INTERPRETING NATURE

VOLUME TWO

1. KINGDOM ANIMALIA 1
2. INVERTEBRATE BIOLOGY 7
3. FISH 47
4. AMPHIBIANS AND REPTILES 85
5. BIRDS 135
6. MAMMALS 219
INTERPRETING NATURE:

A PRIMER FOR UNDERSTANDING NATURAL HISTORY

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PRESENTATION

Presented to you here is a unique synthesis of topics in North American natural history. It is a review of the living and nonliving world in which we live. Most of the information is a survey of the various groups of living organisms. However, ecology, geology and astronomy are also covered.

More than anything else Interpreting Nature is a distillation of material and ideas from a variety of sources of natural history and field identification. It is not a field guide, and it is not an academic text. However, it draws on both these sources including information from other areas. The result is an interesting, comprehensive presentation intended to familiarize you with different kinds of organisms, demonstrate how they relate to each other and their natural environment, and explain certain characteristics of these organisms to help you understand their living styles.

Interpreting Nature is part of a Naturalist Training Program Package to train interpretive naturalists. Most naturalists are strong in one or two areas of knowledge, and the package was designed to broaden the base of expertise. Because the emphasis is on nature interpretation we present many helpful suggestions on how to share knowledge and stimulate the interest of others.

Each section in this book is intended to act as a primer or study guide for the topic discussed. The contents of each section provides the reader with an overview of the topic, emphasizing aspects which are readily observable in nature, or dealing with answers to more common questions. The plants and the vertebrates are given particular importance because they are the most conspicuous organisms in nature. This book may be read from beginning to end as a curriculum in studies of natural history. However, it is especially useful as a reference to quickly familiarize you with individual natural history topics. In the case of plants and each vertebrate group you will find naturalist notes, a general discussion of anatomy, and review of their classification.

Regardless of your background you will find Interpreting Nature useful and enriching. It will broaden your knowledge of natural history, and help you better understand the wonder of nature.
ACKNOWLEDGEMENTS

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Other contributors to the book were Des Wilson, who wrote the first draft of Geology and Ted Rashleigh, who wrote the first draft of Astronomy. In addition we would like to thank the following people for reviewing the manuscript: Terry Taylor - Plants, Fungi; Ross Beatty - Geology; Nora Jones - Fungi; and Russ Haycock - Amphibians and Reptiles. The entire manuscript was reviewed by Michelle Choma who provided helpful advise and eliminated many typographical errors.

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KINGDOM ANIMALIA

Animals are a diverse group of organisms ranging from the relatively simple undifferentiated sponges to the more advanced vertebrates. They are unique in their capacity to respond to environmental stimuli and as a result, in maintaining a constant internal environment. They possess an elaborate array of organ systems which are not seen in any of the other kingdoms. As a group they are the most viable of all organisms.

All animals are multicellular and differentiated. They are heterotrophic, relying on organic material obtained from other organisms for their nutrition. In general they ingest their food material rather than absorb it as occurs in the fungi. Their cells have no cell walls or chloroplasts.

A key distinguishing the major groups of animals is provided on the follow page.
AN EXAMPLE OF THE RELATIVE NUMBER OF SPECIES IN EACH OF TEN PRINCIPLE ANIMAL PHYLA
Kingdom Animalia

Relatively simple - undifferentiated

- Ph. Porifera

Radial symmetry

- One opening
  - Often soft body
    - Ph. Coelenterata

Bilateral symmetry

- Two openings
  - Often hard body, spines
    - Ph. Echinodermata

No rigid skeleton

- Appendages non-jointed
  - Never paired

Rigid skeleton

- Digestive system
  - With one opening
    - Worm-like, flat or ribbon-like body
      - Ph. Platyhelminthes

- Digestive system
  - With two openings
    - Worm-like, cylindrical
      - Non-segmented
        - Ph. Aschelminthes
      - Segmented
        - Ph. Annelida

Non-wormlike foot

- Muscular foot, visceral mass, mantle, may possess shell
  - Ph. mollusca

Skeleton external

- Exoskeleton, jointed body, > 3 pairs jointed appendages
  - Ph. Arthropoda

Skeleton internal

- Endoskeleton, usually 2 pairs jointed appendages, possess notochord

Segments similar

- > 10 pr. legs
  - Cl. Myriapoda

Segments dissimilar

- Without antennae, 4 pr. walking legs
  - Cl. Arachnida

Functional

- Gill slits
  - Subph. Cephalochordata

Sac-like

- Body
  - Subph. Urochordata

With vertebral column, brain case

- Subph. Vertebrata

Gills entire

- Life, scales in adult, skin smooth
  - Cl. Pisces

Lungs present

- (Never possess gills)
  - Cl. Amphibia

Skin dry, scaly

- Cl. Reptilia

Feathers, lay eggs

- Cl. Aves

Skin hairy

- Mammary glands present
  - Cl. Mammalia
INVERTEBRATE BIOLOGY
INVERTEBRATE BIOLOGY

OUTLINE

PHYLUM PORIFERA - sponges 9

PHYLUM CNIDARIA (COELENTERATA) 10
   CLASS HYDROZOA 13
   CLASS SCYPHOZOA 14
   CLASS ANTHOZOA 14

PHYLUM PLATYHELMINTHES - flatworms 17

PHYLUM ANNELIDA - segmented worms 18

PHYLUM MOLLUSCA - slugs, clams, snails 21
   CLASS AMPHINEURA - chiton 21
   CLASS GASROPODA - snails, slugs, limpets 22
   CLASS BIVALVA - clams, oysters, mussels 23
   CLASS CEPHALOPODA - squids, octopus 24

PHYLUM ARTHROPODA - animals with exoskeletons and jointed appendages 27
   CLASS CRUSTACEA - crabs, barnacles, shrimp 29
   CLASS INSECTA - insects 29
   CLASS ARACHNIDA - spiders, scorpions 36
   CLASS MYRIAPODA - millipedes, centipedes 40

PHYLUM ECHINODERMATA - starfish, sea urchins 41

BIBLIOGRAPHY 43
The invertebrates include many phyla with diverse and numerous species. The major Phyla and Classes are described in this section to emphasize common characteristics of their members. The detailed information on specific and smaller groups has been left for the field books to provide.

PHYLUM PORIFERA - The Sponges

Sponges are aquatic and mostly marine existing from mid-tide level on the shore, down to the deep ocean floor. They are considered to be the most primitive of all multicellular animals and are composed of a loose aggregation of cells. The cells are specialized for different functions: some feed, others protect, some support or reproduce.

The characteristic feature of sponges is that they are porous. The pores are vents in the body wall through which water is drawn into the chambers. The chambers are lined with collar cells, each of which bears a flagellum. This acts like a whip to lash the water to create a current which brings in food and oxygen. The exhalent water carries out waste through a large opening called an osculum.

Between the body wall cells and flagellate collar is a nonliving jelly. Within this jelly are amoeboid cells (mesenchyme cells) which can develop into any of the more specialized cell types. They are thought to transport waste materials out of the sponges. Some of the mesenchyme cells secrete spicules. Spicules are made of calcium carbonate and form the skeletal framework which supports the soft cellular mass.

Sponges occur in many forms. On shores they are flat and encrust rocks. In deep water their form is more varied and protrusive from rocks, particularly in still water. Their shape tends to be more symmetrical and regular in general, as the water depth increases.

The sponges' colour is a result of their symbiotic relationship with algae. The shallow water provides more light for the algae to grow, thus the sponges are more colourfull in shallow water.
Sponges can be hard or soft in texture. They reproduce sexually and asexually. The larvae are free floating before attaching to objects to develop into a sessile organism.

Sponges have few predators because of their uninviting texture. Nudibranchs (sea slugs) are one of the few creatures that will eat sponges.

PHYLUM CNIDARIA (COELENTERATA)

This phylum is made up of three Classes: Hydrozoa (hydroids or sea fans), Scyphozoa (large jellyfish) and Anthozoa (sea anemones and corals). They are simple in structure with an inner skin (endoderm) and an outer skin (the ectoderm) which make up the body wall. The internal cavity functions as a digestive cavity.

Cnidarians are radially symmetrical. They have a simple undefined circulatory system and a simple nervous system consisting of nerve nets.

Cnidarians take on two main forms:
(1) the polyp (hydroid)  
(2) the medusa

The polyp is sessile and cylindrical. It is closed at one end with a mouth and tentacles at the open end. The medusa is a free-swimming form. It may be well or umbrella shaped. Both forms occur in alternate generations in some species.
DIVERSITY IN PHYLUM PORIFERA

Regadrella
Poterion
Scypha
Hemicentrotus
Spongia
Haliclona
PHYLUM COELENTERATA (jellyfish, corals, sea anemones, hydras)
Class Hydrozoa

Hydroids are small and often mistaken for plants. Their branching plant-like shape is formed by a colony of tiny polyps connected to a common digestive canal and stiffened by calcium or other firm material.

The polyps reproduce asexually by budding. The buds sprout into little medusae, complete with stalk, tentacles and mouth. The medusa eventually detaches from the polyp parent. It develops into a sexually reproducing animal which will give rise to another hydroid colony.

The hydroid medusa is distinguished from the scyphozoan medusa by the presence of a vellum. The vellum is a shelf which faces inward from the margin of the bell. It is also distinguished by the four-chambered stomach.

Medusae have light-sensitive ocelli which appear as red, brown, or black spots at the base of the tentacles.

*Obilia,* an example of a hydroid coelenterate
Class Scyphozoa

In the Class Scyphozoa the jellyfish/medusoid phase is dominant over the polyp phase. The polyp stage (if it exists in the species) is small. The polyp is never colonial as it is in hydroids.

Scyphozoa jellyfish can be distinguished from hydroid jellyfish by their lack of a vellum, their large size and the existence of oral lobes. They have a four-rayed symmetry.

Jellyfish have tentacles that fringe the perimeter and surround the mouth. Around the medusa bell is a muscle band which contracts and expands the bell to propell the animal through the water.

Class Anthozoa

In the Class Anthozoa, only the polyp stage exists. These creatures are mostly stationary. They have a short main axis from which the wide disc mouth region extends. The muscular and nervous system are more developed than that of the other two classes.

Sea anemones are carnivourous, feeding on fish and invertebrates. They sting their prey with tentacles that guide the food to the mouth. They have been known to live well over 80 years.

Corals are colonial animals, some of which have hard calcareous skeletons. In the tropics the rock corals are responsible for building reefs.
SEA ANEMONE ("flower animal"), an example of an anthozoan coelenterate. Diagram is cut away to show large gastrovascular cavity (one opening).
PHYLUM PLATYHELMINTHES - The Flatworms

Members of this phylum are bilaterally symmetrical. They have no body cavity. They have a nervous system, male and female genitals, gut, mouth, eyes and other sense organs. They absorb oxygen through the skin. There is no anus so digested waste must leave through the mouth.

Their smooth skin may be covered with cilia or mucus. Locomotion is done by moving cilia or muscular contractions.

Platyhelminthes are usually carnivorous or parasitic.

At the seaside or freshwater habitats you will find them in dark sheltered places. They thrive in mudflats and estuaries where there is an abundant microbial food supply.
PHYLUM ANNELIDA - The Segmented Worms

Except for the head and tail each segment is similar, having a pair of excretory structures (nephridia) and a nerve centre (ganglia). The digestive tract runs through the segments. Some marine worms have leg-like appendages called parapodia attached to each segment. These function for movement and respiration.

Some of these worms will bite, especially the nerid worms found at the seashore. Tube worms are found under rocks and logs where they build calcereous tubes in which they live. They feed by trapping plankton on the plumed, feather heads and directed the food to the mouth by beating hairs.

Representatives of three Classes of the Phylum Annelida

Left, a polychaete Nereis virans, the clamworm.
Centre, an oligochaeta, Lumbricus terrestris, the earth worm.
Right, Hirudo medicinalis, the medicinal leech
DIGESTIVE SYSTEM OF AN EARTHWORM

EXCRETION IN THE EARTHWORM
PHYLUM MOLLUSCA (clams, oysters, squids, octopus, snails)
PHYLUM MOLLUSCA - The Chitons, Gastropods, and Bivalves

Mollusca means soft bodied. All members of this phylum have soft bodies divided into four regions:

(1) the head with a mouth, tentacles and eyes
(2) a ventral and muscular foot
(3) a dorsal visceral mass containing the internal organs (coiled in gastropods) and,
(4) a mantle from which the animal can secrete a calcareous shell to protect the visceral mass

A shell is a handicap to active movement so many groups have reduced this protection as a compromise for faster locomotion.

This group is diverse and the typical mollusk features are modified in the different classes. Some of these classes are described as follows:

Class Amphinereura (Subclass Polyplacophora)

Chitons have long flattened bodies and a foot covered with a row of eight long connecting plates. These plates help to conserve moisture when the animal is out of water and protect it from wave action while clinging to rocks.

A chiton moves slowly along rocks by the undulating foot muscles. It scrapes vegetation from the rocks with its radula mouth. If a chiton is removed from a rock it will curl up its shell as a protective measure.

external and internal anatomy of a chiton
Class: Gastropoda

This class includes snails, slugs, nudibranchs, limpets and whelks. Most have a protective single shell. In snails the shell is spiraled. The oxygen absorbing gills are tucked under the shell.

Gastropods have a large basal foot which is used for clasping and locomotion. These organisms are generally slow moving. They eat with the radula (tongue) in the mouth which scrapes the food.
Class Bivalva

The name bivalve means two valves or two shells. Bivalves have flattened bodies covered by two flattened shells. The shells are connected to each other dorsally by a strong ligament. As the animal grows, so does the shell at the ventral section. The growth leaves rings on the shell.

The shells are closed by two large muscles when the animal needs protection. They open when the animal is feeding. Bivalves are filter feeders. Most use their gills to collect plankton as well as to absorb oxygen.

Some bivalves such as mussels and oysters are stationary, being attached to rocks. Mussels are attached by filaments (byssal threads) that anchor the animal to rocks. Clams bury themselves in the substrate. The foot is used to dig the burrow. Scallopss move through the water by opening and closing their shells.

Most bivalves are either male or female but some such as cockles are hermaphroditic. The Japanese oyster conveniently changes its gender.
Class Cephalopoda

Cephalopods include nautiluses, squids, and octopus. The name means "head-footed" because the foot is wrapped around the head and extends to the tentacles. Members of this group are the most elaborate and active of the Phylum Mollusa. The octopus is said to be the most intelligent of all marine invertebrates. The mantle's shell has been reduced in all members except the nautilus which has a coiled shell. The mantle cavity is modified as an organ of jet propulsion with the foot converted into a funnel directing the propulsive stream. Some of the other modifications are a more efficient circulatory system with a branchial heart. Digestion is extracellular and the Cephalopods eat through a strong jaw. Sexes are separate.
CLASS CRUSTACEA Some marine forms in their respective habitats.

EXTERNAL ANATOMY OF A LOBSTER, A COMMON ARTHROPOD
CLASS CRUSTACEA
Some freshwater inhabitants in their characteristic habitats.
PHYLUM ARTHROPODA

The name Arthropoda means 'joint footed'. These animals have jointed appendages and exoskeletons which they must shed as they grow. This group is the most numerous and widespread of all animals. It includes insects, spiders and crustaceans.

Phylum Arthropoda (insects, lobsters, crabs, spiders, millipedes, and centipeds)

Class Crustacea

Like most other arthropods, crustaceans have a segmented body, paired jointed appendages, an exoskeleton, antennae, eyes and other common characteristics.

The exoskeleton supports the body as well as protects it. It can vary from a thin light layer as in water fleas, to a thick calcareous suit of armour as found on crabs and lobsters. This covering is segmented with the segments attached to each other by a flexible ligament to allow easy movement. The exoskeleton must be shed as the crustacean grows. A person can often find crab carapaces on the beach which have been shed to be replaced by a new exoskeleton.

The crustacean is able to absorb water and swell once the skeleton is shed. The period immediately after molting is when the females (particulary crabs) are receptive to fertilization.

Sexes are usually separate in the crustaceans but hermaphrodites are found in some groups. Crustaceans produce eggs. The young emerge from the eggs. In some species the larvae resemble the adults and others show no resemblance. They are often planktonic in early life but develop into adults through several growth stages.
Excretion in the Insect
Malpighian tubules of
tubules of an insect.

The Compound eye of the Horsefly
Each eye is composed of a large number of ommatidia
Class Insecta

Next to plants, insects are probably the most conspicuous members of the natural environment throughout most of the year. They occur in almost all terrestrial and freshwater habitats. They are the most numerous and diverse of all the animals. They generate considerable interest because of their body structure and life histories.

**INSECT CIRCULATORY SYSTEM.**

Insects, like all arthropods, possess an exoskeleton (unlike humans whose skeleton is inside i.e. an endoskeleton). The exoskeleton affords insects excellent protection from damage to soft tissue, and it prevents water loss, allowing insects to live under arid conditions for extended periods of time. It is also articulated which allows for more efficient movement compared to other non-arthropod invertebrates. An exoskeleton has two major disadvantages. First, it is extremely heavy, which restricts the maximum body size of insects; most are very small. Three-quarters of the several hundred thousand species of insects are less than 6 mm long. Secondly, it is rather clumsy and not very flexible in the joints. This accounts for the mechanical appearance of locomotion in insects.

The senses of insects are remarkable and differ considerably from that of our own. Their eyes are compound eyes, consisting of hundreds of individual units (ommatidia). Such an arrangement makes the eyes extremely sensitive to movement (different units are stimulated as an
animal moves through the field of view. Everyone knows how difficult it is to catch a fly, and the reason is found in the unique sense of vision. Some insects, such as bees, are sensitive to polarized light which provides them with a different perspective of the world. Besides vision, insects are unusual in other senses. They are sensitive to chemicals suspended in the air, a capacity which we refer to as "smell". Similarly, they do have a sense of taste, but the sensation is perceived by the feet rather than taste buds with gustatory cells. Finally, some insects can hear but they do so without ears. Sound can be detected by specialized organs in various body parts - the abdomen, front legs, or antennae.

Gas exchange in insects is accomplished by an internal system of tubes (tracheal tubes). There are no lungs. The tubes take gases to and from the body tissues directly. They open on the outside of the insect's body wall by means of little pores called "spiracles".

![Diagram of insect respiratory system]

respiratory system of an insect

Insects are unique amongst the invertebrates in their ability to fly. They are the only invertebrates with wings. Their ability to fly contributes significantly to their relatively dominant position amongst animals on earth. The wings of insects are not modified appendages as in the case of birds and bats. Rather, they represent structures which supplement the regular locomotory organs of the animal.

Metamorphosis is a remarkable feature of the life history of an insect. It can be complete (holometabolous) or incomplete (hemimetabolous). Complete metamorphosis is represented by the life history of a butterfly
where the animal goes from an egg - larvae - pupa - adult. The larval
caterpillar is familiar to everyone. Inside the larva is a group of cells which will
later use the larval tissue to form a butterfly. The pupa of a butterfly is
contained inside a chrysalis or a cocoon. Incomplete metamorphosis is
represented by a grasshopper. In this case the egg hatches into a nymph,
which is essentially a miniature version of the adult. This goes through a
number of successive molts (instars), the last of which produces the mature
adult.

**INCOMPLETE METAMORPHOSIS**

**COMPLETE METAMORPHOSIS**
An interesting feature of some insects is their ability to withstand freezing temperatures. Not all insects have this capacity. Many insects from warmer climates often die quickly at temperatures above freezing (e.g. 5°C). However, some can withstand temperatures as low as -47°C. Ice crystals form around a nucleus of some material, and insects which 'supercool' have unusually low concentrations of these materials. Some insects with a low supercooling point may also have glycerol in their circulatory fluid (hemolymph). This is formed from glycogen.

Finally, insects have a tremendous potential for reproduction. As adults females tend to lay large numbers of eggs, sometimes many thousands per individual. The generation time tends to be short, and there may be a significantly greater proportion of females to males in each generation. All of these factors result in a staggering ability to reproduce. For example, a pair of fruit flies can produce $1.192 \times 10^{41}$ flies by the 25th generation which, if packed together tightly, would form a ball 96,372,988 miles in diameter. This situation of course does not occur because of the high mortality rates of the flies.

A female Ichneuman fly with ovipositer inserted into a plant stem so that eggs may be laid in an insect host within the plant tissue.
LIFE STAGES IN A MOSQUITO

larva (wriggler)

pupa (tumbler)

emerging adult

adult
PREDACIOUS DIVING BEETLE (Dytiscus)

x 4

GIANT WATER BUG (Lethocerus)

x 1
As diverse as insects are, they do possess two common characteristics. All of them have three pairs of walking legs, and one pair on antennae. A few of the more common Orders are as follows:

**Order Orthoptera - grasshoppers, cockroaches**
- front wings narrow, thickened, covering fan-like fragile hind wings when in repose.

**Order Hemiptera - true bugs and relatives**
- two pairs of wings locked in flight

**Order Odonata - dragonflies and damselflies**
- large with long, narrow transparent pair of wings, net-veined

**Order Coleoptera - beetles**
- front wings hard, cup-shaped protecting fragile hind flight wings when in repose

**Order Lepidoptera - moths and butterflies**
- wide membranous wings with scales

**Order Diptera - true or two-winged flies**
- front pair of wings membranous, narrow
- hind pair of wings reduced to short rods acting as balancers

**Order Hymenoptera - wasps, ants, bees**
- narrow membranous front wings
- hind wings much reduced, firmly coupled to front wings
Class Arachnida

This group contains the spiders, ticks, mites and scorpions. They are all characterized by possessing four pairs of walking legs and no antennae.

There are about 30,000 species of spiders worldwide. They can be found in almost all terrestrial habitats. However, any one species is usually specifically adapted to a particular habitat and is not generally found outside of these limits. Spiders are carnivorous, feeding mainly upon other arthropods, especially insects.

Unlike other Arthropods which possess three distinct body segments, (head, thorax and abdomen) the segmentation of Arachnids is more obscure. The head and thorax have become fused forming a single ‘cephalothorax’. This in turn is connected to the abdomen by a very narrow waist called a ‘pedicel’. There is a tough plate called a ‘carapace’ covering the cephalothorax.

On the upper side of the head are a number of eyes, usually eight, but in some species six, four, or two. At the front on the lower side of the head are the jaws, called ‘chelicerae’. These often bear sharp teeth on the inner edge and a fang. These are necessary to penetrate the exoskeleton of the prey. The fang is connected to poison sacs. In addition to the eyes and jaws, the cephalothorax contains a pair of pedipalps (palps for short), and four pairs of legs.
VIEW OF THE COBWEB SPIDER
Note the egg cases.

COBWEB SPIDER
from 6 to 11 mm

VIEW OF THE
FUNNEL WEB
SPIDER

FUNNEL WEB SPIDER
from 6 to 9 mm
A spider does not feed by tearing off bits of prey and swallowing them. Rather, the spider releases digestive enzymes into the soft body tissues of its prey. Digestion is initially external. Then, the spider uses its sucking stomach to pump the liquid contents of its prey into the alimentary canal.

Silk production is an important ability in their daily lives. The silk is a protein, in the form of a liquid, manufactured by silk glands in the abdomen. It is secreted from spinnerets. As a group the spiders manufacture seven different kinds of silk, but no one group produces all. Different silks are used for wrapping prey, making egg sacs, or spinning a web.
Class Myriapoda

This group includes the millipedes (also called Class Diplopoda) and centipedes (Class Chelipoda). They have more than 10 similar segments and one pair of antennae. Millipedes have 4 legs on each segment (except head), and centipedes have 2 legs.
PHYLUM ECHINODERMATA

Echinoderms start their lives as free swimming bilaterally symmetrical larvae which develop into radially symmetrical adults. They have calcareous exoskeletons under the skin. Their surface is spiny.

A distinctive feature of echinoderms is the presence of tube feet. These are used for grasping and locomotion.

Echinoderms have a body cavity and a vascular system of canals used in respiration or locomotion or both. This phylum is exclusively marine and its members are starfish, serpent stars, sea urchins, sea cucumbers, sand dollars, and sea lilies.
Representative echinoderms as they live in the sea
BIBLIOGRAPHY


FISH
## FISH OUTLINE

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NATURALIST NOTES</strong></td>
<td>49</td>
</tr>
<tr>
<td>How to interpret a fish habitat</td>
<td>49</td>
</tr>
<tr>
<td>Collecting and Displaying</td>
<td>52</td>
</tr>
<tr>
<td>Does Red Tide affect you?</td>
<td>54</td>
</tr>
<tr>
<td><strong>WHAT IS A ....FISH?</strong></td>
<td>55</td>
</tr>
<tr>
<td><strong>ANATOMY</strong></td>
<td>59</td>
</tr>
<tr>
<td><strong>CLASSIFICATION OF FISHES</strong></td>
<td>69</td>
</tr>
<tr>
<td><strong>CLASS AGNATHA</strong></td>
<td>71</td>
</tr>
<tr>
<td><strong>CLASS CHONDRICHTHYES</strong></td>
<td>71</td>
</tr>
<tr>
<td><strong>CLASS OSTEOCHITHYES</strong></td>
<td>71</td>
</tr>
<tr>
<td>ORDER ACIPENSERIFORMES - Sturgeon</td>
<td>71</td>
</tr>
<tr>
<td>ORDER SEMIONOTIFORMES - Gar</td>
<td>71</td>
</tr>
<tr>
<td>ORDER ANGUILLIFORMES - Eels</td>
<td>72</td>
</tr>
<tr>
<td>ORDER CCUPERIFORMES - Sardines, Herring</td>
<td>72</td>
</tr>
<tr>
<td>ORDER SALMONIFORMES - Salmon, Trout, Smelt,</td>
<td>72</td>
</tr>
<tr>
<td>Pike</td>
<td></td>
</tr>
<tr>
<td>ORDER CYPRINIFORMES - Minnows, Carp, Suckers,</td>
<td>75</td>
</tr>
<tr>
<td>Catfish</td>
<td></td>
</tr>
<tr>
<td>ORDER GADIFORMES - Cod, Haddock</td>
<td>75</td>
</tr>
<tr>
<td>ORDER GASTEROSTEIFORMES - Stickleback</td>
<td>76</td>
</tr>
<tr>
<td>ORDER PERCIFORMES - Grouper, Bass, Perch,</td>
<td>76</td>
</tr>
<tr>
<td>Snapper, Seaperch, Blenny, Sculpin</td>
<td></td>
</tr>
<tr>
<td>ORDER PLEURONECTIFORMES - Halibut, Flounder,</td>
<td>81</td>
</tr>
<tr>
<td>Sole</td>
<td></td>
</tr>
</tbody>
</table>

**BIBLIOGRAPHY**

82
NATURALIST NOTES

Remember, if you do not have any reference material, start compiling a set of information. To help get you started, here is a reminder of where you can get the information by telephone, mail or in person.

1. Libraries (university, college, public).

2. Public Relations Offices in Government Departments
   - ask for handouts for personal reference
   - ask for handouts for your visitors.

3. Hatcheries
   - the personnel may have some interesting publications or ideas available

4. Aquarium
   - the personnel may have some educational information you may want to incorporate into your own style of interpretation

5. Fishing Clubs and Shops
   - there may be a local club whose members could help you find more information
FISH TIPS FOR BEGINNERS

What should you look for? Be familiar with how to identify local fish by noting any or all of the following points:

(1) whether or not the head has spines

(2) are there any distinguishing markings? If yes, where? (for example distinguishing black spots on the tail fin)

(3) what is the average length and weight of the species?

(4) how may gill rakers does the fish possess?

(5) are any of the fin shapes particularly distinguishing to the fish in question?

For yourself, find a distinguishing shape or mark which represents the fish to you. The above is only a guideline to help you see the fish in a variety of ways. Visitors are often interested in finding out about the life history of the fish. Know where you can secure information on the physical and geographical information dealing with the life cycle. For instance, find out where the fish spawn, where the young are reared, what they look like and whether the fish migrate or are year-round residents.

You may find that your known species may not change their geographical area throughout their life whereas other species may travel many hundreds or even thousands of miles before the end of their lifespan.

Another aspect which sometimes interests visitors is the economy of the given fish population. Is the fish valued? If so, know how the fish is utilized. For example, is the fish useful for sport fishing and commercial fishing?

In any fish habitat there are nine important parameters which cumulatively determine the species of fish that populate the area. Limitations are set by the ability of each species of fish to adapt and therefore tolerate combinations of these parameters.
When interpreting the habitat, keep these following points in mind as reasons why, for example, brown trout can and brook trout cannot live together in a particular body of water:

(1) dissolved oxygen content  
(2) light (penetration and availability)  
(3) cover (vegetation in and surrounding habitat)  
(4) pH of water  
(5) temperature of water  
(6) food availability (terrestrial and aquatic)  
(7) sedimentation (suspended and deposited)  
(8) protection (from predators)  
(9) water depth and flow  

Often representative fish species are used as indicators of the ‘health’ of the habitat. For example, visitors may be concerned about the disappearing trout population but do not know the reason behind this decrease. Take this opportunity to educate these visitors of their role in the overall responsibility to protect habitat.

You may find there are various activities in your area to protect and enhance fish habitat.

(1) Individuals can contact local salmonid enhancement program offices or hatcheries to get details on long term projects (for example: planting trees on sides of moving water to create more cover).

(2) All visitors can be informed on why it is important not to introduce new species of fish from one body of water for example, lake to lake.

(3) All visitors can be informed on the appropriate action to take if they are witness to persons damaging the habitat in any way.

Reading the annual fishing regulations for your area will generally give you a good idea of appropriate people to contact if you wish more information on habitat protection and/or enhancement.
COLLECTING AND DISPLAYING

Fish present a particular observational challenge since, unlike for example birds, one is not likely to see them fly during a presentation. Instead you usually have to bring the fish to the public rather than the public to the fish. This means there are special problems of observing, collecting and keeping. Sometimes special observation chambers can be built. But obviously this involves considerable expense and is a permanent structure that would demand maintenance, etc. An easier method is to somehow collect some fish and keep them in portable aquaria.

There are many different ways to collect fish for display purposes. They include beach seining, Gee trapping, dip netting, electro-fishing, or obtaining fish from a pet store or fish market. Depending on the methods used, permits may have to be obtained from the Department of Fisheries and Oceans (salt water and anadromous fishes) or Ministry of Environment, Fisheries Branch.

Dip netting...

... is probably the easiest and least expensive method of obtaining fish, but is probably the least successful. This method is particularly good for hands on participation. Dip nets can be made by forming a loop or heavy wire, e.g. a coat hanger, and sewing a nylon stocking to the frame. Using a dip net usually requires wading so old shoes or tall boots are essential. Slow movements and patience ‘net’ the best results.

Gee Traps...

...or minnow traps are an effective way of catching smaller fish and should be installed in quiet backwater areas such as pools, sloughs and backeddies. Traps can be constructed of wire mesh (about 1/4 inch grid) obtained from a hardware store. They should be baited daily, (roe is the best bait). Traps should be well marked and checked daily. One of the problems of Gee trapping for interpretation purposes is that it can be hit and miss for catching fish as the traps must be placed in areas where there are fish.

Gee Trap: Fish enter through funnels and are unable to find their way out.
Electro-fishing is probably the most complicated and dangerous method of collection and can be hard on the fish. It should only be utilized by persons who are trained in electroshocker use.

Beach-seining is probably the most reliable method of catching fish. Beach seines come in various lengths, depths and mesh sizes. What you use depends on the size of what you want to catch and and the nature of the terrain in which you are netting.

A beach-seine is set by carrying one end of the net out from shore (distance depends on size of net), walking along the shoreline and bringing the end into shore. The lead line should have a good seal with the bottom. The net is then brought in towards shore, hauling at both ends. The lead line should be brought in ahead of the float line so that the net has a bagged appearance. When sufficient net has been brought in the lead line should be quickly brought in onto shore. The fish can then be taken out of the net.

Beach-Seine: a=floatline, b=leadline, c=bunt (smaller mesh size or bag).

The Pet Store and the Fish Market are the most reliable methods of obtaining examples of finned fauna. While not as ‘fun’ as the other methods they should be considered as an alternative to catching no fish. If all else fails, use pictures.
Keeping live animals must be done in a manner to minimize stress. A home aquarium is a good method for displaying fish. It allows the observer to see what the fish looks like. The tanks should be aerated and kept cool.

For the temporary talk, airstones operated by a line from a scuba cylinder or air pump (AC or DC) can be sufficient for aeration. Tanks can be kept cool by insulating them (put them in old styrofoam coolers), keeping them in the shade and packing the outside with ice. It is important to keep the top of the tanks covered as some fish try and jump out. When you finish your talk, release the fish back to where you got them.

For a more permanent fixture (e.g. in a nature house) there is a wealth of material available from local libraries, pet stores and scientific supply houses.

You do not have the legal means to apprehend offenders of the Fisheries and Wildlife Act. What you can do is to be familiar with the most updated federally issued guidebooks which would be useful in your area; for example, regionally issued tidal water sports fishing guide, fresh water fishing guide, or the hunting guide.

If you happen to witness an offender (for example, keeping more than their limit of sport fish), what you can do is record of date, time and location of the witnessed event. The licence of the offender’s boat or vehicle is also valuable information to record.

With all this information, the best thing that can be done is to send it to or contact the appropriate government agency which would then be able to legally act on this matter.

If you are working in a marine environment, knowledge of ‘red tide’ and its effects is very important. A reference leaflet is very useful in this respect. Having read the guide, you can apply your knowledge to situations where members of the public need to know why it is unsafe to, for example, harvest shellfish when a red tide warning has been posted, or what causes a red tide.
WHAT IS A..... FISH?

Most of the fish species you will be dealing with can be described as follows:

“jaws present, nostrils paired, paired pelvic and or pectoral fins present, gill openings as slits covered by a flaplike operculum, body in a wide variety of shapes with or without scales”.

A diagram of a generic fish is included to help identify the above mentioned parts of a fish.

Fish are aquatic vertebrates whose ancestors were also aquatic. This is in contrast to whales, sea turtles and certain other vertebrates who had terrestrial ancestors but underwent a secondary adaptation to aquatic life. Each of the three living classes and one extinct class of fish has unique characteristics, but all share certain primitive vertebrate features and others that adapt them to the water.

(1) Fishes are ectothermic (internal body temperature of an animal is dependent on external heat).

(2) Their integument contains many simple mucous glands and usually bony scales

(3) Their skeleton is less massive then in terrestrial vertebrates. There is little differentiation of the vertebral column other than trunk and tail; the visceral skeleton is well developed; and the appendicular skeleton consists only of fin supports.

(4) Fishes generally do not have a fleshy muscular tongue, and the intestine is not divided into small and large segments.

(5) Adults exchange gases with the environment through gills located in gill pouches; lungs or other accessory respiratory organs are present in a few groups.
SKETCHES OF ANATOMICAL FEATURES

from:
from:
Scott and Crossman. 1973. p.21
ANATOMY

Essential to a good biological presentation is being able to speak the language of the subject matter. For fish this includes some simple external anatomy. This will aid you in not only the talking but also the identifying of any fish found.

A common observation about the skeleton of a fish is that there are a large number of bones. This is especially true if you are eating a fish - there seems to be a bone or two in every mouthful. For convenience the skeleton of a fish is divided into three components:

1. the vertebral column (backbone)
2. the skull (head)
3. the appendicular skeleton (the fins and their supporting structures)

The vertebral column of a fish is very different between the major groups. In hagfishes there is a simple rod of cartilage (notochord); in lampreys there are vertebrae made of cartilages; in ratfish the vertebral column contains some bony material; and in the bony fishes (teleosts) it is of solid bone. Unlike terrestrial organisms with an elaborate musculature for support, the vertebrae of fish do not require such muscles and as a result, lack the elaborate projections (processes) of vertebrae to which they are attached. In fish there is generally one vertebra per segment to allow for the flexibility of swimming movements.

The ribs of fish extend downward (vertically) between each of the adjacent muscle masses. The bony fish also have ribs extending loosely upwards (dorsally) between dorsal muscle masses. The vertebrae in the trunk region have dorsal projections (processes) to accommodate and protect the spinal cord.

The skull of a fish is extremely complex compared to that of our own. The brain case alone typically has 40 - 50 bones, many of which are fused. The complex skull structure of a fish reflects the varied uses of the head region; the ingestion of food, the passage of water for respiration, the presence of many sense organs, the protection of the brain, gills, and other organs, the attachment of muscles, and the streamlining of the animal for swimming. The gills are supported by rakers which are part of the brachiohyoid apparatus which also makes up the floor of the mouth.
The appendicular skeleton refers to the fins (appendages - pectoral in the front, pelvic in the back, caudal in the tail) and the girdles used to attach the pectoral and pelvic fins to the vertebra column. The girdles are usually quite simple in the cartilaginous fish, and more complex in the bony fish.

Fish are broadly categorized as either:

1. detritivores (eating dead partially decomposed organic material)
2. herbivores (eating plant material)
3. carnivores (eating other animals)
4. omnivores (eating both plants and animals)

Within each of these categories the fish can be considered to have a varied diet (euryphagous), a more restricted diet (stenophagous), or a diet of only one food item (monophagous). Most fish are carnivorous with varied diets.

The structure of the fish mouth (buccal cavity) is highly variable due partly to evolution. The primitive fish mouth (still found in barracuda and pike) consists of firm jaws with sharp teeth to grasp prey. Modern fish have their mouth parts modified to feed by a sucking action, which is very common in fish today.

Certain of the structures in the mouth and throat (buccal-pharyngeal cavity) reflects different feeding habits. In carp there is a dorsal pad at the entrance to the esophagus and this may be used to remove excess water from food. In certain coral-eating fishes there is a dorsal pharyngeal valve and pharyngeal teeth for grinding coral. The gill rakers of cartilaginous and bony fish can also be modified for feeding.

The length of a fish's gut is also related to diet. Long intestines are associated with detritus and algae feeders which ingest large amounts of indigestible materials such as sand, mud, or cellulose. Gut lengths in carnivorous fish are shorter, with carnivores feeding on large prey (relative to their own body length) being the shortest. Carnivorous fish typically have a true stomach, and fish which eat small food items (microphagus) possess a gizzard (which masticates food as well as secreting digestive enzymes).
The blood of fish is similar to that of other vertebrates in that it contains red blood cells for the transport of oxygen, and white blood cells for immunity. However, fish do not have bone marrow, so these cells are produced in a different location. Both cells originate in a variety of organs. In the hagfish they are produced by an envelope of tissue surrounding the gut. In cartilaginous fish they are produced in an organ found in the esophagus (organ of Leydig, some tissue by the gonads, and the spleen). The red blood cells (erythrocytes) of fish contain nuclei is in the case with other vertebrates except mammals.

The flow of blood through the fish body is from the heart to the gills, from the gills to the body generally, and then to the heart again. This fish heart has a single atrium and ventricle, reflecting this single circulation. Birds and animals have a double circulation, the blood coming back to the heart after it is oxygenated before going out to the rest of the body. In addition to the atrium the fish heart has an additional collecting chamber called the sinus venosus which precedes the atrium. There is also a fourth chamber after the ventricle, called the bulbus arteriosus (or the cornus arteriosus in cartilaginous fish). This dampens the pulses in pressure from the ventricle.

The gonads of fish are usually paired structures found over the roof of the body cavity, associated with the kidneys. Sperm from the testes may be shed into the abdominal cavity and leave the body through a pore (lampreys and salmonids). It may instead, as in the sharks, be stored in a seminal vesicle before being expelled through a duct also used by the kidneys. In bony fish the sperm passes through a separate duct. The passage of eggs follows a pattern similar to that of sperm.

Many fish show almost no sexual dimorphism in external appearance even after spawning. Most fish, however, have permanent differences. Sharks and guppies (which have internal fertilization) possess an intermittent organ in males which is usually a modified fin. Egg-laying fish with
territorial males (as in salmon) have larger males than females. Generally, however, if there is a size difference between the sexes the female is larger; this is the rule with live-bearing fish. The males of these species then are usually brightly coloured.

The kidneys of bony fish are elongated and found above the swim bladder. The duct from each kidney joins with the other and form a smaller bladder. The bladder voids through a urinary duct which goes to the outside behind the anus. In the cartilaginous fish the urinary duct and anus empty into a common opening called the cloaca.

Most of the wastes (nitrogenous) are eliminated through the gills in the form of ammonia and urea (about 6 times as much nitrogenous wastes as the kidneys). The kidneys excrete creatine, uric acid, and trimethylaminomineoxide. In cartilaginous fish the main nitrogenous waste is urea.

Many bony fish live in both freshwater and marine environments, and can move from one to the other (anadromous fish). In freshwater environments there is a strong need to retain salts. As a result the kindney is highly adapted to conserve salts. The skin of fish also has very little blood supply, and is covered with mucus, which waterproofs the skin and prevents the loss of salt.

In marine fish there is the opposite problem of losing water and gaining salts. The kidneys in these fish are not as adapted for re-absorbing salts, and there are specialized cells (ionocytes) in gills to remove salts from the blood. In freshwater these cells absorb salts.
Freshwater and marine bony fish face different osmotic environments. Freshwater fishes have body fluids hypertonic to their surroundings and are continually flooded with water; marine bony fishes have body fluids hypotonic to seawater and are continually losing water.

**HYPOTONIC ENVIRONMENT**

![Diagram of a fish in a hypotonic environment showing salt and water movements]

**HYPERTONIC ENVIRONMENT**

![Diagram of a fish in a hypertonic environment showing salt and water movements]
Fish possess the senses we have - sight, sound, smell, taste and touch. In addition, they are able to detect pressure changes in the water around them by means of a lateral line system, and electric currents (electroreception).

Smell and taste are both involved in perceiving chemical stimuli. Smell (olfaction) is the perception of molecules from a distant source whereas taste (gustation) involves physical contact with the source. In fish the olfactory receptors are located in pits on the head. Water is drawn into the pits through an incurrent channel (nares) by cilia, swimming, the movement of the gills, or a combination of these factors. Water leaves the pit through an excurrent channel (nares). Within the pit is a structure with many folds of tissue called an olfactory rosette which contains numerous receptor cells. Elongated rosettes are characteristic of fish relying heavily on the sense of smell.

Taste (gustatory) receptors are localized in taste buds in the mouth and various exterior surfaces nearby - for example, on the fins and barbels of catfish, the well-developed lips of minnows and suckers, and the free pelvic fin rays of codfishes.

Hearing is an important sense in fishes because water is an efficient conductor of sound (much more so than air). Sound waves at the lower frequencies have enough energy to travel into the body of the fish and be perceived by the inner ear. At higher frequencies the tissue is not sufficiently displaced to stimulate the inner ear and other anatomical structures are used to enhance the process. In bony fishes the air bubble in the swim bladder is more readily compressed by a sound wave than the surrounding tissues. The swim bladder pulsates with a high frequency sound and will displace the adjacent tissue, which in turn will stimulate the inner ear. In some fishes (minnows and catfishes) the swim bladder is connected to the inner ear by a chain of small bones (Weberian ossicles).

Pressure changes in the water around a fish can be detected by receptors (neuromasts) found in the lateral line. The pattern of stimulation from the lateral line, running the length of the body on either side, will provide information on the presence of predators and prey, help the animal orientate itself in moving water, and help it to avoid objects (such as transparent walls of aquaria). The lateral line may also be used in hearing.

Electroreception is accomplished by external pit organs in bony fish which open on the body surface through canals filled with a gel. In marine cartilaginous fish the canals are similar structures called the ampullae of Lorenzini. The receptors can detect very small changes in electrical
currents in the water. This sense can allow fish to detect the electrical phenomena associated with the magnetic force field of the earth. It also helps to detect the presence of prey or a conspecific (members of the same species) due to electrical currents generated by the contraction of their muscles.

The eye of a bony fish has a cornea of constant thickness. Therefore all the focusing of light is accomplished by the lens, reducing optical alterations of light coming into the eye. The lens of the eye protrudes through the opening of the pupil, and the eye bulges outward from the surface of the body. This feature, along with the alternating head movements of many fish, allows the fish to see behind itself. The focusing action of the lens is not accomplished by changing its shape as in mammals. Rather, the lens is pulled inward and outward. The fish eye contains both rods and cones, so it can perceive colour. Cartilaginous fish and many bony fish have a reflective layer (tapetum) increasing their ability to see in poor light. The tapetum is responsible for eyeshine.

Fish are quite variable in the types and quantities of scales present on their bodies. To a large degree this reflects their different living habits. Some fish which are rather slow in their movements, such as sturgeon, many South American catfish, and seahorses have large modified scales in the form of bony plates which serve for protection. Numerous fine scales are characteristic of fish which are fast swimmers or live in strong currents, such as trout. Fish living in calm waters and which do not swim at high speeds, such as perch and sunfish, have coarse scales.

The scales of bony fish are either of the cycloid or stenoid type. The cycloid scales are found in fish such as trout, minnows, and herring. They are round, flat, and thin. The stenoid scales are similar but possess tiny, comblike projections (ctenii) on the exposed edge which may improve their hydrodynamic efficiency. They are found in the perches, for example. Sharks possess tiny tooth-like scales called placoid scales which may serve a similar function. Because of these projections fish with stenoid or placoid scales feel rough when touched.

Some fish have no scales, or have them modified for another purpose. These fish include sculpins, catfishes, and eels which live in tight places. Some fast-swimming open water maine (pelecic) fish also have no scales on the surface of the body (swordfish and some mackerels), although some do have scales which are deeply embedded (such as most tunas).

A juvenile fish will have the same number of scales as it grows. The scale grows along with the fish with cells (fibroblasts) in a growth region
towards the edge responsible for adding protein (collagen) and calcification. The growth in the diameter of a scale is at a relatively constant rate, and the additions on the edge form growth rings called circuli. The rings show annual variations called annuli, and these can be used to determine the age of the fish. The growth rate of a fish can be determined by examining the spacing between the circuli. Close spacing indicates slow growth due to cold, fasting, or reproductive cycles.
Lingcod  *Ophiodon elongatus* Girard

Rock Greenling  *Hexagrammos superciliosus* (Pallas)

Sablefish  *Anoplolpoma fimbria* (Pallas)
Classification of Fishes
Arrow Goby  *Clevelandia ios* (Jordan and Gilbert)

Tubesnout  *Aulorophynchus flavidus* Gill

Pipefish  *Syngnathus griseolineatus* Ayres

Wolf-eel  *Anarrhichthys ocellatus* Ayres
CLASSIFICATION OF FISHES

There are about 20,000 - 22,000 living species of fish, making them the most diverse group of vertebrates. They can be found in most aquatic environments. The modern fish contain three major groups -

Class Agnatha  jawless fish
Class Chondrichthyes  cartilaginous fish
Class Osteichthyes  bony fish

Class: Agnatha

45 species, hagfish and lampreys

general characteristics
- eel-like body
- cartilaginous skeleton
- no jaw, paired limbs, or girdles
- single nostril
- 6-14 gill pouches

species
Atlantic Hagfish  Myxine glutinosa
Sea Lamprey  Petromyzon marinus
Pacific Lamprey  Entosphenus tridentata

Class: Chondrichthyes

600 species, sharks, skates, rays, ratfish

general characteristics
- cartilaginous skeleton
- well-developed jaws
- placoid scales
- 5-7 gill slits
- no air bladder (creates buoyancy problems)
- paired claspers for reproduction

species
Sixgill Cowshark  Hexanchus griseus
Sand Tiger Shark  Odontaspis taurus
Giant Basking Shark  Cetorhinus maximus
Whale Shark  Rhincodon typus
Blue Shark  Prionace glauca
Smooth Hammerhead  Sphyma lewini
Spiny Dogfish  Squalus acanthias
Lesser Electric Ray  Narcine brasiliensis
Sawfish  Pristis pectinata
American Big Skate  Baja bincuculata
Pacific Ratfish  Hydrolagus collii

Class: Osteichthyes

general characteristics
- skeleton of bone
- air bladder or primitive lung
- single gill flap (operculum) covering gill openings

Order: Acipenseriformes

Family: Acipenseridae - the sturgeons

general characteristics
- cartilaginous skeleton with dermal cones covering cranium
- plate-like scales along sides
- whiskers on snout
- poor eyesight

species
American Lake Sturgeon  Acipenser fulvescens
Pacific Coast White Sturgeon  Acipenser transmontanum

Order: Semionotiformes

Family: Lepisosteidae - gars

general characteristics
- scales arranged in flat plates forming protective armor
- anal and dorsal fins with few rays

species
Giant Tropical Gar  Lepisosteus tristoechus

71
**FISH**

**Order: Anguilliformes**

**Family: Anguillidae - freshwater eels**

*general characteristics*
- no pelvic or ventral fin
- dorsal and anal fin continuous with tail fin
- air bladder with open duct to throat
- scales present

*species*
- American Eel, *Anguilla rostrata*

**Family: Muraenidae - Moray Eels**

*general characteristics*
- no pectoral fins

*species*
- Atlantic Blackedge Moray, *Gymnothorax nigromarginatus*

**Order: Salmoniformes**

*general characteristics*
- lack spines
- pelvic fins abdominal, widely separated from pectoral fins
- swim bladder connected by a duct to gut

**Family: Salmonidae - trout, salmon, whitefish, graylings**

*general characteristics*
- streamlined body
- forked tail
- axillary process by pelvic fins

*species*
- Rainbow Trout, *Salmo gairdneri*
- Chinook Salmon, *Oncorhynchus tshawytscha*
- Mountain Whitefish, *Prosopium williamsoni*
- Char, *Salvelinus fontinalis*

**Family: Osmeridae - true smelts**

*general characteristics*
- small adipose fin on dorsal surface

*species*
- Eulachon, *Thaleichthys pacificus*
- Surf Smelt, *Hypomesus transpacificus*

**Family: Esocidae - pikes**

*general characteristics*
- ducklike bill
- sharp teeth

*species*
- Northern Pike, *Esox lucius*
- Muskellunge, *Esox masquinongy*
- Grass Pickerel, *Esox americanus*
CLASS CHONDRICHTHYES

Basking Shark *Cetorhinus maximus* (Gunner)

Dogfish *Squalus suckleyi* (Girard)

Big Skate *Raja binoculata* (Girard)

Ratfish *Hydrolagus colliei* (Lay and Bennett)
Order: Cypriniformes

general characteristics
- chain of bones connecting inner ear to swimbladder
- upper jaw protractile
- pharyngeal teeth
- abdominal pelvic fin

Family: Cyprinidae - minnows and carps

general characteristics
- soft rays in fins
- largest family of fish (1600 species)
- rays modified into spines in some forms
- thin lips

species
Coastal Shiner
Dace
Blackstripe Minnow
Flathead Chub
Common Carp
Notropis petersoni
Phoxinus sp.
Fundulus notatus
Hybopsis gracilis
Cyprinus carpio

Family: Catostomidae - suckers

general characteristics
- mouth on underside of head
- fleshy lips

species
Humpback Sucker
Xyrauchen texanus

Family: Ictaluridae - catfish

general characteristics
- 4 pairs of short barbels around mouth
- spines in from of dorsal and pectoral fins

species
V-tailed Channel Catfish
Brown Bullhead
Black Bullhead
Ictalurus punctatus
Ictalurus nebulosus
Ictalurus melas

Family: Amblyopsidae - cavefish

general characteristics
- whitish colour
- sensory papillae in rows on head, body and tail

species
Northern Cavefish
Spring Cavefish
Amblyopsis spelaea
Chologaster agassizi

Order: Gadiformes

general characteristics
- soft-rayed fins, no spines
- pelvic fins anterior to pectoral fins
- ductless air bladder
- codfish, hakes, rattails

Family: Gadidae

general characteristics
- caudal fin separate from dorsal and anal fins
- dorsal fin divided into two or three sections

species
Atlantic Cod
Pollack
Burbot
Haddock
Hake
Gadus morhua
Pollachius virens
Lota lota
Melanogrammus aeglefinus
Phycis sp.

Order: Gasterosteiformes - tube-mouthed fish

general characteristics
- tube-like snout
- bony plates forming complete or partial external armour
Family: Gasterosteidae - sticklebacks

general characteristics
- bony plates along sides
- spines

species
Three-spine Stickleback Gasterosteus aculeatus

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Family: Percidae - perches

general characteristics
- small
- two anal spines

species
Yellow Perch Perca flavescens
Walleye Stizostedion vitreum
Darters Ethostoma sp.

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Order: Perciformes

general characteristics
- largest order of vertebrates, 7000 species, 156 families
- extremely diverse
- predators
- spines
- no adipose fin
- pelvic fins with one spine, five or less rays
- scales ctenoid or absent

Family: Echeneidae - sharpsuckers (remoras)

general characteristics
- sucking disc on top of head

species
Remora Echeneis naucrates

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Family: Lutjanidae - snappers

general characteristics
- top of snout flattened
- sharp teeth

species
Atlantic Gray Snapper Lutjanus griseus
Blue-line Snapper Lutjanus viridis

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Family: Embiototidae

general characteristics
- cycloid scales
- small mouth
- viviparous

species
Striped Seaperch Embiotoca lateralis
White Seaperch Phanerodon furcatus

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Family: Serranidae - sea basses and groupers

general characteristics
- carnivorous
- large mouth, sharp teeth

species
Atlantic Tiger Grouper Mycteroperca tigris

Family: Centrarchidae - sunfish

general characteristics
- deep-bodied
- moderately forked tail

species
Largemouth Bass Micropterus salmoides
Bluegill Sunfish Lepomis macrochirus
Black Crappie Phromis nigromaculatus
FAMILY OSMERIDAE

Surf Smelt  *Hypomesus pretiosus* (Girard)

Eulachon  *Thaleichthys pacificus*

FAMILY CYPRINIDAE

Carp

FAMILY CATOSTOMIDAE

Black catfish or Black bullhead

Brown Catfish
FISH

FAMILY GADIDAE

Hake Merluccius productus

FAMILY GASTEROSTEIDAE

FAMILY CENTARCHIDAE

Stickleback

Black crappie

Striped Seaperch

Smallmouth bass

Pumpkinseed or sunfish
FAMILY PERCIDAE

Yellow perch

FAMILY LUTJANIDAE

Red Snapper

Copper Rockfish
FAMILY EMBIOTODIDAE

Pile Seaperch *Damalichthys vacca*

FAMILY BLENNIIDAE

Black Prickleback *Epigelichthys atropurpureus*

FAMILY COTTIDAE

Sailfin Sculpin *Nautichthys oculofasciatus*  
Staghorn Sculpin *Leptocottus armatus*
Family: Blenniidae - combtooth blennies

**general characteristics**
- no scales
- often with crests, ridges, and fringes on head

**species**
- Redlip Blenny
- Ophiothrix spathula
- Ophiothrix atlanticus

Family: Bothidae - left eye flounders

**species**
- Pacific Sand dab
- Citharinus sordidus

Family: Pleuronectidae - right eye flounders

**species**
- Pacific Halibut
- Hippoglossus stenolepis
- Pacific Starry Flounder
- Platichthys stellatus
- Turbot
- Pleuronichthys sp
- Sole
- Pleuronichthys coenosus

Family: Soleidae - soles

**species**
- Naked Sole
- Gymnachirus melas

Order: Pleuronectiformes - flatfish

**general characteristics**
- one side of body white, eyeless
- benthic
- long dorsal and anal fins
- swim bladder absent

Species:
- Halibut: Hippoglossus stenolepis
- Starry Flounder: Platichthys stellatus
- Pacific Cod: Gadus macrocephalus
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*** most useful
AMPHIBIANS AND REPTILES
AMPHIBIANS AND REPTILES OUTLINE

WHAT IS AN AMPHIBIAN? 87
WHAT IS A REPTILE? 88
CLASSIFICATION 92

CLASS AMPHIBIA
ORDER CAUDATA - Salamanders, Newts 93
ORDER GYMNOPHIONA - Caecilians 100
ORDER ANURA - Frogs, Toads 100

CLASS REPTICIA 111
ORDER CROCODYLIA - Crocodiles, Alligators 111
ORDER TESTUDINES - Turtles 112
ORDER SQUAMATA - Lizards, Snakes 118

BIBLIOGRAPHY 132
WHAT ARE AMPHIBIANS AND REPTILES?

Amphibians and reptiles are grouped together in the science of Herpetology and are often referred to as herpetiles. They are distinguished from other terrestrial vertebrates in that they are cold-blooded or poikilothermic while birds and mammals are warm-blooded or homeothermic. The amphibians and reptiles also have three-chambered hearts, with two atria and a single ventricle. Only the most advanced reptiles have a divided ventricle. The birds and mammals on the other hand, have four-chambered hearts forming a double circulatory system which allows for a complete separation of oxygenated and deoxygenated blood.

As a group, the amphibians possess three characteristics which are immediately evident and draw interesting comments from people on nature walks:

1. **The eggs of amphibians possess one or more layers of protective jelly.** The inner embryonic membranes (amnion, chorion and allantois) never develop and as a result the eggs of amphibians are vulnerable to dessication and must be deposited in moist environments, usually in the form of standing water along moving streams and rivers. An exception to this rule is the Family Plethodontidae or the lungless salamanders. In this family, the majority of species do not depend upon temporary or permanent water in which to breed. Instead, eggs are laid beneath or within ground substrate such as logs, boulders, leaf litter, etc.

2. **Amphibians undergo metamorphosis - a transition from egg to larva to adult.** The larva of amphibians are aquatic and respire through external gills. In the case of larval frogs (tadpoles) the external gills are covered with a layer of skin after a few days of development. A single opening called the spiracle acts as a fish’s gill opening allowing water to be pumped from the mouth across the internal gills and out the spiracle. In the case of frogs and toads the larvae (tadpoles) are herbivorous and eat algae, diatoms, and the feces of other tadpoles. Adults are carnivorous, primarily insectivorous, although large bullfrogs and toads are known to eat snakes, other frogs, mice and small toads.
3. **The amphibian lives in a combination of terrestrial and aquatic environments during different stages of its life.** The dependency on water extends beyond reproduction. In vertebrates the respiratory surfaces are typically gills (fish, larval amphibians) or alveolar surfaces in lungs (reptiles, birds, mammals). In adult amphibians the lungs have a simple structure and do not have a large internal surface area for gas exchange. As a result amphibians exchange gas through two additional mechanisms, both of which are features of the integumentary system (skin). Depending upon the species, amphibians respire through the outer skin of the body, or through the thin lining of the buccal cavity and pharynx (buccopharyngeal respiration). Usually an amphibian will use a combination of two or three respiratory mechanisms for gas exchange. The respiratory surface must be kept moist for gas exchange to occur, and as a result, adult amphibians are tied to moist environments. If the skin of an amphibian dries out it will suffocate.

In addition to the three characteristics mentioned above, another prevalent feature of frogs and toads is their use of vocalization to attract mates. The calls of frogs and toads are prominent sounds around ponds and lakes in spring and summer. These are usually specific to a species and it is exciting for people to be able to identify a frog or toad on the basis of call.

**REPTILES**

The skin of a reptile is significantly different from that of an amphibian, enabling the reptile to live in drier environments. The horny layer of the epidermis is much thicker, forming a protective barrier between the environment and the moist tissue of the organism, enabling the reptile to conserve body fluids. Some of the more conspicuous characteristics of a reptile are as follows:

1. **The horny layer of reptiles' epidermis forms a cornified epithelium which is constantly being replaced.** As underlying layers of the epithelium develop, the outer layer loosens and is lost. This is the basis of a reptile “shedding” its skin (ecdysis). In most snakes and some lizards there is an abrupt period of ecdysis, which results in the shed skin coming off intact. In other snakes and lizards the skin is shed in pieces.

2. **All reptiles except a few turtles have well-developed epidermal scales.** These arise from a folding of the epidermis and the outermost layers of the dermis. The scales vary dramatically in structure within the Class Reptilia, ranging from small and granular to large and...
CHARACTERISTICS OF SALAMANDERS
rectangular, or spiny scales. The larger scales may occur in definite patterns. The scales of reptiles have become specialized to perform functions other than those related to water conservation. These include protective devices (spines of horned lizards), warning devices (rattles of rattlesnakes), and locomotive devices (large ventral scales of some snakes and lizards).

3. Reptiles undergo two types of development found in animals with internal fertilization. Most reptiles lay eggs (oviparity) which have a large amount of yolk. These are complete with amnion, chorion, allantois and a protective outer shell. However, instead of laying eggs, some reptiles give birth to live young. This is called ovoviviparity, a situation where the egg is essentially retained and hatched within the female, with the young born live (garter snakes are a good example). Unlike mammals, however, which also give birth to live young, the reptilian mother provides no nourishment to the developing individual.

**Snake Scale Types**
AMPHIBIANS and REPTILES

CLASSIFICATION

Amphibians and reptiles belong to the Phylum Chordata. They are in the Subphylum Vertebrata with the fish, birds and mammals. Amphibians, reptiles, birds and mammals are all classified in the Superclass Tetrapoda and have the following characteristics:

- paired appendages, typically limbs ending with 5 digits
- cornified layer in the skin
- lungs in the adult forms
- ossified skeleton

The reptiles and amphibians differ from the other tetrapods on the basis of the following characteristics:

- absence of hair or feathers on the skin
- depend on external sources for body heat

CLASS AMPHIBIA

There are three major Orders of living amphibians, represented by
- salamanders
- caecilians
- frogs

The name Amphibia is from the Latin meaning “two lives” and refers to the part terrestrial and part aquatic lives of many members of this group.

- breeding generally occurs in an aquatic environment
- metamorphosis is typical for most of group
- external gills and lateral lines present in larval stage
- skin without scales in temperate groups
- four modern orders are recognized
ORDER: CAUDATA - SALAMANDERS
(formerly called Urodela)

- body resembles that of lizards - with which they are often confused
- females larger than males
- external ears absent
- lungs may or may not be present
- 8 families world wide; 7 in North America
- 112 species north of Mexico

FAMILY SIRENIDAE - The Sirens

- 2 genera in North America
- forage at night

General Characteristics
- aquatic permanent larvae
- long bodies and external gills and gill slits
- no hind limbs, tiny forelimbs
- often confused for eels
- gender not determined visually
- range - southern USA

Species
Dwarf Siren
Greater Siren

Pseudobranchus striatus
Siren lacertina
FAMILY SALAMANDRIDAE - The Newts

- 15 genera worldwide
- 2 genera of 6 species occur in North America
- eastern newts aquatic, western terrestrial
- also occurs in Asia, Europe and North Africa

General Characteristics
- metamorphosis is typically complete in newts
- costal grooves are absent
- skin is rough (except on males in breeding season)
- the back (dorsal region) is generally dark in colour
  and the belly (ventral) is bright orange
- slender bodies
- well defined limbs
- aquatic species have caudal and dorsal body fins
  (more prevalent in males)
- toxic skin secretions from glands that cover the
  entire body

Species
Eastern Newt Notophthalmus viridescens
Rough-skinned Newt Taricha granulosa
Striped Newt Notophthalmus perstriatus
FAMILY PROTEIDAE - Mudpuppies and Waterdogs

- 2 genera with 5 species in eastern North America
- 1 species in Europe which are blind and cave dwelling

General Characteristics
- aquatic permanent larvae
- have deep red plume-like gills
- eggs layed on stones in streams
- female guards eggs until young hatch

Species
Mudpuppy  Necturus maculosus
Gulf Coast Waterdog  Necturus beyeri

FAMILY AMPHIUMIDAE - The Amphiumas

- smallest family of salamanders - 1 genus with 3 species
- found in southeastern United States

General Characteristics
- eel-like
- tiny limbs with 1 - 3 toes
- hatch with external gills
- do not transform completely
- nocturnal
- carnivorous

Species
Two-toed Amphiuma  Amphiuma means
FAMILY AMBYS'TOMIDAE - The Mole Salamanders

- three genera in North America; approx. 18 species
- most breed in ponds or lakes
- live in moist terrestrial shelters during rest of year

General Characteristics
- length 5 - 30 cm (tip of snout to tip of tail)
- short, blunt heads for digging into substrate
- robust bodies and limbs
- larvae with broad heads and long filamentous gills
- conspicuous costal grooves
- laterally flattened tail

Species
Tiger Salamander  Ambystoma tigrinum
Northwestern Salamander  Ambystoma gracile
* Pacific Giant Salamander  Dicamptodon ensatus

* Protected under the Wildlife Act in British Columbia as an Endangered Species
Ensata

Western Red-backed Salamander
FAMILY PLETHODONTIDAE - The Lungless Salamanders

- 23 genera, approx. 215 species
- found only in North and South America
- largest family of salamanders
- most terrestrial of group
- complete their entire life cycle on land
- use elaborate courtship

General Characteristics
- all species lungless
- long slender bodies and limbs
- costal grooves well developed
- use skin and buccal region for respiratory exchange
- nasolabial groove key feature
- eggs laid in moist areas (under bark) singly or in clusters
- embryos pass through gilled larval stage within egg
- hatch as miniature replica of adult

Species
Clouded Salamander  Aneides ferreus
Dusky Salamander   Desmognathus fuscus
Ensatina          Ensatina eschschotzi
Western Red-backed Salamander Plethodon vehiculum
ORDER GYMNOPHIONA - CAECILANS

FAMILY CAECILIIDAЕ

General Characteristics
- elongated bodies segmented by annular grooves
- small rudimentary eyes covered with skin
- larvae, if present, with gill slits but not external gills
- no limbs (eel-like)
- no tail
- recessed mouth

Species
no common name Oscaecilia ochrocephala

ORDER ANURA  FROGS AND TOADS  
(formerly Salientia)

- 16 families in world with 9 occurring in North America
- nearly 2,700 species in world - 80 in North America
- the Latin Anura means 'without tail'

General Characteristics
- adults lack tails
- limbs well-developed - hind developed for jumping
- well-developed eye with lids
- large ears on side of head (tympanum)
- generally loud voice to attract mates and scare off intruders
- microscopic mucus glands keep the skin moist
- some species have poison gland in skin
- most species breed in water
- eggs hatch into tadpoles and later (between 12 days to 3 years) change into frogs
- some species hatch directly as small frogs
CHARACTERISTICS OF A FROG

mask
ear membrane
shoulder
dorsolateral fold
groin
web
toe-pad
parotoid gland
vertical pupil
horizontal pupil
eyes horizontal
eyes upturned
spade
FAMILY ASCAPHIDAE - Tailed Frogs

- 2 genera world wide
- 1 in North America

General Characteristics
- primitve frogs with 2 pairs unattached ribs and presacral vertebrae
- vertical pupil
- do not have a true tail - but a tail-wagging muscle
- live in cool mountain habitats
- lay eggs in cold streams
- hatch into tadpoles and transform 6 months later

Species
Tailed Frog Ascaphus truei

FAMILY RHINOPHRYNIDAE - Burrowing Toads

- 1 species in North America

General Characteristics
- lacks a breastbone
- pupil is vertical
- robust body with smooth skin
- short limbs
- small pointed head
- adapted to burrowing - has spade on hindfoot
- eggs laid in water

Species
Mexican Burrowing Toad Rhinophrynus dorsalis
FAMILY PELOBATIDAE - Spadefoot Toads

- 10 genera with 69 species worldwide
- 1 genus in North America with 5 species

General Characteristics
- vertical pupil
- spade (tubercle) for digging on hind limbs at ankle
- nocturnal
- teeth on the upper jaw
- generally smooth skin
- lack parotoid gland

Species:
Plain Spadefoot Scaphiopus bombifrons
Great Basin Spadefoot Scaphiopus intermontanus

FAMILY RANIDAE - True Frogs

-46 genus with 569 species worldwide
-1 genus with 21 species in North America

General Characteristics
- bony breastbone
- horizontal pupils
- generally large, long legs, pointed toes and extensive webbing on the hind toes
- excellent jumpers
- carnivorous
- mate in spring
- females lay up to 20,000 eggs in the water
- eggs hatch into tadpoles and change into frogs 6 to 24 months later

Species
Red-legged Frog Rana aurora
Northern Leopard Frog Rana pipiens
Bullfrog Rana catesbeiana
Great Basin Spadefoot Toad

Bullfrog
AMPHIBIANS and REPTILES

Tadpole of the Wood Frog
FAMILY MICROHYLIDAE - Narrow-Mouthed Frog

- 61 genera with 270 species worldwide
- 2 genera and 3 species in North America

General Characteristics
- very small
- body shape variable
- nocturnal
- hind legs have tubercles used for digging
- feed on ants

Species
Eastern Narrow-mouthed Frog Gastrophyne carolinensis
Sheep Frog Hypopachus variolosus

FAMILY BUFONIDAE - True Toads

19 genera and approx. 300 species worldwide
1 genus in North America - approx 18 species

General Characteristics
- chunky body with rough warty skin
- lack anterior breastbone
- parotoid gland on the neck - secretes poison to would-be predators
- the warts also contain poison
- do not have teeth on upper jaw
- toads do not cause warts on people!
- breed spring and summer usually after rains
- some true toads lay up to 25,000 eggs in a single clutch
  tadpoles are black

Species
American Toad Bufo americanus
Western Toad Bufo boreas
FAMILY HYLIIDAE - Treefrogs
- 34 genera with approx 600 species worldwide
- 7 genera with 26 species in North America

General Characteristics
- horizontal pupils
- generally small
- slender legs
- have adhesive toe pads to aid climbing
- most are aboreal but breed in water

Species
Northern Cricket Frog Acris crepitans
Pacific Treefrog Hyla regilla
Chorus Frog Pseudacris triseriata

FAMILY LEPTODACTYLIDAE - Leptodactylid Frogs
- 50 genera of about 650 species worldwide
- 4 genera and 7 species in North America

General Characteristics
- extremely variable in size, structure and appearance
- horizontal pupils
- teeth in upper jaw
- young hatch as miniature frogs
- most lay eggs in water nests but some species are terrestrial
- nocturnal
- prominent tubercles at joints on undersides of toes

Species
Barking Frog Hylactophrynus augusti
White-lipped Frog Leptodactylus labialis
Rio Grande Chirping Frog Syrrhophus cystignathoides
Northern Chorus Frog
CLASS REPTILIA - THE REPTILES

- 5 major orders worldwide representing some 6,500 species
- the orders include:
  - turtles
  - lizards
  - snakes
  - crocodiles
  - tuatara (lizard-like animal of New Zealand)
- most species found in tropics or subtropics
- first reptiles appeared some 30 million years ago
- reptiles were important in the evolution of birds and mammals
- in B.C. 18 species - turtles - 6; lizards - 3; snakes - 9

ORDER CROCODYLIA - CROCODILES

General Characteristics
- 3 families, 8 genera and 21 species distributed worldwide in tropical and subtropical regions
- American Crocodile, American Alligator are native while the Spectacled Caiman has been introduced
- first appeared 160 million years ago
- are large and well armored
- all are aquatic, carnivorous and fond of basking
- ear is covered with a moveable flap
- females lay 20-80 eggs in a cavity in a sandbank

Species
American Alligator Alligator mississippiensis
Spectacled Caiman Caiman crocodilus
American Crocodile Crocodylus acutus
AMPHIBIANS and REPTILES

ORDER TESTUDINES - THE TURTLES

- an old group of reptiles dating back over 200 million years
- 12 families in world
- 7 families in North America - 18 genera with 48 species

General Characteristics
- body short and broad covered by a bony shell (carapace)
- in adults the teeth are replaced by a horny beak
- large land dwelling turtles are often called tortoises
- turtles with hard shell, edible and aquatic are terrapins
- all turtles lay eggs although the number of eggs varies greatly

FAMILY CHELYDRIDAE - Snapping Turtles
- 2 species in North America (2 subspecies)
- largest living freshwater species

General Characteristics
- long tail
- massive heads with powerful hooked jaw
- small plastron (half the width of the carapace)
- males larger than females

Species
Snapping Turtle Chelydra serpentina
Alligator Snapping Turtle Macroclemys temmin
FAMILY KINOSTERNIDAE - Musk and Mud Turtles

- New World Family of 4 genera and 23 species
- 2 genera north of Mexico
- Sternotherus - 4 species
- Kinosternon - 5 species

General Characteristics
- give off musky odor when handled
- odor glands located on the side of the body where the skin meets the underside of the carapace
- strongly aquatic
- tail is short and blunt (prehensile in males)

Species
Yellow Mud Turtle        Kinosternon flavescens
Mexican Mud Turtle       Kinosternon hirtipes
Stinkpot                 Sternotherus odoratus

FAMILY EMYDIDAE - Water and Box Turtles

- largest of the living turtle families
- 30 genera and 82 species world wide
- 7 genera and 26 species in North America

General Characteristics
- generally small to medium-sized turtles
- most species are semi-aquatic
- hind legs elongated with some webbing between toes
- box turtles are mainly terrestrial
- mostly omnivorous

Species
Western Pond Turtle       Clemmys marmorata
Painted Turtle             Chrysemys picta
Chicken Turtle             Deirochelys reticularia
Blanding’s Turtle          Emydoidea blandingi
Map Turtle                 Graptemys geographica
Diamondback Terrapin       Malaclemys terrapin
Eastern Box Turtle         Terrapene carolina
FAMILY TESTUDINIDAE - The Tortoises

- 10 genera and 39 species worldwide
- 1 genera and 4 species in North America
  this group includes the giant tortoises of the Galapagos Islands

General Characteristics
- terrestrial - and are good burrowers
- domed shell and large limbs with no webbing between toes
- herbivorous

Species
Desert Tortoise Gopherus agassizii

FAMILY CHELONIIDAE - Sea Turtles

- four genera and 6 species in the Atlantic and Pacific Oceans
  off North America
- largest living marine turtles
- generally tropical or subtropical

General Characteristics
- low streamlined heart-shaped shell
- powerful flippers with claws
- nest along shore with females often laying over 100 eggs

Species
Loggerhead Caretta caretta
Green Turtle Chelonia mydas
Hawksbill Eretmochelys imbricata
Atlantic Ridley Lepidochelys kempi

Conservation note: Sea turtles are vanishing. Some scientists feel the
species will be extinct before the year 2000.
GREEN TURTLE
LEATHERBACK
FAMILY DERMOCHELYIDAE - The Leatherback Turtle

- 1 living species in world
- largest living turtle in the pelagic - often found in tropical waters but move into terperate zones in summer

General Characteristics
- most specialized turtle
- covered with smooth leathery skin rather than horny scutes
- carapace made up of small bony plates in the skin
- ribs and vertebrae not attached to carapace
- powerful swimmer - covers long distances
- main food is jellyfish

Species
Leatherback, Dermochelys coriacea

Conservation note: Endangered

FAMILY TRIONYCHIDAE - Softshelled Turtles

- 7 genera of 23 species worldwide
- 3 species in North America
- found in freshwater

General Characteristics
- have round flat flexible shell
- neck is long
- feet broadly webbed with claws and paddle-like
- strong swimmers
- generally aquatic but will go onto the land to rest and nest
- females larger than males

Species
Spiny Softshell, Trionyx spiniferus
AMPHTIBIANS and REPTILES

ORDER SQUAMATA - THE LIZARDS AND SNAKES

SUBORDER LACERTILIA - THE LIZARDS

- 17 families with 3,000 species worldwide
- 8 families and 115 species native to North America lizard comprise the largest living group of reptile

General Characteristics
- vary greatly in size, colour, and shape
- dry scaly skin
- clawed feet
- external ear openings
- varied life style
- generally diurnal
- most egg laying but some species' young are born alive

FAMILY GEKKONIDAE - The Geckos

- 89 genera with 750 species in the world
- 3 genera and 5 species are native to North America with 2 genera and 5 species introduced

General Characteristics
- have flattened bodies and short limbs
- many species have claws and/or extended toe pads - have hairlike bristles that are tipped with minute suction cups - to allow the Gecko to climb walls
- most vocal of lizards
- skin tears easily and tail can be dropped, then new tail is regenerated

Species
Banded Gecko          Coleonyx variegatus
Yellow-headed Gecko   Gonatodes albogularis
Mediterranean Gecko   Hemidactylus turcicus
Leaf-toed Gecko       Phyllodactylus xanti
Reef Gecko            Sphaerodactylus notatus
FAMILY IGUANIDAE - The Iguanids

- 60 genera with approx. 628 species in the Americas, Madagascar and Fiji
- 14 genera with 44 species native to North America with 4 genera with 8 species introduced

General Characteristics
- range in size from 4 to 72 inches in length
- 5 clawed toes on each of 4 legs
- long tail
- teeth attached to a ledge on the inside of the jaw
- most species aboreal or terrestrial
- most eat insects and other invertebrates while few eat fruit and blossoms
- communicate by show of colour and behavioral signals

Species

Green Anole  Anolis carolinensis
Zebra-tailed Lizard  Callisaurus draconoides
Collared Lizard  Crotaphytus collaris
Spiny-tailed Iguana  Ctenosaura pectinata
Desert Lizard  Dipsosaurus dorsalis
Blunt-nosed Leopard Lizard  Gambelia silus
Spot-tailed Earless Lizard  Holbrookia lacerata
Common Iguana  Iguana iguana
Curly-tailed Lizard  Leiocephalus carinatus
Banded Rock Lizard  Petrosaurus mearnsi
Texas Horned Lizard  Phrynosoma cornutum
Chuckwalla  Sauromalus obesus
Clark’s Spiny Lizard  Sceloporus clarki
Fringe-toed Lizard  Uma notata
Long-tailed Bush Lizard  Urosaurus graciciosus
Side-blotched Lizard  Uta stansburiana
FAMILY ANGUIDAE - The Anguid Lizards

- 11 genera with about 80 species worldwide
- 2 genera with 8 species found in North America

General Characteristics
- elongated, shiny stiff bodies and tail
- caused by bony armour (osteroderms) in the skin
- have a lengthwise flexible groove of soft granular scales along their sides to allow them to breathe
- closeable eyelids
- external ear openings
- tiny (or absent) legs and toes
- most are terrestrial or burrowing
- carnivores - eat insects, small mammals and other lizards
- most are egg-layers but few mountain-dwellers bear live young
- defence techniques include fleeing, smearing the predator with excrement and shedding the tail
- can regenerate tail

Species
Northern Alligator Lizard Gerrhonotus coaeruleus
Slender Glass Lizard Ophisaurus attenuatus
FAMILY HELODERMARTIDAE - The Gila Monsters

- 1 genus of 2 species confined to North America

General Characteristics
- heavy bodied lizards with short stout legs and a thick tail
- tail acts as a storage area for fat when food is abundant
- tail may lose up to 20% of bulk when food is scarce
- the back and head are covered with bead-like scales of shiny black, pink or yellow
- scales contain osteoderms, a sort of bony armor
- carnivores - they use taste and smell rather than sight to locate prey, small birds, rodents and other lizards
- they inflict a venomous bite that can cause great pain

Species
Gila Monster
Heloderma suspectum
AMPHIBIANS and REPTILES

FAMILY ANNIELLIDAE - California Legless Lizards

- 1 genus of 2 species found only in California and adjacent Baja
- 1 species occurs in North America (above Mexico)

General Characteristics
- long and slender lizards
- moveable eyelids
- legless - but have shoulder and hip bones internally
- do not have an external ear opening
- no bony armor within the skin
- burrow in loose soil - seldom seen on surface
- eat insects
- young are born alive
- nocturnal

Species
California Legless Lizard Anniella pulchra

Conservation note: some populations have been effected by the use of pesticides on agricultural lands

FAMILY XANTUSIDAE - The Night Lizards

- 3 genera of 18 species found only in North America and Cuba
- 3 species north of Mexico

General Characteristics
- are related to gecko and have soft skin, flattened body and no movable eyelids
- differ in that they have small rounded scales on back
- large rectangular scales on the belly,
- large shield on the head
- toes end in sharp claws
- light sensitive eyes have vertically elliptical pupils
- mostly nocturnal
- young are born tail first and live

Species
Desert Night Lizard Xantusia vigilis
AMPHIBIANS and REPTILES

FAMILY TEIIDAE - The Whiptails and Racerunners
- 40 genera of about 230 species confined to New World
- most abundant in South America
- 16 species are native to the U.S. and 1 species has been introduced

General Characteristics
- long slender lizards with long whiplike tails and well-developed legs
- size from 4 to 48 inches in length
- generally have small round, non-overlapping scales on the back
- large rectangular scales on the belly
- no bony plates in the skin
- diurnal, terrestrial carnivores
- prey located by sight and smell or taste
- 1 species - Cnemidophorus - all individuals are females
- the female can lay fertile - but unfertilized - eggs that hatch into more females

Species
Jungle Runner Ameiva ameiva
Giant Spotted Whiptail Cnemidophorus burti

FAMILY LACERTIDAE - Typical Old World Lizards
- native to Europe, Africa and Asia
- 2 species have been introduced in North America

General Characteristics
- slender round bodies
- well-developed legs
- long tails
- large head usually contains bony plates (osteoderms) that are not fused to the skull
- most species have moveable eyelids
- daytime hunters of insects, spiders, scorpions and small vertebrates

species
Green Lizard Lacerta viridus
FAMILY SCINCIDAE - The Skinks

- 87 genera and 1280 species found on every continent except Antarctica
- most abundant in the tropics
- 3 genera of 15 species in North America

General Characteristics
- generally have long body and tail which is covered with smooth scales containing bony plates (osteoderms)
- terrestrial skinks have small legs while burrowing species have small or no legs
- tail contains fracture plates that allows the tail to break off when grasped by a predator
- tail is often brightly coloured to attract predator from vulnerable body
- most diurnal
- most eat insects, some are herbivorous
- all North American species are egg-layers

Species
Western Skink                                Eumeces skiltonianus
Sand Skink                                   Neoseps reynoldsi
Ground Skink                                 Scincella lateralis
FAMILY AMPHISBAENIDAE - The Amphisbaenids

- 19 genera and 135 species found in Africa, Mediterranean countries, South America north to Mexico
- 1 species in North America (Florida)

General Characteristics
- resemble earthworms in appearance
- body scales are fused into rings which encircle body
- lack external ear openings
- only one species has short front legs - rest legless
- Florida species eats worms and termites

Species
Worm Lizard
Rhineura floridana
SUBORDER SERPENTES - THE SNAKES

- found throughout the world except Antarctica, Iceland, Ireland and New Zealand
- 11 families with over 2,700 species
- 115 species in North America

General Characteristics
- elongated bodies with no limbs
- scaly skin
- no eyelids or external ear openings
- shed skin
- carnivores who eat prey whole
- some poisonous

FAMILY LEPTOTYPHLOPIDAE - The Slender Blind Snakes

- 2 species in southern USA
- sometimes called worm snake

General Characteristics
- vestigial eyes
- few teeth, upper jaw toothless
- slender form
- females lay eggs

Species
Texas Blind Snake       Leptotyphlops dulcis
Western Blind Snake    Leptotyphlops humilis
FAMILY BOIDAE - The Boas and Pythons

- 20 genera with 59 species worldwide
- 2 species of boa occur in North America
- no pythons are found here

General Characteristics
- wide mobile jaw
- enlarged ventral scales
- well developed eyes
- kills prey by constriction
- feed on birds and mammals
- boas have vestigies of hind limbs in the form of a spur located near the vent
- boas bear young alive

Species
Rubber Boa Charina bottae

Rubber Boa
AMPHIBIANS and REPTILES

Rosy Boa Lichanura trivirgat

FAMILY COLUBRIDAE - The Colubrids

- the largest of all snake families
- over 3/4 of the world’s snakes
- 92 species in North America
- a very diversified group

General Characteristics
- head is wider than the neck
- eyes are well developed
- back scales smooth or keeled
- teeth present in both jaws
- no fangs
- only several species are harmful (Africa)
- most lay eggs
- feed on birds, mammals, mostly some
  eat reptiles, amphibians, insects and fish

Species
Western Yellow-bellied Racer Coluber constrictor mormon
Sharp-tailed Snake Contia tenuis
Pine Gopher Snake Pituophis melanoleucus
Western Terrestrial Garter Snake Thamnophis elegans

Common Garter Snake
Common Garter Snake

Northwestern Garter Snake
Do you know how snakes get around without any legs? A snake pushes sideways against rocks, sticks and other objects it finds on the ground and gets a grip. Using the muscles attached to each of its ribs, the snake then pushes each set of ribs against each gripping point and moves forward.
FAMILY ELAPIDAE - The Coral Snakes

- 2 species in North America
  - highly venomous
  - tropical and subtropical in distribution

General Characteristics
- 2 large grooved fangs in upper jaw
- can be confused with non poisonous snakes
- strikingly coloured
- blunt snout

Species
Arizona Coral Snake  Micruroides euryxanthus
Eastern Coral Snake  Micrurus fulvius

FAMILY VIPERIDAE - The Pit Vipers

- 290 species worldwide
- 3 genera in North America, 17 species

General Characteristics
- all poisonous
- most highly evolved of the snakes
- most are nocturnal
- most bear young alive

Species
Copperhead  Agkistrodon contortrix
Western Rattlesnake  Crotalus viridis
Massasauga  Sistrurus catenatus

Rattle of a rattlesnake
BIBLIOGRAPHY


BIRDS
# BIRDS OUTLINE

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATURALISTS NOTES</td>
<td>137</td>
</tr>
<tr>
<td>WHAT IS A BIRD?</td>
<td>142</td>
</tr>
<tr>
<td>ANATOMY</td>
<td>142</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>153</td>
</tr>
<tr>
<td>ORDER GAVIIFORMES - Loons</td>
<td>154</td>
</tr>
<tr>
<td>ORDER PODICEPEDIFORMES - Grebes</td>
<td>155</td>
</tr>
<tr>
<td>ORDER PELICANIFORMES - Pelicans, Cormorants, Boobies, Frigatebirds</td>
<td>156</td>
</tr>
<tr>
<td>ORDER CICONIIFORMES - Herons, Storks, Ibis, Flamingos</td>
<td>158</td>
</tr>
<tr>
<td>ORDER GRUIFORMES - Cranes, Rails</td>
<td>161</td>
</tr>
<tr>
<td>ORDER ANSERIFORMES - Ducks, Geese, Swans</td>
<td>162</td>
</tr>
<tr>
<td>ORDER CHARADRIIFORMES - Gulls, Shorebirds, Auks</td>
<td>169</td>
</tr>
<tr>
<td>ORDER COLUMBIFORMES - Doves, Pigeons</td>
<td>176</td>
</tr>
<tr>
<td>ORDER FALCONIFORMES - Vultures, Hawks, Falcons</td>
<td>176</td>
</tr>
<tr>
<td>ORDER GALLIFORMES - Grouse, Pheasants, Turkey</td>
<td>182</td>
</tr>
<tr>
<td>ORDER STRIGIFORMES - Owls</td>
<td>184</td>
</tr>
<tr>
<td>ORDER CAPRIMULGIFORMES - Nightjars</td>
<td>188</td>
</tr>
<tr>
<td>ORDER APODIFORMES - Hummingbirds, Swifts</td>
<td>189</td>
</tr>
<tr>
<td>ORDER CORACIFORMES - Kingfishers</td>
<td>190</td>
</tr>
<tr>
<td>ORDER PICIFORMES - Woodpeckers</td>
<td>193</td>
</tr>
<tr>
<td>ORDER PASSERIFORMES - Perching or Song Birds</td>
<td>194</td>
</tr>
</tbody>
</table>

| BIBLIOGRAPHY                                 | 214  |

---

135
NATURALISTS NOTES

This section is a general information section. A variety of topics are covered. It is also an opportunity for you, the Naturalist, to add "bird related" information to the file. Local Birders or other resource people, interesting clippings or articles, and local check-lists.

Often finding that one particular person who has the local birding information can be a task. If your agency can not refer you to someone, try some of the following routes.

(a) Local naturalists club or in the U.S.A. the local Audubon Society Chapter. The local library should be able to help you. Small communities may have to rely on a state or provincial group to give them local information.

(b) Ministry of Environment (Provincial or Federal) or Department of the Interior - Wildlife Branch. These professionals often work with the local amateur in collecting data.

(c) Local fish and game (wildlife) clubs

(d) National or Provincial /State /Regional Parks - the Park Naturalist or Park Ranger

(e) Forest Service, Agriculture, or Lands Branch officer

(f) The local librarian - many groups use libraries for meetings, displays or giving courses. The librarian often gets the newsletters of these various groups.
As a Naturalists you will be expected to “know” all sorts of information, and answer everyone’s questions with speed and accuracy. The unfortunate thing is that many questions leave one “flat-footed”.

A lady rushes into your Nature House carrying a shoe box. “I found this little bird by the edge of the road - - - Can you save it?” she exclaims.

The Naturalist is probably thinking - I’m a Naturalist not a bird doctor. The lady is thinking this person knows all about nature so they can make the bird better.

What do you do?

- show concern for the little bird - just as you would be an injured person, a little on the spot first aid enough air, warm enough or too warm, control bleeding etc.

The next step will depend on the information you have:

(1) Is there an wild animal care unit in the area?

These private groups or individuals care for injured wildlife, rehabilitate them and return the animal back into it own environment. Often a good place to start looking for this person or group is through the local veterinary doctor or hospital as wildlife care people often work hand-in-hand with the professional.

(2) Another route is the local naturalists.

Some people care for injured wildlife in their own homes and are basically just known in the neighborhood as the “bird Lady” or the “bird doctor”.

(3) If you cannot find an appropriate person you can aways suggest the local vet. They at least can determine if the animal will survive or if it should be humanely put down.

Once you have the information you can pass it on to the lady with the bird in the box. Ask her to take the bird to the person and suggest that she phone first.
Anticipating the kinds of questions you may have to face will make your days in the nature house or information centre easier. Ask your senior person for the most asked questions. Do you know the answers?

Birding is one of the fast growing recreational activities in North America. Over 20 million people have taken up this hobby and participate to various degrees. Some watch the birds of their yard, others travel throughout the world to "list" species on their personal life list. Many enjoy feeding birds in winter and putting up nesting boxes in summer to attract the little feathered friends. To walk through a forest on a warm spring morning and listen to the numerous calls of two dozen birds is what birding is about. The road to natural history appreciation began for many with their own "discovery" of birds.

To appreciate birds we often think we have to have numerous pieces of equipment - bird books for identifying, binoculars and spotting scopes for seeing birds, rain gear, sun gear, note books, bird, tape recorder with bird tapes and, if you are a photographer, well you get the picture.

Let us look at basic equipment

**Binoculars:** Most birders recommend 7 x 35 binoculars for standard everyday use. Those that like to watch shorebirds and birds of prey often prefer the stronger 7 x 50 or 10 x 50 binocular. They are much brighter on dark, overcast days. The one problem is that either you must be fairly steady holding them or must place the binoculars on a tripod. One thing to watch when buying new binoculars is the coating used on the lens. Some are so highly coloured that they actually affect the colour of the subject seen. Ask your dealer if you can take them outside of the store and try them in natural light for brightness, colour and ease of focus.

Remember that binoculars are delicate optical equipment. Banging or dropping them, getting them wet or dirty will affect the life and quality of use you get.
Spotting Scope: Not a requirement for a beginning birder - but sure a nice piece of equipment to have just the same. Provides close up viewing for distant species like hawks sitting in trees, shorebirds or offshore gulls. A good tip is to go along on Birding outings where the leaders and more experienced birder take spotting scopes along. You can look through various scopes, talk to their owners and decide which model would suit your needs best. They are expensive - don't rush into buying one!

Bird Books and Guides: Many a beginning birder feels a little discouraged when they first open a bird guide and find out how many bird species there are in North America. A good guide will prove invaluable in the field if it contains a good drawing of the bird, a brief but clear write-up and a good range map. Songograms are of little use to the beginner.

One of the best tips to give a beginner is STUDY YOUR FIELD GUIDE! Become familiar with the order in which the birds are listed so that when you see a "sparrow-like bird" you can turn to the sparrow section and begin your hunt. Most birds will not sit long enough for you to fumble through the guide, look through the binoculars and back to the guide again. Familiarity with the birds that occur in your area is a great asset. Birding in teams or with a group also makes it easier as you can share describing and looking up the bird. Nothing is more frustrating than having the bird fly off while your head is buried in the field guide. Be patient, practice on species that generally do not fly off like the ducks and geese and leave the gulls, shorebirds and "little brown birds" for birding with your friends.

There are numerous field guides available. The three listed here are among the most popular in North America at this time. Each have good and bad points about them but generally they are good. Before buying a guide visit a library or borrow a friend's guide to see which one you prefer.

A Field Guide to the Birds of North America
R.T. Peterson    H.M. Co. "Peterson" series

Bird of North America
Robbins, Bruun, Zim; A Golden Guide

Field Guide to Birds of North America
National Geographic Society
Clothing: Little needs to be said here except that a warm, dry Birder is a happy birder. Dress in layers. Rain gear is especially important, as are wind-resistant clothes. Standing on a dyke overlooking a field or the open ocean on a cold windy day can often take the enjoyment out of your birding outing. Remember the motto: BE PREPARED. The dry pair of socks and shoes and the ever important coffee break make the day more enjoyable.

Note Book: Recording your daily bird findings serves two purposes. It helps you learn to identify the birds and provides a record of your findings. Many birders keep detailed notes of what they see, how many, where, when and what the bird was doing. Others only keep special records. Whatever you decide to keep it is important. Local museums, wildlife branches, parks and bird clubs keep records and develop check-list and status reports from notes just like yours.

Bird Tapes: A very good tool for learning bird songs. There are several excellent tapes on the market. Again your library may have a copy you can borrow (comes in records and tapes). Using bird calls to attract birds is not recommended (and is illegal in some areas of the country). Too many birders using tapes in too small an area puts stress onto species that are trying to nest, causing the birds to abort nesting. Using owl calls to attract owl in the non-breeding season can provide good views of the night time critters. Again, care should be used not to harrass any bird.

Now armed with all the above information you are ready to begin birding.

Good birding.
WHAT IS A BIRD?

INTRODUCTION

Sounds like a very simple question to answer. A bird is a very distinctive and unique living creature. Birds are unique because they are covered with feathers - a feature that no other animal possess. Birds also share some common features with other animals in that they are warm-blooded and can control the temperature of their bodies to that of the surrounding environment.

The nearest relatives of birds are their immediate ancestors, the reptiles. Their skeleton closely resembles that of a reptile but has been modified for the adaptation of flight. The feathers of birds resemble reptilian scales in that they are similar in composition and are arranged similarly on the body.

Scientists now believe that the first birds were "gliders"; that the birds climbed to high places and them jumped into space and glided with the aid of feathered forelimbs. In time their skeletons developed other flight modifications, including modification for lightness, the fusion of various bones and the creation of a broad sternum or breastbone for the attachment of powerful wing and flight muscles.

In this first section we will look at the skeleton of a bird and discuss key features of their anatomy from their bones, to the systems of digestion, circulation, excretion, reproduction, their special senses like smell, hearing and sight, and most importantly their feathers.

SKELETON SYSTEM

The skeleton system of birds has two notable features.

They are: (1) the tendency for joining (fusion) of adjacent bones;
          (2) hollow air spaces in the bones resulting in lighter weight

The skeleton consists of three main parts:

(1) bones of the limbs
(2) bones of the trunk, and
(3) bones of the head
GAS EXCHANGE IN BIRDS

The lungs of birds are extraordinarily efficient. These small organs are expanded and compressed by movements of the body wall. Each lung has several air sacs attached to it. These fill and empty with each breath. No gas exchange occurs in the sacs. Instead, the appear to act like bellows, flushing to lung with each breath. This reduces very little residual "dead" air left in bird lungs. (Dead air is a common phenomenon in mammals.)

THE RESPIRATORY SYSTEM OF A BIRD

Attached to the lungs are many air sacs. Some of these even penetrate into the marrow cavities of the wing bone.
**Trunk:** Vertebral Column - This provides a base for the bones of the trunk and limbs and is a main support for the head. In most vertebrates the vertebral column is divided into regions:

(a) cervical    neck  
(b) thoracic    chest  
(c) lumbar      loin   
(d) sacral      pelvis 
(e) caudal      tail

In man and other mammals the bones of the vertebral column (vertebrae) are relatively separate, like spools strung along a thread, but in birds the main groups are often fused, and have undergone considerable modifications. The cervical (neck vertebrae) alone remain unfused and relatively mobile.

In man and most mammals the number of cervical vertebrae is seven. In birds it ranges from 8 - 24. Thus, even a small sparrow has more neck vertebrae than a giraffe.

**Sternum:** This is one of the most specialized parts of the bird skeleton. Flightless birds, such as the ostrich, have a sternum with no “keel” or downward projection. In flying birds, however, the sternum has a prominent keel which allows more surface for the attachment of important wing muscles.

**Skull:** The bird skull, compared to that of man and other mammals, shows several features. The eye sockets (orbits) are comparatively large and spacious. They are so large, in fact, that the bones enclosing the brain are crowded behind the eye socket area. There are also no teeth present in modern birds. Certain bones have become greatly elongated and covered with a horny covering, to form the bill, replacing the teeth functionally. Finally, the lower jaw (mandible) is made up of several bones, or of two compound bones, one on each side of the head.
**DIGESTIVE SYSTEM**

**BIRDS**

**Mouth:** The number of mouth glands is variable in birds, being considerable in seed-eating birds, lower in waterfowl and sometimes completely absent, as in the Pelicaniformes (Pelicans). Mouth glands lubricate the mouth and begin the process of digestion via the secretion of enzymes. However, mouth glands may also have special functions:

(a) secretions of a sticky fluid - woodpeckers
(b) secretion of "glue" for nest building - swifts

**Tongue:** The organ is much adapted to various modes of life in different bird groups. The tongue of hummingbirds is adapted to their nectar-feeding habit, as a long, extensible, tube. Parrots have a thick, fleshy tongue for the manipulation of seeds and fruit before crushing them in their mandibles. Duck's tongues are modified to help strain food from the water. In birds which swallow their prey whole (Pelicans and Kingfishers) the tongue may be much reduced and may be attached to the floor of the mouth.

**Esophagus:** The esophagus is essentially an extensible tube, lined with a mucous epithelium. In all birds it serves as a temporary reservoir for food. In most birds it can be engorged with food, sometimes noticeably so. In pigeons it is extended into a pocket, known as the crop. The crop is essentially an organ of food storage - its digestive functions are minor.

In some crop-bearing birds, such as pigeons, the lining of the crop is rough which produces a milky substance (Pigeon's Milk) that is mixed with stored food and regurgitated to feed the young.

**Stomach:** A major modification of the bird stomach is the gizzard, actually a hold-over from bird's reptilian origins. The gizzard is very muscular in those birds which eat large amounts of seed and herbage, and less so in birds which eat fruit. The mucous glands of the gizzard secrete a horny lining which helps seed-eating birds to grind their hard food. In flesh-eating and fruit-eating birds the gizzard is less developed and the mucus does not form a horny layer.

**Small Intestine:** The intestine is generally longer in seed and herbage eaters than in flesh eaters. In birds which are primarily herbivorous, the intestine has pockets (caeca) which increase the surface area of the intestine and provide a place for cellulose-digesting bacteria to live.
**Blood:** Birds share with mammals the distinction of having the 'richest' blood, that is, their blood contains the greatest number of red-blood cells per unit volume. Smaller birds generally have a greater number of the red blood cells than do large birds. Because these are the oxygen-carrying cells, this means that the blood of small bird is very effective in oxygen transport.

**Heart Rate:** In birds the heart rate is generally greater than in mammals of equivalent size. In small birds, the heart rate is very much greater. In the resting human, for example, the heart rate is about 72 beats per minute. In a resting wren, the heart rate is 550 - 650 beats per minute. The rate may be much greater during the night when the temperature is lowest.

**Heart Size:** Birds as a group have generally larger hearts than do mammals of equivalent size.

**Body Temperature:** The body temperature of Passerine birds varies between 102 degrees F. to 112.3 degrees F. There is no bird which has a normal body temperature as low as that of man - 98.6 degrees F. (37 C).

Birds are warm-blooded and are able to remain active in low environmental temperatures. Birds control or regulate their temperature, depending on the temperature of their surroundings, by certain responses, i.e., fluffing the feathers or shivering in low temperatures. When it is hot they can compress their feathers and they can pant.

Some young birds are essentially "cold-blooded" or semi-cold-blooded and it takes them a while to establish temperature control.

Some birds, such as the Poorwill have the capacity to hibernate. During these torpid periods their temperatures may be very close to that of their surroundings. This dormant state enables them to survive periods without food.
Avian kidneys are relatively larger than those of reptiles or mammals. In bird urine, as in reptiles, the nitrogenous wastes are in the form of uric acid, a practically insoluble material, whereas in mammals these wastes take the form of urea, a much less concentrated material. The urine is usually voided by birds in a semi-solid, whitish coloured condition. About 98% of the water filtered by the kidneys is reabsorbed for further use either in the bird's kidney or in the cloaca. Birds lose more water through evaporation from the lungs and air sacs than via the urine.

Ovary and Eggs: The avian ovary may contain as many as 13,000 ova. Only a small fraction of these will actually develop to maturity in the life of the bird. Following ovulation the ovum moves through the oviduct, to the uterus, where it may remain for 18 - 20 hours before being forced by contraction through the vagina, cloaca, and anus. During the last 5 hours in the uterus the egg gets its colouration.

Spermatozoa: The sperm are produced in testicles which are inside the bird's body cavity. They may mature in seminal vesticles, which are often inside the cavity, but which may protrude into the cloacal chamber where the lower temperature may aid in the maturation of the sperm. The sperm are motile, having a head and tail, but they are differently shaped from those of mammals. The sperm swim from the cloaca, up the oviduct, where they fertilize the egg. The time between copulation and fertilization is usually 72 hours, but it may be as low as 19.5 hours.

Some species of birds have a keen sense of smell, while others have nearly none. In most birds the sense of smell is moderately developed.

The eyes of birds are generally very highly developed and have a number of special features.

Eye Glands: The tear glands and oil glands of birds' eyes vary in development according to the habitat of the bird. In sea birds the tear glands are small, probably due to the watery environment of the birds, but the oil glands are large and secrete a thick, oil substance which protect the bird's eyes from salt water.

Size and Shape of Birds' Eyes: Birds have huge eyes. They are the largest structures of the head and they often outweigh the brain. The shape
of birds' eyeballs may vary from flat, in pigeon-like birds, to globular, elongated or tubular in birds of prey. These elongated eyeballs broaden and sharpen the image thrown on the retina and afford better vision at a distance. This is an important advantage for hunting birds who seek their prey from the air.

**Adjustment in Birds' Eyes:** In mammals, including man, the eye adjusts in order to form a properly focused image on the retina, regardless of the distance of the object from the eye. This adjustment in birds and in mammals is mainly accomplished via contraction of the lens muscles, thus changing the shape of the lens. In some birds the shape of the whole cornea can also be altered.

**Visual Acuity:** Bird eyes have a remarkable resolving power or ability to produce distinct images of objects as they become smaller or closer together. In the human portion of the retina there are 200,000 visual cells per square millimeter, in the English Sparrow the number is 400,000. In the Red-tailed Hawk the number in the same area is about 1,000,000 /mm². The retina of most birds have both cones (the image forming, colour sensitive cells) and rods (the light sensitive, black and white colour sensitive cells). The relative proportions of the rods and cones varies depending on whether the bird is nocturnal (night) or diurnal (day) dwelling.

**Hearing:** This is keen and ranks next to sight in its importance to birds and their survival. The ear openings in most birds are covered with feathers, and are on the sides of the head. In nocturnal birds such as owls the ear placement can be asymmetrical (left and right ears are different shaped and usually one opening is higher than the other). It is believed this helps the bird to locate the exact spot from where the sound is originating.

**Feathers:** These are peculiar to birds and constitute their principal covering. Like the horny sheath of the bill, the scales on the feet, and the claws on the toes, feathers are outgrowths of the skin, modifications of the lifeless, outermost layers of epidermal cells. It is probable that feathers represent modifications of the reptilian scale.
Bird feathers serve a variety of functions:

1. insulation
2. the increase of surface area and control surface for flight.
3. aid in camouflage
4. in courtship, sex and species recognition

Feathers of Adult Birds

Contour Feathers: These feathers take part in forming the shape or outline of the bird. The primary wing feathers are a good example of this type of feather. This is the typical quill pen feather.

Down Feathers: This type of feather is hidden beneath the contour feathers. The barbs are very slender, and arise from a common point. Barbules have hooklets for interlocking.

Filoplume: This is a hair-like feather, frequently located on the underside of the bird, under the contour feathers. It is sparsely distributed and grows usually at the base and on the dorsal side of a contour feather. A number of barbs will be found growing as a tuft at the tip of this type of feather.

Powder-down Feather: This type of feather is present only on certain groups of birds, such as herons and bitterns. It is a modified down feather which grows throughout the life of the bird, the barbs continually disintegrating into a fine powder. This powder is used as a dressing to clean slime, etc, from the other feathers.

Feather Colouration: Feather colours may be produced by the actual presence in the feather of a pigment. Alternatively, the colour may be produced via the diffraction of light passing through the structure of the feather, or by a combination of pigment and diffraction and refraction of light. Reds, oranges, yellow, brown, gray, black, tawny, and some greens are produced by pigments. White is produced by the absence of pigments plus feather structure. Blue and some green, as well as iridescent colours are produced by structure or by structure plus pigment granules.
BIRD TOPOGRAPHY

- nape
- upper mandible
- lower mandible
- mantle
- median wing coverts
- tertials
- upper tail coverts

Parts of the wing of a duck

- scapulars
- primaries
- secondaries
- speculum
CLASSIFICATION

In North America ornithologists have classified - or grouped - bird species into groups based on species' relationships beginning with the most primitive or ancient birds. North American birds are ranked in 20 ORDERS and the birds of each order resemble each other fundamentally in structure - usually the shape of the bones of the head and their arrangement; the shape of the breastbone, the number of toes, the number of tail feathers, etc.

The following is a taxonomic classification of the Common Crow:

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Animalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Chordata</td>
</tr>
<tr>
<td>Subphylum</td>
<td>Vertebrata</td>
</tr>
<tr>
<td>Class</td>
<td>Aves</td>
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<tr>
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<td>Passeriformes</td>
</tr>
<tr>
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<td>Corvidae (Crow)</td>
</tr>
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<td>Genus</td>
<td>Corvus</td>
</tr>
<tr>
<td>Species</td>
<td>brachyrhynchos</td>
</tr>
</tbody>
</table>

In this section we will be dealing with the ORDER, FAMILY and some of the GENUS/SPECIES for some of the key North American species.

This list represents only part of the total North American bird fauna. The order of species followed is based on the American Ornithologist Union (A.O.U.) 6th Edition, 1983 and Supplemented in July, 1985 and 1989. This committee determines Order, Family and Species name based on the most up to date scientific studies and will be the reason that some of the older field guides may list older classifications, names or orders for birds.
ORDER GAVIIFORMES - LOONS

- the oldest living group of birds dating back 65 million years

FAMILY GAVIDAE - Loons

- 5 species nest in North America

General Characteristics
- long sharp pointed beak
- bones are heavy and solid for diving unlike most birds which are hollow and air filled
- nests are on or near water and made as mounds of mud and reeds
- wings are short and in flight, head is held lower than body
- legs completely encased in skin and placed far back on the body therefore walk awkwardly
- run long distances to take off from water
- adapted to swimming and diving (web footed)
- young often carried on parent's back
- sexes are alike
- generally migrate

Species:

Red-throated Loon                    Gavia stellata
Arctic Loon                         Gavia arctica
Pacific Loon                        Gavia pacifica
Common Loon                         Gavia immer
Yellow-billed Loon                  Gavia adamsii
ORDER PODICIPEDIFORMES - GREBES

FAMILY PODICIPEDAE - Grebes

- 6 species in North America

General Characteristics
- legs are short and placed well back on the body
- take offs are long and strenuous
- wings are short, in flight rapid wing beats
- feet with lobed fringing membrane outlining only the three front toes
- nest built on floating vegetation

Species
Pied-billed Grebe
Horned Grebe
Red-necked Grebe
Eared Grebe
Western Grebe
Clark's Grebe
Podilymbus podiceps
Podiceps auritus
Podiceps grisegena
Podiceps nigricollis
Aechmophorus occidentalis
Aechmophorus clarkii
ORDER PELECANIFORMES - PELICANS, CORMORANTS, BOOBIES, FRIGATEBIRDS

- among the largest living birds with a wing span up to 9 feet

FAMILY PELECANIDAE - Pelicans

- 2 species in North America

General Characteristics
- all four toes are joined by webs of skin (totipalmate)
- have extensible beak pouch for catching and carrying food
- nest in large colonies
- chicks are dependent on adults when first hatched (altricial)

Species
American White Pelican Pelecanus erythrorhynchos
Brown Pelican Pelecanus occidentalis

- In British Columbia the American White Pelican is on the Provincial Endangered Species List.
FAMILY PHALACROCORACIDAE - Cormorants

- 6 species in North America

General Characteristics
- dive from the water surface
- often perch with wings half open to dry
  their feathers do not have complete
  water proofing as in other water birds
- tail long, wide, stiff and wedge shaped
- is used as a rudder along with webbed
  feet when under the water
- gregarious, nest in colonies

Species
Great Cormorant     Phalacrocorax carbo
Double-crested Cormorant Phalacrocorax auritus
Brandt’s Cormorant   Phalacrocorax penicillatus
Pelagic Cormorant    Phalacrocorax pelagicus
ORDER CICONIIFORMES  
- HERONS, STORKS, IBISES, FLAMINGOS

- waders associated with fresh, salt or brackish water especially marshes or shallow bays
- long legs, neck and bill

FAMILY ARDEIDAE - Herons

- 15 species in North America

General Characteristics
- diet includes frogs, small mammals, and fish which are swallowed whole
- undigested food is regurgitated in pellets
- nest in colonies called heronries

flight profile:
- legs straight back, necked tucked onto shoulder in S shape

Species
Great Blue Heron Ardea herodias
Black-crowned Night-Heron Nycticorax nycticorax
American Bittern Botaurus lentiginosus
Snowy Egret Egretta thula
GREAT BLUE HERON

Did you know that herons use their long skinny legs to help them fish? A heron wades in shallow water, then stands motionless. When a fish comes close, the heron slowly folds its neck back and moves one leg in the direction of the prey. Suddenly, its head plunges towards the fish, catching it in its beak and swallowing it.
SANDHILL CRANES
ORDER GRUIFORMES - CRANES AND RAILS

- 3 species in North America
- live in marshlands, wet plains and prairies
- migration in V-shaped flocks or long lines
- long necks and legs

flight profile:
- fly with necks extended forward and legs trailing behind

FAMILY GRUIDAE - Cranes

- 3 species in North America

General Characteristics
- long, heavy bill
- courtship rites include dancing
- wing feathers droop over rump forming a bustle that distinguish cranes from herons

Species
Sandhill Crane  Grus canadensis
Whooping Crane *  Grus americana

*Whooping Cranes have been on the Endangered Species list in North America for many years. The small population winters in the Gulf Coast region of Texas and spends the summer in northern Alberta and Saskatchewan, Canada.
FAMILY RALLIDAE - Rails

- 13 species in North America, (9 native, 4 foreign)

General Characteristics
- lobed feet with long toes adapted for water and muddy environs
- compact with short tails and rounded wings
- most species secretive can be identified by distinctive call

Species
Virginia Rail Rallus limicola
Sora Porzana carolina
American Coot Fulica americana

ORDER ANSERIFORMES - DUCKS, GEESE AND SWANS

FAMILY ANITIDAE - Swans, Geese and Ducks

- 64 species in North America

General Characteristics
- smallest ducks weighs one pound while the largest swans range up to 30 pounds
- water birds
- the front three toes are webbed and the hind toe is free
- young are covered in down when hatched
- adult plumage is thick and waterproof
- bill broad and rounded with a soft membranous covering and a “nail” or hard hooked tip on the upper mandible
- migrate in well-defined north-south flyways in North America
SUBFAMILY ANSERINI -
Swans, Geese and Whistling Ducks

Swans
- 4 species in North America

**General Characteristics**
- largest of the waterfowl
- have long slender necks
- North American species are white
- seldom dive but can do to avoid predators
- male-cob, female-pen, young-cygnet
- must run along water to take off (15-20 ft)

**Species**
Tundra Swan (formerly Whistling)  Cygnus columbianus
Trumpeter Swan  Cygnus buccinator
Mute Swan*  Cygnus olor

* (Introduced to N.A.)

Geese
- 8 species in North America

**General Characteristics**
- have shorter necks than swans
- sexes are similar-size not a good guideline because of number of races and interbreeding
- highly social—very strong pair bonds
- more adapted for walking on land than ducks

**Species**
Snow Goose  Chen caerulescens
Brant  Branta bernicla
Canada Goose  Branta canadensis
Whistling Ducks

- 3 species in North America

General Characteristics
- long necks and legs
- whistling calls
- goose-like body

Species
Fulvous Whistling-Duck Dendrocygna bicolor
Black-bellied Whistling-Duck Dendrocygna autumnalis

SUBFAMILY ANATINAЕ - Ducks

- this subfamily includes the dabbling or surface-feeding ducks, the fresh water diving ducks, the sea ducks, the stifftail ducks, and the perching ducks

The Dabbling Ducks

- 14 species in North America

General Characteristics
- prefer inland waters of marshes, lakes and ponds for breeding
- 'dip' for food instead of diving
- have brightly coloured wing patches called a speculum
- go through a complete molt in early summer which leave them temporarily flight-less
- take off in a direct leap from the water

Species
Wood Duck Aix sponsa
Green-winged Teal Anas crecca
Mallard Anas platyrhynchos
Northern Pintail Anas acuta
Northern Shoveler Anas clypeata
America Wigeon Anas americana
Gadwall Anas strepera
Fresh water Diving Ducks

- 6 species in North America

General Characteristics
- breed inland on lakes and rivers, winters on coastal bays and river estuaries
- dive from the surface
- North American species do not have a speculum
- legs set further back than on dabblers
- run along water surface to take off
- courtship displays are spectacular

Species
Canvasback
Redhead
Ring-necked Duck
Greater Scaup
Lesser Scaup
Barrow's Goldeneye
Bufflehead
Harlequin Duck
Common Eider
Oldsquaw
Surf Scoter

Aythya valisineria
Aythya americana
Aythya collaris
Aythya marila
Aythya affinis
Bucephala islandica
Bucephala albeola
Histrionicus histrionicus
Somateria millissima
Clangula hyemalis
Melanitta perspicillata
Mergansers

- 4 species in North America

General Characteristics
- a fish eating duck whose bill has serrated edges (saw-teeth) for holding onto prey
- dives under water
- legs placed well back on body - moves awkward on land
- nest inland, winter along coast

Species
Hooded Merganser  Lophodytes cucullatus
Common Merganser  Mergus merganser
Red-breasted Merganser  Mergus serrator

Stifftailed Ducks

- 2 species in North America

General Characteristics
- more aquatic that any other North American duck
- have dense and shining body plumage
- can sink slowly below the water
- use stiff tail as rudder under water
- male helps care for young
- female voiceless

Species
Ruddy Duck  Oxyura jamaicensis
California gull.

(Adult.)  (Juvenile.)
ORDER: CHARADRIIFORMES - GULLS, SHOREBIRDS AND AUKS

- spend much of time on or near water
- long pointed wings
- consists of three sub-orders:
  - 1. **Gulls** including Gulls, Terns, Skuas and Skimmers
  - 2. **Shorebirds** including Jacanas, Oystercatchers, Plovers, Thick-knees, Sandpipers, Avocets and Phalaropes
  - 3. **Auks**

Only a few families will be discussed below.

FAMILY LARIDAE - Gulls and Terns

- in North America
  - 25 species of gulls
  - 15 species of terns

**General Characteristics**
- associated with fresh and salt water
- webbed feet
- long pointed wings for gliding and flying over long distances
- hooked bills
- nest in colonies
- omnivorous

**Species** - many species in North America

**Gulls:** There is no such thing as a SEA GULL. Gulls are found near coastal areas, in the interior of the continent (the prairies) and at open ocean. Gulls take from two to four years to attain their adult plumage. They are difficult to identify while in the immature plumage.

**Terns:** Terns plunge dive to feed. Many species have a forked tail. Many migrate long distances.
SUBORDER: SHOREBIRDS

FAMILY HAEMATOPODIDAE - Oystercatchers

- 2 species in North America

General Characteristics
- brightly coloured feet and bills
- three toes-no hind toe
- bill twice as long as the bird's head
- bill shaped like a double-edged knife, with a chisel-like tip to pry open prey
- food includes bivalves, urchins, seastars, and marine worms

Species
American Oystercatcher Haematopus palliatus

FAMILY SCOLOPACIDA - Sandpipers

- 51 species in North America, 36 nest, 24 visitors

General Characteristics
- long slender bills often curved-used to probe into mud for food
- young are able to forage when hatched (precocial)
- some species are often seen in flocks

Species
Marbled Godwit Limosa fedoa
Whimbrel Numenius phaeopus
Greater Yellowlegs Tringa melanoleuc
Spotted Sandpiper Actitis macularia
Wandering Tattler Heteroscelus incanus
BIRDS

Black oyster catcher.

Lesser yellow-legs. Greater yellow-legs.
FAMILY RECURVIROSTRIDAE - Avocets

- 2 species in North America

General Characteristics
- wading birds known for their extremely long legs
- stilts have the longest legs in proportion to their body size of any bird
- live near water, swim and dive readily
- American Avocets feed by sweeping their curved bill from side to side through the water

Species
American Avocet Recurvirostra americana
Black-necked Stilt Himantopus mexicanus

FAMILY PHALAROPOLIDAE - Phalaropes

- 3 species in North America (world)

General Characteristics
- moderate to long bills
- lobed, semipalmated toes
- in phalaropes the role of the sexes is reversed - the female is larger and more brightly coloured and takes the initiative in courtship
- the male generally builds the nest, and incubates the eggs and rears the young (the male has brood patches - the female does not)
- feed by spinning on the water to stir up insects larvae

Species
Wilson’s Phalarope Phalaropus tricolor
Red-necked Phalarope Phalaropus lobatus
Red Phalarope Phalaropus fulicaria

• name change from Northern Phalarope in 1985.
FAMILY CHARADRIIDAE - Plovers

- 13 species in North America
- group includes true plovers and lapwings

General Characteristics
- distinguished from other shorebirds by pigeon-like bill, dove-like head and relatively large eyes
- strong flyers, can swim, migratory, sexes alike, travel in large flocks, active day and night
- all plovers use the distraction display to lead predators away from nest site or young

Species
Snowy Plover Charadrius alexandrinus
Killdeer Charadrius vociferus
Black-bellied Plover Pluvialis squatarola
SUB ORDER: AUKS

FAMILY ALCIDAE - Auks

- 20 species in North America

General Characteristics
- often referred to as alcids
- are the ecological counterpart of penguins of the Arctic in that they both have dense, water-proof plumages and dive and swim for all their food
- prefer salt water
- duck-like with short necks and very rapid wingbeats

Viewing tip: best time and place to see alcids is in stormy weather, in winter, along the coasts where a few strays may come close

Species
Common Murre
Pigeon Guillemot
Marbled Murrelet
Ancient Murrelet
Rhinoceros Auklet
Tufted Puffin

Uria aalga
Cephus columba
Brachyramphus marmoratus
Synthliboramphus antiquus
Cerorhinca monocerata
Fratercula cirrhata
ORDER: COLUMBIFORMES - DOVES AND PIGEONS

FAMILY COLUMBIDAE - Pigeons

- 17 species in North America

General Characteristics
- dense feathers of many colours, some metallic or iridescent
- strong flyers;
- usual habit of immersing bill and sucking up water as a horse drinks
- adults (both) feed young a milky substance produced in the crop

Species
Band-tailed Pigeon Columba fasciata
Rock Dove Columba livia
Mourning Dove Zenaida macroura

ORDER: FALCONIFORMES - VULTURES, HAWKS, OSPREY AND FALCONS

- diurnal birds of prey
- have well developed sense of sight and smell
- eyes laterally placed in head - use binocular vision for finding prey
- long wings for gliding and hovering
- sexes are alike - female generally larger than male
- hooked beak with a fleshy protuberance on the upper mandible (cere)
- lower mandible is shorter that upper
- foot (tarsus) consists of four talons for grasping prey
Rock dove.
FAMILY CATHARTIDAE - New World Vultures

- 4 species in North America

General Characteristics
- large broad winged birds adapted for soaring long periods of time
- head naked (no feathers)
- generally scavengers
- keen eyesight
- voiceless birds

Species
Turkey Vulture Cathartes aura

FAMILY ACCIPITRIDAE - Hawks, Harriers, Eagles

- 26 species in North America (4 eagles, 5 kites, 17 hawks)

General Characteristics
- heavy scaling on legs and feet (usually yellow)
- short rounded wings
- wingbeats short-interrupted by glides
- neck short and strong
- turn head to direct vision
- have binocular / monocular vision to aid hunting
- interesting courtship behaviour

• ALL members of the Hawk Family are protected by law in Canada and the USA. It is illegal to keep such a bird without a permit from the local government wildlife branch.
BIRDS

Hawks

- 17 species in North America

Species
Northern Goshawk Accipiter gentilis
Cooper's Hawk Accipiter cooperii
Sharp-shinned Hawk Accipiter striatus
Red-tailed Hawk Buteo jamaicensis
Rough-legged Hawk Buteo lagopus

Eagles

- 2 species in North America

General Characteristics
- large sized bird
- diurnal

- Bald Eagle
  - is basically a scavenger feeding on carion like spawned salmon, it will also take small waterfowl like Bufflehead
  - takes five years to reach adult plumage of white head and tail
  - reaches sexual maturity at seven years
  - nest in tall trees

- Golden Eagle
  - generally a bird of mountains and hilly terrain
  - nests on cliffs or tall trees
  - food includes small mammals, birds, snakes and carrion

Species
Bald Eagle Haliaeetus leucocephalus
Golden Eagle Aquila chrysaetos
Harriers

- 1 species in North America

General Characteristics
- sexes different colours - (male grey-female brownish)
- tail long, white rump patch, and long legs
- nests on ground
- holds wings in a V while gliding over ground
- feeds on mice, frogs, small ducks and other prey

Species
Northern Harrier (formerly Marsh Hawk)  Circus cyaneus

FAMILY PANDIONIDAE - Osprey

- 1 species in North America

General Characteristics
- fishing birds able to dive under water
- flies with fish parallel to body for less air friction
- builds large nest near water
- migrates to Argentina in winter

Species
Osprey  Pandion haliaetus
BIRDS

FAMILY FALCONIDAE - Falcons

- 7 living species (1 extinct) and 1 foreign visitor

General Characteristics
- rapid flyers (100-275 mph)
- pointed wing tips
- streamlined bodies
- strongly hooked bill with small tooth on upper mandible

Species
Gyrfalcon  Falco rusticolus
Prairie Falcon  Falco mexicanus
Peregrine Falcon  Falco peregrinus
American Kestrel  Falco sparverius
Merlin  Falco columbarius

ORDER: GALLIFORMES - GROUSE, PHEASANTS, TURKEYS

- 10 species in North America

General Characteristics
- also known as game-birds
- have round chicken-like bodies
- live mainly on the ground feeding on seeds and insects
- strong legs for running and walking
- poor flyers
FAMILY TETRANIDAE - Grouse

- 5 species in North America

General Characteristics
- feathers on bill, legs and feet
- flight is strong, rapid but short
- courtship includes drumming, dancing and displaying

Species
- Ruffed Grouse  Bonasa umbellus
- Spruce Grouse  Dendragapus canadensis
- Willow Ptarmigan  Lagopus lagopus
- Greater Prairie Chicken  Tympanuchus cupido

FAMILY PHASIANIDAE - Pheasant

- 9 species in North America, 6 native 3 - introduced

General Characteristics
- long tail feathers
- bill, legs and feet without feathers
- feet and bill adapted to scatching on ground for food

Species
- Gray Partridge *1  Perdix perdix
- Ring-necked Pheasant  Phasianus colchicus
- California Quail *2  Callipepla californica

* Introduced to North America from 1. Europe and 2. Asia
FAMILY MELAGRIDIDAE - Turkey

- 2 species in North America

General Characteristics
- largest game bird in North America
- smaller than the domesticated bird
- forage on ground for seeds, nuts and insects
- roost in trees
- re-introduced in many areas

Species:
Wild Turkey Meleagris gallopavo

ORDER: STRIGIFORMES - OWLS

- Includes 2 families - 1) the Barn Owl and 2) the Typical Owl
- can be active in daytime (diurnal), night-time (nocturnal) and dusk and dawn time (crepuscular)

General Characteristics
- broad head on short neck
- can turn head 270 degrees
- eyes are fixed to stare forward and are surrounded by a facial disk (must move head to direct vision)
- plumage very soft to aid in hunting prey
- food varies from small mammals like mice, shrews, squirrels and rabbits to other birds, insects reptiles and amphibians depending on the size of the owl
RUFFED GROUSE

Did you know that the male ruffed grouse is a great drummer? In the spring, the male rests its tail on a fallen tree and beats its wings faster and faster until they whirr and make a hollow sound like the beating of a drum. Males do this to stake out their territory and lure a mate.
FAMILY TYTONIDAE - Barn Owl

- 1 species in North America

General Characteristics
- live in barns, old buildings, caves, burrows or hollow trees
- facial disk is triangular or heart shaped
- long, feathered legs with sharp talons
- longer, narrower wings as compared to other owls
- "dark eyed" owl
- thought that they mate for life
- relies on hearing-not eyesight-for finding most of its prey

Species
Barn Owl Tyto alba

FAMILY STRIGIDAE - Typical Owl

- 17 species in North America

General Characteristics
- sight and hearing extremely keen
- four toes on each foot- the outer toe on each is reversible

Species
Western Screech-Owl Otus kennisotii
Great Horned Owl Bubo virginianus
Snowy Owl Nyctea scandiaca
Northern Pygmy-Owl Glaucidium gnoma
Burrowing Owl Athene cunicularia
Great Grey Owl Strix nebulosa
Short-eared Owl Asio flammeus
Long-eared Owl Asio otus
Northern Saw-whet Owl Aegolius acadicus
ORDER: CAPRIMULGIFORMES - NIGHTJARS

- nocturnal
- insect eaters
- take insects on the wing
- small weak feet
- heads are flat
- distinctive white patches on wings or tail

FAMILY CAPRIMULGIDAE - Nightjars

- 7 species in North America

General Characteristics
- also called goatsuckers or mosquito hawks
- active from dusk to dawn
- one species - the poorwill-hibernates
- spend much time on ground are cryptically coloured for protection

Species
Common Nighthawk Chordeiles minor
Common Poorwill Phalaenoptilus nuttallii
Whip-poor-will Caprimulgus vociferus
ORDER: APODIFORMES - HUMMINGBIRDS and SWIFTS

- long pointed wings for fast flying
- feed on insects
- Latin name "apidos" means without feet - BUT they do have tiny feet!

FAMILY APODIDAE - Swifts

- 4 species in North America (with 3 species casual from Asia)

General Characteristics
- are not songbirds or perching birds
- strong claws adapted to clinging to walls, cliffs and rocks
- some swifts become torpid during cold weather when insects flying unavailable (i.e., White-throated Swift)

Species
Black Swift Cypseloides niger
Chimney Swift Chaetura pelagica

FAMILY TROCHILIDAE - Hummingbirds

- 21 species in North America
- (5 species in Canada)

General Characteristics
- ability to fly backwards and hover
- can endure cold weather by becoming dormant
- iridescent colours
- spectacular courtship "flight" in some species

Species
Anna's Hummingbird Calypte anna
Rufous Hummingbird Selasphorus rufus
ORDER CORACIIFORMES - KINGFISHERS

FAMILY ALCEDINIDAE - Kingfishers

- 3 species in North America

General Characteristics
- compact birds with short necks and large heads
- long sharp pointed bill
- three toes forward - one toe pointed back
- brightly coloured-greens and blues
- dive headlong into the water
- eat fishes, amphibians, crustaceans, and aquatic insects
- mainly solitary or in pairs
- nest in stream banks (burrows)

Species
Belted Kingfisher  Ceryle alcyon
Green Kingfisher  Chloroceryle americana
Yellow-bellied sapsucker.

Male.  Female.

Hairy and downy woodpeckers.
Pileated Woodpecker

Yellow-bellied Sapsucker
ORDER PICIFORMES - WOODPECKERS

FAMILY PICIDAE - Woodpeckers

- about 23 species in North America

General Characteristics
- not songbirds
- adapted to lives on tree trunks and branches
- legs and short with toes that are long and strong - sharp clinging nails for holding on to the bark
- use tail to 'prop' themselves against the trunk or branch while drilling
- use chisel-like bill for drilling next site, finding food, and for drumming during courtship
- have extremely long worm-like tongues for finding worms and grubs in trees
- food: many eat larvae and adults of beetles, ants, aphids, flies, caterpillars; some eat acorns, pine seeds, nuts and berries while others eat fruit, grains and sap

Species
Red-breasted Sapsucker  Sphyrapicus ruber
Northern Flicker  Colaptes auratus
Pileated Woodpecker  Dryocopus pileatus

- Many woodpecker species rely on dead snags for homes and roosting areas. In many states and provinces projects are underway to conserve snags for wildlife. In Germany trees are even girdled to make snags.
ORDER PASSERIFORMES - PERCHING OR SONG BIRDS

- large order of birds (29 families in North America)
- perching birds - three toes forward and one toe back
  adapted for holding on to branches
- believed to be the most advanced form of birds
- many species noted for their singing

FAMILY TYRANNIDAE - Tyrant Flycatchers

- 35 species in North America

General Characteristics
- one of the most primitive and successful of the song
  birds
- difficult to identify in the field
- catch insects on the wing
- head has slight crest

Species
Eastern Kingbird       Tyrannus tyrannus
Olive-sided Flycatcher Contopus borealis
Western Wood-Pewee    Contopus sordidulus
Hammond’s Flycatcher   Empidonax hammondii
FAMILY ALAUDIDAE - Larks

- 2 species in North America

General Characteristics
- ground dwelling on open bare land (deserts, beaches, grasslands)
- walk rather than hop
- wings long and pointed
- elaborate and beautiful songs

Species
Horned Lark  Eremophila alpestris
Eurasian Skylark  Alauda arvensis

*Eurasian Skykarks were introduced into North America (Vancouver Island, Canada) from Eurasia and Africa at the turn of the century. A small population still exists on the Saanich Peninsula near Victoria.
FAMILY HIRUNDINIDAE - Swallows

- 11 species in North America

General Characteristics
- often confused with swifts but not related
- includes Martins
- spend more time in daytime flight than other passerine
- slender, sleek and plumage is iridescent
- nest in colonies - trees buildings cavities and stream banks

Species
Purple Martin          Progne subis
Barn Swallow          Hirundo rustica
Cliff Swallow         Hirundo pyrrhonota
Tree Swallow          Tachycineta bicolor
FAMILY CORVIDAE - Crows

- 18 species in North America
- group includes crows, ravens, jays, magpies and nutcrackers

General Characteristics
- highest degree of intelligence in the bird world
- can solve puzzles, have good memories, and can associate objects and can mimic other birds
- most have complex social structures both as families and a flocks
- omnivorous
- heavy beaks
- sexes generally alike
- strong flyers

Species
American Crow • Corvus brachyrhynchos
Gray Jay Perisoreus canadensis
Steller's Jay Cyanocitta stelleri
Black-billed Magpie Pica pica
Clark's Nutcracker Nucifraga columbiana
Common Raven Corvus corax

• formerly the Common Crow

In the coastal area of British Columbia from the boarder to Alaska the Northwestern Crow (Corvus caurinus) replaces the American Crow.
FAMILY PARIDAE - Titmouse (Chickadee)

- 13 species in North America
- includes chickadees and titmouse
- in 1985 the Bushtits were removed from this group and put in their own Family (Aegithalidae)

General Characteristics
- less than 6 inches in length
- sexes generally alike
- soft, thick plumage usually grays and browns
- short, stout pointed bills
- strong legs and feet
- rounded wings
- cavity nesters
- often flock when feeding

Species
Black-capped Chickadee Parus atricapillus
Bridged Titmouse Parus wollweberi

FAMILY REMIZIDAE - Verdin

General Characteristics
- small birds with finely pointed bills
- feeds like a chickadee

Species
Verdin Auriparus flaviceps
Steller's Jay

Flight silhouettes of northwestern crow, western crow, and raven. Note the small beak and round wing of the northwestern crow, and the very large beak and somewhat pointed wing and tail of the raven.
BIRDS

Clark nutcracker.

Black-capped chickadee. Chestnut-backed Chickadee.

Common Bushtit
FAMILY AEGITHALIDAE - Bushtit

- 1 species in North America
- formerly a subfamily of the Paridae (Titmouse)

General Characteristics
- tiny, long tailed gray-brown birds
- very short bill
- glean insects and spiders from foliage
- build gourd-shaped hanging nests of moss, lichens twigs, and rootlets
- often flock together with chickadees and kinglets when feeding

Species
Bushtit Psaltriparus minimus

FAMILY SITTIDAE - Nuthatches

- 4 species in North America

General Characteristics
- moves down the tree head first in search of food
- short legs with strong claws allowing them to cling to bark
- move in short hops
- most are not migratory

Species
Pygmy Nuthatch Sitta pygmaea
Red-breasted Nuthatch Sitta canadensis
FAMILY CERTHIDAE - Creepers

- 1 species in North America

General Characteristics
- slender bill, wings and tail
- very long sharp claws
- creep on bark in search of insects under the bark

Species
Brown Creeper Certia familiaris

FAMILY CINCLIDAE - Dipper

- 1 species North America

General Characteristics
- solitary except at nesting time
- territory is usually about 1/2 mile of stream front
- soft filmy plumage with thick undercoat of down
- large preen gland
- movable flap over nostril (to keep water out)
- nictitating membrane to protect eyes when in water
- short stubby wings and tail
- strong underwater swimmer
- name derived from its habit of bobbing body rapidly up and down
- nest along stream or under waterfalls

Species
American Dipper Cinclus mexicanus
FAMILY TROGLODYTIDAE - Wrens

- 10 species in North America

General Characteristics
- small, extremely quick
- brownish-gray plumage
- sharp pointed bill
- short rounded wings
- usually carry tail cocked straight up
- live close to ground

Species
Bewick's Wren Thryomanes bewickii
House Wren Troglydytes aedon
Marsh Wren Cistothorus palustris
Rock Wren Salpinctes obsoletus

FAMILY TURDIDAE - Thrushes

- 19 species in North America
- includes bluebirds, robins, thrushes, solitaires, the veery and wheatear

General Characteristics
- leg (tarsus) is unscaled, or “booted”
- perching foot
- range in size from 4 - 13 inches in length
- some of the finest singers
- eat insects and fruit

Species
Mountain Bluebird Sialia currucoides
American Robin Turdus migratorius
Townsend's Solitaire Myadestes townsendi
Varied Thrush Ixoreus naevius
Veery Catharus fuscescens
Northern Wheatear Oenanthe oenanthe
FAMILY SYLVIIDAE - Old World Warblers

General Characteristics
- small, very active birds
- often flock when feeding
- forest dwellers
- migratory
- eat insects and some fruit

Species
Blue-gray Gnatcatcher  
Ruby-crowned Kinglet  
Arctic Wabler  
Polioptila caerulea  
Regulus calendula  
Phylloscopus borealis

FAMILY BOMBYCILLIDAE - Waxwing

- 2 species in North America
- tree-dwelling in coniferous and deciduous forests
- eat berries, small fruit, and insects

General Characteristics
- soft, silky plumage
- short, thick bills
- short legs
- sleek, strongly crested birds
- sexes alike
- small pellets of bright red waxy material form on the secondary feathers of wings and tail (purpose unknown)

Species
Bohemian Waxwing  
Cedar Waxwing  
Bombycilla garrulus  
Bombycilla cedrorum
Golden-crowned kinglet. Ruby-crowned kinglet.

**GOLDEN-CROWNED KINGLET**

Bohemian waxwing. Cedar waxwing.
FAMILY LANIIDAE - Shrikes

- 2 species in North America

General Characteristics
- only predatory songbird
- prey on vertebrate animal and insects (comparable to hawks and owls)
- generally solitary except when nesting
- often hang prey in tree (larder) from where it got its name "butcher bird"
- hunt by day (diurnal)
- patterned grey, black and white
- large heads and bills
- black band through/behind eyes (giving a masked appearance)
- strong feet and claws

Species
Loggerhead Shrike
Northern Shrike

Lanius ludovicianus
Lanius excubitor

Loggerhead shrike. Northern shrike.
FAMILY STURNIDAE - Starling

- 3 species introduced into North America from Asia or Europe.

General Characteristics
- strong legs and bills
- tails short and square cut
- plumage dark coloured - often with metallic sheen
- beaks and plumage change colours with season
- highly social birds - form large flocks

Species
European Starling Sturnus vulgaris

Introduced from Europe into New York City in 1890. Population gradually spread across continent reaching the Pacific Northwest in the late 1940’s.

Crested Myna Acridotheres cristatellus

Introduced into Vancouver, British Columbia from the orient around 1897. The population has been declining during the 1980’s.

FAMILY: VIREONIDAE - Vireos

- 12 species in North America

General Characteristics
- plain olive, green or gray plumage
- sexes similar
- bill short and straight
- bristle-like feathers partially cover the head
- eat mostly insects and berries
- prefer upper branches of trees therefore making them hard to see

Species
Hutton’s Vireo Vireo huttoni
Red-eyed Vireo Vireo solitarius
FAMILY PARULIIDAE - American Wood Warbler

- 56 species in North America
- includes some warblers, chats, ovenbirds, redstarts, waterthrushes, and yellowthroats

General Characteristics
- active, brightly coloured songbirds
- eat insects
- toes long and slender
- bill either slender and sharp pointed or broad and flattened
- migratory
- live in woodlands and swampy places

Species
Yellow-breasted Chat Icteris virens
American Redstart Setophaga ruticilla
Yellow-rumped Warbler Dendroica coronata
Northern Waterthrush Seiurus noveboracensis
Common Yellowthroat Geothlypis trichas
FAMILY Icteridae - Blackbirds

- 22 species in North America
- include blackbirds, grackles, orioles, meadowlarks, cowbirds and bobolinks

General Characteristics
- small to medium sized birds
- sexes generally unlike - males highly coloured
- some species form large flocks when roosting
- one species (Cowbird) lays its eggs in the nest of another species (parasitic)

Species
Red-winged Blackbird Agelaius phoeniceus
Bobolink Dolichonyx oryzivorus
Brown-headed Cowbird Molothrus ater
Common Grackle Quiscalus quiscula
Western Meadowlark Sturnella neglecta
Northern Oriole* Icterus galbula

* formerly Bullock's Oriole

FAMILY Thraupidae - Tanagers

- 5 species in North America

General Characteristics
- amongst the most brilliantly coloured birds
- monogamous
- rictal bristles around mouth (distinguishes from Orioles)
- fruit and nectar eaters

Species
Scarlet Tanager Piranga olivacea
Western Tanager Piranga ludoviciana
House sparrow.
**FAMILY FRINGILLIDAE - Finches**

- 83 species plus 8 subspecies in North America
- largest family of all families in number of species

**General Characteristics**
- finest North America songsters
- most migratory
- strong flyers
- gregarious when not nesting
- cone-shaped strong bills adapted to seed-cracking
- also eat fruit and insects
- some have special mouth pouches for carrying food
- most feed on the ground

**Species**
- This is a very large group - consult field guides for species in your area.

<table>
<thead>
<tr>
<th>Bird Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lazuli Bunting</td>
<td>Passerina amoena</td>
</tr>
<tr>
<td>Northern Cardinal</td>
<td>Cardinalis cardinalis</td>
</tr>
<tr>
<td>Common Redpoll</td>
<td>Carduelis flammea</td>
</tr>
<tr>
<td>House Finch</td>
<td>Carpodacus mexicanus</td>
</tr>
<tr>
<td>American Goldfinch</td>
<td>Carduelis tristis</td>
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<tr>
<td>Evening Grosbeak</td>
<td>Coccothraustes vespertina</td>
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<tr>
<td>Dark-eyed Junco</td>
<td>Junco hyemalis</td>
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<tr>
<td>Lapland Longspur</td>
<td>Calcarius lapponicus</td>
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<tr>
<td>Pine Siskin</td>
<td>Cardeulis pinus</td>
</tr>
<tr>
<td>Rufous-sided Towhee</td>
<td>Pipilo erythrphthalmus</td>
</tr>
</tbody>
</table>

Sparrow - numerous species

- The House Sparrow is NOT in this family but a member of the Weaver Finch Family. It was originally introduced in North America at the turn of the century.
BIBLIOGRAPHY


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1967. No. 5 Gulls, Terns Jaegers and Skua
1967. No. 6 Waterfowl
1970. No. 7 Owls
1964. No. 8 Chickadees, Thrushes, Kinglets, Pipits Waxwings and Shrikes
1978. No. 9 Diving Birds and Tube-nosed Skimmers
1983. No.11 Sparrows and Finches


MAMMALS
MAMMAL OUTLINE

WHAT IS A MAMMAL 221

ANATOMY 222

ENDANGERED AND THREATENED MAMMALS 233

CLASSIFICATION OF MAMMALS 235
ORDER MARSUPIALIA - Opposum 235
ORDER INSECTIVORA - Shrews, Moles 236
ORDER CHIROPTERA - Bats 241
ORDER LAGOMORPHA - Picas, Rabbits, Hares 246
ORDER RODENTIA - Squirrels, Marmots, Gophers 248
Mice, Rats, Beavers
ORDER CARNIVORA - Foxes, Wolf, Bears, Raccoons, 262
Weasels, Skunks, Otters, Cats, Seals
ORDER SIRENIA - Manatees 273
ORDER ARTIODACTYLA - Boars, Peccary, Deer, 274
Pronghorns, Sheep, Goats

BIBLIOGRAPHY 282
WHAT IS A MAMMAL?

Mammals are a class of animals of complex organisms which ingest (eat) their food. They all possess mammary or milk glands which produce a secretion used to nourish their young. The mammary glands are modified sweat glands which are usually localized in a breast.

In addition to mammary glands all mammals possess hair or fur. The hair evolved as a modified scale (remember the reptiles) and is used to help insulate the body. Mammals, like birds, are warm-blooded (homoiothermic); birds originally evolved feathers from scales to insulate their bodies. The hair may be greatly reduced in mammals found in warm climates (e.g. elephants), or in aquatic environments where the hair is lost to improve streamlining for movement through the water. The hair of mammals is often coloured to camouflage the individual in its surroundings, and may change with the seasons (e.g. shoeshoe hare).

The Class Mammalia has many diverse life forms. Originally mammals evolved as land-dwelling (terrestrial) animals walking on four limbs (tetrapods). In some forms the front limbs have reduced or lost (e.g. whales). In bats, the digits (fingers) of the front limbs have become greatly elongated and support a membranous skin flap for flight.

There are three general groups of mammals. These are:
- monotremes
- marsupials
- eutherians

The monotremes have body temperatures of 30-33 C, lay eggs, and do not have milk glands localized in breasts. They include the duck-billed platypus and the spiny anteater.

The marsupials have body temperatures of 34-37 C, give birth to live young still in an embryonic stage of development, and have pouches in which the young continue to develop. The kangaroo is in this group.
The majority of mammals are *eutherians*. They have body temperatures of 35 - 40 °C, give birth to well-developed live young, and have a placenta to provide nourishment for the young while still in the uterus of the mother. Humans belong to this group.

The skeletons of mammals are basically similar in structure to our own (human). The bones are heavily ossified (very hard). The skull has a well-developed brain case with bones joined very closely together. The lower jaw is attached directly to the rest of the skull without any connecting bones inbetween. The bones on the back of the skull (occipital) have two projections which joins the skull to the vertebral column (backbone).
ANTERIOR VIEW OF THE HUMAN SKELETON
Most mammals walk on four limbs. In doing so they typically bring the chest over whichever of the front limbs is on the ground. This produces a side-to-side movement as the mammal walks. This type of movement does not require well-developed chest muscles. In the case of reptiles and amphibians the front limbs are kept well to the side as the animal walks; they in turn have well-developed chest muscles. This manner of movement in mammals allows them to have a longer stride for the same length and mass of limbs. As they walk mammals may stand on the soles of their feet (plantigrade, as in humans), or on the toes (digitigrade, as in dogs).

When running a reptile and amphibian use lateral bends of the body, which is suited to increasing their stride because the limbs are placed laterally. The mammalian “gallop” involves bending the back vertically up and down, not side-to-side; the limbs are best extended in this way considering that they are placed under the body. Forelimbs and hindlimbs also move together. Strong back muscles can enhance the action of the legs. The structure of the vertebrae in mammals, with their articulating processes, allows for this necessary vertical movement. The vertebrae of amphibians and reptiles restrict vertical movements.

The teeth of mammals have different shapes (and functions) in different parts of the jaw. The front teeth, called incisors, are adapted for cutting. The lower incisors may tilt forward to allow them to slide under objects to pick them up. Next to these are canines which in meat-eating mammals are pronounced. They are sharp and curved for tearing at prey. Next to the canines are premolars which are useful in initially cutting food into smaller pieces. The molars are next to these. These break the good into still smaller pieces before it is swallowed. Mammals break up their food before swallowing much more than any other vertebrate group. The larger surface area of the finely chewed food increases the rate of chemical breakdown by enzymes. A rapid rate of digestion is important to mammals because of their high metabolic rate.

Some mammals eat only plants (herbivores), some only other animals (carnivores), and some both (omnivores). The different diets are usually reflected in changes to the teeth.

Once chewed the food passes into an esophagus down to the stomach. In the stomach proteins are broken down by gastric juice. The food plus the gastric juices (a mixture called chyme) passes into the small intestine.
Mammals

where further digestion and absorption (of nutrients into the bloodstream) occurs. The small intestine joins a large intestine with a structure called a caecum occurring at the junction. In the large intestine water and mineral salts are absorbed. The waste (called feces) is formed and storred in a rectum.

Mammals which eat only plants have a problem in obtaining sufficient protein because the cellulose of plant cell walls is difficult to digest. Some herbivores have an enlarged caecum containing bacteria which can digest cellulose. Other mammals, called ruminants, have bacteria in special chambers of the stomach to digest cellulose; these are the cud-chewing mammals. Herbivorous mammals without an enlarged caecum or additional chambers in the stomach must consume large amounts of vegetation to compensate for the inefficient retrieval of protein from the diet.

Circulation

Mammals have a 4-chambered heart, as in the case of birds. They have a complete separation of oxygenated and deoxygenated blood in their bodies. The greater efficiency of oxygen transport is necessary to maintain their body temperature, which requires a higher metabolic rate than cold-blooded animals.

Blood flows from the body into the right atrium, through a valve into the right ventricle, from which it is pumped into the lungs. All mammals breathe through lungs. Blood returns from the lungs back to the left atrium of the heart, through a valve into the left ventricle, and then out to the body. Blood cells contain the pigment hemoglobin which is used to transport oxygen.

An interesting feature of mammalian circulation is the role it plays in maintaining body temperature. This is especially important in aquatic mammals which could lose a great deal of body heat through their limbs and skin. In terrestrial mammals the blood supply to the skin and extremities may be increased to reduce body temperature and prevent overheating and vice versa. Notice that people appear more reddish when hot, and blue when cold.

Aquatic mammals also have the veins and arteries in their limbs arranged in a special pattern called a counter current system. This further prevents heat loss. Alternatively, the horns of some mammals are thought to reduce the temperature of the blood before it goes to the brain, preventing heat damage to the delicate brain tissue which can be seriously damaged by heat.
Circulation Through 2, 3 and 4 Chambered Hearts

**FISH**
- Single circulation

**AMPHIBIAN**
- Double circulation with partially divided heart

**MAMMAL**
- Double circulation with completely divided heart

A) FISH

B) AMPHIBIAN

C) MAN
Human Excretory System

- adrenals
- inferior vena cava
- kidney
- aorta
- ureter
- urinary bladder
- urethra

Human Kidney - Gross Internal Anatomy

- renal cortex
- fibrous capsule
- renal medulla
- pyramid
- renal pelvis
- hilus
- renal artery
- renal vein
- ureter
Most mammals are viviparous - they give birth to live young. The monotremes (platypus and spiny anteater) are exceptions. They lay eggs and are called oviparous.

During development in the marsupials and eutherians the yolk sac and allantois membranes surrounding the embryo (as seen in reptiles) are attached to the wall of the uterus to form the placenta and umbilical cord. In marsupials, usually the yolk sac and chorion form the placenta. In eutherians, the chorion and allantois form the placenta. In the placenta the blood of the mother and the blood of the fetus come close together but never actually mix together.

Young mammals are fed milk after birth. The milk is produced in mammary glands or breasts (except monotremes), which vary in number from 2 - 20, depending upon the litter size of the species. The milk is a watery substance containing fat globules. The fat content can vary from 1.5 % by weight in the case of a horse to 20 % in a reindeer, or more in whales. In addition to fat, milk contains sugars, salts, and proteins. The sugar in eutherian mammals is lactose, with additional sugars present in the milk of marsupials.

Mating in most species of mammals, especially in small mammals such as insectivores, rodents, and bats, is promiscuous and indiscriminate. Other mammals such as deer and seals can be polygamous. Monogamous relationships are rare.

Parental care is usually provided by the mother. The degree of parental care usually varies inversely with the number of young produced. In general, the more evolutionarily advanced mammals produce fewer young with a greater degree of parental care.

Birds and mammals are capable of producing urine which is higher in concentration of dissolved substances than their blood. Reptiles are not capable of producing such concentrated urine. This ability in mammals is especially important in order to conserve water. Birds and reptiles can excrete their nitrogenous wastes primarily as urea in solution.
Unlike other vertebrates, mammals have an external ear with a pinna which acts to collect sound waves. In addition to amplifying sound waves the pinna helps to determine the location of a sound source. This is due in part to a comparison of which ear receives the sound first, but is also due to the shape of the pinna. The reflection of sound waves from the pinna onto the eardrum is complex and depends in part on the direction of the sound source.

The middle ear of mammals is peculiar in containing three bones (auditory ossicles) instead of just one. The additional bones further serve to amplify the energy of the sound coming from the external ear. The hearing ability of mammals in general appears to be better than in other vertebrates.

The visual acuity is also increased in some mammals by using the lens as a colour filter to absorb the blue end of the spectrum and reduce chromatic aberration on the surface of the retina. For example, red oil droplets appear in the lens of some diurnal marsupials and insectivores; a yellowish colouration appears in the lens of humans and most tree squirrels; ground squirrels and prairie dogs have orange in the lens.

Nocturnal mammals often have an additional layer in the eye behind the retina called the tapetum. This contains metallic deposits which reflect light back through the retina a second time, increasing the stimulation of the retina in poor light. An unusually bright light can be reflected back out through the pupil from the tapetum, producing eyeshine.

A nocturnal mammal may make use of the length of its rods rather than their diameters in perceiving poor light. If this is the case it can obtain good resolving power in bright light if it can reduce the sensitivity of its eyes to the light. This is done by means of the slit-shaped pupil (either vertical or horizontal) found in many nocturnal mammals.

The position of the eyes is important in determining the field of view and binocular vision. The more the eyes are placed anteriorly with a greater overlap of the field of view, the greater the degree of binocular vision and depth perception. This is especially important for tree-dwelling (arboreal) species which regularly move in three dimensions.

Most fishes, reptiles, and birds can perceive colour, but not mammals. Only the primates and monkeys can perceive colour at all well. Carnivores, rodents and most other mammals are colour blind.
Primates and whales have a poor sense of smell. In other mammals smell is used for locating prey or predators, determining the sexual conditions of their partners, determining food quality, and probably recognizing individuals. However, the sense of smell seems to vary considerably from one group to the next.
Blue Whale
*Balaenoptera musculus*
ENDANGERED AND THREATENED MAMMALS

The following is a complete list of endangered mammal species in Canada as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1987.

Extinct: Dawson Caribou
         Sea Mink

Exirpated: Atlantic Gray Whale
           Atlantic Whale (St Lawrence population)
           Black-footed Ferret
           Swift Fox

Endangered: Bowhead Whale
            Eastern Cougar
            Right Whale
            St Lawrence River Beluga Whale
            Sea Otter
            Vancouver Island Marmot
            Wood Bison

Threatened: Maritime Woodland Caribou
            Newfoundland Pine Marten
            North Pacific Humpback Whale
            Peary Caribou
            Prairie Long-tailed Weasel

Rare: Black-tailed Prairie Dog
      Blue Whale
      Eastern Mole
      Fin Whale
      Grey Fox
      Northwest Atlantic Humpback Whale
      Plains Pocket Gopher
      Queen Charlotte Island Ermine
      Western Woodland Caribou
      Wolverine
WATCHING MAMMALS

Mammals are often elusive and are therefore more difficult to see and identify in the field. Mammals can be interpreted by identifying their scats, skeletons or tracks. In order to identify mammals, naturalists should be aware of their habits as well as physical features.
CLASSIFICATION OF MAMMALS

The Phylum CHORDATA includes all mammals, fishes, birds, amphibians, and reptiles. The phylum is divided into Classes, with mammals in the Class Mammalia. Classes are subdivided into Orders. Worldwide there are 19 Orders with 9 Orders occurring in North America north of Mexico. Orders are divided into Species of which there are 368 in North America.

<table>
<thead>
<tr>
<th>Order</th>
<th>Number of Species</th>
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</thead>
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<tr>
<td>Marsupials</td>
<td>1</td>
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<tr>
<td>Shrews and Moles</td>
<td>37</td>
</tr>
<tr>
<td>Bats</td>
<td>40</td>
</tr>
<tr>
<td>Edentates</td>
<td>1</td>
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<tr>
<td>Lagomorphs</td>
<td>19</td>
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<tr>
<td>Rodents</td>
<td>200</td>
</tr>
<tr>
<td>Carnivores</td>
<td>54</td>
</tr>
<tr>
<td>Sea Cows</td>
<td>1</td>
</tr>
<tr>
<td>Ungulates</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total species</strong></td>
<td><strong>368</strong></td>
</tr>
</tbody>
</table>

ORDER MARSUPIALIA - POUCHED MAMMALS

- 1 species found in North America
- most primitive group of the mammals that bear their young alive (viviparous mammals)
- they differ in that they lack a true placenta but do have a fur-lined pouch (marsupium) covering the female's mammae.
- gestation period 1-2 weeks
- young are born in an undeveloped (embryonic) state and make their way from the base of the mother's tail to the pouch where they attach themselves to a nipple
- of the 250 species native to Australia the marsupials fill many niches with species of squirrels, moles, mice, cats, rabbitlike animals, dogs and anteaters
MAMMALS

FAMILY DIDELPHIDAE - New World Opossums

- 1 species in North America

General Characteristics
- house cat size
- greyish-white fur (pelage) - some hairs black-tipped and coarse
- tail naked, prehensile
- ears naked with pink tips
- legs short, first toe of hind foot thumb-like (opposable)
- average life span - 7 years
- found in open woods, brushy wastelands and farmlands, occasionally found in urban areas
- nocturnal and solitary
- when threatened often rolls over and closes eyes - "playing possum"
- does not hibernate, but may den up during extreme weather
- often killed on roadways while scavenging carrion

Species
Virginia Opossum
Didelphis virginiana

ORDER INSECTIVORA - SHREWS AND MOLES

- small mammals with short, dense fur
- 5 clawed toes on fore and hind feet
- small eyes and ears
- they do eat insects and their larvae but will eat other invertebrates
- are land-dwellers, burrowers, and some spend life in water

- 2 families are represented North America:
  shrews (Soricidae)
  moles (Talpidae)
FAMILY SORICIDAE - Shrews

General Characteristics
- are the smallest living mammals
- often resemble mice but have 5 clawed toes (mice have 4)
- fur can lay forward or backward - to allow for movement in burrows
- have high metabolism so that they must feed every three hours day and night
- eats twice its own body weight each day
- eats insects, fungi, and small mammals - dead or alive
- some have squeaky voices, while others echolocate like bats
- are the prey food of owls, snakes and some mammals
- average life span 1 - 2 years
- usually 1 - 2 litters per year each with 2 - 10 young
- shrews become easily excited and can die from fright - when the heart reaches 1,200 beats per minute

Species
Vagrant Shrew Sorex vagrans
Pygmy Shrew Microsorex hoyi
Short-tailed Shrew Blarina brevicauda
Least Shrew Cryptotis parva
Desert Shrew Notiosorex crawfordi
FAMILY TALPIDAE - The Moles

- larger than shrews

General Characteristics
- have shorter tails
- streamlined bodies, narrow pelvis
- fur is velvety and grainless
- hearing is well-developed
- eyes light sensitive, vision poor
- naked snout, very important in finding food through smell and vibrations pick up through whiskers
- active day and night
- can burrow approximately 1 foot per minute in porous soil
- main food earthworms

Species
American Shrew-mole
Townsend's Mole
Hairy-tailed Mole
Eastern Mole
Star-nosed Mole

Neurotrichus gibbsii
Scapanus townsendii
Parascalops breweri
Scalopus aquaticus
Condylura cristata
ORDER CHIROPTERA - BATS

- bats are unique in the mammal world in that they fly
- other mammals that have “flying” as part of their name actually glide and are not capable of sustained flight (i.e. flying squirrel)
- one of the most numerous mammals next to rodents
- four families and 39 species occur in North America

General Characteristics
- well-furred bodies
- naked wing membranes
- head has small eyes and large ears
- chest large, hips narrow
- most North American bats locate their prey by echolocation which operates by a system similar to sonar
- a high frequency sound is emitted from the bat and is returned when the signal hits the prey object
- some prey are able to confuse the bat by sending back false signals
- most bats are nocturnal
- in winter some bats migrate while other hibernate

FAMILY MORMOOPIDAE - The Leaf-chinned Bats

- 8 species restricted to tropics of new world
- 1 is found north of Mexico (Texas and Arizona)

General Characteristics
- the chin has flaps and grooves which aid with the echolocation
- ear (tragus) has a horizontal pocket-like fold

Species
Ghost-faced Bat         Mormoops megalophylla
FAMILY PHYLLOSTOMATIDAE - The Leaf-nosed Bats

- 140 species in the tropical regions of the New World
- 5 species reach the south-western limit of the United States

General Characteristics
- nose has a vertical projecting flap which is part of the emission of ultrasonic sounds
- can hover in flight
- have large eyes - can see quiet well

Species
California Leaf-nosed Bat  Macrotus californicus
Long-tongued Bat  Choeronycteris mexicana
Mexican Long-nosed Bat  Leptonycteris nivalis
Hairy-legged Vampire  Diphylla ecaudata

FAMILY VESPERTILIONIDAE - Evening Bats

- found in temperate and tropical regions throughout the world
- most North America bats belong to this group
- as the name implies these bats are generally seen in the evening
- insectivorous
- some migrate, but most hibernate

General Characteristics
- most have developed echolocation system that sends out an ultrasonic vibration through their mouth
- have plain noses
- earlobes form a tragus
- tail extends only slightly beyond the back edge of the interfemoral membrane
Species
Little Brown Bat
Silver-haired Bat
Western Pipistrelle
Big Brown Bat
Red Bat
Evening Bat
Spotted Bat
Townsend’s Big-eared Bat
Pallid Bat

Myotis lucifugus
Lasionycteris noctivagans
Pipistrellus hesperus
Eptesicus fuscus
Lasiurus borealis
Nycticeius humeralis
Euderma maculatum
Plecotus townsendii
Antrozous pallidus

FAMILY MOLOSSIDAE - The Free-tailed Bats

- 80 species in the warmer parts of the world
- 6 species occur in North America north of Mexico

General Characteristics
- naked tails that extend past the edge of the interfemoral membrane
- wings are narrow and flight is swift and straight
- groom themselves with spoon-shaped bristles on hind toe of their broad feet
- thumbs and toe claws have double talons

Species
Brazilian Free-tailed Bat
Western Mastiff Bat

Tadarida brasiliensis
Eumops perotis

• largest bat in North America
MAMMALS

ORDER EDENTATA - THE EDENTATES

- this group includes the armadillos, sloths and anteaters
- Latin name means toothless - but this incorrect
- teeth generally pegs
- found mostly in South and Central America
- only 1 species in North America

Species
Nine-banded Armadillo          Dasypus novemcinctus
Snowshoe Hare
GENERAL CHARACTERISTICS
- possess two pairs of upper incisors
- the first enlarged and chisel-like
- the second small, directly behind the first and lacking in cutting edges
- the incisors continue to grow in most animals but are worn down by constant use
- this group was originally thought to be rodents
- two families in North America
  - the rabbits and hares (Leporidae)
  - the pikas (Ochotonidae)

FAMILY OCHOTONIDAE - The Pikas
- all species belong to one genus
- live in mountains in central Asia, Japan and western North America

GENERAL CHARACTERISTICS
- short, rounded ears
- short legs
- no tail
- about 7 inches long and 3 inches in height
- main food plants, grasses and sedges
- in the late summer collects (harvests) food for winter storage
- lives generally above the tree line in Rocky Mountains
- make sharp whistle-like sound to warn of predators
- originally pronounced pee-ka from the Mongolian-in North America usually pronounced Pie-ka

SPECIES
American Pika (pica) Ochotona princeps
FAMILY LEPORIDAE - The Rabbits and Hares

- small grazing animals
- with big ears and long hind legs
- two pairs of large upper incisors
- females larger than males
- often nocturnal

differences between rabbits and hares

**rabbits:** young are born naked, blind and helpless in underground burrows

**hares:** young are precocious and able to run loose soon after birth

- unique digestive system called reingestion or refraction where the predigested plant food is reingested - that is re-chewed and goes through the digestive tract for the second time.

**Species**

Eastern Cottontail  
Snowshoe Hare  

Sylvilagus floridanus  
Lepus americanus

Eastern cottontail rabbit.
ORDER RODENTIA - THE RODENTS

- largest order of mammals both in number of individuals and number of species 3,000 +
- range in size from mice weighing under 10g to beaver at 110 pounds (50,000g)
- found throughout the world except Antarctica
- primarily herbivorous in diet
- an important species in the food chain
- generally small in size

General Characteristics
- have two pair of specialized incisors in the front of the mouth
- separated from the cheek teeth by a large gap (no canines)
- teeth continue to grow throughout the animals life and gnawing keeps the teeth the correct length
- most have 4 toes on forefeet and 5 on hindfeet
- most nocturnal
- most active throughout the year

FAMILY APLODONTIDAE - The Mountain Beaver

- only 1 living member of this family
- found only in western North America
- one of the most primitive living rodents

General Characteristics
- common name is misleading - does not live in the mountains
- has similar habits of diverting streams and eating bark
- nocturnal
- feeds on vegetation such as ferns, bark of conifers, and grasses
- reingests the soft fecal pellets
- whistles when disturbed

Species
Mountain Beaver  Aplodontia rufa
FAMILY SCIURIDAE -

The Squirrels, Chipmunks and Marmots

- a large and diverse groups that occurs in a wide variety of habitats including terrestrial and arboreal
- most diurnal some nocturnal
- found worldwide except Australasia, southern South America and Madagascar
- in North America there are 63 species in 9 genera including the chipmunks, tree squirrels, ground squirrels, flying squirrels, woodchucks, marmots, prairie dogs.
- most diurnal (except flying squirrels)
- many hibernate, some estivate

General Characteristics
- internal cheek pouches
- four toes on forefeet, five on hindfeet

Genus Marmota - The Marmots (Woodchuck)
- stout body with short bushy tail
- feed on herbaceous plants and grasses
- live in burrows under trees or large rocks

Species
Yellow-bellied Marmot Marmota flaviventris
Woodchuck Marmota monax

• The noted character of Groundhog Day on February 2. If this famous character does not sees his shadow winter is over while; if the sun is shining, winter will continue for at least six more weeks.
MAMMALS

Genus Spermophilus - The Ground Squirrels
- found in North America and Eurasia

General Characteristics
- small burrowing rodents
- small ears
- short tail

Species
Columbia Ground Squirrel  Spermophilus columbiaus
Thirteen-lined Ground Squirrel  Spermophilus tridecemlineatus

Genus Eutamias - The Chipmunks
- found in North America and Asia

General Characteristics
- five blackish and four whitish stripes of approximately equal width give this group a distinctive body markings
they have two pale stripes on head, above and below eye
tail measures 40% of the total length of the animal

Species
Yellow-pine Chipmunk  Eutamias amoenus
Genus Sciurus - Tree Squirrels

General Characteristics
- larger than the red squirrel
- tail bushy
- body colour grey or black

Species
Fox Squirrel  Sciuerus niger
Grey or Black Squirrel  Sciuerus carolinensis

• This species was introduced from Eastern Canada into Stanley Park, Vancouver, B.C. in 1914. During the 1980's its range expanded to cover a good portion of the Greater Vancouver region.

Genus Tamiasciurus - The Red Squirrels (Chickarees)

- the latin name *tamias* means storer and the ending *us* means true
- although they do hibernate they do store food
- highly vocal

Species
Red Squirrel  Tamiasciurus hudsonicus
Douglas Squirrel  Tamiasciurus douglasii
MAMMALS

Genus Glaucomys - The Flying Squirrels
- inhabits forested areas of North America including Alaska

General Characteristics
- has loose folds of furred skin connecting the fore and hind limbs on each side of the body - forming a gliding membrane
- tail is broad and flat
- eyes large - nocturnal habits
- soles of the feet are furred

Species
Northern Flying Squirrel Glaucomys sabrinus

FAMILY GEOMYIDAE - The Pocket Gophers
- occur only in North America - 3 genera with 16 species
- most highly evolved of mammalian burrowers
- short stalky animal with small eyes and ears
- fur-lined “external” pouches (pockets) on cheeks
- make two kinds of burrows; 1. near surface for food gathering and; 2. deeper - for storage and shelter
- usually forage underground - pulling the plant into the burrow
- liquids are derived from vegetation - do not need water
- gopher burrows are on angles (moles are vertical)
- young born in spring - litter 2 - 11
- start digging tunnels at 2 month (leave home)
- sexually mature at 3 months

Species
Northern Pocket Gopher Thomomys talpoides
Plains Pocket Gopher Geomys bursarius
Yellow-faced Pocket Gopher Pappogeomys castanops
FAMILY HETEROMYIDAE -
The Pocket Mice and Kangaroo Rats

- members in this group are neither mice or rats but closely related to the pocket gophers and ground squirrels

General Characteristics
- nocturnal
- burrowing animals with fur-lined cheek pouches for carrying food
- populations subject to periodic fluctuations
- do not hibernate but become inactive during hot or cold weather
- they are eaten by rattlesnakes, hawks, coyotes, foxes, weasels, badgers and skunks

Species
Great Basin Pocket Mouse
Pale Kangaroo Mouse
Ord’s Kangaroo Rat
Mexican Spiny Pocket Mouse

Perognathus parvus
Microdipodops pallidus
Dipodomys ordii
Liomys irroratus

FAMILY CASTORIDAE - The Beavers

- found in North America only
- one species

General Characteristics
- adapted to aquatic lifestyle
- tail is paddle shaped and covered with scales
- forefeet are dextrous
- hind feet are large and webbed which act as paddles when swimming
- do not hibernate
- formal family structure with female dominant
- build lodges or bank burrows for homes

Species
American Beaver

Castor canadensis
MAMMALS

FAMILY CRICETIDAE - The New World Rats and Mice

- largest family of mammals in North America
- consists of 19 genera of 70 species
- found in every habitat
- mouse-like creatures that are highly adaptable - range in size from 1/8 ounce (Pygmy mouse) to 4 pounds (Muskrat)

General Characteristics
- two groups

1) **cricetines** that includes most mice and rats
   - most have long tails
   - large eyes and ears
   - teeth with well developed cusps
   - most nocturnal are omnivorous
   - species are so similar that they can only be distinguished by careful examination of their internal bone structure

2) **microtines** that includes voles and lemmings
   - stout bodies with short legs and tails
   - inconspicuous ears and eyes
   - teeth adapted for grinding fibrous grasses and leaves

Species
**cricetines:**
Marsh Rice Rat
Plains Harvest Mouse
Deer Mouse
Bushy-tailed Woodrat
Southern Red-backed Vole
Heather Vole
Musk rat

**microtines:**
Meadow Vole
Northern Bog Lemming

Oryzomys palustris
Peithrodon tomus montanus
Peromyscus maniculatus
Neotoma cinerea
Clethrionomys gapperi
Phenacomys intermedius
Ondatra zibethicus

Microtus pennsylvanicus
Synaptomys borealis
FAMILY MURIDAE - Old World Rats and Mice

- very adaptable
- no other mammal family contains more species

General Characteristics
- long scaly tails
- large ears
- active all year
- nocturnal

- members of this family carry diseases such as plague, typhus and food poisoning, while others destroy crops
- a positive note is that they are used for scientific and medical research

Species
Black Rat Rattus rattus
Norway Rat Rattus norvegicus
House Mouse Mus musculus

FAMILY ZAPODIDAE - Jumping Mice

General Characteristics
- reddish or yellowish mice
- very long tails
- large hindfeet
- good runners and jumpers
- plants, berries and insects main food
- mostly nocturnal
- do hibernate up to 6 - 8 months
- live off body fat - do not store food

Species
Meadow Jumping Mouse Zapus hudsonius
FAMILY ERETHIZONTIDAE - New World Porcupines

- one species in North America
- generic name means “one who rises in anger”

General Characteristics
- large body
- short legs
- quills on rump and tail totaling approximately 30,000 per animal
- unusual soles on feet
  forefeet have 4 toes
  hindfeet have 5 toes
- long curved claws
- vegetarian

Species
Porcupine  Erethizon dorsatum

FAMILY CAPROMYIDAE - The Nutria

- native to South America and the Caribbean
- two species introduced to North America as a ranch fur-bearer

General Characteristics
- large aquatic rodent weighing up to 23 pounds
- small ears and eyes
- hind feet longer than forefeet
- similar to muskrat
- vegetarian
- colonial and live in burrows
- marsh dwelling

Species
Nutria  Myocastor coypus
ORDER CETACEA -
THE WHALES, DOLPHINS AND PORPOISES

- thought to have evolved from terrestrial mammals

General Characteristics
- under the skin is a thick fibrous layer of fat (blubber) which conserves the body heat (replaces fur)
- forelimbs short and paddle-like
- four or five toes
- hind limbs generally absent
- ears are small
- nostrils on top of head

FAMILY ZIPHIIDAE - The Beaked Whales

- small to medium sized toothed whales

General Characteristics
- forelimbs short
- mandibles have many vestigial teeth embedded in gums
- males have two broad tusks in the mandibles which are characteristic of this group

Species
Giant Beaked Whale Berardius bardi
MAMMALS

FAMILY PHYSETERIDAE - The Sperm Whale

- only member of this family is the Sperm Whale

General Characteristics
- toothed species
- large head with small lower jaw containing strong conical teeth
- dorsal fin is replaced by a series of humps

Species
Sperm Whale Cachalot macrocephale

SUBORDER ODONTOCETI

- have teeth
- one hole blowhole
- mostly carnivorous

FAMILY DELPHINIDAE - The Dolphins and Porpoises

- sharp peg-like teeth

Species
Blue Dolphin Stenella caeruleoalba
Killer Whale Orcinus orca
Dall's Porpoise Phocoenoides dalli
SUBORDER MYSTICETI - THE BALEEN WHALES

FAMILY ESCHRICHTIDAE - The Grey Whale

- main food is small crustaceans or “krill”
- one member in family

General Characteristics
- paired nostrils
- short baleen plates for feeding

Species
Grey Whale Eschrichtius robustus

FAMILY BALAENOPTERIDAE - The Rorquals

- members of this family are the largest animals that have ever lived

General Characteristics
- diagnostic feature is the numerous throat grooves, or pleats which allow enlargement of the mouth capacity

Species
Fin Whale Balaenoptera physalus
Humpback Whale Megaptera novaeangliae
ORDER CARNIVORA - THE CARNIVORES

- generally flesh-eaters
- some are omnivores
- range in size from mouse-sized least weasel to the brown bear
- also included in this order are seals, sea lions, and walrus

General Characteristics
- all have three rows of incisors and strong canines
- one litter per year

FAMILY CANIDAE - The Dogs

- part of a group consisting of wolves, dogs and foxes called cursorial predators (that is: they chase their prey and kill it by snapping and slashing)

General Characteristics
- long legs
- muscular bodies
- long fluffy tail that helps balance
- long slender snouts
- acute sense of smell and hearing
- non retractable claws

Species
Coyote Canis latrans
Wolf Canis lupus
Red Fox Vulpes vulpes
GRIZZLY BEAR

*Did you know* that bears are pigeon-toed and flat-footed? Most other large animals like dogs, horses and even elephants walk on their toes. The flat-footed stance of bears makes it easy for them to stand up straight as humans do.
FAMILY URSIDAE - The Bears

- largest of the terrestrial carnivores
- 3 species in North America

General Characteristics
- range in size from 600 to 1700 pounds
- powerful bodies
- vision is poor
- bears in Canada hibernate to some extent
- eat plants and animals
- bob-tailed

Species
Black Bear  Ursus americanus
Grizzly Bear  Ursus arctos
Polar Bear  Ursus maritimus

![Bears Diagram]
FAMILY PROCYONIDAE - The Raccoons and Their Allies

- diverse group of animals from lesser pandas of Asia to olingos of South America
- 3 species in North America

General Characteristics
- long tails with dark and light banding
- cheek teeth blunt rather than sharp for eating a wide variety of foods
- 5 clawed toes on each foot
- walks on soles of feet
- good climbers
- nocturnal
- most social

Species
Ringtail ........................................ Bassariscus astutus
Raccoon ........................................ Procyon lotor
Coati ........................................ Nasua nasua
Mammals

Spotted Skunk

Fisher

Marten

Weasel
FAMILY MUSTELIDAE -
The Weasels, Skunks, Badgers, Otters and allies

- members of this family vary greatly in appearance and in habitats
- include tree-living marten, aquatic otters, and burrowing badgers

General Characteristics
- most are small animals with short legs and long bodies
- all are solitary
- nocturnal
- most have paired anal scent glands
- claws are non retractable

Species
Marten
Fisher
Ermine (Short-tailed Weasel)
Mink
Wolverine
Badger
Striped Skunk
River Otter
Sea Otter

Martes americana
Martes pennanti
Mustela erminea
Mustela vison
Gulo gulo
Taxidea taxus
Mephitis mephitis
Kutra canadensis
Enhydra lutris
FAMILY FELIDAE - The Cats

- native to most parts of the world except Australia and New Zealand
- 7 species in North America

General Characteristics
- long, sleek bodies, powerful legs
- binocular vision eyes that face forward
- excellent night vision
- rough tongue for grooming and tearing meal from bones
- climb well
- can swim
- mark territories with urine and tree scratches

Species
Mountain Lion  Felis concolor
Lynx  Felis lynx
Bobcat  Felis rufus
Seals, Sea Lions and the Walrus -
Many texts and field guides will list the following as Order Pinnepedia. A recent change has placed these animals in the Order Carnivores. Scientists now believe that these animals have evolved from the same ancestral groups as bears and the mustelids. While physically they are different, their teeth structure is similar, and they feed solely on flesh, mainly fish and aquatic invertebrates.

**FAMILY OTARIIDAE - The Eared Seals**

- occur worldwide except Arctic Ocean and Antarctica
- includes sea lions and fur seals
- thought to have evolved from the ancestral group as bears

**General Characteristics**

- small external ears
- long, slender bodies
- more agile on land than in the water
- use for limbs to walk (similar to dog)
- in the water forelimbs for propulsion and rear limbs to steer or as rudders
- heavy fur and underfur
- gregarious

**Species**

Northern Fur Seal  
Callorhinus ursinus

Northern Sea Lion  
Eumetopias jubatus

California Sea Lion  
Zalophus californianus
MAMMALS

FAMILY ODOBENIDAE - The Walrus

- evolved from an ancestral eared seal over 7 million years ago
- 1 species in this family

General Characteristics
- can use hind flippers on land for walking
- bulls are polygamous
- no external ear
- has tusks

Species
Walrus Odobenus rosmarus

FAMILY PHOCIDAE - The True Seals

- most highly specialized
- most numerous and widespread of seals found throughout the world in freshwater and seas
- thought to have evolved from otter-like mustelid ancestors

General Characteristics
- hind flipper permanently turned back (for aquatic use)
- no external ear
- clumsy on land
- in water use hind flippers for propulsion and front flippers for steering
- gregarious, but in small groups
- monogamous

Species
Harbor Seal Phoca vitulina
Northern Elephant Seal Mirounga angustirostris
ORDER SIRENIA - MANATEES

- large aquatic animals that live in coastal waters or rivers in tropical regions of the world
- 2 families; 4 species in world
- 1 species is found in Florida
- thought to have evolved from the terrestrial hoofed mammals, i.e. elephants

General Characteristics
- herbivores
- skeleton is heavy
- forelegs are rounded flippers
- hindlegs are absent

Species
Manatee Trichechus manatus
MAMMALS

ORDER ARTIODACTYLA - THE EVEN-TOED HOOFED MAMMALS

- the order name means 'even toed' each species has 2-4 toes on each foot
- sometimes referred to as "cloven hoofed" mammals

General Characteristics
- medium to large sized animals
- long, slender legs with the third and fourth toes forming a hoof
- the other toes (declaws) are higher on the leg
- most North American species are herbivores which have a cartilaginous pad instead of teeth on the upper jaw
- molariform teeth are adapted for nipping or tearing off and grinding vegetation
- stomach is four-chambered

FAMILY SUIDAE - The Old World Swine

- the domestic pig is a member of the family
- some European species have been released in North America

General Characteristics
- long, pointed head
- stocky body

Species
Wild Boar
Sus scrofa
FAMILY TAYASSUIDAE - The Peccaries

- related to domestic swine and Wild Boars
- descended from large pigs that live 25 millions years ago
- 2 living species in world, 1 in Mexico

General Characteristics
- smaller than domestic and wild pigs
- straight tusks
- strong musk gland on upper rump

Species
Collared Peccary                     Dicotyles tajacu
FAMILY CERVIDAE - The Deer

General Characteristics
- all male members of North American deer species and female Caribou are distinguished by antlers - that are shed annually
- antlers are replaced each year
- skull is long and lacks upper incisors
- stomach has four compartments

Species
Moose
American Elk
Mule Deer or Black-tailed
White-tailed Deer
Caribou or Reindeer

Alces alces
Cervus elaphus
Odocoileus hemionus
Odocoileus virginianus
Rangifer tarandus
Mammals

Mule Deer

Caribou
DEER

Did you know that a deer's foot has four toes? The two small outside toes are called dew claws and the two middle toes form the hoof. The hoof is covered by an extra tough, thick toenail which allows the deer to run on tiptoe.
FAMILY ANTILOCAPRIDAE - Pronghorn

- family has one species
- found in North America only
- generic name means “antelope-goat” BUT it is neither
- remnant species from 20 million years ago
- fastest animal in the Western Hemisphere
- active day and night

General Characteristics
- horns (not antlers) 12 - 20 inches in length continue to grow throughout the animals life and the outer layer (keratin) is made of material similar to human finger-nails
- outer layer of horns is shed twice a year
- medium size, deer-like

Species
Pronghorn Antilocapra americana
FAMILY BOVIDAE - Bison, Goats, Muskox and Sheep

- domestication of bovidae began over 8,000 years ago

General Characteristics
horns:
- have true horns which are permanent bony outgrowths
- horns are hollow and never branched which grow throughout the animals life
- used as defensive weapons against predators
- present on males, sometimes on females

Species
American Bison or Buffalo BISON bison
(largest terrestrial animal in North America)

Mountain Goat Oreamnos americanus
Muskox Ovibos moschatus
Rocky Mountain Bighorn Sheep Ovis canadensis
Dall Sheep Ois dalli
SHEEP

Did you know that some types of domestic sheep in Europe climb low growing trees to feed on the leaves? Mountain sheep have hooves with hard rims around the outer edge and a soft concave area in the middle, giving excellent traction on rocky terrain.
BIBLIOGRAPHY

