plot size is also a factor to consider. The larger the quadrant area the less variability present. However, larger quadrants take more time to evaluate.

Transects: transects can be used in various forms to evaluate populations. A transect is a path along which one counts and records the occurrence of an individual or an object that is being counted as a representation of the occurrence of an individual or species. For example, many species of lemmings (brown and collared) as well as voles make winter nests in their tundra habitats. These winter nests are made from vegetation (mainly grasses and sedges) underneath the snow (subnivean layer) and are used to keep the small mammals warm during the winter. They appear like a ball of cut grass and are abandoned in the spring. They are counted and picked up as a representation of the winter small mammal population. To evaluate the small mammal population, researchers walk transects of a known distance and count each winter nest they encounter. If the winter nest is not on the straight line transect, the researcher leaves the transect at a 90° angle and measures the distance between the transect and the winter nest. Transects have also been used to evaluate snowshoe hare populations by looking at pellets at specific locations down the transect.

Mark-recapture: mark-recapture methods are one of the most common and best methods to get information not only on abundance, but birth, death, and movements. It can require substantial time and effort to collect this data. They are commonly used to monitor small mammal populations, but are not limited to this function. They have also been used (for example) to look at the growth and condition of American alligators, dynamics of increasing lake trout populations, and different responses of Agriotes click beetle species to pheromone traps. The methods for mark-recapture vary between populations that are closed (stable, no birth, deaths, or movements) or open (major changes in size and/or composition during the study). There are four methods for closed populations, Petersen method, Schnabel method, and Schumacher-Eschmeyer, and one common method for open populations, Jolly Seber. We will focus on the Petersen method, one of the most simple methods for a closed population.

Petersen Method (Closed population)



Total (estimated) population size (N) calculation:

$$\frac{Number\ marked\ individuals\ (M)}{Estimated\ population\ size\ (N)} = \frac{Number\ recaptured\ individuals\ (R)}{Number\ of\ individuals\ captured\ in\ resampling\ (C)}$$

$$N = \frac{MC}{R} = \frac{12\ x\ 14}{4} = 42$$

If you have a small number of individuals caught in the surveys, you can make a correction to account of these small sample sizes. For our example above…

Total (estimated) population size (N_c) corrected:

$$N_c = \frac{(M+1)\,x\,(C+1)}{R+1} - 1$$

$$N_c = \frac{(12+1)\,x\,(14+1)}{(4+1)} - 1 = \frac{13\,x\,15}{5} - 1$$

$$N_c = 38$$

DIET RECONSTRUCTION

Knowledge about the diet of wildlife not only helps us have a better understanding of the ecology of a region, but also the relationships between species, the role of a species in the ecosystem, potential for competition with other species, their impacts on prey populations, and factors that limit their abundance and impact dynamics in the ecosystem.

Many methods are used to estimate diet of animals:

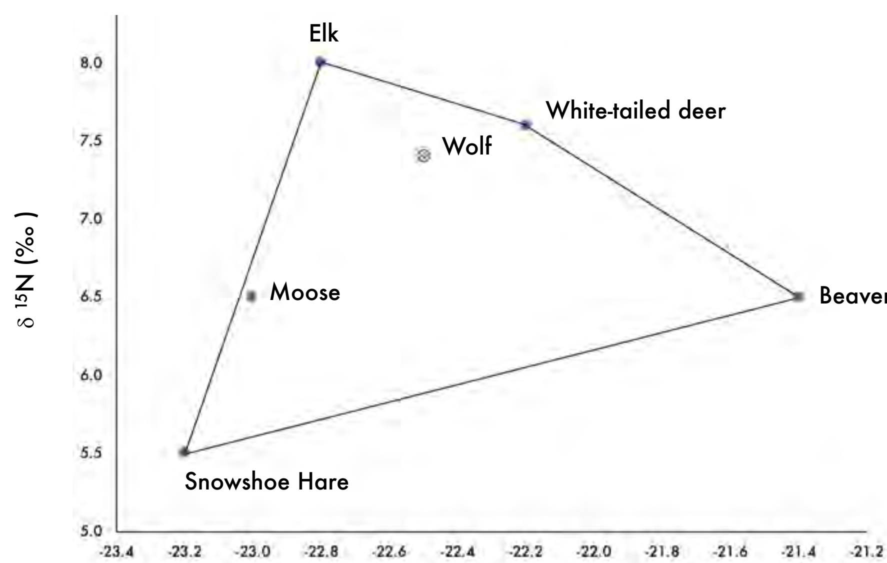
Observational: by observing feeding behaviour (e.g. following a wolf pack to their kill, watching a fox or owl hunt, etc.) we get some insight into both the food items included in an animal's diet but also their hunting or scavenging behaviours.

Stomach and fecal analysis: Stomachs and/or feces are collected to look at the diet of each individual. It gives insight into the animal's last meal. Remains from the food items, such as bone, hair, eggshells, feathers, seeds, and exoskeletons (e.g. insects and zooplankton) survive the digestive process and can be used to identify the prey. They can also be quantified to provide estimates and importance of each item. Owl pellets can also be used in a similar manner to reconstruct their diet. Although this method can be good in giving a broad idea of the foods included in a population's diet, most soft-bodied prey are difficult to identify since they digest rapidly.

Fatty acid signature analysis: Fatty acids can be used as a natural biomarker to assist in the reconstruction of a predator's diet, particularly when the diet is of marine origins. Fatty acids are the main part of most lipids (or fats) and unlike many other nutrients (e.g. proteins and carbohydrates) are not readily broken down during digestion. Animals can also only make a limited number of fatty acids; we are able to distinguish between fatty acids created by the body versus those taken in from the diet. The fatty acids are passed on from prey to predator throughout the food web. Fatty acids can also represent the diet of the predator over a longer period, representing the average diet of an individual over a set time (e.g. a month, year, etc.).

Stable isotope analysis: stable isotopes are a natural biomarker (like fatty acids) that can be used to reconstruct diet of an animal. Researchers measure the ratio of heavy to light isotopes of different elements (e.g. carbon, nitrogen, sulphur, oxygen, hydrogen, etc.) which have been transferred from the food item (plant or animal) to the consumer. Stable isotopes can indicate the trophic level the animal is eating at, the length of the food web, and source of primary production in this food web. They also can be used to study animal movement, looking at where an animal may spend its winter or migrate.

Carbon and nitrogen are the two most commonly used stable isotopes ratios in reconstructing the diet as carbon is influenced by the type of plant eaten by the primary consumer and nitrogen increases with every increase in trophic level. Marine and terrestrial stable isotopes also vary greatly in carbon stable isotope ratios. Due to these differences, researchers are able to start to reconstruct the diet of an individual consumer. Further, using the stable isotope ratios of the consumer you can look at the overlap of the diet of two competing species.



Stable Isotope Food Web
(Urton and Hobson 2005)

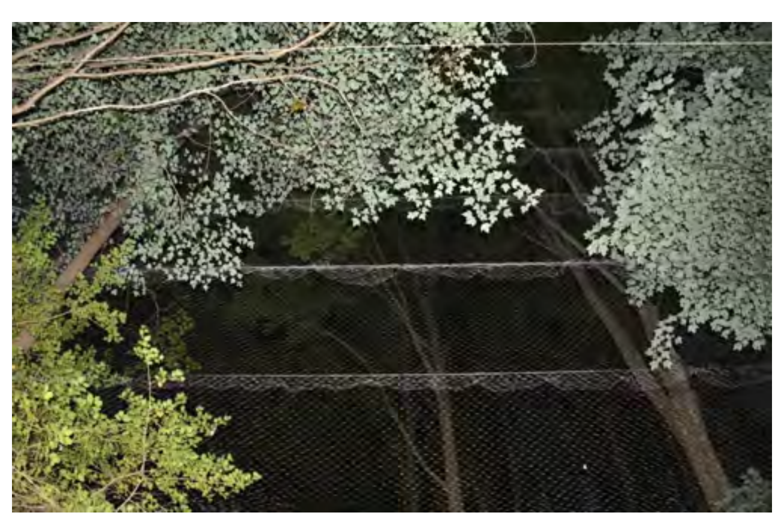
A researcher can also use different tissues from the consumer that represent the diet of the individual from different periods. For example, the blood of an animal is rapidly turned over and so its stable isotope ratios will represent the diet of the animal over the past few days. On the other hand, muscle represents the diet of the individual over the past few months.

To reconstruct the diet of an individual, or a population, a researcher (with modelling software) will examine the stable isotope values of the consumer (e.g. wolves in the example below) and compare its 'location' (represented by its carbon and nitrogen stable isotope values) to those of possible prey (e.g. white-tailed deer, elk, beaver, snowshoe hares, and moose in the example below). Based on its distance from these possible prey, the proportion of each type of prey in the diet of the consumer (e.g. wolf) can be estimated.

ANIMAL TRACKING IN MANITOBA

To try and understand population sizes, migratory routes, or other information about animal populations, researchers will often track the animals using a variety of different animals. With larger animals such as caribou and polar bears, the animal is usually tranquilized then fitted with a radio collar (picture below), which allows for the individual to be tracked from a plane.

Smaller animals, like birds or bats, can't wear conventional radio collars because they are too small. In this case, bands or PIT (Passive Information Transponder) tags are used for monitoring. In Manitoba, birds are banded to track their migration routes and to gather information about population sizes. Birds (and bats) are often caught using a mist net. Once removed from the net, a small band is placed on one leg that is unique to each individual. Migration routes can be mapped when a banded bird is caught in another location.



In Manitoba, bats were formerly tracked with bands just like birds, but the bands were placed on the arm at the top of one wing. However, banding bats was found to cause occasional wing damage or injury to the bat. Now, bats are monitored using PIT tags that are inserted under the skin between the shoulder blades. PIT tags (see picture below) cannot be monitored from a plane, but by panels placed at the entrances to caves or mines that read the "barcode" of each bat as they fly by, or by PIT tag readers used to scan bats that are captured. To insert the PIT tag, bats are captured using mist nets or harp traps. Currently, researchers at the University of Winnipeg are monitoring bat populations because of the disease White-Nose Syndrome (WNS) caused by an invasive fungus, which hasn't arrived in Manitoba but is now as close as North-Western Ontario. Each bat that is PIT tagged also has a genetic sample taken from it. Researchers hope to be able to look in the genes of bats that survive WNS to find a cure for the disease.

MAMMALS OF MANITOBA

Manitoba has a great diversity of mammals, reflecting the wide diversity of ecosystems within this large province. Manitoba contains prairie, parkland, boreal forest, and tundra. Over 89 mammal species live within these terrestrial and aquatic ecosystems and the coastal waters of the Hudson Bay. This section is by no means an exhaustive list of all the species within the province, as many of the small mammals (e.g. rodents, bats, shrews, and moles) are not included. Each entry aims to give a brief description of the appearance of the organism, as well as any unique features of the specific species.

ORDER RODENTIA (PORCUPINES, MICE, GOPHERS, SQUIRRELS, ETC.)

Beaver (*Castor canadensis*)

Beavers are a primarily aquatic rodent. They have a waterproof, rich, glossy, reddish brown or blackish brown coat.

Special features – The beaver's tail is used in water as a rudder. If the beaver becomes scared it may slap the water with its tail, warning all beavers in the vicinity of the danger. This behaviour may also drive away any potential predators. Beavers can make large habitat changes by

Beaver
© Calgary Zoo

cutting down trees and constructing dams. The dams are constructed with sticks and branches and sealed with mud and stones. As beavers may need to spend months under the ice, they store these foods under the ice for access during the winter.

ORDER LAGOMORPHA (RABBITS, HARES, AND PIKA)

Eastern Cottontail (*Sylvilagus floridanus*)

Eastern Cottontail
© Gareth Rasberry

Eastern cottontail rabbits are small rabbits with dense, buffy brown underfur and longer coarse grey and black-tipped guard hairs. Their ventral fur is white. They have a short tail with a white-underside. They have distinctively large eyes for their size.

Special features – Eastern cottontails are solitary and tend to be very intolerant of each other. They also have very good senses of sight, smell, and hearing assisting in predator detection and avoidance. They are crepuscular and nocturnal and are active all winter. They are also very quick and can reach speeds of up to 30 km/hr. Vocalizations of the eastern cottontail can include very distinct distress cries. As the majority of its diet is cellulose and complex carbohydrates, eastern cottontails as with many rabbits and hares, use caecal fermentation to digest their food. They must reingest their fecal pellets (after going through their digestive system once) to reabsorb their nutrients.

ORDER CARNIVORA (BEARS, CANIDS, FELIDS, MUSTELIDS, SEALS, ETC.)

Black Bear (*Ursus americanus*)

Black bears are generally black in color but may range to lighter brown (sometimes blonde). Black bears are a wide-ranging mammal in Canada, only avoiding cities although they have been well adapted to living near humans. Black bears are thick set, bulky animals. The adult black bear has a moderate-sized head with a straight facial profile and a tapered nose with long nostrils. Unlike other animals, the lips of a black bear are not attached to their gums allowing black bears to use them with great dexterity. The eyes are small, and ears are rounded. The tail is not noticeable and very small.

Black bear and cubs
© Liron Gertsman

Special features – Black bears are generally crepuscular, although feeding and breeding activates may alter this. Black bears are also good swimmers and fast runners. They are primarily solitary, except for the close bond between the female and her young cubs and pairing for mating. Black bears go through seasonal lethargy during the winter period in which they do not eat and subsist entirely on stored fat. They may lose up to 30% of their pre-denning mass.

Arctic Fox (*Vulpes lagopus*)

Arctic foxes are a small white fox, with a short legs and a fluffy tail. They are well adapted to living in cold climates, with a thick white fur during the winter, and brown, light gray and black during the summer. Arctic foxes have two different colour morphs, the "blue" and "white", with the "white" being more common in Manitoba. In the winter, "blue" moults from chocolate brown in the summer to lighter brown tinged with blue in the winter.

Arctic fox
© Hannah Anthony

Special features – Arctic fox are generally solitarily (other than the breeding season), and when food is abundant they will cache the food for later use. Arctic foxes have many physical adaptations to living within the arctic environment. Their fur has the best insulative properties among all mammals. They further conserve body heat by the fur on their soles of their feet, small ears, short noses, and the ability to reduce blood flow to the peripheral regions of their bodies.

Canada Lynx (*Lynx canadensis*)

Canada lynx are a medium size cat with varying colouration, but normally yellowish-brown. The upper parts of their body may have a frosted grey look and the underside may be more buff. Many individuals have dark spots. They have very small tails that are often ringed and tipped in black. Lynx have triangular ears tipped with tufts of long black hairs. Their paws are quite large and furry, adapted for moving through the snow.

Canada Lynx (*Lynx canadensis*)
© Conservation Northwest

Special features – Lynx are primarily solitary and appear to be somewhat territorial. Although female home ranges may overlap, males occupy very distinct areas. Lynx primarily hunt visually but also have well-developed hearing. They primarily nocturnal and prey are generally stalked. Females have been known to hunt in cooperation with their kits, increasing their success. Lynx are well adapted to hunting in their northern range. They have long, muscular legs and large furry feet with toes that spread out giving them extra mobility on the snow. They are also powerful fighters and good swimmers, travelling high in the water.

Fisher (*Martes pennanti*)

Fishers are a medium to dark brown mustelid with gold to silver hoariness on their head and shoulders as well as black legs and tails. They are a secretive and rarely observed mammal. Fishers are agile and fast tree climbers and are well known for their ability to walk or run down trees. They live a solitary life, using resting sites, such as logs, hollow trees, stumps, brush piles, and nests of branches throughout the year.

Fisher (*Martes pennanti*)
© John Jacobson

Special features – Fishers are known for their ability to prey on porcupine, which they kill by attacking their face and head over and over again. They waste very little of the porcupine, eating everything but the skin, large bones, feet, and intestines. They are also well adapted to walk and run on trees. Their hind feet can be turned so their claws can better grip on the trees, similar to many species of squirrels. They also have short, heavy legs, sharp claws, and a long, bushy tapering tail that assists in balance. Fishers also have large feet, allowing them to walk on top of the snow. They have pads on each of their toes, and the middle portion of each foot. The heavy fur on their feet helps protect them during the winter.

ORDER CETACEA (BALEEN AND TOOTHED WHALES)

Beluga (*Delphinapterus leucas*)

The white whale, more commonly known as the beluga, is an Arctic whale well adapted to its life in the northern seas. Belugas have milk white skin, although they are born gray and their colour gradually fades with age. They lack a dorsal fin but have a shallow ridge along their back. They have narrow appendages and a melon shaped head.

Beluga (*Delphinapterus leucas*)
© Zoofari

Special features – Belugas are well adapted to life in the Arctic, with a number of anatomical and physiological characteristics. They have thick blubber (up to 10 cm thick) helping them survive the cold temperatures. Their melon-shaped head is the center for echolocation. Beluga also aggregate in herds of hundreds to thousands of individuals.

BIRDS OF MANITOBA

Manitoba has a great diversity of birds, reflecting the wide diversity of ecosystems and seasonal shifts in resource availability. Over 145 bird species live within Manitoba, with over 88% of species migrating annually.

Manitoba is quickly acquiring a reputation to be one of the best places in the world to view a large variety of birds. As our province is located in the geographic centre of the continent, we host a combination of both northern and southern species, as well as birds from both the east and west.

Birds make up the class Aves. The taxonomy of genera and species as well as common and scientific names used in this book follow the seventh edition of the American Ornithologists' Union (AOU). This document is designed to give a brief overview of many of the important bird species living within Manitoba. The document is by no means an exhaustive list of all the species within the province, as many of the songbirds are not included, as well as domestic species and rare bird visitors.

Birds of Manitoba document is first split into larger functional groups, following the AOU Checklist of North American birds. Each entry aims to give a brief description of the appearance and size of the organism, a description of their songs and calls, some life history characteristics, current population status, as well as any unique features of the specific species. Please note that although many species have different plumages depending on sex and age not all may be shown in the accompanying picture.

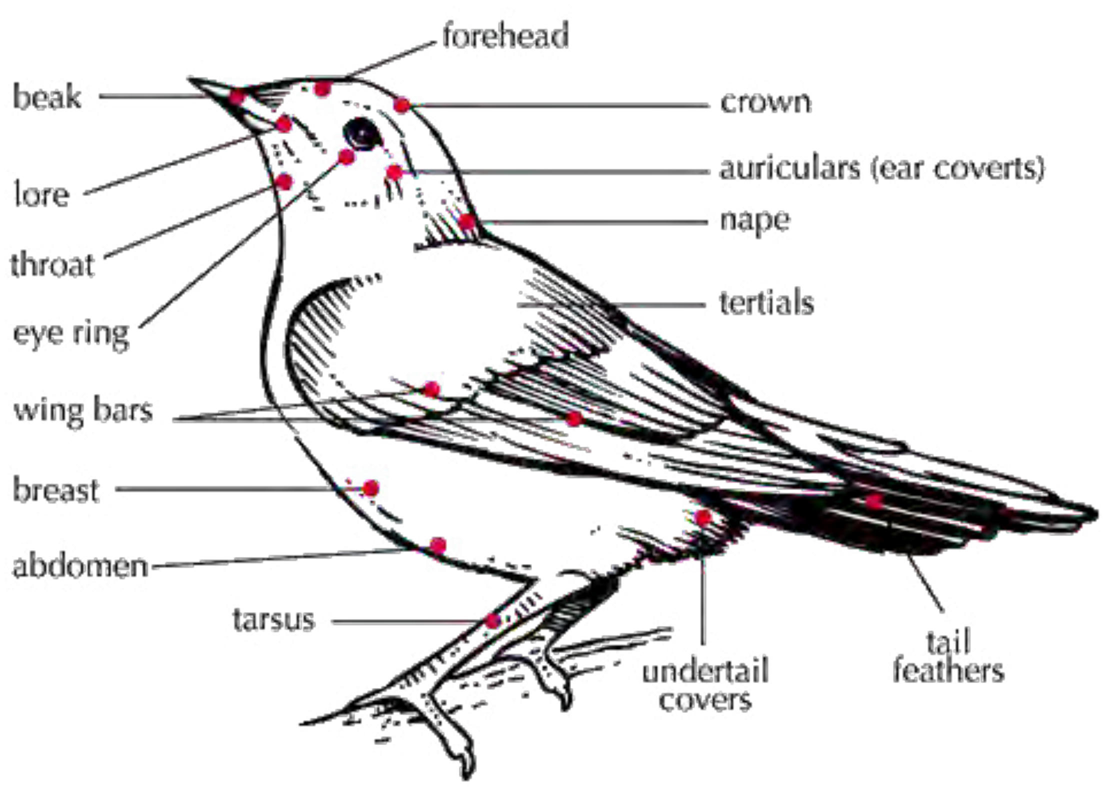
HOW TO IDENTIFY BIRDS

One of the challenges with identifying different bird species is that they often have different plumage in spring and summer than they do in fall and winter. Many species have different breeding and non-breeding plumages and immature birds often look different from their parents and other adults. We will focus on the plumages that you are most likely to see in Manitoba.

Birds are covered with feathers; however their bodies are not uniformly covered. The feathers grow in discrete groups, leaving other parts of the body bare. Knowing the basic feather groups and how the feathers in each group are arranged may be the most important tools a scientist can possess when trying to identify a bird by its appearance. Learning the basis of common markings (e.g., wing-bars, eye-ring, etc.) will greatly enhance your understanding birds' appearance.

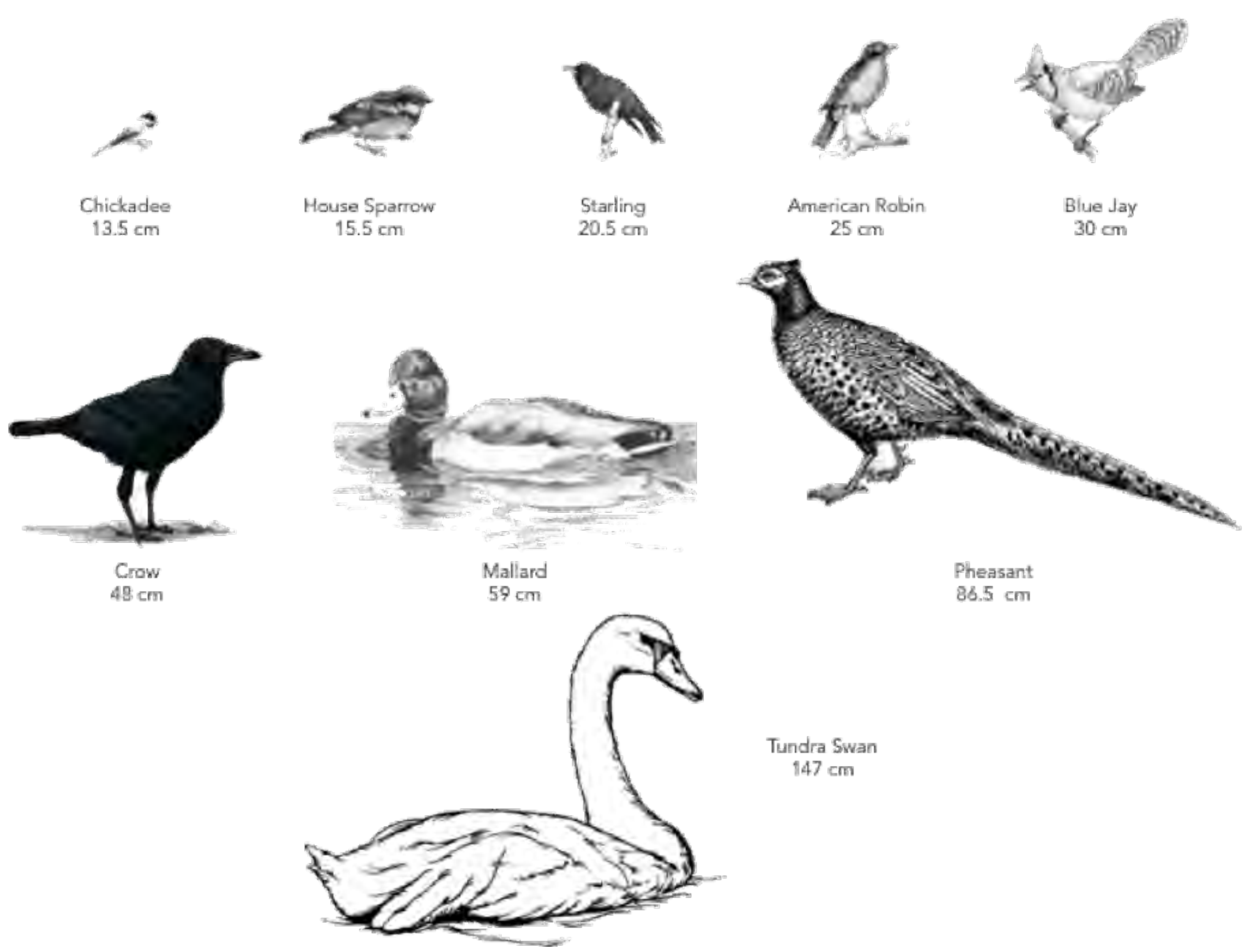
Parts of a Passerine

This figure shows the basic parts of a passerine, or songbird.



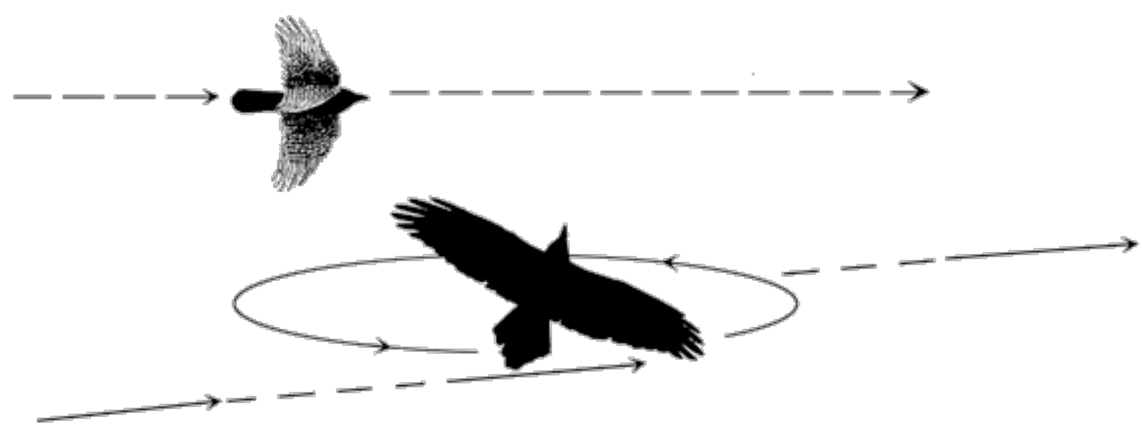
What size is it?

The best way to judge a bird's size is by comparing it with one of these nine common birds. Size is measured from the bill-tip to the tip of the tail.



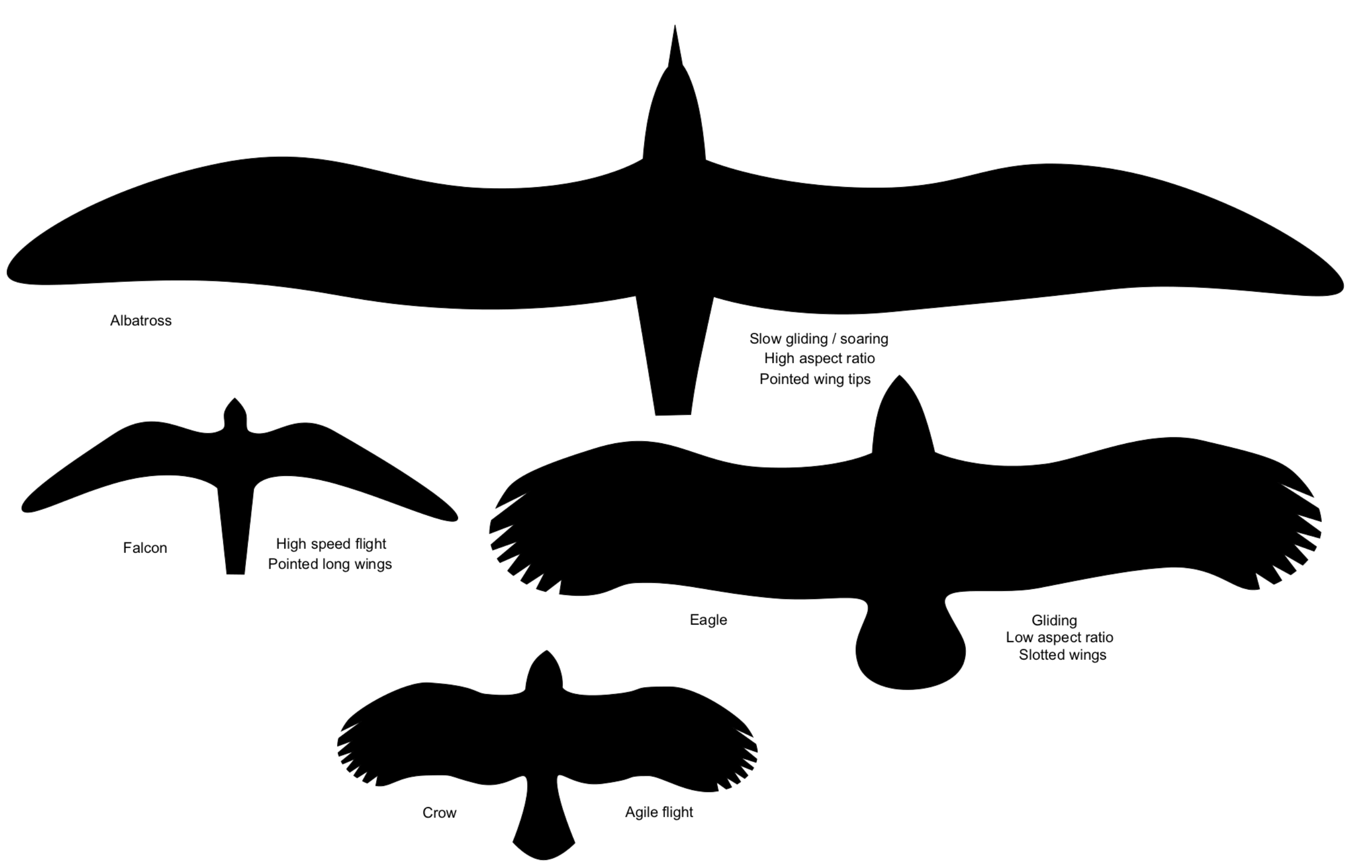
How does it fly?

Birds glide, soar, flap, hover, and perform a multitude of aerobatic tricks; and the way in which they fly can be very distinctive. A kestrel is unmistakable when hovering; so is a fly catcher when it darts from its perch to catch an insect. Some birds rise and fall rapidly, then holding them closed. For example, the difference in flight patterns between crows and ravens is illustrated below:



What shape are its wings?

Even when a bird is flying too high for anything else to show up, its silhouette is often enough to place it in a broad group; and practice at 'reading' silhouettes can lead to exact identification.



How long are its legs?

The design of a birds legs reflect its way of life or the sort of habitat in which it lives.

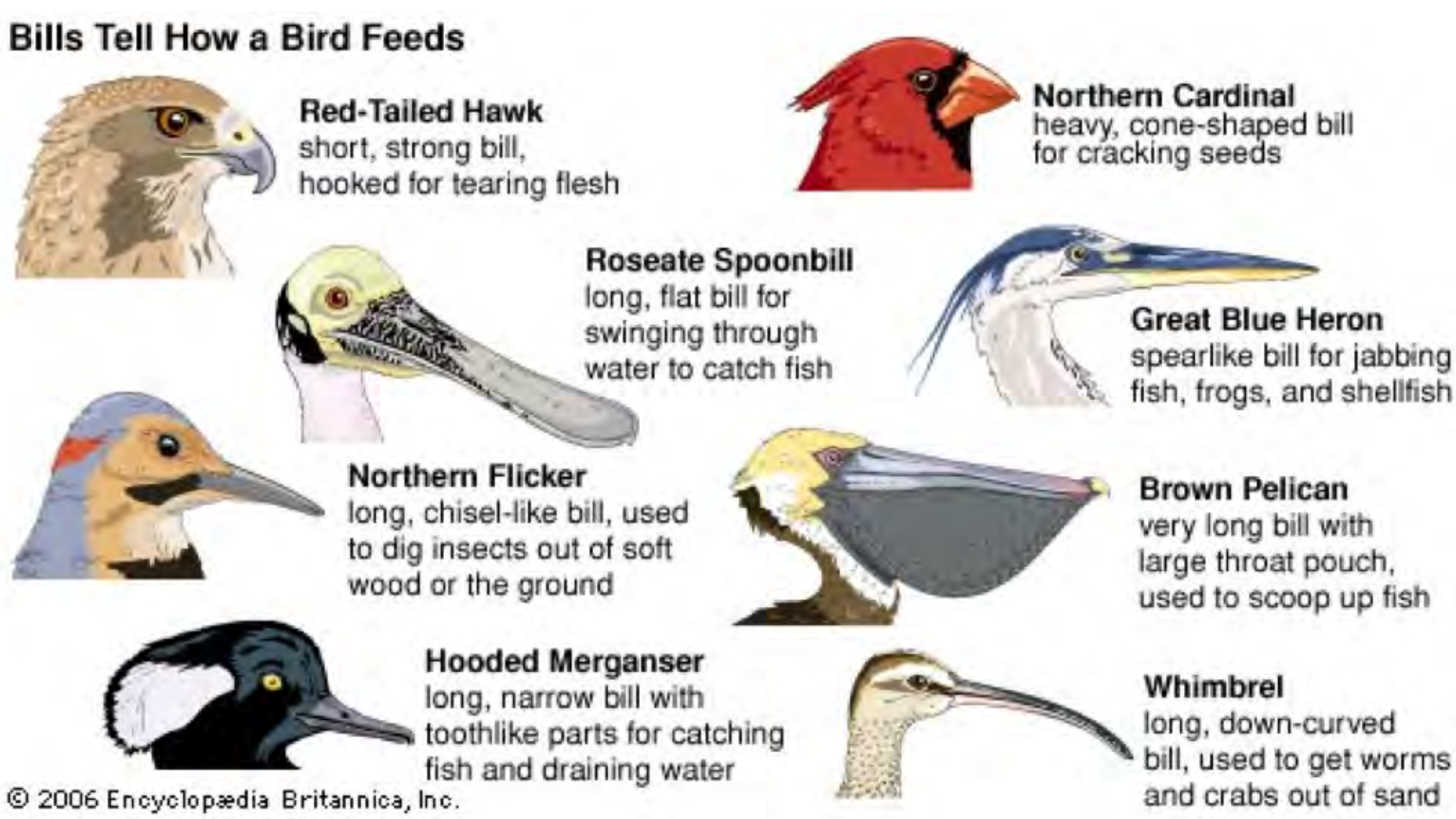
Starling
Medium legs, for general purposes

Heron
Long legs, for wading through water

Snow Bunting
Short legs, for bunting

What shape is its tail or bill?

The shape of a bird's tail, like the shape of its wings, can be sufficiently distinctive to be a useful recognition feature even when it is flying high. A bird's bill is designed to suit the way it feeds, and the more specialized the feeding habits, the more distinctive the bird's appearance.

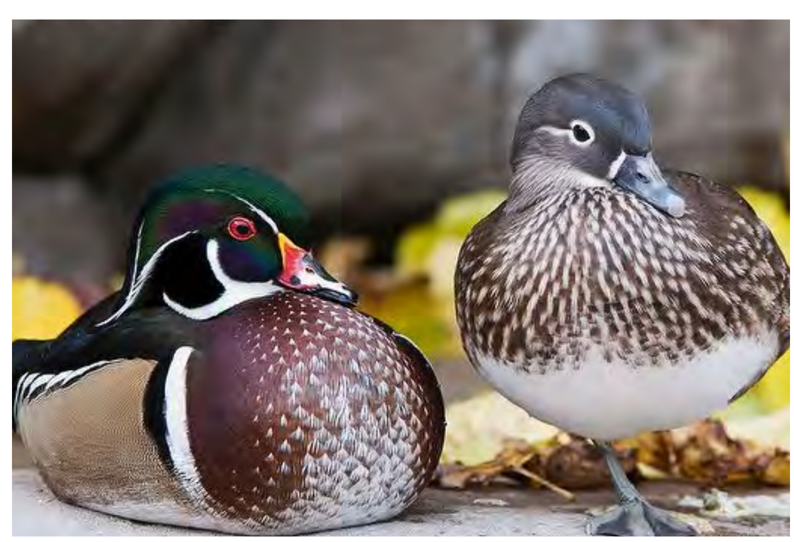


Categorizing Birds

Birds can be grouped based on their behaviour (rather than their biology). Four functional groups is a good place to start. Birds of prey are a predatory bird, distinguished by their hooked bill and sharp talons. Examples include owls, eagles, hawks, and falcons. Songbirds are perching birds that belong belonging to the clade Passeri often having melodious songs or calls. They are amongst the smallest of all birds and can hold tightly to branches with their toes. Examples include warblers, sparrows, and blackbirds. Waterfowl are strong swimmers with medium to large bodies. They have historically been an important food source, and continue to be hunted as game, or raised as poultry for meat and eggs. Examples include ducks, geese, swans, grebes, loons, pelicans, and cormorants. Wading birds are long-legged birds that wade in water in search of food and commonly occur in reedy areas, shallow waters, ponds, and other bodies of water. Examples include herons, rails, and shorebirds.

WATERFOWL

Waterfowl are certain wildfowl of the family Anatidae, which includes ducks, geese, and swans. Waterfowl are strong swimmers with medium to large bodies and webbed feet. They tend to prefer open bodies of water, such as lakes, ponds, and other types of wetlands. They have historically been an important food source, and continue to be hunted as game, or raised as poultry for meat and eggs. The domestic duck is sometimes kept as a pet. Swans and geese are generally larger than ducks, with long necks and feed by tipping up or grazing. They are generally found in flocks and they will call loudly in flight. Dabbling ducks (e.g., Mallard, Northern Pintail, and Wood Ducks) rarely dive, and feed mainly by dabbling their bills in the water or by tipping forward. Diving ducks (e.g., Canvasback and Ruddy duck) frequent deeper water and generally will dive underwater for food. Diving ducks are heavier-bodied so they can faster and need to run along the surface of the water to become airborne.



Wood Duck
© Donna Ikenberry

Wood Duck (*Aix sponsa*)

Habitat - Forests, swamps, marshes, and beaver ponds

Nesting - Cavity (in trees, man-made structures)

Special features - The Wood Duck nests in trees near water, sometimes directly over water, but other times up to 2 km away. After hatching, the ducklings jump down from the nest tree and make their way to water. The mother calls them to her but does not help them in any way. The ducklings may jump from heights of up to 89 m without injury. The Wood Duck is the only North American duck that regularly produces two broods in one year.

BIRDS OF PREY

Birds of prey, also known as raptors, are birds that hunt or feed on other animals. The term "raptor" is derived from the Latin word rapere (meaning to seize or take by force).They are characterized by keen vision that allows them to detect prey during flight and powerful talons and beaks. Because of their predatory nature they face distinct conservation concerns. In most cases, the females are larger than the males.

Birds of prey include members of seven families: Accipitridae (hawks, eagles, buzzards, and kites), Pandionidae (osprey), Sagittariidae (secretary birds), Falconidae (falcons and caracaras), Strigidae (most owls), and Tytonidae (barn and bay owls). The variety in the wing shape and body proportions of birds of prey are related to their hunting style and preferred prey. Species with similar shapes tend to have similar habitats.

Harriers are large, slender hawk-like birds with long tails and long thin legs. Eagles tend to be large birds with long, broad wings and massive feet. Ospreys are very similar to eagles with a single species found worldwide that specializes in catching fish and builds large stick nests. Kites have long wings and relatively weak legs and they spend much of their time soaring. Hawks are medium-sized raptors with long tails for turning on tight angles. Falcons are medium-size birds of prey with long pointy wings. Owls are variable-sized, typically night-specialized hunting birds (although they are NOT all exclusively nocturnal). They fly almost silently due to their special feather structure that reduces turbulence and they have particularly acute hearing.

Great Grey Owl
© Mary Ann McDonald

Great Gray Owl (*Strix nebulosa*)

Habitat - Boreal forest

Nesting - Broken-topped dead trees or existing nest of other bird species

Special features - Great Gray Owls are Manitoba's provincial bird. Although the they are the tallest North American owl with the largest wingspan, it is just a ball of feathers. It preys on small mammals and has relatively small feet. Both the Great Horned and Snowy owls weigh half again as much, and have larger feet and talons

SONGBIRDS

A songbird is a bird belonging to the clade Passeri of the perching birds. This group contains some 4,000 species found all over the world, in which the vocal organ typically is developed in such a way as to produce a diverse and elaborate bird song. Songbirds are among the smallest of all birds. Warblers, tanagers, orioles, finches, and hundreds of other species make up this diverse group of birds.

Black-capped Chickadee (*Poecile atricapillus*)

Habitat - Deciduous and mixed forests

Nesting - Tree cavities (e.g., natural holes, abandoned woodpecker cavities).

Special features - Winter flocks with chickadees serving as the nucleus contain mated chickadee pairs and nonbreeders, but generally not the offspring of the adult pairs within that flock. Other species that associate with chickadee flocks include nuthatches, woodpeckers, kinglets, creepers, warblers and vireos. Most birds that associate with chickadee flocks respond to chickadee alarm calls.

Chickadee
© Andrew Olynyk

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