Chapter 2

We can never have enough of nature.
- Henry David Thoreau

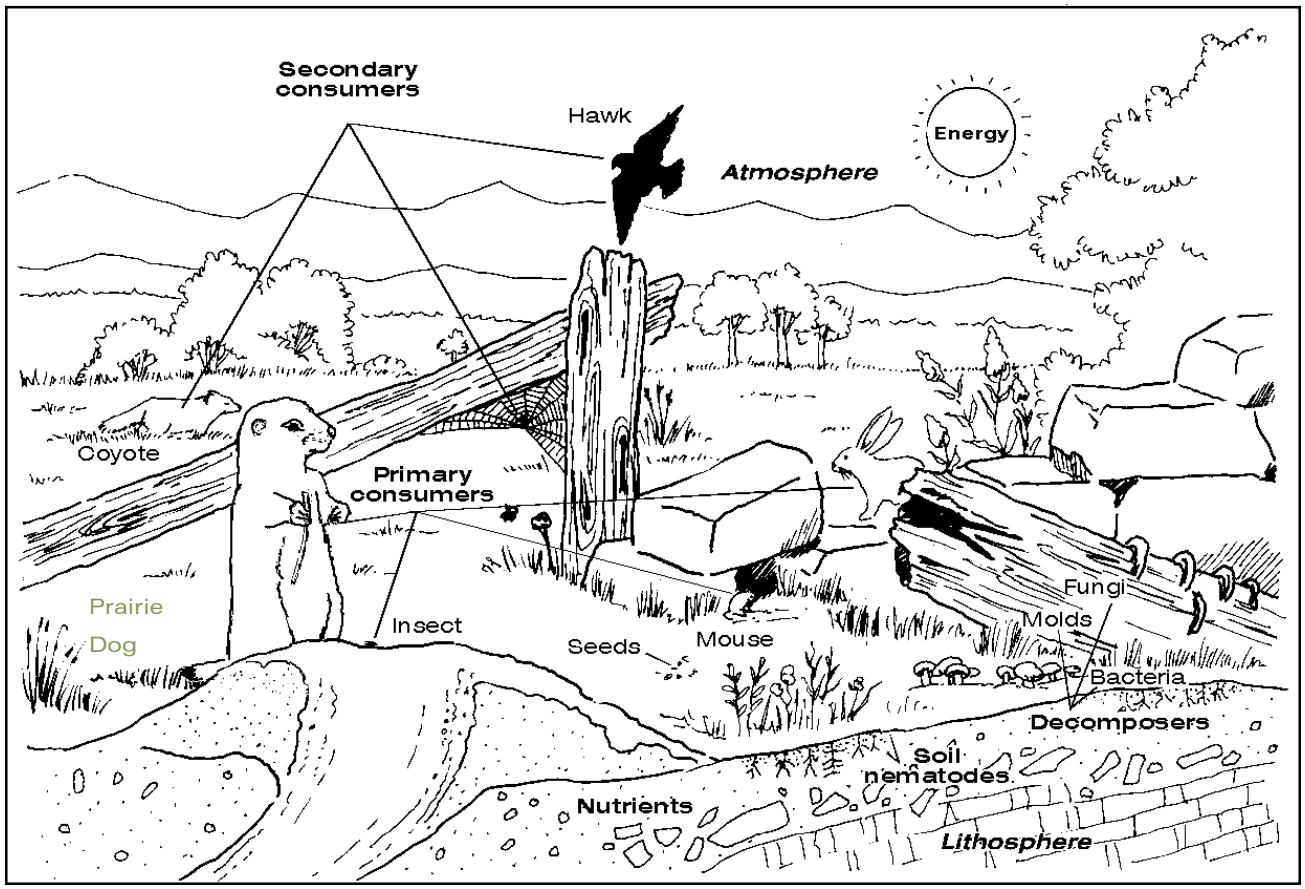
BASIC ECOLOGY

To gain an appreciation of our natural areas we need to understand the ecological processes that define and regulate them. Ecology is a broad complex science that is dynamic and constantly changing.

Identification of plants and animals is a key component of understanding a natural area, but it is only one component. We also must try to understand the role or niche of the organism in its community, how its presence or absence affects the ecosystem, and how our activities affect that organism. Identification and understanding can seem bewildering and sometimes frustrating, but it is also enormously rewarding. The study of the ecology of our natural areas offers lifelong challenges and learning experiences.

Ecology

Ecology is the study of the interactions between organisms and their environment. "Eco" is derived from the Greek *oikos*, which means "house" or "place of residence." Ecology deals mainly with the roles filled by organisms in nature and how environmental conditions affect and are affected by these roles.



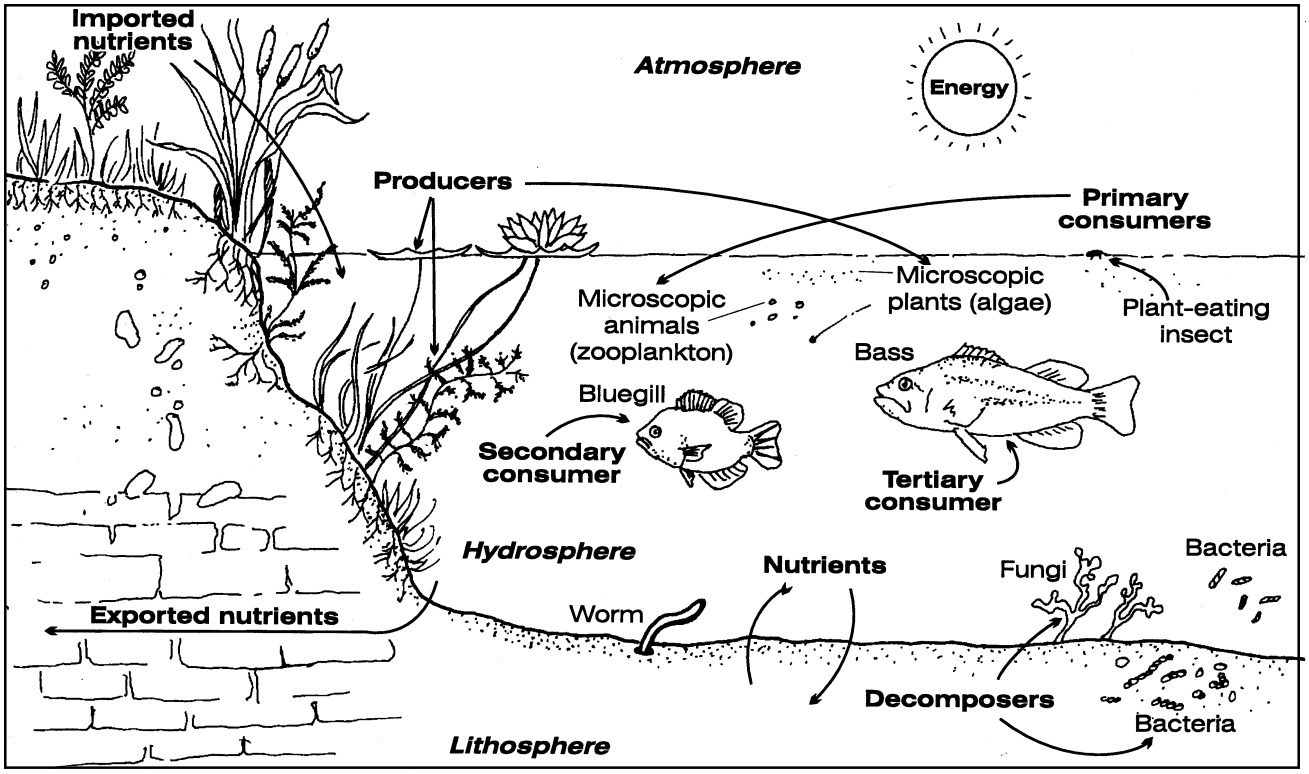
Terrestrial Ecosystem. Each of the roles of producer, consumer, and decomposer is filled by a number of different organisms. The same fundamental relationships exist between these classes of organisms in every ecosystem.

An ***ecosystem*** is composed of abiotic (non-living) and biotic components in a self-regulating community of plants and animals interacting with each other and their environment. The sun is the source of energy for all ecosystems.

Carrying capacity is the maximum number of a given organism that can survive in a given ecosystem without causing deterioration. Carrying capacity varies with season, and over time, depending on the climatic conditions such as rainfall, and other uses of the land such as domestic animals. Populations of living things tend to fluctuate naturally around some level. Carrying capapcity affects that level. For example, a population may be temporarily below its carrying capacity such as in the spring following a hard winter, or temporarily above it, such as after the removal of a predator.

Producers are green plants and algae that capture solar energy and chemicals from the soil and convert them to more complex chemicals that make up the substance of the plant. ***Consumers*** are animals that eat the producers. Primary consumers (herbivores) eat plants; secondary consumers (carnivores) eat primary consumers. ***Decomposers*** comprise a special class of consumers that derive energy by digesting waste matter and dead plant and animal material. This process is extremely important to the ecosystem because it returns nutrients to the soil. These nutrients then become available again to producers.

A ***food chain*** is a group of organisms involved in the transfer of energy from its primary source. It is simply what eats what. Each link in a food chain is a *trophic level*. There are many overlapping food chains in an ecosystem so ecologists refer to ***food webs.*** A food web is a pattern of interconnecting food chains in a com-

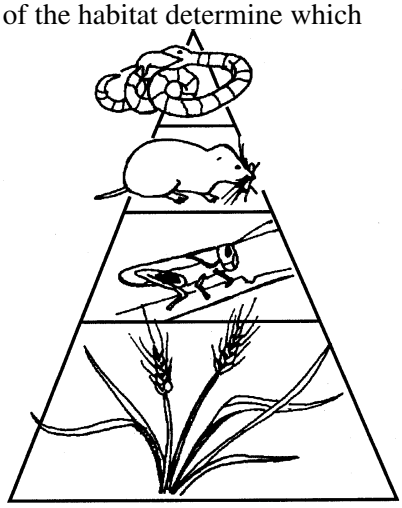


A Pond Ecosystem. Each of the roles of producer, consumer, and decomposer is filled by a number of different organisms in a pond ecosystem. For example, additional secondary or tertiary consumers might be water snakes, snapping turtles, and various birds of prey. Although ecosystems are often thought of as closed systems, none of them are really closed. Typically, both living and non-living things are constantly imported and exported.

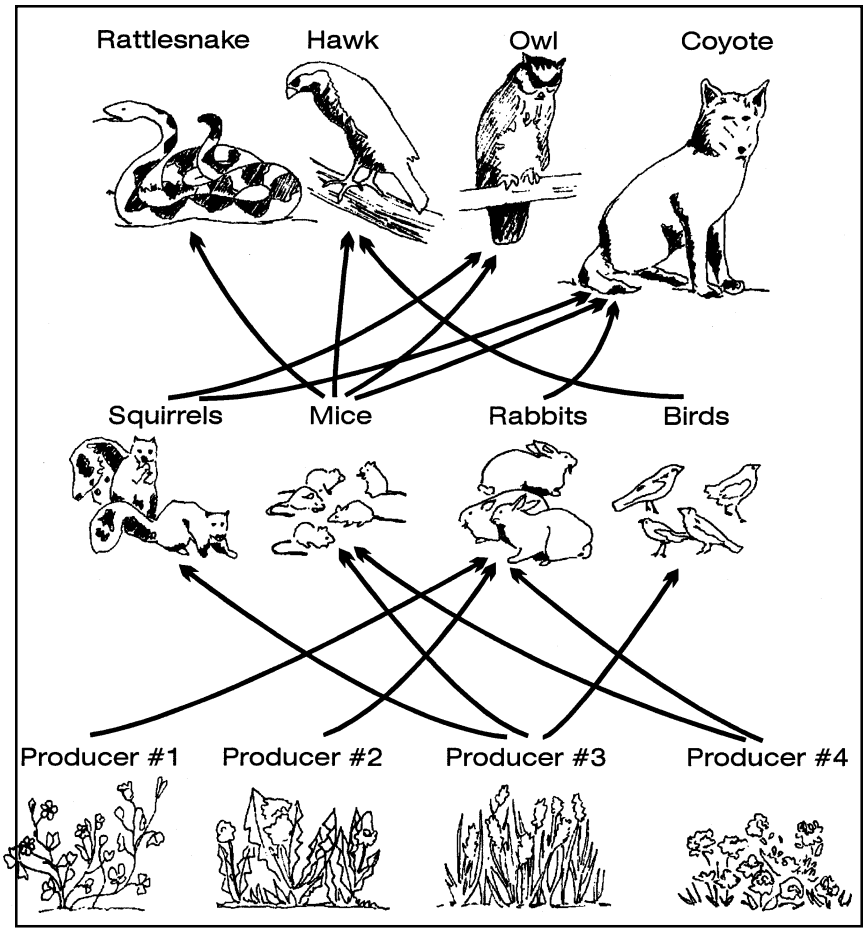
munity or between several communities. Many different animals actually eat the same type of plant, and several different animals may eat the same type of animal, therefore food webs can be very complex.

Food webs, taken collectively, form an ***ecological pyramid***, which is broader at the base than at the top. The bottom of the pyramid must support all of the other layers. It is the largest layer in terms of *biomass*, the weight of total living organisms in a particular place, and in terms of energy. Only about 10% of the energy in each level is passed on or used for growth in the next level. This is why most food chains have no more than three or four trophic levels. The longest food chains are in the oceans.

Plants and animals have certain requirements for survival. The ***habitat*** must provide these requirements. The habitat is the physical area in which a particular plant or animal species is found. The abiotic components of the habitat determine which species can live there.



An Idealized Energy Pyramid. In this general case, 10% of the energy available at each trophic level appears at the next level. In actual ecosystems, the decline of productivity with each trophic level varies with the species that make up the food chains.



A Food Web. Many species can occupy the same trophic level in any ecosystem. Certain species may predominate, however, and some species occupy more than one level. This illustration does not capture the essence of nature in the raw. We could not possibly represent something so dynamic and ever-changing on paper. To cite just a few of the things this figure fails to show: Predators change their prey from season to season; some predators and herbivores eat different things when they are young than they do when they grow up; some predators are more flexible than others when their food of choice decreases in supply.

The ***niche*** is the role of an organism within the ecosystem, including the resources it uses, its period of activity and its effects on other members of the community. Flycatchers catch insects in the air. Warblers glean insects from leaves and branches. Grouse scour the ground for insects and plant matter. Each method of feeding represents a part of that particular animal's niche.

The ***home range*** of an animal is the area in which it lives, eats, and carries on all its activities. The ***territory*** of an animal is the area that is defended from other individuals of the same species. Some animals have extensive home ranges, but generally defend a much smaller territory. Territories may be defended for mating opportunities, or food or space requirements.

An ***indicator species*** is one whose presence or absence indicates the condition of the ecosystem. A ***keystone species*** is one

whose removal from the ecosystem causes the extinction of other species. The northern spotted owl is an indicator species in old growth forests. The black-tailed prairie dog is a keystone species on the shortgrass prairies. Often, a keystone species is also an indicator species.

Soils and Geology

Soil formation is a complex process involving water, climate, topography, and plant and animal life over time. Variations in soil types produce variations in vegetation. The qualities of the soil and the underlying geology determine, in large part, which plants become established in a particular area. The vegetation, in turn, plays a major role in determining which animal species inhabit the area.

Water dissolves minerals on bedrock material. It causes cracks and fragmentation by freezing and thawing. Living organisms grow and tunnel in among the broken particles releasing organic acids which break down the particles further. As vegetation dies and decays, it mixes with the mineral particles adding an organic dimension to the material. This promotes vegetation growth and subsequent animal life. This process occurs over eons of time and the soil we have today may represent tens of centuries in the making.

The texture of a soil is important in determining the availability of water. Coarse soils have rapid internal drainage. Fine soils may hold water so tightly that plants are unable to absorb it. In general, if soil depth is two feet or less shrubs will be the dominate vegetation.

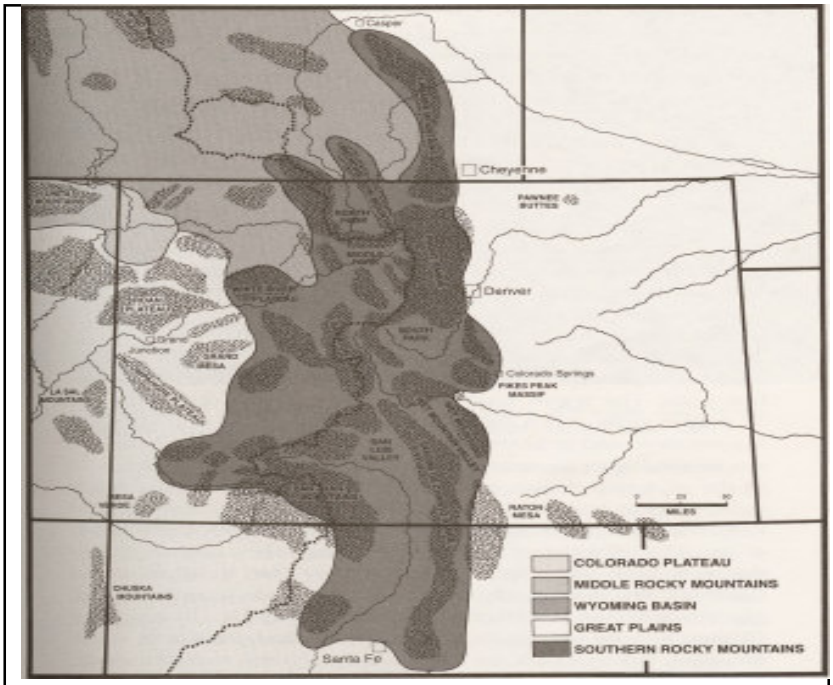
Colorado soils generally have a high clay content, which tends to make compaction a problem. When the soil particles are pressed together by vehicles, bicycles, or footsteps, water cannot penetrate between the particles and, instead, runs across the surface. Soil particles are often carried away with the water and erosion occurs. Erosion is a natural process that shapes the topography of many areas. Severe erosion can lead to reduction in the productivity of the land by depleting it of organic matter and limiting rooting depth.

Geology and Land Forms

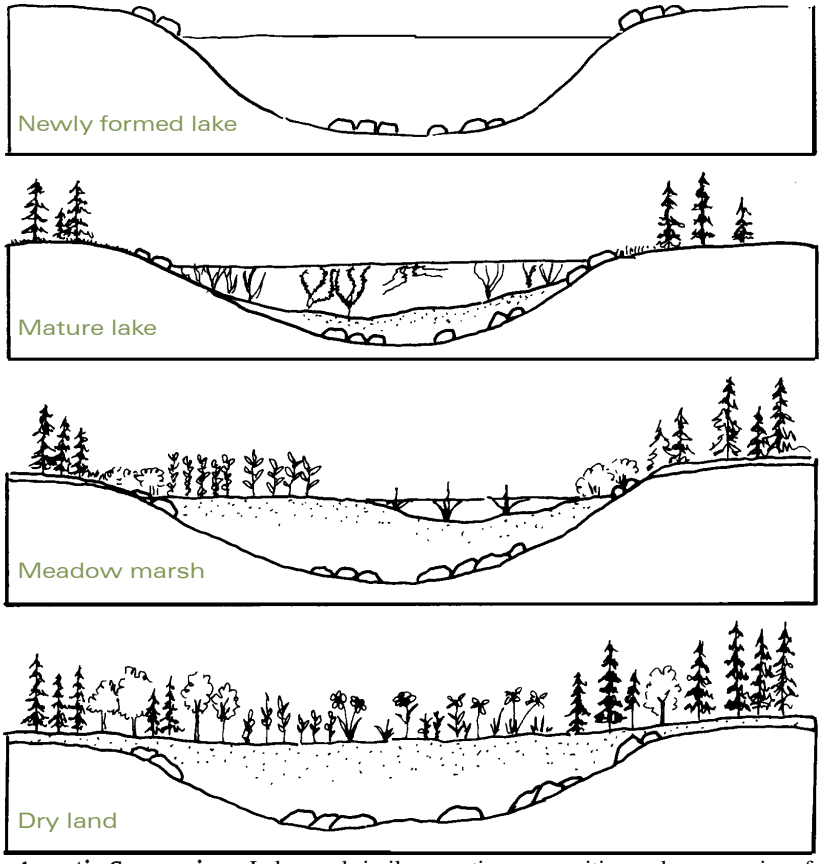
In Colorado, geologic acitivity has created three geomorphic zones: the eastern High Plains, the Rocky Mountains that bisect the state, and the Colorado Plateau in the western part of the state. The High Plains and the Rocky Mountains, along with an intermediate zone between the two, the foothills, occur in our area.

The High Plains occur at elevations of 4,000-5,500 feet, and are characterized by a relatively flat landscape underlain by alkaline sediments composed of siltstones, shales, and sandstones. The soils are predominately alkaline, having developed from the underlying alkaline bedrock (also called the *lithosphere*).

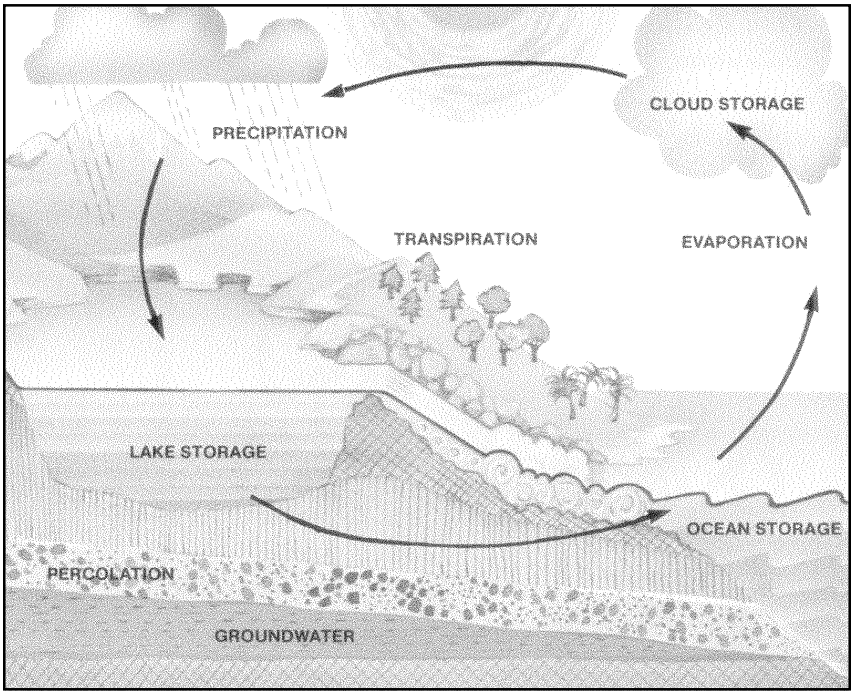
The foothills are transitional between the plains and the mountains. They occur at elevations of 5,000-6,500 feet and are characterized by a ridge and valley topography. The foothills are composed of a thin strip of tilted sediments which were originally deposited horizontally and then tilted into their present positions by the uplift of the Rocky Mountains. The foothills are not completely continuous. They are bisected and offset by faults that accompanied the mountain building. Exposed bedrock is common on the ridges, and supports only those plants able to thrive in little or no soil. The valleys support grasses



Landforms of Colorado. Topographically, scenically, and geologically, Colorado can be divided into three provinces: plains, mountains, and plateaus.



Aquatic Succession. Lakes and similar aquatic communities undergo a series of changes as over time they begin to fill with sediment and organic debris. Eventually, lakes become solid land and undergo terrestrial succession.



Water Cycle

and shrubs, and are generally wetter than the plains.

The mountains occur at elevations of 6,000-14,000 feet and are dominated by the presence of igneous and metamorphic rocks, although some sedimentary rocks that were not eroded away in the uplift process are found. Elevation tends to determine plant communities in the mountains.

Succession

Disturbance of the landscape creates a series of changes called *succession*, in which a new group of plants and animals partially or completely replaces the original biota. Over a period of time, some species invade an area and other species die out until a relatively stable group of populations occupies the site. This brings about a stable long-lasting *climax community*. Human activity constantly fosters succession but rarely do these areas reach a climax community. Areas that are permanently disturbed, such as croplands and lawns, are called

disclimaxes.

Water

One may sit upon the bank pondering the edge of immortality and wonder where the water went.

- Anonymous.

Water, alone, or in conjunction with temperature, is probably the most important physical factor affecting the ecology of terrestrial organisms. All animals require some form of water in their food or as drink to operate their metabolic and excretory systems. Plants are affected by soil water levels and the humidity of the air around leaf surfaces.

Water cycles through an ecosystem via evaporation, transpiration, and precipitation. The rates

of evaporation and transpiration are primarily dependent on temperature. There is a strong interaction between temperature and moisture and how this affects plants and animals.

Plants and animals vary greatly in their ability to withstand drought and flooding. Plants in drought-prone areas use strategies that improve water uptake in the roots, reduce water loss on leaf surfaces, and improve storage of water. Plants in flood-prone areas have special adaptations that allow them to withstand "wet feet" during all or part of the year.

Animals adapted to drought-prone areas may slow their metabolism, rely on water formed as a by-product of metabolism, and have kidneys that are able to concentrate urine so that very little water is excreted with waste material. Animals in flood prone areas often have webbed feet, or gills on the surface of their bodies, or specialized ear and eye membranes, or they may switch to an arboreal existence, or move to upland areas for the duration of the flood.

Extinction and Speciation

Destroying species is like tearing pages out of a book that we haven't read, written in a language that we hardly know how to read.

- Holmes Rolston

Evolution is the formation of new species from pre-existing ones by a process of improved adaptation to the environment. Those species that are better adapted to the environment replace the less well-adapted species. This process is called *natural selection*.

Extinction is a natural and integral part of the evolutionary process. About 95% of the four billion species that have existed have gone extinct.

Speciation is the formation of new species, or the opposite of extinction. Speciation and extinction occur slowly over long periods of time. The fossil record indicates that the extinction of one species made way for the emergence of another, so that there was a sort of counterbalance between the two processes. It is estimated that a new terrestrial vertebrate took tens of thousands of years to emerge. Even insects, with their short generation times, usually require centuries to evolve into a new species.

It is the rate of extinction that concerns many biologists today. From 600 million years ago to 63 million years ago the rate of extinction is estimated have been one species per year. Current estimates of the rate of extinction range from one species per day to 80 species per day.

The primary cause of the extinction of species, populations, communities, and entire ecosystems is, inarguably, loss of habitat. Natural habitats are replaced by housing, malls, streets, suburban parks, cropland, highways, etc. Urban areas also create introductions of species that prey on native populations, compete for limited resources, and are pathways for disease and parasites to which native species may be susceptible. Many of our native species, such as the American bison and the black-footed ferret, have suffered extirpation from their traditional habitats, and have undergone lowered population levels. They may eventually become extinct.

Predation

I have watched the face of many a newly wolfless mountain, and seen the south-facing slopes wrinkle with a maze of new deer trails. We have not learned to think like a mountain. Hence, we have dustbowls, and rivers washing the future into the sea.

- Aldo Leopold

Predation is an ecological principle often charged with emotion and misunderstanding. Predators have stereotypically depicted as villains and their prey as innocent victims. Humans have spent much time and energy attempting to control or eliminate certain predators (i.e. coyotes, wolves).

Predators and prey have evolved together. Over evolutionary time natural selection increases the efficiency with which predators detect and capture prey. The concurrent process of natural selection also improves the prey's ability to avoid detection and to escape. This is referred to as the "evolutionary arms race." The complex adaptations and counter-adaptations between predators and their prey are testament to their long coexistence.
Natural predators do not eliminate their natural prey species. Populations of most predators grow slowly, and the reproductive potential of the predator is usually much less than that of the prey.

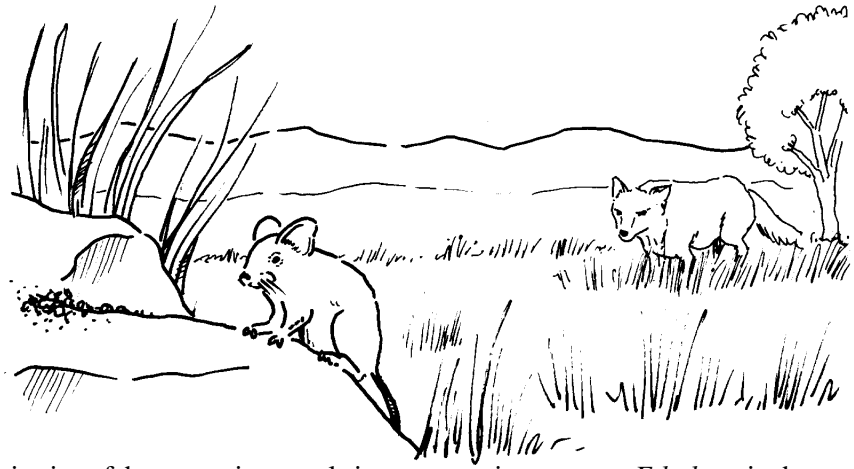
Predators frequently switch prey species with fluctuating population densities. For example, coyotes prey upon rodents and birds, but if these become scarce they will readily eat plants and insects. In this way predators take advantage of the shifting mosaic of prey abundance.

Predation often benefits the prey population by taking inferior or diseased individuals. These animals most likely will not survive.

It's important to understand that some individual animals die but the overall population remains healthy.

Competition

There are two types of competition: between individuals of the same species (*intraspecific*) and between individuals of different species (*interspecific*). The outcomes of each are different. Intraspecific competition results in the stable regulation of population size within the confines of the environment. Interspecific competition may result in the extinction of the competing population.



Two species cannot coexist in the same community if their niches are identical. Many cases of niche overlap occur and thus competition occurs between species in that area of overlap.

One indication that competition has shaped the community is *resource partitioning*. The classic example of this is Robert MacArthur's studies of closely related warbler species. Individuals of five similar species feed on insects in spruce trees. Each species forages in a different zone of the tree. The species are clearly sorted out with minimal overlap, each having its own feeding domain that varies by height in the tree and distance from the middle. This partitioning allows coexistence by reducing direct competition. Similar species coexisting in the same area must have at least one important niche difference among them. This difference could be temporal as well as spatial.

Animal Behavior

The development of *sociobiology* applies the principles of evolutionary biology to the study of social behavior in animals. *Behavioral ecology* examines the ways in which animals interact with their living and nonliving environments. *Ethology* is the systematic study of the function and evolution of behavior in relation to the animal's natural way of life and environment. There is no clear distinction between the boundaries of these fields of studying animal behavior, but one thing emerges with clarity: The study of animal behavior is endlessly fascinating, and more meaningful when we can answer or partially answer the question: "Why do they do that?" When humans understand the motivation for certain behaviors it is easier to accept the actions and perhaps even make provisions for them.

Frequently, the "why" question for behavior can be answered in terms of evolutionary adaptation to the physical environment, but it may a play dual role. A bird fluffs its feathers to increase the physiological properties that provide insulation, but also to appear larger when threatened. A coyote cocks it ears to improve hearing of its prey's movements, but also to denote interest in another animal.

Facial and body postures are often forms of communication between *conspecifics* - members of the same species. Canines "grin" and crawl when being submissive, crouch with hindquarters

elevated when inviting play, and display teeth and erect hair to show aggression. Each of these signals and others much more subtle are instantly understood by other members of the group. Often, these signals must be learned and this learning process is an integral part of growth for any animal.

Dispersal & Habitat Fragmentation

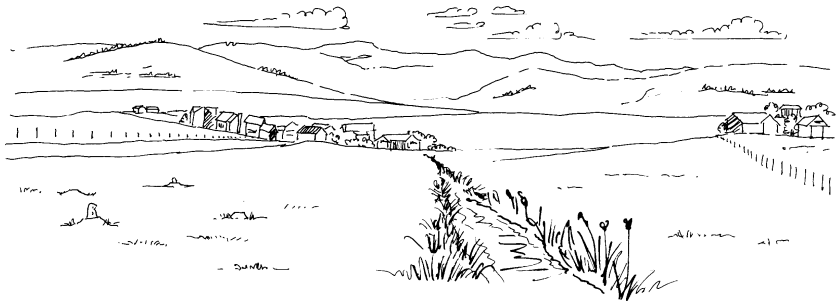
The ability of an individual or population to disperse is as necessary to the survival of the species as the ability to reproduce. Plants and animals need to be distributed in space and time so that each one can satisfy its needs. In animals, territoriality is one means by which spacing is ensured, and the young usually establish home ranges separate from those of their parents. Plants depend on outside agents, such as birds, mammals, insects, and the wind to disperse their seeds and colonize unoccupied areas. The ability to expand into new areas is dependent on environmental conditions and on the presence of physical barriers (water, cliffs, mountains, cities, parking lots, fences, highways, housing developments, etc.).

Natural areas in urban environments may contain key corridors that help facilitate dispersal. Riparian corridors, like the Cache la Poudre, and smaller streams and ditches in Fort Collins become extremely important to dispersal. Upland areas also may be important corridor zones. A stretch of native grasses, an unmowed field, a farmer's windbreak plantings, or a patch of mature trees, may contain just the crucially needed cover, resting area, or food source for a dispersing animal or plant.

Birds and mammals that use these corridors are frequent agents of seed dispersal. Shelter for seedlings from harsh weather conditions may be found near established plants.

Natural area corridors and adjacent surrounding habitats are among the most valuable urban natural areas and provide for biological diversity. Corridors also furnish habitat for species adapted to areas where two different habitats meet, or so-called *edge species*. White-tailed deer, skunks, raccoons, blue jays, foxes and brown-headed cowbirds are highly successful in these fragmented landscapes.

Natural areas in cities are often small and isolated from each other. The City of Fort Collins makes key land acquisitions and manages sites to help establish an interconnected natural areas system.



PLANTS

Whatever a man's age, he can reduce it several years by putting a brightly-colored flower in his buttonhole.

--Mark Twain

The plant life of an area gives it its character and quality. The vegetation dictates the wildlife that inhabits the area; indicates soil quality and water conditions; and provides shelter, food, nesting materials, and homes for wildlife. In short, plants dominate the landscape. Grasses, forbs (non-woody flowering plants), shrubs, and trees have the amazing ability to capture sunlight and convert it to food. Plants have a tremendous tenacity for recovery after disturbance. Plants form the basis of the food chain that supports all of life.

Plants are not scatted haphazardly over the earth but are grouped into biotic communities in response to environmental conditions. The most important environmental factors are light, temperature, and moisture. Slope and aspect modify these factors. Slope is the slant of the land measured in degrees or percentages. Aspect is the direction the slope faces. If the slope is slight, water will be retained. Wet meadows, marshes, or ponds may result. On steeper slopes, surface drainage is greater and soil may be carried away with the water (erosion). Therefore, soils on slopes tend to be shallow and with few trees. Differences in vegetation associated with aspect are due to varying amounts of solar radiation. Northern and eastern aspects are cool and moist compared to southern and western aspects, which tend to be warm and dry.

Most of the more than 275,000 plant species are flowering plants, or the *angiosperms*. Flowering plants did not appear on earth until long after the first dinosaurs. The fossil record dates flowering plants to 125 million years ago.

The flowers are the reproductive structures. Showy petals and sepals are designed to attract insect, bird, and mammal pollinators. Seeds are produced in completely enclosed protective tissue layers.

The body of a flowering plant is divided into two portions: the root system and the shoot system. Both have internal pipelines that conduct water, minerals and organic substances throughout the plant body. The roots lie below ground level and anchor the plant, absorb minerals and water, and store food. The shoot system consists of stems, leaves and reproductive structures. Water and minerals are sent from the roots to the shoots. Shoots take in carbon dioxide from the air.
The *gymnosperms* produce "naked" seeds that are borne on surfaces of reproductive structures rather than being surrounded by tissues. The gymnosperms began the long evolutionary pilgrimage from the seas to the land about 400 million years ago. Pines and junipers are gymnosperms.

Most plants grow from the tips of their roots and shoots. Each tip's cells divide repeatedly, elongate and develop into specialized types of cells. This is called primary growth. Many plants also show secondary growth in which the diameter of roots and stems is increased. The regions responsible for secondary growth do not occur at the tips of plant parts. Rather a lateral, long cylinder produces new cells along the length of an older root or stem. Extensive secondary growth results in the tissues called wood.

Weeds

Some exotic plant species have invaded large areas of several western states, including Colorado. The most threatening are Russian olive (*Elaeagnus*

angustifolia), purple loosestrife *(Lythrum salicaria*), and tamarisk (*Tamarix ramosissima)*.

Russian olives were introduced into the U. S. in the 1800's and have since been promoted as a planting for windbreaks and erosion control. Russian olives are good competitors, crowding out our native cottonwoods and willows, which cannot re-establish themselves in the shade of this invader. The result is a permanent conversion from native woody riparian vegetation to Russian olives. Its food and nesting values for wildlife are low. The Natural Areas Program and the City's Forestry Department are systematically removing Russian olive and Siberian elm from city natural areas.

Purple loosestrife grows in shade or sun, and in a variety of soils. As a result, this European native is quickly becoming established in wetlands. It forms dense stands and displaces native plants, blocks ditches, and clogs marshes. The dense stands form an impenetrable barrier that exclude wildlife. Its very tiny seeds have little value to wildlife as a food source, yet become widely scattered. It is against the law to have purple loosestrife in Fort Collins.

Tamarisk is well-adapted for growing along stream drainages. It forms dense stands of brush that prevent establishment of native cottonwoods and willows. The wildlife value is very low. Tamarisk is found in some areas along the Cache la Poudre River, and near reservoirs.

ANIMALS

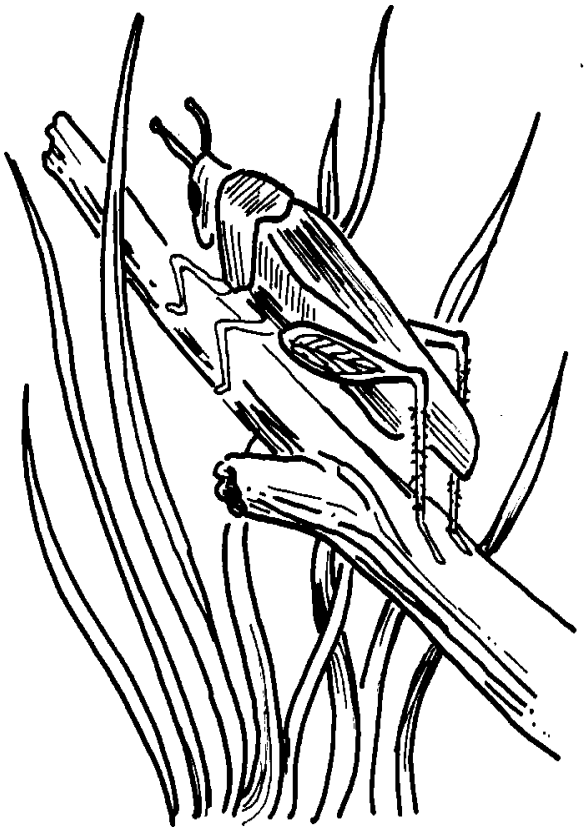
The largest divisions into which the animal kingdom is divided are Phyla. There are 32 animal phyla represented by living species. The animal fossil record begins about 570 million years ago. Most of the major phyla are represented virtually from the beginning of the record, and not appearing at different points over the vast expanse of geologic time.

Invertebrates

Animals that do not belong to the Subphylum Vertebrata are informally called invertebrates. Invertebrates are animals lacking a vertebral or spinal column. They represent an enormous diversity of life forms and a mind-boggling number of organisms. The soil and water, even the atmosphere, are teeming with visible and invisible invertebrates. About 95% of all animals species are invertebrates. Invertebrates are important food resources for many other organisms.

The overwhelming majority of invertebrate animals are arthropods, meaning "jointed appendage." In terms of species diversity, distribution and sheer number, arthropods are the most successful phylum of animals ever to live. The body of an arthropod is covered with an external skeleton which protects the animals and provides points of attachment for the muscles that move the appendages. To grow, an arthropod must shed its exoskeleton and secrete a larger one in a process called molting.

In terms of species diversity, the arthropods belonging to the Class Insecta outnumber all other forms of life combined. Described species of insects number upwards of 751,000. In comparison, there are 3,900 amphibians, 7,000 reptiles, 19,000 fishes, 9,000 birds, 4,000 mammals, and 275,000 plant species. *Entomology* is the study of insects. It is a vast field with many subspecialties.



FISHES

We asked the stream for trout, and it gave us chub.

- Aldo Leopold

There are nearly 25,000 living species of fishes, more than all terrestrial vertebrates combined. They inhabit most bodies of fresh water and all oceans. A few even make brief excursions onto land. Fishes are not a formal taxonomic group but rather an assemblage of five distinct classes. They are superbly adapted for life in the water.

Fishes are subject to extremes of water temperature, water velocity, and water levels. Extreme water fluctuations from spring runoff, and releases from reservoirs and dams, to nearly dry conditions in our rivers, streams and ditches dictate the presence or absence of many fishes. Most of our lakes and reservoirs are stocked with a variety of fishes for consumption or recreational fishing. These are typically warmwater species, very few of which are native to the area.

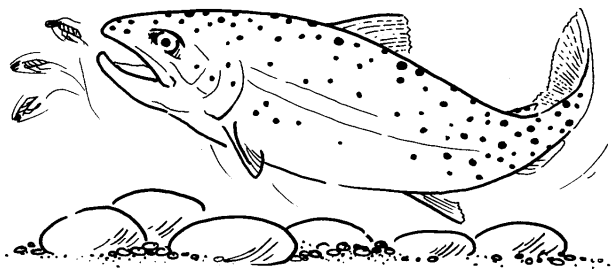
Fishes secrete a mucous that gives them their characteristic sliminess, an adaptation that reduces drag during swimming. Running the length of each flank of the fish is the lateral line system, a row of microscopic organs sensitive to changes in the surrounding water pressure, enabling the fish to detect minor vibrations. Fishes breath by drawing water over four or five pairs of gills that are located in chambers covered by a protective flap called the *operculum*. Water is drawn into the mouth through the pharynx, and out between the gills by movement of the operculum and contraction of the muscles contained within the gill chambers. This enables the fish to breath while stationary. Fishes control their buoyancy via an air sac, called a swim bladder. Transfer of gases between the swim bladder and the blood modifies the inflation of the bladder and adjusts the buoyancy of the fish.

Fishes are more than 400 million years old. That's older than most other living creatures on earth. They swim by making a wave with their body, starting at the head. Fishes use their fins mostly for changing direction and positioning their bodies.

Fishes have scales for protection. Like a tree the age of a fish can be determined by counting the rings on the scales.

Fishes have been highly impacted by human activities: dams, introduction of exotic sppecies, channelization, fishing, boating, removal of adjacent bank vegetation, etc. Strategies to improve stream habitat include installing log deflectors, anchoring trees, and constructing small log dams and islands. These structures tend to increase cover for fish, by creating deep pools of slower moving water where they can rest from the current, spawn, and watch for prey.

The experience of fishing is nearly universal. People of all ages, all economic and cultural backgrounds, all educational levels, and in every imaginable career have “gone fishin’” at least once in their lives. The best part of the fishing experience is not the number or size of the fish caught, but the setting in which the fishing occurs. A degree of naturalness and isolation is desired. Fishing in quarries at the edge of a city is not as appealing as fishing along a naturalized pond or river. Fort Collins has many fishing opportunities such as the Poudre River and lakes and reservoirs.



HERPTILES

The frog does not drink up the pond in which he lives.

-- American Indian Proverb

Amphibians and reptiles are collectively called herptiles. Toads, frogs, snakes, lizards and turtles are herptiles. Amphibians and reptiles are generally innocuous creatures that rarely cause harm to humans or their property, yet many are purposely killed. These animals play an important role in the ecology of our natural areas, acting as natural pesticides by eating an enormous amount of insects and rodents. Herptiles are sensitive to heavy pesticide use, which reduces the food supply for insectivorous species and contaminates aquatic breeding areas.

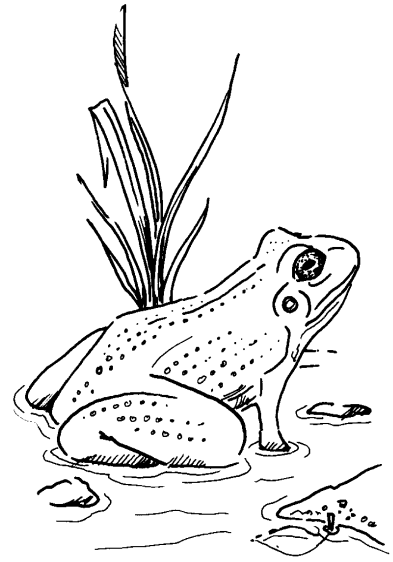
Herptiles can be difficult to observe. They are often secretive and nocturnal. They are most active on warm, sunny days and evenings, especially after heavy summer rains. Early mornings and late afternoons are the best times to observe them.

Herptiles are *ectothermic*: The environment dictates their body temperature. They are, therefore, subject to temperature extremes. On hot days they may seek shade or shelter underground, or in the water. On cold days they take advantage of the sun and often can be seen basking on rocks or even asphalt to warm up.

Herptiles can best be observed by walking slowly or sitting quietly on rocks or near a pond. Lifting rocks, logs, and other debris on the ground is a good technique for finding them. Objects that have been moved always should be carefully returned to their original position so the hiding place is preserved for future use. Rock piles, brush piles, and stone walls are good places to look for herptiles.

Amphibians

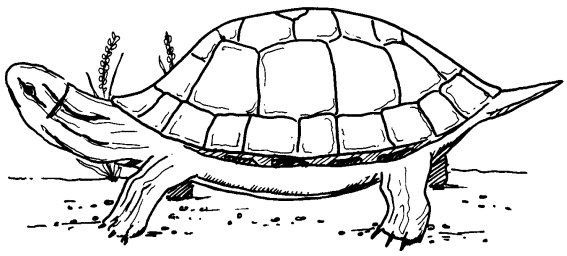
The word amphibian means "dual life". Amphibians live part of their lives on land but are tied to water for reproduction and respiration. Eggs are shed directly into the water or laid in moist surroundings and are externally fertilized. The skin of most amphibians is thin and not protected from dessication. Most amphibians breathe with the skin as well as the lungs. Amphibians include frogs, toads, salamanders and newts.



Scientists are alarmed and frustrated by the rapid worldwide decline of amphibians in the past decade. Theories postulate that acid deposition or damage to the Earth's ozone layer which allows more ultraviolet radiation to penetrate the atmosphere, hampers the amphibians' ability to reproduce. Recent studies indicate that parasites from introduced species may be a factor. Many of us have experienced a sense of loss when visiting a favorite pond on a warm summer's evening, to hear only a few mournful mating calls of the leopard frog - or worse, silence - when but a few summers earlier there was a virtual cacophony of sound to signify that life was teeming in our little pond.

Reptiles

Reptiles were the first truly terrestrial vertebrates. The development of a shelled egg with amniotic fluid to provide nourishment to the developing embryo, allowed reptiles to live their entire life cycle in a dry environment. Fertilization is internal. Respiration is via lungs instead of by gills. Reptiles have tough, dry, scaly skin offering protection against desiccation. Reptiles include lizards, snakes, turtles, tortoises, and crocodiles. Lizards and snakes comprise 95% of the reptiles.



Snakes

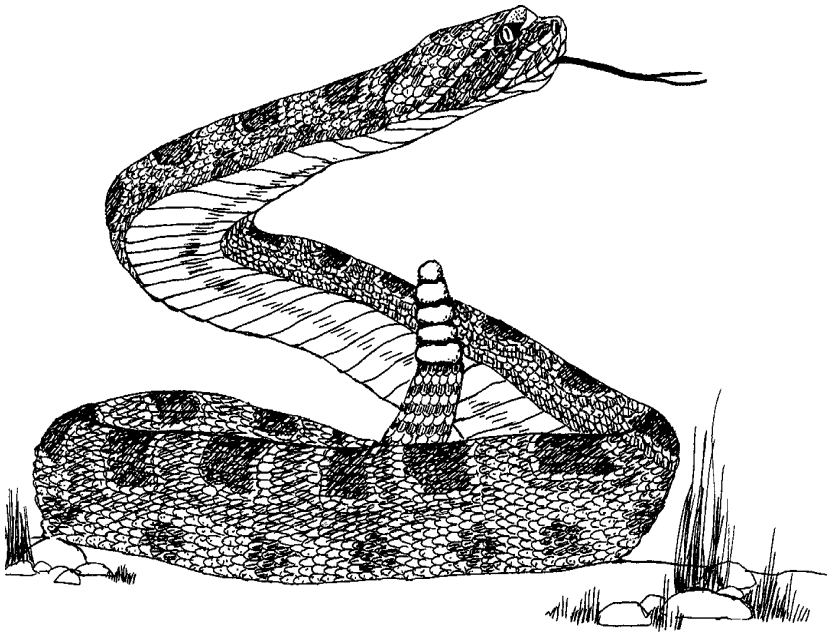
Snakes seem to evoke strong reactions in people, and all too often, this reaction is fear or loathing. They are, however, of great benefit to our natural areas and should be encouraged to take up residence. Snakes annually consume thousands of insects and rodents.

There are 26 species of snakes in Colorado. Two are poisonous. These are the western rattlesnake and the less common massasuaga. The massasuaga resides in southern Colorado. Neither species is aggressive and they both seek to minimize contact with humans. Look for rattles at the end of the tail, a broad, triangular head and a narrow neck. These are characteristics of poisonous snakes.

The western rattlesnake is found in virtually every terrestrial habitat up to 7,500 - 9,500 feet in elevation. A subspecies of the western rattlesnake, the prairie rattlesnake, is the most common in our area. It inhabits grasslands and foothills, frequently using prairie dog burrows as denning sites.

Never allow anyone, or pets, to approach or threaten snakes. Even non-poisonous snakes will coil and strike if cornered. If you encounter a snake, simply stop and wait for it to move away. It wants to avoid encounters with humans as much as you want to avoid it.

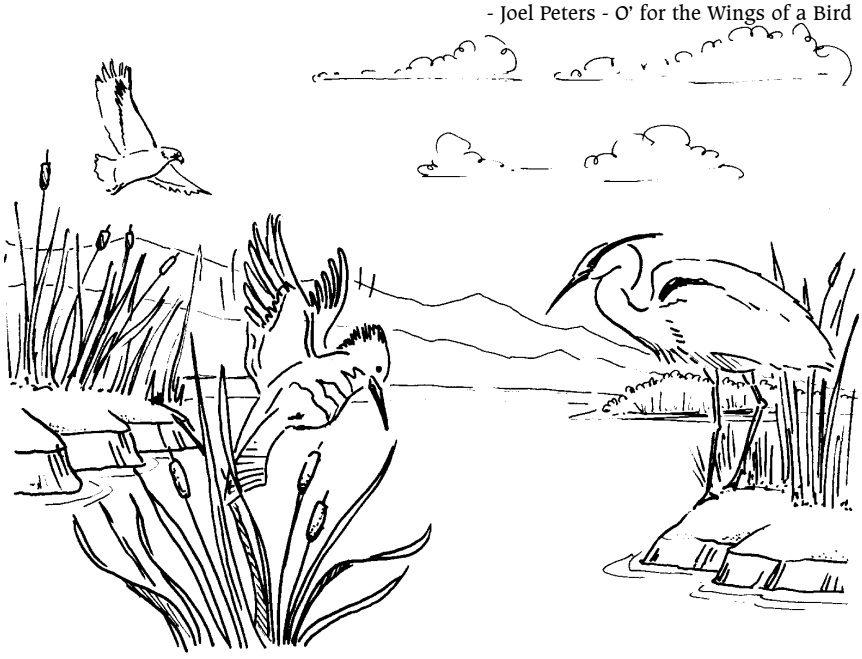
Of all the wild creatures, birds seem to generate the most interest, perhaps because they are ubiquitous, easy to observe, often colorful, social, and noisy. We are cheered by their songs, entertained by their squabbles and captivated by their ability to fly. Because they are so abundant and visible, they are especially useful in describing or recognizing biotic communities. Those species restricted in their ecologic distribution are the best indicators of



BIRDS

They hover, swoop, and flutter, soar and glide;
On beating wings they climb to heaven's height;
On unseen currents of the air they ride
Secure in space, in mastery of flight.

- Joel Peters - O' for the Wings of a Bird



habitat type. Most numerous are the species that are typical of a particular habitat but are also found in adjacent habitats. Some species are truly ubiquitous, occurring over a wide range of habitats: American robin, common raven, mallard, red-tailed hawk, and great horned owl.

Birds have been described as reptiles with feathers. They were the first group of animals to regulate their body temperature (*homeothermy*), allowing them to live in almost every environment of the world.

Bird Ecology

A bird's feet and bill reveals much about its ecology. The webbed feet of a mallard propel it across lakes as it searches for food. The talons of a great horned owl tells us how it grasps and kills its prey. A hairy woodpecker's sharp toenails help it cling to the side of a tree. The heavy bill of the evening grosbeak is adapted for cracking seeds. The long slender bill of the rufous hummingbird explains its fondness for nectar. The probing bill of the spotted sandpiper finds invertebrates in the mud.

Population declines of migrant birds are of increasing concern throughout North America. Some declines are a result of habitat fragmentation from development, and subsequent large domestic and feral cat populations, cowbird parasitism, and predation from birds and mammals whose populations underwent explosions due to exploitation of human habitation. Skunks, raccoons, blue jays, brown-headed cowbirds, and starlings are hugely successful around human development and often prey upon or exclude smaller songbirds. Forest songbirds and grassland birds have especially suffered enormous population declines.

Identifying Birds

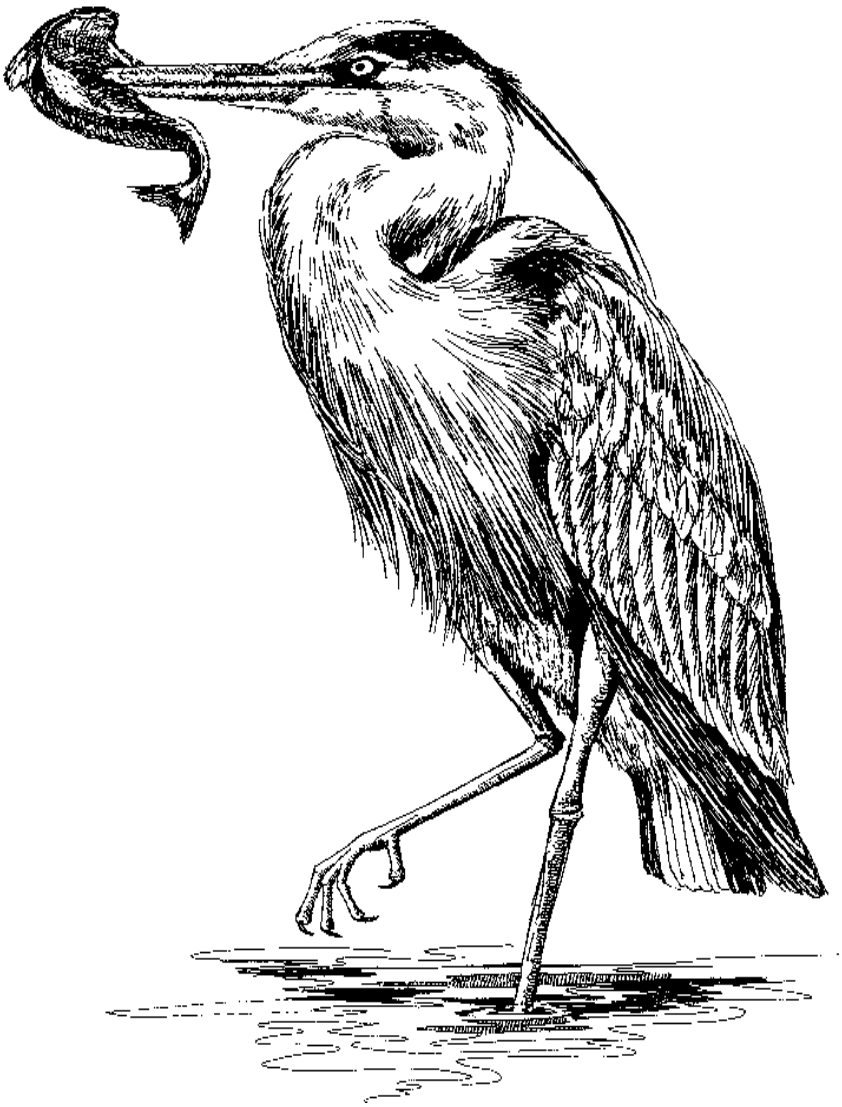
The American Ornithologists' Union has standardized the common names of birds in North America, so there is no longer confusion between local names for the same bird.

The primary criteria for identification is to know what to expect in particular habitats. You will soon know what birds to look for in the cattails bordering a pond, in wet meadows, in the deep water of lakes and reservoirs, on the shortgrass prairies, and in ponderosa pine forests.

Size and color are next in importance, both of which can be misleading. Many birds have an iridescent quality to their feathers so that the colors change with changing light and angle of view. Many times the birder is faced with onlya dark silhouette against the sky, so color can not be determined at all. Size is often misjudged. It helps to think in terms of familiar birds for comparison: about the size of a sparrow; or larger than a robin.

Correct terminology of the parts of the bird will help aid in observations, descriptions, and ultimately identification. Study a

diagram of the topography of a bird, often found in guide books. Then look for eye rings, eye stripes, moustaches, wing and tail bars, rump patches, breast markings, bill shapes, etc. in the field. Further challenges include learning bird songs, flight patterns, behaviors, and food preferences. Describing these details will often lead to correct identification.



MAMMALS

Mammals are homeothermic (maintaining a constant body temperature), have two pairs of limbs, generally give birth to live young, and have hair. Their diagnostic feature is mammary glands used to feed their young. Compared to other vertebrates, they are more adaptable and intelli-gent. They have diversified intomany species in a wide variety of habitats from tree-dwelling (*arboreal*), to living underground (*fosso-rial*), to living in the water (*aquatic*).

The diet of a mammal reveals much about its habits and ecology. *Omnivores*, such as bears and badgers, adjust their diet to changes in the availability of different foods. Many *herbivores* must adapt to changes in the availability of their plant foods by moving to new areas, storing food, or by reducing their food requirements by reducing their metabolism (*hibernation* and *torpor*). *Carnivores* are more mobile and less abundant than their prey.

Observing mammals can be difficult. Many are nocturnal, secretive, or extremely wary of humans. Many are highly mobile or have low population densities. Detection of their presence and activities is often by "signs" left behind. These are mainly tracks, feces or scat, homes, and evidence of feeding or marking territories.

Identifying most large mammals is easy, but some small mammals such as shrews and many rodents are difficult to classify. It is helpful to collect small samples of scat, take pictures of scrapes, or draw diagrams of footprints. It is more important to understand the ecology of the animal than to decide whether you saw a meadow vole or a sagebrush vole; or a deer mouse or a white-footed mouse.