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Shrub-Steppe Seasons

A Natural History of the Mid-Columbia Basin

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Preface

This book collects and updates a series of articles about the natural history of the Mid-Columbia region. The articles first appeared as a monthly column titled "Natural History" in the *Tri-City Herald*, beginning in May 1991.

The book never would have happened without Don McManman, copy editor at the *Tri-City Herald*, who originally conceived the idea of publishing a weekly column comprising different articles focused on the out-of-doors. Georganne O'Connor, a talented nature writer herself, provided nearly constant guidance and suggestions and also took on the onerous task of assembling all the past articles into a book format. Irene Hays conceived the idea of making the monthly articles available in book form to students and other newcomers to the area. She also secured the necessary funding to make it happen.

My approach has been to condense the best of what is known about the ecology of the region to a manageable length with little in the way of technical language and terms. Admittedly, there is a bias toward those topics and species on which I have either been personally involved or observed as part of the ecology research programs conducted on the Fitzner / Eberhardt Arid Lands Ecology (ALE) Reserve.

The ALE Reserve is situated on the northeast-facing flank of the Rattlesnake Hills. Rattlesnake Mountain with a crest of over 3,600 feet is visible throughout much of the Mid-Columbia. Shrub-steppe grasslands once covered a large part of the western United States but most have been converted to other uses. The ALE

site is the only remaining sizeable acreage (120 square miles) that is in near pristine condition and provides the only clear indication as to what the early trappers, traders, pioneers, and tribal members may have encountered in their day-to-day activities. In this respect, ALE provides a visible touchstone linking the past with the present for all of us.

I was hired by Battelle, which operates the Pacific Northwest Laboratory for the Department of Energy, in March 1972. There was a need to understand how the natural system functioned to be able to predict how it might respond to various energy generation or waste management scenarios then being considered at Hanford. ALE was our outdoor laboratory.

For me, these were the "glory years." A time spent learning about the remote places on ALE and about the plants and animals who live there. It is to recapture some of these experiences and insights that this book was put together. My hope is to provide information about the natural history of the area for any newcomers and perhaps some entertainment as well for those "oldtimers" among you who may have read them before but would like to read them again. Happy Reading.

Lee Rogers

Fall

Living in an Ancient Grassland

The shrub-steppe region where we live is a land of great contrasts. To some it seems a lonely and lifeless expanse, but to those who take the time to observe and recognize its special qualities it is a unique place, teeming with a variety of insect, bird, mammal, and plant life.

The shrub-steppe is the largest natural grassland area in North America. It extends from western Wyoming into northern Utah and southern Idaho, through eastern Oregon and eastern Washington to the Cascade Mountains, and even northern California and Nevada.

The term "steppe" is a Russian word that refers to a vast treeless plain, but the topography of the region is highly varied, ranging from sandy plains near sea level to mountain slopes and rocky ridge lines.

As we know, the nature of shrub-steppe winters is cold weather with strong winds and blowing snow. Summers are hot and dry with temperatures reaching above 100 degrees fahrenheit, then cooling at night.

This pattern of cold moist winters and hot dry summers has led to the region being described as a cold desert, but it is more properly termed shrub-steppe.

Lewis and Clark's journals offer the first insight into the early conditions of the shrub-steppe. They arrived at the confluence

of the Snake and Columbia rivers—where the Tri-Cities now are—in October 1805. That year they remained in the area a few days, meeting with the Wanapum Indians and obtaining food supplies such as sage grouse, which were abundant at that time.

When they returned from the coast in April 1806 they were surprised at the seasonal changes in the Columbia Basin and commented on the beauty of the area and on the luxuriant grass and herb cover.

Lewis wrote, " The plain is covered with a rich verdue of grass and herbs from four to nine inches high and exhibits a beautiful scene, particularly pleasing after having been so long imprisoned in mountains and these almost impenetrably thick forests of the seacoast."

During the next 40 years or so visitors to the shrub-steppe were limited to trappers and traders, who left very little in the way of written records. Most of their recorded comments have to do with the abundance of forage available for their animals and the scarcity of water and game animals.

The opening of the Oregon trail in the 1840s heralded the impending settlement of the region. Early day settlers who started from Independence, Missouri, passed through Fort Laramie and crossed the Continental Divide at South Pass, Wyoming. From there they traveled south by way of Fort Bridger, passed down the Snake River to old Fort Boise, then crossed the Blue Mountains near current-day Walla Walla, and journeyed to the Columbia River near The Dalles.

The Whitman mission near Walla Walla was a way station for many of these early travelers. The National Park Service maintains a visitor center at the site of the Whitman Mission that portrays early conditions of the area, and small remnants of the native vegetation still can be seen on nearby hillsides.

Homesteading and the introduction of livestock to the shrub-steppe region occurred at a rapid rate in the 1880s, following construction of railroads through the area. Where precipitation was sufficient, the native grassland was plowed and planted to dryland wheat—the Horse Heaven Hills, for example. Other areas were used for grazing cattle, horses, and sheep.

The introduction of livestock to an area that had little previous exposure to large grazing animals resulted in the rapid decline of the native bunchgrasses. The shrub-steppe, unlike eastern grasslands, lacks sod-forming grasses. The soil between the bunchgrasses is covered by a fragile moss-algae-lichen crust that is vulnerable to trampling by livestock and to other forms of soil disturbance.

The combination of plowing and overgrazing allowed for the introduction and rapid spread of weedy plants in the Columbia Basin.

These "alien" plants, including cheatgrass, tumble mustard, Russian thistle, knapweeds and chickweeds were brought to the area mostly by mistake with the early settlers.

By early 1900, the native bunchgrasses were severely depleted over wide areas and in some places nearly eliminated. Where the soil was disturbed by plowing or grazing, these alien

plants took hold to some degree. In severe cases, areas were completely covered by these plants, usually cheatgrass, and have continued to grow and take over the native grasses.

In the nearly 190 years since Lewis and Clark passed through the area, the lands they first explored have been settled, mined, farmed, and grazed, and railways and roads have been built. With this rapid growth and development came a correspondingly rapid increase in the rate of depletion of the native vegetation and certain native animals such as the sage grouse are no longer abundant.

As a result of the protection provided by ALE a great deal has been learned about the characteristics of the original shrub-steppe system. At ALE, a number of scientists of various specialties and faculty and students from a variety of Colleges and Universities in the region work together as a team to develop a better understanding of how shrub-steppe ecosystems function. Understanding its nature and the reactions of its plant and animal components to various natural and human-imposed changes, is providing insight as to better ways to manage these fragile lands.

Beyond Sagebrush

This is a good time of year to learn the names of a few local shrubs. The shrub-steppe lands that fill a large part of Washington and much of the West are home to native plants that seem obscure or even strange.

To understand the seasonal or yearly changes in these plants you need to understand at least some of the species present. It's not enough to recognize the difference between shrubs, flowers, and grasses. Many different kinds of each grow in the region, and they have their own adaptations and peculiarities. But if you learn as few as a dozen species, you will be able to understand how they seem to prefer certain locations, associate with other species, and change with the seasons.

Fortunately, it's not difficult to learn most of the plant species common to undisturbed areas around the Tri-Cities. If you can't find a friend who knows the local flora, several books and guides can help you. I think *Sagebrush Country* by Ronald Taylor and Rolf Valum (Touchstone Press) is one of the best guides to local plants. It includes color photographs to help you identify plant species. The authors provide information about the habits of the plants and their value as forage for wildlife.

Another book—*Shrub-Steppe: Balance and Change in a Semi-Arid Terrestrial Ecosystem* (Elsevier Publishing), written by several Battelle scientists who studied the U.S. Department of Energy's Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve

located on nearby Rattlesnake Mountain—is more technical (and more expensive) but describes the results of ecological studies at Hanford. It should be available through our local libraries.

Four common species of local shrubs should be blooming now: sagebrush, rubber rabbitbrush, green rabbitbrush, and white sage (also called snow buckwheat). One of my pet peeves is the misuse of the term "sagebrush" to refer to almost any kind of shrub or weedy plant. Big sagebrush (*Artemisia tridentata*) is the most common sagebrush species in our area. It is a stout shrub, normally 3 to 5 feet tall although it can grow to be as tall as 10 feet, especially if it grows near water. Sagebrush leaves are a gray-green and mostly three-lobed at the leaf tips. This time of year it should be flowering, but the flowers are tiny. Look for a yellowish tinge on the gray-green foliage.

The rabbitbrushes (*Chrysothamnus*) are also native shrubs of the region and can be mistaken for sagebrush. Rabbitbrush normally grows 1 to 2 feet tall but occasionally may grow taller (3 to 4 feet). They grow very well on dry, sandy soils. Rabbitbrush lacks the pungent odor of sage and has long, linear, and unlobed leaves. The bright yellow flowers that grow in showy clusters on the rabbitbrush are most apparent at this time of year.

Rabbitbrush is somewhat more limited in its range than sagebrush and is rarely found in pure stands. It is more common to find rabbitbrush in among sagebrush and other plants. Interestingly, rabbitbrush readily sprouts from the roots after a wildfire while sagebrush is usually killed. You'll notice areas in the region that have burned where a lot of rabbitbrush is growing but very little sagebrush.

Actually, two species of rabbitbrush are common in this area, rubber rabbitbrush (*Chrysothamnus nauseousus*) has gray-green leaves and a woolly pubescence (hairy) while its close kin green rabbitbrush *(Chrysothamnus viscidiflorus)* lacks the woolly pubescence and has greener leaves. Green rabbitbrush also tends to have very sticky stems and flowers. Rubber rabbitbrush also has a nauseous odor if you crush the stems and leaves. Neither of these rabbitbrush species provide very good forage for wildlife, although jackrabbits, mule deer, and elk eat them.

Snow buckwheat (*Eriogonum niveum*) usually begins flowering the first or second week of September in the Tri-Cities. This low-growing shrub is very inconspicuous except when flowering. It usually is less than 2 feet tall with spreading branches. Its leaves and stems are covered with white woolly hairs that give it a gray-white appearance. The white flowers are attractive although small. They persist for a couple of weeks and tend to take on a red hue as they age.

Snow buckwheat is an important nectar source for native bees, and the plant's seeds are a good food source for birds, rodents, and seed-harvesting ants. This plant is receiving increasing study for possible use in revegetating disturbed areas in Eastern Washington and Oregon.

These four fall-flowering shrubs described can be found throughout Eastern Washington shrub-steppe lands. The closest place to see them near the Tri-Cities is near Highway 240 (the Vantage highway) and Snively Road close to Horn Rapids Park. Another good location would be to drive out Stevens Drive in Richland and turn left on Horn Rapids road just past Battelle

Boulevard. Watch along the roadsides for the bright yellow flowers of the rabbitbrush and the whitish-red hues of snow buckwheat. You should have no problem locating sagebrush. It should be abundant wherever you find the other species, except for where there have been recent fires.

Rattlesnake Hills Elk Thrive in Desert

Elk—or more correctly wapiti since the term "elk" properly refers to a European member of the deer family—are the largest wildlife species inhabiting our shrub-steppe region. We don't usually think of elk living in our area, but in 1972 a small herd moved onto the Hanford Site, most likely from the Cascade Mountains.

Originally, the wapiti was not just a forest animal but inhabited the open plains and prairies. Before the arrival of European immigrants, these elk occupied most parts of the United States and southern Canada. Now, the Rocky Mountain elk is primarily limited to remote mountainous regions of the western United States extending from New Mexico to Canada. The Roosevelt, or Olympic, elk is a slightly larger variety and inhabits the coastal mountain ranges from California to British Columbia.

It is not clear whether elk ever have been common in the Columbia Basin. Early-day explorers, traders, and trappers left little in the way of written records to indicate an abundance of any large game animals, but archaeological excavations from prehistoric Indian camp sites have revealed the presence of elk bones, hide, and teeth, indicating that the animals were eaten by native peoples. We don't know, though whether the elk were hunted locally, brought back by hunting parties, or obtained through trade with other tribes.

However the elk found their way here, their recent return to our grassland area was a rare event. When the first elk arrived, no one thought they would stay. Conventional wisdom was that the

treeless steppe, as represented by the Hanford Site and surrounding areas was too hot, too dry, and had too little vegetation to either shade or conceal the elk. We thought they would leave with the onset of summer, but they stayed and prospered.

During the early years, elk restricted their movements to various parts of the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE), land owned by the U.S. Department of Energy between Highway 240 and the crest of Rattlesnake Mountain. At first the only evidence of their presence was their tracks around watering places and the sagebrush torn up by the bulls as they rubbed velvet from their antlers in the fall.

Gradually we sighted small groups of elk. I well remember the first elk I saw on ALE. I was working near the mouth of Snively Canyon when a cow elk broke from the brush along the stream bed and ran up the hillside. My mind kept registering deer, a very large and funny looking doe deer. (The white tail, large off-white rump patches, brownish-gray body color, and brown neck distinguish elk from other members of the North American deer family.) Finally, after the animal had disappeared over the canyon ridgeline I realized it was a cow elk. I had just seen my first elk on Hanford.

That original handful of elk grew at an outstanding rate of about 20 percent per year, one of the highest rates ever observed for elk. When herd size reached about 100 animals, some began to wander outside ALE boundaries. Now, some animals are killed each year by hunters on surrounding lands. This hunting mortality has served to stabilize the herd, which otherwise has no natural predators. Coyotes take a large percentage of the mule deer fawns each year on Hanford, but they can't contend with a mad mamma elk.

The reappearance of elk in the shrub-steppe region has offered a unique opportunity for scientific study on the Hanford Site. Former Battelle staff member Les Eberhardt and graduate students Scott McCorquodale and Steve Petron have chronicled the elks' behavior, habitat use, movement, physiological responses, and population growth over the years.

Some surprises from their research include the following:

- Elk seldom use the remote upland areas of ALE. Except for the calving period in April and May, they spend most of their time in the open lowland areas.
- The area where they spend most of their time (their home range) is larger than the area used by elk in forested regions. This is probably due to the lower quality and quantity of food (forage) available in shrub-steppe habitats.
- The elk move farther daily than elk in other areas. Again, probably because of poorer forage quality.
- The elk are more active at night. Because little vegetation exists to hide their movements, the elk may be using darkness as a form of concealment.
- The elk are in "good shape" (not under physiological stress) even during the hot, dry summer months.
- The elk's very large antler size and high bodyweight indicate that, healthwise, the animals are doing as well as or better than elk in forested regions.

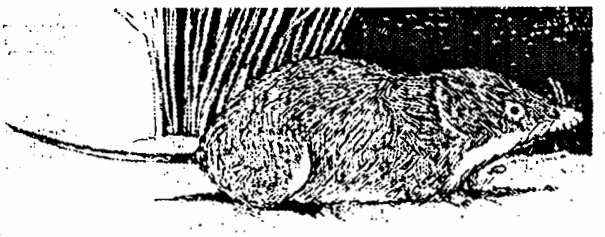
Another surprise to researchers was that the elk use the short-statured sagebrush shrubs for shade and to conceal themselves.

It's an eerie feeling to have first one and then a whole herd of elk rise up from the sagebrush in front of you without having even suspected their presence.

One of the first problems researchers had with the elk studies was simply locating the herd. This problem was solved when several animals were fitted with radio collars. Now, researchers can fly in a plane over the area and locate the collared elk using a small directional radio.

In addition to using sagebrush, the Hanford Site elk are also masters at using the terrain for concealment. A few weeks ago Charles Pasternak from DOE and I were inspecting the fenceline along the western boundary of ALE. While returning along a dirt road, a small group of about 11 cows and a bull elk crossed the road in front of us, ran a couple of hundred yards, and simply disappeared. What they did, of course, was run down into a small ravine we could not see. I suspect they were on their way to water at Rattlesnake Springs about 2 miles away, and they probably followed the ravine most of the way. We didn't see them again.

The Secret Lives of Shrews



The contrast between a shrew weighing a few ounces and a 1,000-pound elk illustrates the enormous range of mammalian life on ALE. Although the entire class of mammals includes only about 30 species on ALE, they are a diversified lot in terms of both their habits and the habitats they select. However, none are more unique or poorer known than that group of mammals known as the shrews.

Shrews lead a very secretive life. They spend their time scurrying about beneath the litter layer and in the burrows and runways of other small mammals. Shrews have some very interesting specializations. For one thing they have flat feet. Technically they are referred to as having plantigrade feet, which causes them to walk with the entire foot on the ground in the same fashion as bears. They also have long snouts with sensitive "whiskers" that help them locate their prey. Shrews have eyes, but they are small and they don't see well.

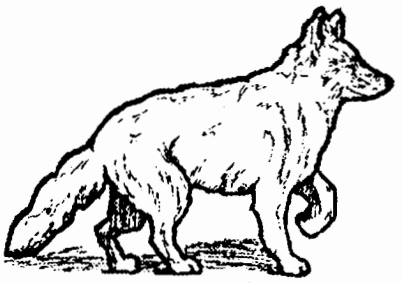
Most shrews are carnivorous and prey on insects, worms, spiders, and mice. Some eat small amounts of plant matter. Shrews do not hibernate and must eat every few hours. It is rare to observe a shrew in the wild, partly because they do spend most of their time below the ground's surface and partly because they skitter about so quickly. Occasionally one may dash across an open space between litter layers permitting a quick glimpse.

Nature has produced a variety of different shrew species. One of the most interesting, although I have never seen one in nature, is the northern water shrew (*Sorex palustris*). This large shrew, about mouse-sized, can actually run about on the surface of mountain streams or dive beneath the surface in search of aquatic insects. Its thick fur helps protect it from the bone-chilling cold of the icy mountain streams.

Perhaps the smallest mammal in the world is the pygmy shrew *(Microsorex hoyi)*. This tiny creature weighs a fraction of an ounce and is about the size of a large insect. Not much is known about them. They range from the Appalachian and Adirondack Mountains northward across Canada to Alaska. One subspecies (*M. hoyi washingtoni*) has been found in northeastern Washington, northern Idaho and northwestern Montana.

The only shrews that live in our Mid-Columbia region are the vagrant shrew (*Sorex vagrans*) and Merriams shrew (*Sorex merriami*). The vagrant shrew lives in wet places created by streams and springs while Merriams shrew occupies dry-land habitats associated with the open shrub-steppe of our region.

Wily Coyote Survives on Wits



Coyotes. The mere mention of the name is almost certain to elicit a strong reaction —either admiration or hatred. To some people, the coyote is a ruthless killer of livestock and doesn't deserve to live. Others see the coyote as a noble creature, part of nature's system of checks and balances and the "trickster hero" of many American myths. The truth probably lies somewhere in between.

One thing is clear, coyotes are highly adaptable. As a fur bearer and killer of livestock, the coyote has been shot, poisoned, trapped, snared, run over, and even electrocuted; still, it not only persists but continues to expand its range. Lewis and Clark described their first encounters with the "small burrowing wolf of the prairies" in 1805 while traveling over the Missouri River plains near present-day Nebraska. By the turn of the century, the coyote had reached Alaska. By 1960, it had made itself at home in the eastern states, now coyotes inhabit every state except Hawaii.

The reasons for the coyote's ability to successfully migrate and thrive in these places are not fully known because almost all studies of coyotes have focused on hunting and trapping the creatures. However, recently Peter Stoel, a former graduate student from Portland State University, studied the food habits of coyotes on ALE. Coyotes on the reserve, which is remote from agricultural areas, haven't been hunted, trapped, or shot since 1952. Peter found the ALE coyotes to be opportunistic and omnivorous feeders,

eating pretty much whatever was available, including mice, birds, reptiles, gophers, ground squirrels, rabbits, road kills, grasshoppers, darkling beetles, and fruits. Clearly, coyotes can find food just about anywhere.

Other studies of coyotes on ALE have looked at the social structure of the animals and how the population structure changes over time. Bob Crabtree, a former graduate student from the University of Idaho, found the ALE coyotes to be highly territorial creatures, consisting of adult mated pairs, helpers, loners, and nomads.

Bob determined that the adult pairs occupy well-defined territories they defend against other coyotes. Helper coyotes are generally young coyotes that live with the adult pair, helping them hunt and rear pups. The loner coyotes successfully defend a territory, but for some reason have not attracted a mate. Nomads are just that. They are mostly young coyotes without a territory, wandering from place to place. These coyotes are the ones most likely to run afoul of humans. Because they do not occupy a territory and wander about so much, it is only a matter of time until they come across some "easy pickings" such as chickens, house cats, or livestock.

I'm convinced that sheep and coyotes, in particular are just plain incompatible. When a sheep is frightened or confronted with the unknown, its natural tendency is to run away; but when a coyote is confronted by an animal that runs away, its natural tendency is to attack.

In his studies, Bob also determined that not as many coyotes were born on ALE as he had expected. For one thing, he found that

only females with an established territory attracted a mate and successfully raised a litter of pups. Because coyotes on ALE live a long time, a mated pair can hold on to their territory for several years. This has a tendency to raise the average age at which female coyotes begin to breed. Bob also found that older females had trouble reproducing, which also tends to lower the overall population.

Bob found that the average litter size at ALE— about five pups—was somewhat smaller than for coyote populations outside the area's protected confines. The reasons: when coyotes are under pressure from hunting, trapping, and poisoning, there are simply more vacant territories available, so some of the younger female coyotes are able to breed. But the end result of the increased predator control efforts is simply more coyote pups being produced to replace those being eliminated. Not a bad trick for the trickster.

A good, well-balanced summary of past interactions between coyote and human populations is contained *in The Coyote, Defiant Songdog of the West* by Francois Leydet, published by the University of Oklahoma Press in Norman, Oklahoma.

Rancher Outsmarts Coyote With Llamas

If you ask western sheep ranchers, "wily coyote" is something other than a cartoon character. Coyotes are at least a nuisance and, at times, can take heavy tolls on sheep, particularly during spring lambing. Although not all coyotes automatically become sheep killers, when problem coyotes take up residence on sheep-grazing lands, they can mean the difference between profit and loss for ranchers. Hunting, trapping, poison baits, guard dogs, and many other methods have been used to control coyote populations or deter attacks on sheep. But the fact that coyotes learn rapidly to avoid danger and can respond to population declines by quickly increasing productivity means that most control measures have met with only limited success. At least one local rancher, Bob Rashford, who raises sheep near Moses Lake, is going "low tech" in an attempt to keep coyotes away from his spring lambs. Bob purchased three llamas and plans to place one of the long-necked camlids with each of his ewe flocks late next winter. Several other western ranchers have reported that a lone llama will "bond" to newborn lambs and maintain a constant vigil over the flocks, aggressively defending the sheep from coyote attacks.

Wary Bobcat Most Common Wild Cat

Bobcats (*Lynx rufus*) are seldom seen, and when you do see one, it is usually by accident. It was years before I saw my first on the ALE Reserve, and this species is the most common wild cat in the State. It is distributed throughout Washington but is probably most common at lower elevations of the mountains, especially in rough and rocky areas near cut-over forests.

I well remember my first sighting. It was in 1977, 5 years after I started work at the Pacific Northwest Laboratory. I had driven out Highway 240 and left the highway to go to Snively Canyon. I was driving one of the old four-wheel drive pickups, one that had seen a lot of hard use. I hit a bad stretch of road near Rattlesnake Springs. The pickup was bouncing and rattling around, when all of a sudden a bobcat streaked across the road right in front of the pickup and disappeared into the sagebrush. I figured the jangling, crashing sounds coming down the road were just too much for the animal, so it dashed into the open.

My next bobcat sighting occurred several years later and wasn't nearly as dramatic. Someone opened the back door of the ALE headquarters building to get something, and there was a bobcat sitting on a fence post. Everyone rushed to have a look. The cat just sat there posing nicely about 100 yards away. I made a dash to find a camera with a telephoto lens, but by the time I got back the bobcat had had enough and was gone.

Bobcats do most of their hunting at night but are also active during the day. They look somewhat like large house cats, but they have larger ears, stubby tails, and long, thick side whiskers. A good-sized bobcat would be a little less than 3 feet long and weigh 15 to 20 pounds.

Bobcats mostly eat small mammals such as rabbits, ground squirrels, chipmunks, and mice. There are reports of bobcats attacking and killing larger species such as deer, but such attacks are probably very rare and only occur where the deer is in a weakened condition.

Breeding occurs during late winter. One-to-four, but usually two, kittens are born about 2 months later. During the first 2 weeks of life the kittens are blind and nearly deaf, but they have a very keen sense of smell. Like newborn human infants, most of their time is spent either eating or sleeping. But unlike human infants, bobcat babies double their body weight during their first 2 weeks of life.

Other wild cats that occur in Washington are the cougar and lynx. *Lynx (Lynx canadensis)* occur mostly in the high unbroken forests of Alaska and Canada. Very little is known about them in Washington as they are both rare and secretive in their movements. They look somewhat like a larger version of the bobcat but have very large paws and long hind legs. This enables them to pursue and capture snowshoe hares, their favorite prey. Lynx do not occur in the Columbia Basin area.

Cougar (*Felis concolor*), on the other hand, have been reported from time to time in our area. There has been at least one reliable

sighting of a cougar on Hanford and reports of their occasional sighting by farmers and ranchers in the surrounding area. Cougars, especially young males, are known to wander over large areas so it is likely that they at least pass through our area. Cougar numbers have been increasing throughout the western United States recently, so it is possible that cougars may become permanent residents of our Columbia Basin region.

Skunks: Keep Your Distance

Most small animals have evolved coats and behavior patterns that provide some measure of protective coloration, enabling them to blend into the landscape and thus avoid detection by animals that will eat them. To hide is to live. Not so for skunks.

Skunks have a special means of protection—an ability to release a very unpleasant spray called musk. The striking black-and-white color pattern is thought to provide a warning to a potential predator. Attack at your own risk.

When first disturbed, the common striped skunk (*Mephitis mephitis*) of our area usually attempts to retreat. If that fails, the skunk calls attention to itself by arching its back and raising its tail over its back; sometimes it stamps its front feet on the ground in a way that seems to ask "Do you really know who you are messing with here?"

As a last resort the skunk turns its body in a U-shaped position so its head and tail both face the intruder. It then squirts its musk from two tiny nipples located just alongside the anus. The skunk can direct the musk fairly accurately over a distance of 10 to 12 feet, and the smell is easily detected a half-mile or more downwind. This scent usually is enough to deter even the most determined predator, who probably would not make the same mistake again.

Striped skunks are found in a variety of habitats: wetlands, grasslands, and woodlands, but rarely in strictly dry-land areas. For example, I don't believe I've ever run across one within the interior of ALE on the Hanford Site.

Skunks are most active in the evening and at night. They spend daylight hours in a burrow, under a building, or in just about any dry and protected area. For most of the summer we had a family of skunks living beneath a shed on our acreage. We seldom were aware of their presence, because there was no "aroma." But we occasionally saw them returning "home" from their nightly foraging activities through the neighborhood yards and pastures.

Striped skunks are generally considered to be beneficial to humans and the environment. They help keep insect pests such as grasshoppers in check. They also feed on insects, mice, and other small rodents, and consume fruit, grain, and some green vegetation. On the negative side, they are known to attack poultry and are reported to be a principal carrier of rabies among North American wildlife.

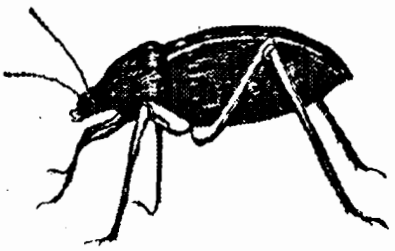
Skunks are a serious pest for beekeepers. They often scratch at the entrance of beehives until the bees swarm out to fight off the intruder. The bees quickly become tangled in the long fur of the skunk where they become a leisurely meal. Over time, the skunk may kill and eat enough of the bees so the entire hive dies out.

Skunks mate from February to mid-April. The period of pregnancy is about 60 to 70 days, and the young are born in May or early June. Usually four or five young are born in each litter.

The newborn—called kittens—open their eyes when they are 3 weeks old, are weaned at 8 weeks, and leave their mother in the fall.

Count yourself lucky if sometime at dusk or dawn you see a mother skunk ambling along with her 4 - 5 kittens all in a line. They will probably not pay any attention to you, but keep an eye out for that raised tail. It should serve as sufficient notice to keep your distance.

Darkling Beetles Raise a Stink



Beetles, one of the most common of all animal groups, make up nearly one-half of all known insect species. Here in the Mid-Columbia Basin, darkling beetles (Tenebrionidae) are one of the most common members of the beetle community. They are mostly dark colored and spend a good deal of time walking about on the ground but there the similarity ends.

Darkling beetles feed mostly on dead plants (called detritus), but they also eat some green plant material. Most darkling beetles walk rather slowly, and a very few are able to fly. They are an important part of the diet of some predators, such as coyotes and burrowing owls.

About 20 species of darkling beetles live in our area; some are quite common, others rather rare. *Eleodes hispilabris* , a common species, is one of the largest darkling beetles. It has striations or ridges down its back. *E. hispilabris* lives above ground from about March through late November. With the onset of winter weather, it seeks shelter below ground in the burrows of other animals where it will remain until spring.

E. hispilabris frequently can be found wandering in the yard, or most certainly will be seen by anyone who spends time hiking in nearby sagebrush/bunchgrass communities. This beetle always seems to be in a hurry, walking purposefully toward some unknown destination.

I have spent considerable time observing them but never have been able to determine where they were going or why they were in such a hurry. Sometimes they even change directions and scurry back along the same path they just traveled. A good high school science project might be to study how much time this species spends feeding, moving, or resting—in short, developing a time budget for the beetle. Such information largely is unknown for many common animals and would provide some interesting and useful information about the beetle world.

Many darkling beetles have a very interesting defense mechanism. If disturbed they will assume a head down and tail up position, and if handled roughly, they will emit a dark-colored, evil-smelling fluid. This behavior is enough to discourage all but the most persistent of predators. Simply tap the back of the next darkling beetle you find and see if it doesn't display this behavior. Don't worry about their defensive fluid, it washes off easily.

You'll find most darkling beetles throughout the year as long as favorable weather conditions permit, but others, such as *Philolithus densicollis* "Philo" and *Stenomorpha puncticollis* "Steno" occur only above ground for a short time each year. They emerge from the soil in September and spend the next few months above ground feeding and searching for mates. The females deposit eggs in the soil where they hatch, and the larvae develops over the next 2 years. With the onset of freezing weather or the first good snowfall, the adults die, usually sometime in early December. Studies at ALE have tracked the fluctuating abundance of these two species for nearly 30 years. Sometimes, they were extremely abundant, even reaching what might be called "outbreak"

conditions. At other times, they were relatively scarce. Right now, the population appears to be on the low side.

Now is a good time to search for these species. Look for Philo at the lower elevations, below 1,000 feet and for Steno along the hillsides at higher elevations. Good luck, and let me know if you find any locations where these beetles are extremely abundant.

The Life of Desert Streams

In arid lands, water is life. Most streams and rivers that flow through regions such as ours originate in faraway mountain highlands. The Yakima River, for instance, originates in the high Cascades and the Columbia in the mountains of British Columbia; the Snake begins its trek to the sea from the Rocky Mountain region of northwestern Wyoming.

Some streams also originate in the desert, but generally they are small. For example, springs in the Rattlesnake Hills give rise to permanent streams such as Corral Creek near Benton City. Other small streams such as Snively and Rattlesnake flow on the eastern side of Rattlesnake Mountain on ALE.

Whatever their size, the rivers and streams of the Columbia Basin abound with plant and animal life. Just ask a fisherman. A summer mayfly hatch, with trout rising from the stream depths to greedily gobble up the molting nymphs, is a sight to gladden the heart of any fishermen. But few of us have the training to fully appreciate not only the fish but all the adaptations and variety of plants and animals that live in streams or to understand the roles of other living things such as bacteria, aquatic plants, and insect larvae in forming the life of the stream.

Bert Cushing, of Pacific Northwest Laboratory, has spent most of his scientific career studying river and stream ecosystems in arid regions. He makes a wonderful case for how things living and growing in water (aquatic ecosystems) and things living and growing on land (terrestrial ecosystems) depend on each other to survive. For one thing, Bert says, streams use food produced in the water

(algae, mosses, and large rooted plants) and food produced on land (leaves, sticks, pine cones, even tree trunks that fall or get blown into the stream) to feed the complex food webs that exist within them.

In rivers and larger streams that receive a lot of sunlight, three main groups of plants produce food: algae, mosses, and large rooted plants. Microscopic algae, by far the most important in most cases, are present in astounding numbers. Truly, they are the "grasses" of streams and rivers. Mosses are found mostly in the cooler, headwaters of streams. The large, rooted plants grow in the warmer, slow-flowing reaches where enough sediment has settled out to provide a place for the plants to root. You'll notice these plants growing in the Yakima River where it flows through the Yakima Valley.

But what about the smaller streams where overhanging vegetation creates a closed "canopy," limiting photosynthesis, and thus, the number and variety of food plants that can live and grow in the streams? This is where the leaves, sticks, pine cones, and tree trunks become important to the life of the stream. Organisms feed on the sticks and leaves, breaking them down into finer material, which then becomes the main food source for other organisms.

The dependence of streams on food produced in the terrestrial ecosystem is one of the least recognized and most important relationships governing stream ecology. Next time you see sticks, leaves, and other such things in desert streams, just realize they are providing food for organisms living in the water.

What kinds of organisms feed on sticks and leaves? The most obvious and numerous ones are aquatic insects. Hundreds of

different species coexist in most streams, unless they are highly polluted, then only a few hardy species can survive. Although each species has its own particular source of food and way of obtaining it, the species can be grouped based on how they obtain their food. The groups include **shredders,** which feed on coarse particulate organic matter (sticks, leaves, and pine cones); **grazers/scrapers**, which feed by scraping algae from the surface of rocks; **collectors**, which feed by gathering or filtering the fine particulate organic matter (the material left after the shredders have consumed the sticks and leaves); and **predators**, which feed on other organisms.

While I was a graduate student at the University of Wyoming I had a study site along the upper reaches of the Snake River. Here the mighty Snake is little more than a boisterous shaded stream. As you would expect, plenty of coarse organic material is in the stream because of the abundance of vegetation along the banks and little in the way of algae because of the shaded banks. Consequently, the insect community is dominated by shredders feeding on this coarse material and collectors, which eat the fine materials produced by the feeding activity of the shredders. Few grazers are present because of the lack of algae growing on the rocks.

The stream widens as it moves closer to our area, more sunlight reaches the stream bed and the riparian vegetation (what grows on the stream bank) becomes less important. In this reach of the river, you find few shredders because of the lack of coarse organic material, but many grazers because sunlight can now reach the stream, allowing algae to grow for them to eat. Collectors are still prominent in this spot, especially the filtering-collectors, because of the large amount of fine organic material being transported by the stream.

As the river becomes large, such as it is near the Tri-Cities, a significant change in its ecology occurs. Here, because the bottom is soft and the water somewhat turbid, algae cannot flourish so you find few grazers. Coarse organic matter is lacking, so there are few shredders. Instead, the community is dominated by collectors, usually organisms like clams and various worms that can live in soft, muddy river bottoms.

So, next time you're walking by a river or stream, think about the hundreds of species of living things that survive there, sometimes with the help of land plants that feed them.

Mayflies: To live for but a day

Mayflies are frequently seen along the rivers near the Tri-Cities or clinging to the screens of your house. The adults have a shiny body with two or three long threadlike tails and transparent veined wings held tent-like above their body. Immature mayflies, called nymphs, may live up to two years at the bottom of a lake or stream. But after emerging they live for but a day, often surviving only a few hours. The adult female must stay alive only long enough to mate and deposit her eggs on the surface of the water. The nymphs feed on algae and bits of organic matter in the stream, but the adults don't feed at all. In fact, they don't even have mouth parts. You might think that such an insect would be ill-fitted to survive, but not at all. They are known from the fossil record from as far back as 250 million years. May the human race be so fortunate.

Mid-Columbia Rivers and the Cycle of Water

Natural systems, much like human households, require a continual supply of water. The earth's water cycle consistently renews the supply of fresh water, and simultaneously creates a variety of habitats for plant and animal populations.

When the earth began to cool a few billion years ago, billowing clouds of steam began condensing on the earth's surface. Since that time, water has been flowing in a continuous cycle of evaporation and precipitation.

Raindrops that fall to earth during a storm begin their journey back to the ocean, which is the source of nearly all water. In fact, the combined volume of all the water in lakes and rivers, icecaps and glaciers, atmosphere and ground amounts to less than 3 percent of the earth's supply; the rest resides in the oceans.

Water occurs in three general phases: as freshwater or ice on the continents, as sea water in the oceans, and as water vapor in the atmosphere. This continual recycling of water between phases takes a tremendous amount of energy. The sun provides this energy by evaporating water from both the surface of the sea and from land. Plants and animals also give off water vapor, especially green plants, which constantly lose water from their leaves through the process of transpiration. This is why a tropical forest with its large number of trees makes a huge contribution to the recycling of fresh water, and is one reason tropical forests are so important to us, even though we are located half a continent away and in a semi-arid area.

Once a raindrop reaches the earth's surface it begins its downhill race to the sea. It may be delayed in lakes and ponds, get taken up by plants and animals, or slowly percolate through the ground, but sooner or later it returns to the sea.

Water is vital to all life on earth. It flows in our veins as well as within the bodies of all plants and animals. Living cells are mostly water, which aids in the transport of food and oxygen and helps eliminate waste products. Not surprisingly, the lifecycles of plants and animals inhabiting our semi-arid Mid-Columbia region are closely in tune with the annual precipitation cycle.

Although our region receives only about 10 inches of rain per year, it is a predictable event. The fall rains usually begin in late September or October. They are followed either by rain or snowfall during the winter months.

Most flowering plants are adapted to this cycle and produce seed either during the early spring months (lupines, hawksbeard, balsamroot, phlox) when adequate water supplies are usually available or during the fall months when precipitation can be expected to occur (sagebrush, rabbitbrush) in the near future.

"Wetlands" is a term used to describe those areas where water is held up on its journey to the sea. They go by a variety of names, including bog, marsh, streamsides, or fen. The plants and animals of these habitats are all adapted to the waterlogged and climatic conditions occurring there. Wetlands are among some of the most productive areas for waterfowl and aquatic wildlife. As a result of increasing pressure for productive agricultural land and for housing developments, many of our wetland habitats are fast disappearing.

Large rivers such as the Columbia and Snake represent the final stage of the raindrops' return to the ocean. Rivers have long been used for transportation and fishing and are now a source of water for hydroelectric power, irrigation, and recreation. Riverbanks offer as much habitat variety as the river itself. Mink, otter, and muskrat all live on the river's edge. Waterside trees, such as willow and cottonwood, also grow there, and along with the sedges and grasses, help stabilize the banks and provide nesting and feeding sites for birds and insects.

Dams on the Columbia and Snake rivers have provided protection against floods as the waters rush to the sea. Dams also provide electricity for people throughout the West and irrigation water for agriculture, but not without a cost.

The fish, aquatic invertebrates, and variety of plants, birds and mammals that have adapted to the free-flowing river conditions that existed over the last several thousands of years now must adjust to the slackwater conditions created by the dams. In many instances, such an adjustment may not be possible.

Nevertheless, the water flowing through our Mid-Columbia rivers plays a role in connecting the oceans, atmospheric, and terrestrial systems together, supporting a variety of aquatic life and nurturing wildlife habitat along its banks.

Pathways of Recovery

Environmental impact and environmental recovery. These two phrases usually refer to some type of human-related activity that adversely has impacted a part of our natural world. But sometimes we fail to realize that adverse environmental impacts have been happening naturally, long before humans ever populated the earth.

The damage from Hurricane Andrew in 1992 in south Florida and floods in the Midwest in 1993 are just two examples of severe disruption of naturally functioning ecosystems. In our area, if you look closely at the pristine grassland communities of ALE on Rattlesnake Mountain, you will see localized disturbances by pocket gophers, ant hills, pocket mouse and ground squirrel burrows, and badger holes. Observing the harmony of natural recovery processes may offer insights for restoring areas damaged by our activities.

Over time, these localized areas of disturbance are naturally restored. But it doesn't happen overnight. The process by which nature heals the scars and returns disturbed areas to a self maintaining and productive condition is called succession. Several stages or steps may occur before the restoration process is complete.

In general, succession is initiated by "weedy" species of plants. These plants are adept at invading new areas and becoming established. They are followed by short-lived plants, which further modify conditions so that eventually the dominant species (sagebrush and bunchgrass in the Mid-Columbia Basin) can take over.

Of course, not all disturbances that initiate succession are necessarily small. Large-scale natural disturbances include windstorms,

wildfires, floods, insect outbreaks, and even drought. Human activities that can lead to initiation of the succession process include such things as building roads and abandoning agricultural fields.

At Hanford the current focus of the site is on cleaning up and restoring large areas previously dedicated to nuclear material production and/or management of the related wastes. Past studies at ALE provide a theoretical basis for predicting rates and pathways of recovery for Hanford vegetation as cleanup and restoration proceed. But we are finding that we do not know enough. During the last 100 years, many new plant species have migrated to the Mid-Columbia region. Spotted knapweed, Russian thistle, cheatgrass, and tumble mustard all are part of this new contingent of weedy species. What will be their role in the successional process? Will they facilitate providing a stable and self-sustaining environment? Or will they interrupt and lengthen the time for shrub-steppe communities to fully recover?

The restoration of natural systems is a fantastically complicated and sophisticated process. Even the most accomplished grassland ecologists are just beginning to learn how natural succession functions. How succession might be enhanced to speed up the restoration process currently is uncertain. One bit of wisdom is emerging. Restoration and the natural recovery process have similar roots.

When Bugs Come Inside to Get Out of the Cold

Like most entomologists I have had good and bad experiences in helping identify insects for the general public. Although it's not part of my regular job, somehow vials and insect-containing envelopes frequently find their way off the street to my desk.

I have learned to open these containers carefully as the little critters inside are sometimes quite alive and well. More than once I have had to scamper down the hallway attempting to recapture a wayward bug.

The fall months are times when many bugs seek out warm and dry places to spend the winter. They are more than willing to share their space with humans. Consequently, that's when I start getting bombarded with bugs. To entomologists, bugs represent a particular family of the insect world—the hemiptera.

All insects such as flies, bees, ants, and beetles are not necessarily bugs. But all bugs are insects. True bugs have two distinguishing characteristics—their wings and their mouth parts.

Wings are what give rise to their order name hemiptera. In Greek, the two words hemi (one-half) and pteron (wing) describes the half-and-half nature of a bug's wing structure. The base half of the bug wing is hard and thickened, while the distant half is membranous and clear like that of a bee or dragonfly.

The mouth parts of bugs are a piercing and sucking type and are formed into a long and slender beak that rises from the front of

their head. To feed, plant feeding bugs (herbivores) stick their beak into a plant, while predators (carnivores) stick their beak into another animal and suck up the juices.

Bugs are very common insects. Many species abound on vegetation; some species live on the surface of water while others live within the water depths. Even a few bugs are parasitic on birds and mammals.

Some of the more common plant-feeding bugs that often enter buildings during the fall with the onset of cold weather include the leaf-footed plant bug, the box elder bug, and the squash bug. They are just looking for a sheltered place to spend the winter and really mean no harm.

Common bug predators of our area include the assassin bugs and ambush bugs. Assassin bugs spend their time hunting for their prey on vegetation while ambush bugs usually can be found waiting in ambush, as the name implies, for their prey to happen along.

Here in the Mid-Columbia, ambush bugs can frequently be found waiting on most common garden flowers. In the fall, a yellow-colored species of ambush bug inhabits rabbitbrush. Its coloration blends with the yellow flowers of the rabbitbrush, making the bug difficult to see. When an insect visits the flower, the ambush bug quickly grabs it with its grasping front legs and jabs it with its beak. Sometimes you can find a bee, wasp, or fly (its usual prey) still wiggling, impaled on the beak of its executioner.

Bugs are just one of the many groups of wildlife inhabiting the natural world here in the Mid-Columbia, and unlike many other wildlife species, bugs are perfectly willing to move right in with you for the winter.

Winter

Enduring Winter's Chill

If you stop along the Vantage highway northwest of Richland on a quiet spring day and let your gaze wander toward the crest of Rattlesnake Hills, the new growth of shrub-steppe grasses will seem to stretch out like a green carpet, broken only by patches of yellow or blue of native flowering plants. But it is not always so. On a cold winter night with the wind blasting out of the north, the hills are inhospitable, a place of sudden death for any warm-blooded creature lacking adequate food and shelter.

The spring view of the unspoiled shrub-steppe is one of an unfolding profusion of species and colorful patterns. At this point in the cycle of plant life, grasses dominate the landscape, but the hillsides are decorated with the blue and purple hues from lupines, lavender-colored phlox, and the bright yellow of balsamroot. By June, the flowering plants are mostly gone and even the grasses have begun to dry up with the onset of summer drought. Only deep-rooted plants such as greasewood, sagebrush, and rabbitbrush remain green during this period of intense heat and little rainfall.

The autumn rains begin again in late September or October, and the annual cycle of plant life continues. Although this explains how plants deal with weather by limiting their lifecycles to non-winter months, how animals native to our region cope with winter weather is another story.

Most of the larger mammals such as elk, deer, and coyotes, adapt to winter by growing thick coats of fur and seeking out sheltered places to rest and feed. These animals are able to go about their business as usual because their thick fur helps insulate them

against the cold. Other animals, such as ground squirrels, pocket mice, gopher snakes, or rattlesnakes cope with winter by avoiding the intense cold. They spend the winter months underground, emerging again in late winter or early spring when weather is more amenable. And of course, many bird species avoid the cold simply by migrating to warmer weather farther south.

But what about the tiny creatures that don't have fur for protection and or are too small to migrate south? Spiders, centipedes, ground beetles, and scores of other creepy-crawlies seek refuge in the bases of the thick bunchgrasses or below ground in the dens of small mammals. Others seem more cold hardy.

When the temperature drops, the liquids in some insects becomes supercooled. Supercooling means that ice does not form in their tissues until the temperature has fallen far below the freezing point. In some instances, their body temperature can be as much as minus 58 degrees below zero (Fahrenheit). Some beetles and flies use supercooling to keep their tissues from freezing.

Other insects actually produce glycerol within their bodies. This tends to lower their freezing temperature just as antifreeze does in the radiator of an automobile. Some ants, wasps, and caterpillars are known to produce glycerol and keep from freezing in this manner. A few insects actually can withstand freezing of their tissues. Some files and caterpillars are known to be able to spend the winter in a frozen state and thaw out in the spring without any visible damage.

Many insects have a life cycle adapted to the seasonal cold period. They "overwinter" in the form of eggs or pupae. The adults

may die off with the onset of winter, but the next generation is just waiting until the soil warms in the spring. Our Mid-Columbia winters may seem harsh, but the native plant and animal life clearly is well adapted to withstand its rigors.

Snowflies

My favorite winter Mid-Columbia inhabitants are the snowflies or snowfleas. They seem to just ignore winter. They come out during warm spells between October and March and sometimes can be seen mating and cavorting on the surface of the snow, thus giving rise to their names.

Snowflies belong to a little known family of insects within the order Mecoptera (scorpionflies). These winter gnomes are dark colored and barely one-tenth of an inch in length, so you have to look closely to see them on the snow. Snowflies resemble tiny grasshoppers somewhat both in form and movements since they can leap with their long hind legs. The snowflies spend most of their time in the litter layer beneath shrubs or within the bunchgrass tussocks where they feed on dead matter. There is little else known about how these hardy creatures spend their time.

So if you are bored on this long winter day, bundle up the kids and go out looking for snowflies. Who knows, you might just create something very special in their lives —a memory about the time you all went snowfly hunting in the dead of winter.

Wildlife Best Observed in Their Own Backyard

Frequently, I am asked about good places to observe Mid-Columbia Basin wildlife in a natural setting. Common animals you might see while exploring sagebrush country include mule deer, elk, pheasants, pocket mice, and several species of birds.

This month, as we edge toward the shortest day of the year, you are more likely to notice an animal's tracks in snow or dust than see the animal itself. But, even in warm weather, it is difficult to find and observe animals in a natural setting because most animals are fairly secretive and tend to avoid humans.

At this time of year, what you see depends, in part, on where you look. This is because the species of animals that exist in a given area depend on the habitat available. All animals have specific preferences for what they like or need to eat, where they nest or seek cover. For example, common mammals in our area such as the black-tailed jackrabbit or cottontail prefer the habitat of our grassy sagebrush plants. They rest under sagebrush or other shrubs and feed mostly on grasses in summer and buds, bark, or small twigs in winter. So, you're more likely to see these rabbits if you're out walking in an open field rather than on a path near the river.

But, unlike most other animals, jackrabbits and cottontails don't seem to mind humans too much. For some reason, jackrabbits have been abundant in fields around the Kennewick Airport. This may be a good place to spot them or at least their tracks in snow as they speed away.

The time of day you're looking for wildlife also is important as many creatures are nocturnal, active mostly or only at night. Badgers, the great diggers, are one such creature. They are seldom seen even in areas where they are abundant. Even if you visit an area where badgers are likely to live—open grasslands where the animals burrow in dens—the most you can expect is to see is a pile of soil left over from a badger digging out a ground squirrel or mouse for lunch.

I've always considered it a lucky day if I caught a glimpse of a badger. A few years ago I led a car tour of ALE for a visiting scientist from the East, who wanted to see a badger. I had just explained how we rarely see them, and when we do it usually is accidental, when what came trotting down the road with a ground squirrel in its mouth but a badger. The visiting scientist jumped out of the car to take a picture, but succeeded only in chasing the badger, hissing and snarling, into a nearby burrow.

Even harder to see are the other resident mammals of the Mid-Columbia Basin that burrow, such as shrews, weasels, gophers, mice, and voles. About the only way to know where they are and what they're doing is to watch for their droppings or tracks in snow.

Time of year also determines what wildlife you might see in our area. If you're out for a winter walk along one of the Mid-Columbia's waterways, this is a good time of year to catch a glimpse of a bald eagle. Eagles use black locust, Siberian elm, and white poplar trees located near river shores as night roosts and daytime perches.

A colleague of mine told me recently how he saw a bald eagle on the banks of the Columbia as he was watching out the window from a dentist's chair on George Washington Way.

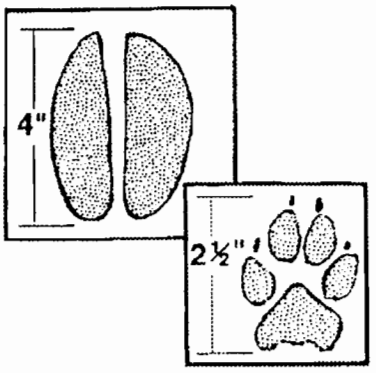
Riverine and riparian habitats also provide nesting and foraging for other migratory birds. Just locating and identifying all the different ducks currently in our area could keep you busy for weeks. Along river shorelines, watch for mallards, shovelers, gadwall, teal, mergansers, and pintails, just to name a few.

Many other Mid-Columbia resident bird species are fairly readily observed most of the year. You can see most of the shrub-steppe's abundant birds, meadowlarks, horned larks, shrikes, and the American magpie in grassland areas. Shore birds, such as herons, ducks, coots, sandpipers, gulls, terns, and occasional pelicans or swans are easily observed along the Columbia, Yakima, and Snake rivers.

The animals we see today in the Mid-Columbia region and where we see them is part of a complicated process that has, over time, involved the formation and extinction of species, their movement and migrations, competition and balance. Who knows what changes will occur here in the next 200 years.

Hopefully, we will be wise enough to ensure the continued presence of enough natural habitat to allow native animals to survive for the enjoyment of all. But if the past is any indication, future generations may have far fewer opportunities to see free-living wildlife populations than you do today.

Stories in the Tracks of Animals



Most wild animals are rather shy and reclusive. Many are nocturnal and only venture out after sunset and return to their dens or hiding places before the first morning light. The only evidence of their presence is oftentimes the tracks they leave behind in snow, dust or soft mud near ponds, streams or rivers.

There is a story to be read in the tracks left behind. Early in the morning after a fresh snowfall is an especially good time to distinguish various animal tracks, and figure out what the animals were doing the previous night.

Mice leave dainty little tracks in snow as they scamper about, but a scuffle in the snow with a sudden end to the mouse trail may show an unexpected encounter with an owl or other bird of prey.

Hooved animals such as elk, deer, goats, moose, horses, or cattle leave tracks that are quite distinctive and easier to identify and follow than those of rodents, but even these tracks are not always easy to tell apart. For example the tracks of a large Hereford calf and those of an elk can be very similar in size and shape, much to the chagrin of many a hunter.

You can recognize members of the dog family because their prints all have four toes. The size of dog tracks can vary tremendously, though, so size is not very helpful in identifying different

kinds of dogs. It takes a real expert to identify the difference between coyote tracks and those of a domesticated dog of similar size.

Cats also leave four-toe tracks. The difference between cat and dog tracks is that members of the dog family usually leave tracks with clearly distinguishable claw marks. Cats have retractable claws, so their tracks do not show the claws.

In our area, the handlike tracks of the well-known raccoon often can be found along waterways. Their tracks are quite distinctive and can be identified by the presence of five toes on both the front and hind feet and by their flat-footed prints. Their foot prints are also usually paired, with the right hind foot placed near the left fore foot.

During most of the year, you can expect to find skunk tracks anywhere near a waterway. During the coldest part of winter skunks hibernate, but they frequently revive and travel during warm spells. This year I noted skunk tracks in the snow and frost as late as mid-December. Skunk tracks are about the same size as a large house cat. However, skunks have five toes on both the front and back feet and also have toe nails. Skunks are not very agile animals, so their trail usually just sort of moseys along. If you follow a skunk's trail a short distance you should also find small diggings where it has been grubbing for insects or other prey.

Mammals are not the only group of animals that leave tracks, of course. Birds often leave very distinctive tracks as do many of the insects and even snakes. Last spring while driving along the dirt road that parallels Rattlesnake Ridge on ALE I was

surprised at the number of snake tracks crossing the road. The snakes had apparently been quite active the previous night; yet, they are rarely seen during daylight hours.

Identifying and "reading" animal tracks is not always easy to do, but it can make your outings in the Mid-Columbia Basin, and elsewhere, a lot more fun and interesting.

At some point you may want to consider preserving animal tracks as a souvenir or perhaps for further study. It's easy to do. You just need a small bag of plaster of Paris, some water, and a tin can or other small container in which to mix them together. When you find a track you want to preserve, just make a runny mixture of the plaster of Paris, and pour it in the track, wait about 10 minutes, and then gently lift the print out. Sometimes it helps to carry small strips of light cardboard that you can place around the track to contain the plaster. It's very difficult to make casts of tracks in snow, so find some in soft mud to practice on first.

If you would like to learn more about identifying animal tracks, I recommend a book published as part of the Peterson Field Guide Series by Olaus Murie, *A Field Guide to Animal Tracks*. This book was first published in 1954 and has been reprinted many times, but is still the best reference available.

Mule Deer Dot Basin Landscape

Deer are the most abundant big game animal in our region and the one most easily recognized by nearly everyone. They provided meat, clothing, and other essential articles for Native Americans long before European settlers first arrived in North America. When the pilgrims arrived on the eastern shores of this continent, the white-tailed deer (*Odocoileus virginianus*) provided a ready source of meat for the table as well as a variety of other useful articles such as buckskin for clothing, sinews for sewing, and bone and antlers for utensils and ornamentation.

Although some white-tailed species live in our region, the most common deer and the one you are most likely to see is the mule deer (*Odocoileus hemionus*). The "mulie" gets its name from its large "mule-like" ears, which seem to be constantly on the alert for sounds of approaching danger. This animal has the odd habit of running with bounding leaps when startled and lands with all four feet close together, which gives it a peculiar bouncing motion. The deer's bouncing leaps catapults it upward 3 or 4 feet into the air, enabling it to see over nearby vegetation and to keep track of any approaching danger.

Deer are speedy animals. They can reach top speeds of over 30 miles per hour and can clear an 8-foot fence with ease. A few deer seem to enjoy the presence of humans and make a nuisance of themselves by feeding in agricultural fields and nearby orchards. They may even come in close to houses and farmsteads to feed on flower beds and lawn shrubbery.

I have always been intrigued that deer appear to like to swim and, in fact do it very well. The late Lester Eberhardt studied the movement patterns of 37 radio-collared mule deer on the Hanford Site. His study showed that the Columbia River was not a barrier to deer at all. Eight of the 37 radio-collared deer crossed the river at least once, and one animal crossed at least eight times in a 19-month period. Other studies at Hanford have shown that the does will frequently swim out to Columbia River Islands, where they give birth to their fawns.

Deer fawns are born in June or early July. Twins are fairly common, and triplets occur occasionally. The fawns, a dark brown color, are covered with spots that help them blend into the background as they hide. The first few hours after birth the fawns have little scent, which helps protect them from predators. They are usually weaned by fall and, by then, are almost as large as their mothers and have lost most of their spots.

Only the male or buck deer grow antlers, which they shed each year after the mating season. The antlers begin to grow in the spring, and by mid-summer they are full grown and covered with velvet. The velvet dries by the end of September, and the deer scrape it off by rubbing against various shrub and branch-rubbing posts.

The antlers are not for protection from predators. Deer mostly protect themselves by rearing up and slashing out with their front hooves. The bucks use their antlers in a vigorous contest with other males, pushing and shoving with their antlers to assert their dominance. Only the strongest and most dominant bucks have much of an opportunity to mate. By the middle of winter, after mating, the bucks lose their antlers and

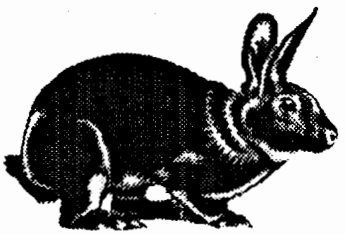
return to their docile ways. The loss of antlers causes no pain to the deer; the antlers simply drop away like leaves from a tree. Sometimes they both drop at once, or one may drop first with the other side falling away a day or two later.

The average mule deer reaches its peak at about age 6 or 7. Once past prime, or when food is poor, a buck's antlers may not develop fully, remaining small even though he is a large animal. Although antlers are usually symmetrical, there are many records of abnormally shaped antlers in nature. Occasionally, deer are found with antlers that don't even look like regular antlers but rather resemble chunks of coral from the ocean floor. Such deer are called "cactus bucks" and may have a mass of knobs in the place of the normal antler beams and points.

One of the enduring questions concerning the mule deer population on the Hanford Site has been its ability to remain relatively stable over time in the absence of hunting or predation by large game animals. Brett Tiller, a researcher at Pacific Northwest Laboratory, is conducting a study to help answer this question. Over the last 3 years he has captured deer and outfitted them with radio-collars to estimate their total numbers and determine their use of habitats along the Columbia River. He also has noticed that some (four) of the captured bucks had atypically shaped antlers that were still velvet covered in March and April. Investigators from other regions have noted this anomaly occurs for a variety of reasons, including heredity, age, disease, sunlight, vitamin deficiency, organochlorine contamination, plant estrogens, and many others; however, no one has really found the definitive answer. Perhaps Brett will solve the puzzle once and for all.

As you ride about the Columbia Basin, keep your eyes peeled for a glimpse of these graceful creatures. The best time to see them is early morning or late evening. If you see a large animal bouncing like a rubber ball across the sagebrush terrain you can be certain you have seen our most numerous deer species, the mulie, and you may be surprised just how close they have been all the time.

Of Rabbits and Hares



Of all our small native mammals, rabbits and hares are most likely to be familiar to the casual observer. The jackrabbit zipping across the road in front of your car or zigzagging between clumps of sagebrush as it makes its escape is a sight most Columbia Basin residents have observed.

Jackrabbits and cottontails belong to the family called Leporidae. Members of this family consist of two general types, the rabbits and hares. This can be a little confusing since jackrabbits are not rabbits at all but hares.

Rabbits are born nearly naked and blind. They are quite helpless for several days after being born in a special fur-lined nest carefully constructed by their mother. "Hares," on the other hand, are born fully furred and with their eyes open. They are also born in the open with little more than a scraped-out depression for protection, and they can run shortly after birth.

All rabbits and hares are herbivorous (plant-eating animals) whose diets consist of a variety of shrubs, forbs, and grasses. Some leporids have an unusual method of processing their food. Two types of "rabbit pellets" are produced: the small dark brown pellets from which the nutrients have been removed are feces, but there is also a larger greenish pellet produced that contains only slightly predigested foods. These pellets are re-eaten in a manner somewhat resembling that of cattle where a cud of vegetation is returned to the mouth from the stomach to be rechewed and finally swallowed.

Both black-tailed (*Lepus californius*) and white-tailed (*Lepus townsendi*) jackrabbits occur in our area. The black-tailed jackrabbit is somewhat smaller than the white-tailed. It is a grayish brown color with large ears tipped with black, and its tail has a conspicuous black streak on the surface. The white-tailed jackrabbit is a larger hare. In summer it is a grayish color, but in winter it's nearly all white except for its dark ear tips. Its tail is almost entirely white.

The white-tailed jackrabbit was once very abundant in the Columbia Basin, but it is seldom seen anymore. It still occurs in some of the protected sagebrush/bunchgrass areas at Hanford, and is reportedly still fairly common in the Okanogan Valley. The conversion of large tracts of shrub-steppe habitat to agricultural and other uses has reduced its populations and may eventually result in the elimination of this large and beautiful hare from Washington.

The pygmy rabbit (*Sylvilagus idahoensis*) is the smallest and most secretive rabbit species in the Columbia Basin. It only occurs where dense stands of shrubs such as sagebrush or greasewood grow. Because this is the only rabbit species that makes its own burrow system, it also requires deep, loosely packed soils. Pygmy rabbits were earlier reported to occur on ALE by the late Dick Fitzner. I believe they may still occur there, but they have not been seen in recent years. The large wildfires that burned over much of the Hanford area eliminated large stands of sagebrush, thereby reducing the available habitat for this smallest of our rabbit species.

The native Nuttall's cottontail (*Sylvilagus nuttalli*) has been joined in some parts of our region with the introduced eastern cottontail. The two are difficult to tell apart in the field. Both are

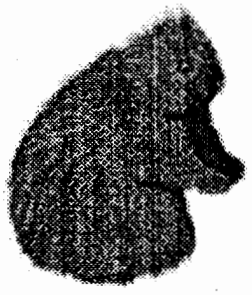
about the same size, and both have the same "cotton tail" that is readily apparent as they run. Nuttalli's cottontail have been able to adapt to humans quite easily, often living within our towns, parks, and farmsteads.

Rabbits and hares are a favorite prey for a variety of predators such as coyotes, hawks, golden eagles, bobcats, and dogs. Jackrabbits rely on their long ears to detect the approach of predators such as the coyote a long way off. Then they depend on their running ability to escape from danger. Cottontails also rely on their speed, to some extent, but they remain close to cover and rapidly dash to a burrow or brush pile when danger threatens.

Pygmy rabbits are the smallest and slowest of the rabbits. They remain close to their burrows while feeding among the tall and densely spaced sagebrush. The slightest hint of danger, and the pygmy rabbit dashes into the mouth of its burrow and, if necessary, below ground for protection.

Winter is a good time to look for rabbits and hares. They are most active in early morning and late evening. Right after a light snowfall is a good time to take a hike through sagebrush country. You may not actually see a jackrabbit or cottontail, but you will surely see some tracks and know they are there.

Porcupines



Porcupines are funny-looking creatures to humans. They are slow moving and appear to be clumsy. They have a short, broad head attached to a large, thick body. Small eyes peer out of a hairy face in a way that seems to say, "I'm busy right now, please go away and leave me alone."

The animal's body and tail are dark colored and covered with long spines called quills. Normally, the quills lie flat, but when the animal is disturbed the quills can stand straight up. With its tail swishing from side to side, the porcupine can form a formidable defense against predator attacks.

The quills are attached loosely to the skin. A swipe of the tail is enough to drive them into any animal foolish enough to get too close to a porcupine. Once attached, the barbed quills tend to work deeper into the body. Dogs are the most common victims. In areas where porcupines are common, dogs frequently turn up with a nose full of porcupine quills.

Porcupines are vegetarians. They eat flowers, buds, leaves, and other herbaceous plant materials during the summer months. When winter arrives, they mostly eat the bark of trees. They prefer evergreens but will include other trees and shrubs as well.

Because of their diet, porcupines are most commonly found in forested areas. However, they can be found far beyond the limits of the forest, even in the Tri-City area, if a suitable winter food supply is available.

I was headed to Rattlesnake Springs ALE the first week of December and came across a young "porky" taking a leisurely drink right at the place where the road goes through a stream. Porky was in no hurry, so I waited until it was finished and started to amble away before fording the stream. ALE is certainly not the typical habitat for porcupines, but I know they have been present there for at least the last 20 or so years. Willow and other trees at Rattlesnake Springs and in Snively Canyon, where porcupines also live, are probably enough to ensure their survival.

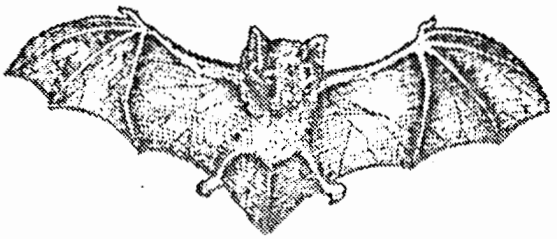
Baby porcupines are born in the spring of the year. Normally, only one baby is born to a mother porcupine each year. They are on their own after only 4 or 5 months of care from their mother. The young porcupine I saw at Rattlesnake had probably only recently left its mother's care.

Porcupines are prey for a few large predators, including cougar and lynx. The only predators on ALE that might be able to take a porcupine would be a bobcat or coyote, and I think that would happen rarely, if at all.

Porcupines can be quite a pest to campers. They have a fondness for chewing on axe handles, canoe paddles, and even on the tires or electrical wiring of cars.

Winter is good time to look for porcupines. Porcupines often leave deep trails on their journey from their denning areas to favorite feeding sites. The animal drags its heavy tail behind as it waddles along, leaving recognizable swish marks in the snow.

The Myth and Mystery of Bats



One purpose of these stories is to introduce readers to the oftentimes commonplace but little known plants and animals of the Mid-Columbia. Bats certainly fit the "little known" category. Although 20 percent of the known mammal species of the world are bats, they remain little known and clouded in mystery and sometimes fear. In medieval Europe it was believed that spirits arose from the grave at night as vampire bats to attack people and drink their blood. The bat's habits of flying at night and hiding during the day may have helped perpetuate this myth.

Bats share most of the common characteristics of other mammals such as hair, teeth, production of milk, and the birth of live young. However, bats are the only group of mammals capable of directed flight. Animals such as the flying-squirrel may glide from place to place, but they cannot actively fly from place to place.

The flittery flight of bats makes them one of the easiest groups of mammals to recognize, but their shy nature has also made them one of the least known. Bats belong to the scientific order known as *Chiroptera*, which comes from the Greek words Cheiros (meaning hand) and Pteros (meaning wing). They are therefore known as the hand-wing animals. Bats have a forearm, wrist, thumb, and four fingers much like yours and mine except in miniature. These structures form the basis of the wing. Unlike birds that grow overlapping feathers that act as the wing surface, bats have a

wing surface composed of skin. The skin is stretched out from the sides of the body and legs and extends over the bat's forearm and hand. During flight, the bat maneuvers by moving the hand and fingers to help direct its flight.

The saying "blind as a bat" is another myth perpetuated about bats. Bats have eyes and can see quite well. However, since bats are active at night, they don't depend on their eyesight. They use something called echolocation to help them navigate and locate their prey. Bats literally "see with sound." They emit a very high-pitched sound produced at short intervals. This sound bounces off objects in the vicinity and provides the bat with a "picture" of the immediate area. That's what keeps bats from crashing into things at night and why they are so good at capturing insects where they literally scoop them out of the air. Most people can't hear these sounds; they're too high pitched.

Bats originated in the tropics, and this is where you find most species today. Tropical countries may have close to 100 species of bats present, while far fewer live in our area. A total of 12 species have been found on the Hanford Site as a result of the arid land studies program. About 70 percent of the bat species in the world feed entirely on insects. Another 20 percent or so feed on fruit; 5 percent feed on nectar and pollen. The remainder feed on fish, small animals, insects, and blood. Vampire bats really do exist, but only in Central and South America where they prey on warm-blooded animals. Bats are known to carry the virus that can cause rabies as do many other mammals. This is a more serious problem where vampire bats occur. All the bats in our area are

insect eaters. They mostly fly during late evening and at night when they scoop insects out of the air.

In our area, winter means a shortage of prey for animals that depend on insects for food. Consequently, most bats hibernate with the onset of winter. Some species may migrate several hundred miles to reach favorite caves or abandoned mine shafts where they hibernate. It is during this time that you may find a single bat resting in their normal head-down position beneath the eve of your house, attached to the window screen, or perhaps within a shrub or tree. We found a bat resting in the barn this last October. Luke and Hayley Clemmens, two of my grandchildren, and I gently removed it and took it outside and watched it fly away through the orchard.

If you want to look for bats, you might try areas where there are a lot of flying insects. Areas with nearby waterways along with shrub or tree growth along the shore would be a good bet. The best time is in the evening right before dark, except when the bats are all snuggled in for the winter.

The Invisible Ecosystem

I have spent a good part of the last 20 years thinking about the shrub-steppe ecosystem and how it functions. It gradually has become clear to me that the shrubs, bunchgrasses and associated beetles, birds, and mammals are little more than a reflection of the real, functioning ecosystem, which is primarily invisible. The invisible part is dominated by tiny invertebrate animals (small insects, nematodes, and mites) and microbes—mostly bacteria and fungi.

The microinvertebrates—bacteria and fungi—seldom come to our attention, but without them the shrub-steppe ecosystem would soon become clogged with the dead remains of plants and animals and cease to exist. The breakdown of dead plant material into smaller particles is initiated by mites and nematodes. This makes it easier for the fungi and bacteria to continue the breakdown process, releasing the essential nutrients contained in the dead material so they become available for the next cycle of growth.

Harvey Bolton, at the Pacific Northwest Laboratory, has been studying the patterns of nutrient availability in the shrub-steppe ecosystem as part of the arid lands ecology project. He has noticed that nitrogen, a critical element for plant growth, is not distributed randomly in the natural world, but rather, as islands of concentration across the environment.

Harvey theorizes that these islands of concentration are the result of plants mining the soil for nutrients through their roots. As the leaves and roots die and decompose in the soil, the nutrients are released and concentrate near the plants. These

"resource islands" are present a decade after the shrubs are burned off by fire, ghosts of past plant distribution patterns.

Harvey also speaks of mycorrhizal fungi that live in close association with plant roots, obtaining food from them, and in turn, helping the plant obtain needed nutrients and water from the soil. Nitrogen fixing bacteria also occupy the fungal mat, and in some places, the crust that covers the soil supplying nitrogen in a usable form to the plant.

The fascinating influence of fungi often can be seen in our own backyards. Fairy-ring fungi display circular rings of dark green bands in contrast to the blue-green color of the late summer lawn. Starting at a central point, the fairy ring grows outward at the perimeter, each year growing larger as the mycelium or slender threads of the fungus grows beneath the ground.

Centuries ago people thought that fairy rings were caused by fairies dancing in a circle, which caused fungi such as mushrooms and puffballs to grow at the edge of the circle. The real story is less fanciful but just as interesting. The mycelium of the fungi initiates chemical changes in the soil. Dead organic matter is reduced to ammonia, which is then changed by bacteria to nitrites. Other bacteria change the nitrites to nitrates, a form needed by plants for growth. This extra nitrate acts as a fertilizer and causes the ring of luxuriant plant growth in the lawn.

Fungi may not be readily apparent to the casual observer, but that doesn't mean that it is small. Last year, scientists in Michigan reported a single fungus that covered 30 acres and weighed at least 10 tons. This was quickly overshadowed by a specimen

from western Washington, which covered more than 2 square miles, possibly the largest living organism on earth.

Bacteria and fungi currently are being investigated as possible means for cleaning up old contaminated sites at Hanford and elsewhere. Initial results are very promising and may well provide a quicker and cheaper means for environmental cleanup. Certain bacteria and fungi can "eat" or degrade organic compounds that contaminate our groundwater such as gasoline, oils, or pesticides, to name a few. This method of using microorganisms to clean up or help remediate a contamination problem is called bioremediation. Understanding how to enhance the activity of these microorganisms to degrade the organic contaminant is a key aspect of current research on bioremediation.

Global Warming and the Columbia Basin

In the last few years you have probably heard a lot about global climate change, especially about global warming. Although the subject has been debated hotly in scientific circles for sometime, scientists now predict a rise in temperature worldwide from the release of large amounts of "greenhouse gases" (carbon dioxide, methane, nitrogen oxides, and chlorofluorocarbons) into the Earth's atmosphere. These and other gases in the atmosphere act like a blanket and trap the sun's warmth near the Earth's surface, causing Earth's temperature to rise.

The greenhouse effect is a natural phenomenon. According to Bill Pennell, of Pacific Northwest Laboratory's Global Studies Program, most of the greenhouse effect is caused by the large amount of water vapor in the Earth's atmosphere. It is this warming that makes the Earth a hospitable place for life. Without the natural greenhouse effect, the average temperature of the Earth would be some 60 degrees colder than it actually is. What concerns Pennell and other scientists is the enhancement of the natural greenhouse effect caused by the addition of greenhouse gases to the atmosphere due to human activities.

There is one thing certain about the greenhouse debate. Human beings already have changed the chemical composition of the atmosphere in significant ways.

Over the last 100 years or so, the amount of carbon dioxide in the atmosphere has increased by 25 percent. The amount of methane has more than doubled. The concentration of nitrous oxides has increased by about 8 percent, and the concentrations of

chlorofluorocarbons have gone from nothing to levels that have both a greenhouse influence as well as a negative impact on the amount of ozone in the higher atmosphere. All these increases have been attributed to industrial and agricultural activity, and most of them will continue.

Carbon dioxide concentrations, for example, will certainly continue to increase, because the world will continue to burn fossil fuels for the forseeable future. Sometime in the next century the concentration of carbon dioxide in the atmosphere is predicted to be twice what it was before the Industrial Revolution.

This level of carbon dioxide combined with projected increases of other greenhouse gases will be large enough to have a measurable influence on the Earth's climate. What is uncertain is the exact size and nature of this influence.

In an attempt to understand the impact of increasing greenhouse gases as well as other natural and human influences on climate, scientists have created large, complex computer models of how the climate system work, Pennell says.

As complex as the models are, however, they can only represent approximately how nature really operates. As a result, climate change predictions will always contain a degree of uncertainty.

Using these types of climate models, scientists have estimated that the average temperature of the Earth's surface could rise as much as from 2 to 9 degrees over the next 50 to 100 years.
If the actual increase turned out to be on the high side of the prediction, it would mean that the average temperature of the Earth would be higher than it has been for the last 150,000 years.

In addition, this amount of warming in this short a time is thought by many scientists to be greater than anything the Earth has experienced in its recent past.

Because the Earth may never have experienced such a rapid increase in temperature, we don't really know what to expect, but it's likely that if the Earth's temperature gets hotter by just a few degrees it could change the weather all over the planet.

The severity and frequency of storms could change as well as the timing and amounts of precipitation. Some locations could become considerably warmer and drier, some locations wetter, and some locations could experience no significant changes at all. Snowlines would, in general, move up in elevation and to higher latitudes (bad news for skiers), but some locations actually could receive more snow. Sea levels also would rise. These changes are indicated by current climate models and geological records from periods in the Earth's history when it was a few degrees warmer than it is now.

It's still too soon for scientists to be able to predict with any certainty just what the ultimate effects of global warming might be. However, scientists all over the world—including those in the Global Studies Program at the U.S. Department of Energy's Pacific Northwest Laboratory—currently are gathering data to help them understand and predict the magnitude, timing, and regional effects of any global climate change.

In studying global change it is important to understand how ecosystems, like our arid land ecosystem, respond to changes in climate. For example, weather always has been a primary factor in

determining the kinds of plants and animals that inhabit an area. If the climate changed rapidly, it's likely we would see irreversible changes in the region's ecosystems.

If the climate warmed (and became drier) in the Northwest, we would be sure to see some lasting changes in the kinds and abundance of plants and animals that inhabit the Columbia Basin. With sufficient warming, it is likely that shrub-steppe lands, like ours, would expand their range. Both sagebrush and bunchgrasses would move into the surrounding foothills and mountain slopes.

Forested areas in nearby mountains would shrink in size, and some tree species could even be displaced. Douglas fir, for example, a common conifer tree in the Cascade Mountains, would likely migrate to higher elevations and be replaced in lowland areas by pines. Overall, pine trees—which are more drought tolerant—would increase at the expense of many of the present-day tree species in nearby forests such as fir, hemlock, larch, and spruce.

It's also likely that other plants currently having a difficult time surviving in Northwest ecosystems would face the greater risk of extinction. For example, rosy balsamroot (*Balsamorhiza rosea*) and Columbia milkvetch (*Astragulus columbianus*), two plant species that have limited distributions in eastern Washington, might not be able to adapt quickly enough to survive warming temperatures.

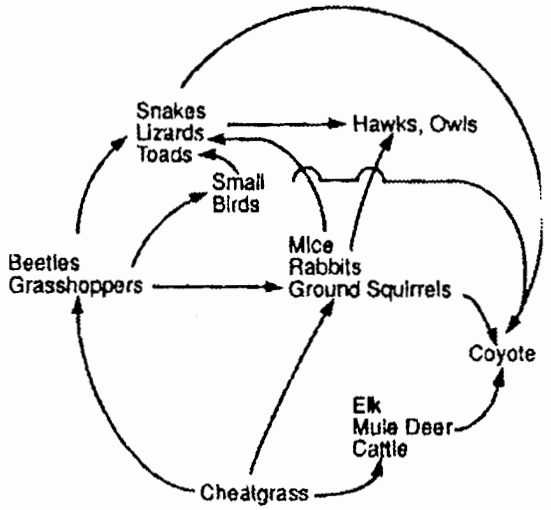
Predicted climate change may have less impact on animals in the Columbia Basin because they are more mobile than plants. But animals depend on plants as a source of food and for cover. So, it's

likely that the more adaptable animals would shift their ranges to compensate for vegetational shifts in their habitat. Those animals that could not adapt to changes in reduced food or cover could suffer reduced populations or become extinct.

The spotted owl, for example, a rare species that depends on the old-growth forests of western Washington and Oregon for its survival, could have difficulty if the forests changed their boundaries. Increased forest fires, a possible consequence of global warming in some areas also could place added stress on spotted owls and other species. Wide-ranging animal species such as the cougar also could find it hard to survive in an ever-shrinking forest habitat.

Although some plants and animals would suffer under changing climatic conditions, other generalists of the natural world—cheatgrass, Russian thistle, starlings, sparrows, coyotes, small rodents and insect pests—would probably thrive. Coyotes and deer mice, common creatures in the Columbia Basin, also have proved to readily adapt to human-modified habitats. Such animals likely would fill any gaps left by plants and animals unable to adapt to changing conditions, but it would be a far-less interesting world without them.

Of Mice and Coyotes and Thermodynamics



Sunlight pouring over the shrub-steppe of eastern Washington provides energy for plants to grow by the process of photosynthesis. When a plant such as cheatgrass, "captures" the sun, it uses the sun's energy not only to "feed" itself, but also to feed a lot of other living things in the natural ecosystem.

Plants play the lead role in all food chains. They form the base from which all other creatures—including humans—eat. Because only plants perform the "energy capture function" to any extent, they are known as primary producers. Who eats what after that depends on how an ecosystem is organized and how it functions.

Let's look at how a simplified food chain works in our shrub-steppe ecosystem.

First, much of the energy a plant captures is used for its own maintenance, growth, and reproduction. Our example, cheatgrass, also stores energy in its tissue. This stored energy then becomes a source of energy (food) for any living thing in the shrub-steppe that eats the cheatgrass and subsequently is consumed by another animal.

For example, after the cheatgrass stores its energy, a mouse comes along and feeds on the plant's tender growing stems. The mouse becomes the first, or primary, consumer in the food chain.

The mouse uses a lot of the energy it gained from eating the cheatgrass while it's running around the shrub-steppe, but the mouse, too, stores some energy in its tissues. The mouse tissue then becomes available as a source of energy to the gopher snake that decides to eat the mouse. The gopher snake, a carnivore, becomes a secondary consumer in the food chain. Carnivores are secondary consumers because they eat animals that eat plants.

Then the snake becomes the prey of a hawk hunting along the face of Rattlesnake Mountain; the hawk is an even higher level consumer in the food chain.

Food chains are so named because of these "pathways" of constant energy flow through the ecosystem. When we study food chains in our arid land ecology studies, we always start by first determining what consumers and producers are present and what they eat. Scientists can determine the diets of most plant eaters, like mice, by collecting their droppings (scat), drying it for a few days, grinding it, and then mounting the material on slides so it can be analyzed with a microscope. Not all plant material consumed is digested.

Green plants, which serve as the base of all food chains, are common while higher level consumers such as hawks and owls are few in number.

We have only to look to the first and second laws of thermodynamics to understand why this has to be the case.

- For example, the first law of thermodynamics says that the total amount of energy must remain constant. In regard to food chains, this means that when the mouse eats the cheatgrass, the energy is merely converted from one form to another.
- But the second law of thermodynamics says that energy cannot be converted from one form to another (the gopher snake to the hawk, for example) without some energy being lost as heat. In general, in ecological systems, this means that only 10 percent of the energy stored is transferred, which is quite low. When the hawk consumes the gopher snake, 90 percent of the energy is lost.

Let's use the coyote as an example to follow how this energy transfer process works in the food chain. Say you see a coyote running across the road. Believe it or not, there goes about a ton of grass, forbs or shrubs. At 10 percent energy efficiency, a mouse needs to eat 10 pounds of vegetation to make 1 pound of mouse tissue, and a coyote needs to eat 10 pounds of mouse tissue for 1 pound of coyote tissue. So if a coyote weighs 20-25 pounds, it took nearly a ton of grass, shrubs, and other vegetative matter to make those 20-25 pounds of coyote tissue.

Of course the ecological food chain is not always so simple. Actually the term "chain" is an over simplification of what really goes on. The mouse described above may feed on several different plant species and may end up as prey for any of a variety of different snake, mammal, hawk, or owl species. It is more proper to refer to these individual links as being part of a more complex food-web rather than as a simple chain.

Spring

The Awakening Land

If you look off toward the Rattlesnake Hills on a midwinter day the various shades of brown extending as far as the eye can see provide ample evidence that the land is still locked in winter's somber embrace. But it's not that way all the time. Our view is occasionally enhanced by passage of a storm, leaving the mountain covered with a light coating of snow.

Storms come and go, and suddenly spring is here. For me, the bleakness of winter's overcast skies are broken when I first see the tiny green shoots of Sandberg's bluegrass (*Poa sandbergii*) poking up from the soil. This diminutive bunchgrass would hardly be noticed later in the spring, but what a welcome sight in February.

Thompson's ground squirrels (*Spermophilus townsendii*) reappear above ground in February. These small rodents require green plants such as Sandberg's bluegrass as food, and their emergence from winter sleep is closely timed to its availability. Pocket mice, too, appear above ground in late February. However, unlike the ground squirrels that scamper during the daylight hours, pocket mice are strictly nocturnal. Fresh mounds of soil also appear in early spring as evidence that the northern pocket gopher (*Thomomys talpoides*) is actively expanding its below ground burrow system.

The ferruginous hawk (*Buteo regalis*) usually returns to the Columbia Basin in late February or early March. This large raptor feeds primarily on rodents such as ground squirrels and pocket mice. Consequently, its migratory behavior patterns are directly attuned to that of its prey and indirectly to the greening of the grasses.

March is a time of great activity in the natural world. The first week of March is when the star flower (*Crocidium multicaule*) population begins to bloom at Hat Rock State Park near Umatilla. The individual plants of this species are small and not especially attractive individually, but they frequently occur in such profusion that they provide a spectacular display of bright yellow flowers at a time when few shrub-steppe plants have begun to flower.

Dandelions also begin to bloom in March. This much-maligned little flower provides an abundance of nectar and pollen for a variety of insect species at a time when little else is available for them.

Burrowing owls return to the area in March and begin the search for burrows to serve as a nest. These small owls usually can be found sitting on the ground near an old burrow entrance or on a nearby fence post. They begin nesting in early April. Watch for Curlews on about the fifteenth of the month. Their long, curved beak and plaintive "curlew" cry make these pheasant-sized birds easy to spot.

The lupines (*Lupinus species*) begin to flower in early April. Lupines are one of the most characteristic of the flowering plants that inhabit the shrub-steppe. They have pea-like flowers that come in a variety of colors blue, purple, and even white. Bitter-brush (*Purshia tridentata*) is the largest spring flowering shrub of our area. The flowers are small but numerous, making the plant particularly attractive when it flowers. Watch for flowering right after the cherry and apple trees have finished blooming in early April. Bitterbrush normally blooms for 3 to 4 weeks, so you have plenty of time to search them out.

Sandhill cranes (*Grus Canadensis*) frequently migrate through our region in mid- to late April as they head north to their nesting areas, but they rarely land. I usually hear them before I see them as they pass high overhead, alternately flapping their wings and gliding. Their call is very characteristic, sort of a loud musical rattle and one you will never forget.

By the end of April the activities of the shrub-steppe will be in full swing. Multitudes of insects will have hatched. Most small bird species will be engaged in preparing the nest and rearing young. Once again the cycle has turned and the land is green again.

The Greening of Spring

During late winter and early spring in the Columbia Basin, when the earth slowly warms, there is real beauty in this land—at least for those who take time to seek it out. This beauty appears in the form of growing grasses, in the colorful display of wild flowers, and the reappearance of native animals as they reestablish their age old cycles of life. Let's look at what's been happening with plants and animals in the shrub-steppe and what will likely happen as the seasons change.

March

- Bluebunch wheatgrass, a large bunchgrass, several inches in diameter, begins its growth cycle. Bluebunch wheatgrass starts to grow about March 1st, grows rapidly during April and May, forming seed heads by the end of June before the heat of summer sucks moisture from the soil. This grass supported the vast herds of Indian horses and early livestock industry of the Columbia Basin. Most of the original bluebunch wheatgrass habitat is now under cultivation but you can still see it in nearby hills.
- Goldstar, one of our earliest blooming wild flowers begins to flower this month. This tiny annual is less than 6 inches tall. Sometimes its flowers are so abundant they carpet the ground with a spectacular display of bright yellow. The best place to view them near the Tri-Cities is around Hat Rock State Park near Umatilla. Goldstar normally remains in bloom until the end of March.

- Bitterbrush, a sagebrush look alike, begins to bloom about the end of March. Scattered patches of bitterbrush also occur at Hatrock, so if it's too late for the goldstar bloom it will still be worth the trip to see this shrub. Bitterbrush has small yellow flowers so you have to look closely to see them. Sagebrush has even smaller flowers and blooms, but it blooms in the fall so there is no mistaking the two at this time of the year.
- As a boy growing up in the Midwest, I always watched for the first robins of spring. In the Columbia Basin, robins are pretty much around all year long, except during the coldest part of winter. Now I watch for the return of the curlews. If you are not familiar with curlews they are a large bird (about 20 inches tall) and have a long downward-curving bill. Their call is a plaintive "*curlew*" with a rising inflection on the last syllable.

April

- The lupines start blooming and should remain colorful until the first of July. Their flowers grow in rather dense, elongated clusters at the tip of the stems. Lupine flowers are pea-like and vary from blue to lavender and occasionally white. Some years the lupine bloom is quite spectacular, extending for miles. At other times, only scattered individuals may bloom. Lupines are members of the legume family, and like other legumes, fix nitrogen and are therefore an important component of the arid ecosystem. They are not, however, welcome on rangeland because they contain poisonous alkaloids and have been known to injure livestock, especially sheep who feed on the toxic seeds and pods.

- Balsam root is a sunflower-like plant that should be well into bloom by mid-April when its yellow flowers bring a bright display of color to the shrub-steppe. Balsamroot grows as distinct plants scattered through the bunchgrass and sagebrush. Its leaves are large, and unlike sunflowers grow from the base of the plant. Balsamroot has long and thick roots that, reportedly, provided a food resource for native peoples and early settlers of the region.

- Phlox, a low-growing, cushion-like plant, should be in full bloom in April. Its flowers vary from pink to a lilac-purple color. Often, phlox grows beneath sagebrush with its branches climbing up and over the sagebrush limbs, making it appear as if the sagebrush is sporting colorful flowers.

- April is also the time to observe nighthawks. They nest on the ground or occasionally on the roofs of flat-topped buildings. Nighthawks are insect eaters that catch their prey on the wing. They are most active in late afternoon and evening. Near their breeding areas they fly high in the air and then dive rapidly, making a musical whirring sound, something like the sound of rushing wind followed by a soft "Whoooom!" The Rattlesnake Slope Wildlife Recreation area east of Horn Rapids Road between Highway 240 and Benton City is a likely place to see nighthawks, as well as balsam root, lupine, and the phlox.

May

- Hawksbeard should be blooming in May. This wildflower superficially resembles the common dandelion with its bright

yellow ray-like flowers. Its leaves are deeply notched and rise from the base of the plant. Hawksbeard is a much smaller plant than balsamroot, which should also still be in bloom.

- Hopsage, a small shrub, also should be in bloom. This is an interesting species because there are separate male and female plants. Hopsage flowers are very tiny and difficult to see. As seeds develop on the female plants they become tinged with red and are quite colorful.

June

- This is the month when many plants and animals prepare for the stressful summer drought. The long seed heads of bluebunch wheatgrass should be mature, and the above ground leaves will have begun to brown. Ground squirrels once again return to their underground burrows where they will wait out the hot, dry summer and cold winter conditions only to reappear again the following year.

A Window of Wildflowers

There are many people who live all of their lives in the Mid-Columbia without ever learning to recognize the native plants or learn their names. I believe this may be at least partly due to the somewhat peculiar appearance and strange sounding names of many of the plants.

Take bastard toad-flax (*Comandra umbellata*), for example. To me, this plant is as unattractive as it sounds. It is rather short in stature (less than 12 inches) and has gray-green leaves and pale-colored flowers. It normally occurs in sandy areas at lower elevations. It makes its living as a parasite on the roots of a variety of other plants, although it does engage in photosynthesis and can survive on its own, if necessary.

Fortunately, identification of many of the common shrub-steppe plants like bastard toad-flax is not difficult. Books such as *Sagebrush Country,* published by Touchtone Press or *Washington Wildflowers*, published by The Seattle Audubon Society provide excellent illustrations of common plants as well as background information about their habits and uses. Other excellent guides and booklets are available at local bookstores.

Shrubs and grasses are the dominant native plants of the area, but it is the floral displays of the forbs that catches the eye in the early spring. I always look forward to the blooming of phlox (*Phlox longifolia*). Their pinkish colored flowers first appear in early spring and remain through the early summer months. Balsam root, too, with its long silvery leaves and sunflower-like yellow

flowers are characteristic of the upper the slopes of shrub-steppe habitats if livestock grazing has not been too intense in earlier seasons.

However, it is the elegance of the native lilies that steal the show in pure wild beauty. The Mariposa lily (*Calochortus macrocarpus*) is a particular favorite of mine. It is never abundant but dots the landscape with a seemingly random scattering of isolated individual flowers. It is always a surprise to come upon them nestled in among the sagebrush and bunchgrasses. This is a large plant from 8 to 20 inches in height with long grass-like leaves that rise from a perennial bulb located several inches beneath the ground Mariposa lilies have large and showy lavender flowers that normally bloom for only for a short time.

The sego lily (*Calochortus nuttalli*) is a close relative of the mariposa lily and is another pretty little flower common to shrub-steppe lands. It blooms earlier in the spring and is of a much shorter stature than the sagebrush mariposa. The bulb-like roots of the lilies are probably eaten by native animals such as pocket gophers and other rodents. They also were considered a great delicacy by the Indian tribes and early settlers of the region.

The floral season in the shrub steppe is short but marked by a magical display if you take the time to seek the flowers out. Many native species can be found within easy walking distance along our Mid-Columbia roadways. For best results, search lowland areas such as those along the Snake and Columbia rivers early in the spring (March/April) and gradually shift to higher elevations such as the Horse Heaven Hills, Saddle Mountains, or the Umtanum Ridge later in the season.

But remember, the flowers of the shrub-steppe are here only for a few short weeks each year, so don't wait.

For the Love of Lupine

Lupines—the lovely purple-blue spiked flowers reminiscent of English cottage gardens—are one of the most characteristic wildflowers of the Mid-Columbia region. Although the different species often are difficult to tell apart, as a group you can readily distinguish these flowers from other shrub-steppe wildflowers.

Janelle Downs, a research scientist who specializes in Hanford plants, says we have three common species of wild lupines in our area.

- One, the velvet lupine (*Lupinus leucophyllus*) is a tall plant with a long spikelet of flowers that range from lavender to nearly white.
- Another species is the sulphur lupine (*Lupinus sulphureur*). It's a smaller plant with more branches than the velvet lupine.
- The spurred lupine (*Lupinus laxiflorus*) grows on upland areas and is frequently abundant along ridge tops near the Tri-Cities. It readily integrates with velvet and sulphur lupines, so its appearance is highly variable.

Lupines begin growing each year in early April, flower during April and May, and stop growing in June. Sometimes you'll see them scattered among the sagebrush and native grasses. At other times you may see a flush of growth, large colorful fields of lupine flowers waving in the breeze.

One of the most distinguishable characteristics of lupine is their pea-like flowers and the palmate leaves that rise along the elongated stem. Palmate simply means several, usually five to seven leaflets, all rise from the same point on the stem and extend out like the palm of your hand with your fingers spread.

Lupines have an interesting method of dispersing seeds. The plant and seed pods dry out as the seeds mature. When the seeds are fully mature, the pods suddenly pop open, and the seeds are forcefully expelled. This is nature's way of releasing the next generation from the parent plant.

Lupines belong to a group of plants called legumes, and like all legumes, they are able to "fix" nitrogen. This is a very important attribute because many soils in our region are nitrogen deficient. Ted Hinds, a former colleague at Pacific Northwest Laboratory, studied the effects of lupine on the amount of nitrogen in soils on ALE. He found that the plants provided a very important contribution to the ecosystem: they nearly doubled the available nitrogen in soils during those periods when flushes of lupine growth occurred.

But there is also a negative side to the lupine story. Lupine seeds and pods contain poisonous alkaloids. Alexander McGregor in his book *Counting Sheep From Open Range to Agribusiness on the Columbia Plateau* describes how hungry sheep were poisoned and died while being trailed through and feeding on lupine patches.

So, lupines, like so much of our native flora and fauna, are beautiful and useful and must also be treated with respect as part of our natural world.

Spring Flowering Trees

We usually think of wildflowers as flowering herbs that are native to a particular area or region. However certain weeds, exotic species that are not native to the region, as well as shrubs and trees also produce flowers that are sometimes spectacular. Two of my favorite flowering trees of the Columbia Basin are the black locust and Russian olive.

Black locust (*Robinia Pseudoacacia*) usually begins flowering in our area in early May. Its fragrant white flowers hang in long clusters up to 5 or 6 inches long. Locust trees are good for wildlife. Birds and small mammals eat their seeds, deer browse the foliage, and honeybees make a very good quality honey from the nectar. The flowers are particularly attractive to bees.

As an amateur beekeeper, I always heave a big sigh of relief when the locust trees begin to bloom. I know then the spring flowering period has begun in earnest, and I no longer need worry about the bees starving from lack of available food. The pollinated flowers develop into long, brown leathery seedpods. Some stay on the trees through fall and winter months, and when the wind blows they make a dry rustling and very pleasant sound should you happen to be strolling beneath their branches.

Black locust is native to eastern North America. The tree frequently grow to a height of 70 or 80 feet in the eastern United States, but in our region 40 or 50 feet is more typical. The bark is dark brown and furrowed, and the wood is strong and resists decay.

It is a deeply rooted tree particularly adept at resisting periods of drought. For these reasons, early settlers of the region frequently planted black locust trees around their homesteads. Consequently, the tree now grows throughout the continent at elevations below 5,000 feet.

It is frequently possible to identify the locations of abandoned homesteads in our area by the presence of these early plantings. Some black locust trees planted around homesteads located on the Hanford Site, for example are still growing after nearly 50 years without human care.

Russian olive (*Elaeagnus angustifolia*) trees have a tough time deciding whether they really are trees or shrubs. They make an attractive looking tree if the lower branches are pruned while young, growing 25 to 30 feet tall. If the side branches are allowed to grow (and with some pruning) they are a nice looking shrub about 10 feet in height. This attractive tree is native to central Asia and southern Europe and was introduced into North America during colonial times.

Russian olive is a very hardy tree and is now planted throughout the United States. The foliage has a silvery hue that is quite pleasing. The flowers are small, bell shaped and yellow. They are very fragrant and particularly attractive to bees. Russian olive usually blooms in our area about 10 days to 2 weeks later than locust.

Russian olive is highly resistant to drought, cold, and wind damage, and consequently, makes a good wind break. Frequently planted as close as 5 to 6 feet apart, they make an almost impenetrable living wall and provide both cover and food for wildlife. The small mealy berries are consumed by a variety of birds and

other animals. However, you shouldn't try them yourself. Russian olives are not true olives.

Both black locust and Russian olive trees are popular ornamentals and common in local windbreaks and parks (Hood Park near the Snake River bridge is a good place to see both species). You have to watch to determine when the black locust is in bloom, but you will know when the Russian olive trees bloom (about mid-May). The fragrance from the tiny Russian olive flowers is simply overpowering, at least to me.

Clouds and Ecosystems

One of the fundamental laws of ecology is that all living things are interconnected in some way with all other living and nonliving things. Except for clouds that is. Scientists have mostly ignored clouds in the study of ecology because we don't really know what to do about them. They drift along in great towering masses or sometimes individually looking for all the world like Aunt Martha's pet poodle Henry. But how do clouds affect the natural world around us?

Years ago, when I was a graduate student working on my Ph.D. dissertation in insect ecology, I would drive out to the Pawnee Grasslands in eastern Colorado to study the role of harvester ants on the environment. One of the things I wanted to know was what kinds of food materials and how much food the ants were bringing into the colony every day. One thing I noticed was that the ants stopped foraging whenever soil surface temperatures reached about 120 degrees.

When clouds passed over, temporarily shading the mounds, the ants rushed out to collect seeds and capture small prey such as grasshoppers, caterpillars, and aphids. Then, as the sun reappeared, the ants would rush back inside. I didn't attach much significance to this observation at the time. These types of observations are usually considered to be "noise." I wanted to know the influence of temperature, but clearly the number of clouds, their size, and how fast they moved across the sky directly affected the ants' rate of seed collection and prey capture.

What about plants? How do clouds affect them? Steve Link, a research scientist at Pacific Northwest Laboratory, is studying the life processes, activities, and functions of shrub-steppe plants on ALE. He has "wired" various plants to monitor their water use and rates of photosynthesis. One thing Steve has noticed is a drop in water use when clouds pass overhead, sometimes by as much as 50 percent. You might say that the grasses and shrubs "sense" this silent passage of clouds.

Taking things a step farther, what happens to all the little aphids and other insects who happen to be blissfully sucking the juices from the leaves and stems of plants when a cloud passes? Does the change in water pressure cause a reverse flow, suddenly sucking the aphids stomach contents back inside the plant? We know that many of these little insects carry viruses and other microorganisms that cause disease. Does this mean that clouds may have a direct influence on the infection rate of plant diseases? And would an overall change in cloudiness in the world increase the incidence of disease for native plants as well as agricultural crops, reducing the availability of food? I don't know, but it is interesting and a little scary to speculate about possible future conditions.

What can we expect in the way of clouds for the future? Well, they will still be here that's for sure, but right now it's not clear if we will see more or fewer of them. Most of the global climate model predictions are for global cloudiness to decrease with increasing levels of CO_2; however, there is some historical information that indicates an increase in cloudiness when global temperatures warmed in the past. We know that any climate change associated with increased carbon dioxide levels in the atmosphere will

result in changes in the type, height and amount of cloud cover in the world. Increased cloudiness would likely mean warmer nighttime temperatures and cooler daytime temperatures, and some scientific evidence exists for both in recent records.

What do all these changes in the amount of cloud cover mean for our plant and animal friends? Less sunshine would probably mean less plant production. Our desert plants would likely improve their water use efficiency so we might see a shift in the kinds of plants (more shrubs and less grasses) and animal species, not an overall reduction in abundance. What is becoming clear is that both our wild land and agricultural areas are closely coupled to conditions in the atmosphere. Any change in cloud dynamics will cascade down, affecting the plants, aphids, ants and all other consumers, even humans, in our natural world.

A Niche for Ants

Ants have fascinated humans for thousands of years. Many of the ancients such as Aesop, Solomon, and Pliny all held these industrious creatures up as an example to be followed. Perhaps that is why so few people like ants: nothing is more exasperating than a good example.

Of the about 2,000 species of ants worldwide, many live here in the Columbia Basin. On ALE on the northeastern slope of Rattlesnake Mountain, I have collected and cataloged about 20 species. You probably are familiar with the little brown house ant (don't worry—everybody has them) and perhaps the red and black Formica ants common to the yard and garden. But others of the region's ants are far more secretive. For example, two species of a rather large ant are seldom seen, since they only come out at night.

The most conspicuous signs of ants in the Columbia Basin are the huge mounds of the red harvester ant (*Pogonomyrmex owyheei*). About a foot in diameter, the mound is usually a somewhat flattened cone from 3 to 6 inches tall. Often, the mound is surrounded by a bare area that the ants keep cleared of vegetation.

The harvester ant makes its mound of small gravel and soil particles, cemented together so that the mound is waterproof. The ants often pick up other small particles of material such as pieces of glass from the surrounding area and place them on the mound. In Colorado I have seen mounds that contained small pieces of jade and even the teeth of small animals. You generally find a refuse dump on the backside of the mound. Here the ants "dump" the

hulls of seeds or other pieces of inedible organic matter they remove from the nest. The mound itself leads to a series of tunnels and galleries that extend 6 or more feet into the ground, where in winter the single queen ant and her workers hibernate below the frost line. I have excavated colonies where the over-wintering chamber was as much as 12 feet below ground.

The queen spends the spring and summer months laying eggs raised by her workers. As the season progresses, the workers move the eggs and young larvae up and down through the soil to maintain just the right temperature and moisture for the baby ants. This time of year you can often find the queen and young larvae up in the mound itself, which warms quickly during our sunny days. During evening hours the ants move their charges back below ground to avoid cool temperatures near the surface.

As the plant seeds mature, thousands of foraging ants search the area around the nest for food. These foraging journeys can be as long as a football field. They store seeds in chambers that serve as their granaries. Harvester ants will take any seed they can carry. They are also predatory, capturing caterpillars, immature grasshoppers, small beetles, and other small insects to provide protein in their diet.

It is uncertain just why ants remove vegetation from around the nest. The bare disc does provide a certain amount of protection from wildfires. The cleared area also increases the amount of soil water around the nest, and since the ants have no access to drinking water, I suspect that the clearing serves to keep vegetation from sucking up soil water needed by the ants.

New ant colonies are established each year. Tremendous numbers of winged ants, the reproductive males and females that develop from the first eggs of the year, emerge simultaneously from several colonies (frequently after a storm) and fly to some prominent nearby feature such as a hilltop, tree, telephone pole or building, where they form mating clusters.

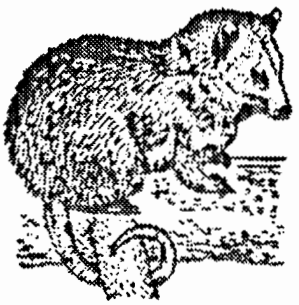
While studying ants in the short-grass plains, I experienced being the tallest nearby "structure." Being covered with thousands of mating harvester ants is something you don't soon forget.

Following mating, the female queens disperse to start new colonies. (The males are not so fortunate; any male lucky enough to mate does so at the sacrifice of his own life.) The female sheds her wings, digs a chamber into the soil and lays her first eggs. The first brood will take over all foraging, nest-building, and brood-care activities when they mature, leaving the queen with the sole duty of laying eggs.

Harvester ants are one of the more primitive ant groups. The harvester ant, like most of its bee and wasp cousins but unlike the red and black formica ants that you see in your yard, is armed with a stinger. I have been stung frequently by honeybees during my bee keeping activities, and I will take a honeybee sting over the sting of the harvester ant anytime. Because its stinger is small and somewhat weak, the harvester ant has a more difficult time stinging. It needs to grab a small piece of skin with its jaws (mandibles) bringing its abdomen up to insert the stinger in the piece of pinched skin. Normally, you can get them brushed off before all of this happens. Although a harvester ant sting is not unbearably painful, it does remain swollen, red, and itchy for several days.

In spite of their stings, these ants, like other members of this little-known group of insects, are an interesting and likable part of sagebrush country.

Mid-Columbia Opossum Not Typical Mammal



The American opossum (*Didelphis marsupialis*) is different from most mammals that occupy the Mid-Columbia. It is a marsupial, which means the female has a pouch (marsupium) on front of her abdomen in which she carries her young. The best known marsupial is the kangaroo from Australia. Other opossum-like marsupials exist in North America, but they all occur far to the south in Central America and Mexico.

The American opossum traditionally has inhabited the southeastern United States, but has spread over much of North America. The grasslands and deserts of the West historically have limited their western distribution. However, since they were introduced to Pacific Coast areas in the early part of the 20th century, they have expanded their northward range rapidly and now occur from Mexico to Canada.

The average opossum is about the size of a large domestic cat. It has a grayish body with dark-colored ears and feet and a white pointed face. Its tail is nearly as long as its body and is covered with scales. The tail is also prehensile, which means the opossum can wrap it around a branch and use it as an "extra hand." This tail conjures up the familiar image of the opossum hanging by its tail from a tree branch. The animal's hind foot has an opposable toe that, which along with its prehensile tail, helps it climb about in trees.

You aren't likely to see a live opossum as they tend to be highly nocturnal, as are many animals in the Columbia Basin. Opossums locate their dens in hollow trees, beneath buildings, or even in the burrows of other animals. They line the nests with leaves and other dry vegetative materials.

Opossums are highly omnivorous, which means they eat a wide variety of food items. They kill rodents and snakes, but mostly they feed on insects, fruits, birds, and bird eggs. A large part of their diet consists of animals that already are dead. They frequently forage for dead animals along roadways, and consequently, are themselves frequently hit and killed by cars.

The American opossum displays a unique defensive technique that has given rise to the term of "playing opossum." If attacked, the "possum" may roll over on its side and with its eyes closed, lips pulled back, and tongue extruded appearing as if it has died. This may cause its attacker to disregard it long enough for the opossum to suddenly wake up and scamper to safety.

The breeding season for opossums is long, running from late winter into the fall months. As many as 20 or more young are born about 15 days after mating. They are extremely small when born, about the size of a honeybee and must immediately find their way up through their mothers' fur to the marsupial pouch. There they stay for the next 2 months, nursing and growing larger. After that, they are too large to fit in the pouch, but remain in close association with the mother for another 6 weeks, often riding about on her back.

The best place to look for opossums in nature is along streamsides or near agricultural lands where there is plenty of food and cover. Watch for tracks in the mud and soft soil. The peculiar hind foot with its slanted or backward-pointing "big toe" and the three middle toes close together will help identify this inhabitant of our Mid-Columbia region.

Beavers

The beaver (*Castor canadensis*) is the largest rodent in North America. It may reach lengths of about 3 feet and weigh more than 60 pounds, but any beaver you see in the wild is more likely to be about half that size. Its size and its flattened tail make the beavers easy to distinguish from other aquatic rodents in the Mid-Columbia.

The beaver's tail is a remarkable appendage. It is long and flattened from top to bottom and appears to be used as a rudder when the beaver swims. If startled, the beaver slaps the surface of the water with its tail and dives for cover. A beaver's hind feet are fully webbed to aid the animal in swimming, and it has large "gnawing" rodent teeth that continue to grow as long as the animal lives. Beavers also have a luxurious chestnut colored fur that has been much sought after by hunters and trappers.

No other animal has been as responsible for the exploration of western North America than the beaver. The quest for beaver pelts led trappers and explorers to initiate trade with the Native American tribes and establish trails that would be used later by settlers during their westward migrations. In our own area, old Fort Walla Walla was established as a trading post about 1820. The fort was close to the banks of the Walla Walla and Columbia rivers near present-day Wallula.

Beavers always are found close to water. They are well known for their habit of constructing a dam from sticks and mud, often creating a pond several acres in size. They then build a dome-shaped lodge in the pond for their home. There will be one or more underwater entrances below the ice level to allow them to enter and

leave the lodge during the winter months. In large streams or lowland areas, beavers are not so inclined to build lodges and dams but instead make a nest by burrowing into the river banks.

Beavers do not hibernate and must have a food supply all year around. They are able to fell trees of more than a foot in diameter by gnawing. They then cut the pieces into smaller sections and drag them to water where they are floated to the dam or lodge. Green twigs and branches are taken to the deeper parts of the pond and anchored in the mud for winter use. Favorite foods include willows, alders, birch, aspen, and cottonwood trees. Unfortunately, beavers have found that apple and cherry trees planted along the Yakima and Columbia rivers are quite tasty, too, much to the consternation of local orchardists.

Beavers are believed to begin mating when they are about 2 years old. The litter of two to six kits is delivered during April and May. The young weigh about a pound, are fully furred, and born with their eyes open. The young remain with their parents for the first year but leave shortly after to seek new homes. At such times, they are most vulnerable to attack from predators. Bobcats, coyotes, mountain lions may all take a few beaver when they wander far from the protection of deep water.

It is easy to tell when you are in the vicinity of a beaver lodge or den. Watch for the pointed tree stumps and snipped-off bushes and reeds along the water's edge that tell you beavers have been at work. You may also see a large dome-shaped house (some 5 or 6 feet high and 20 feet across). Note the presence of the beaver dam. Also watch for their tracks. The large webbed hind feet are distinctive.

The Yakima River is a good place to look for beaver "signs." Another good place is along banks of the Snake River at Hood Park. Beavers also have been seen within the McNary pond system. Late afternoon or evening is a good time to look for beavers as they begin their nocturnal activities. Approach the area quietly and you may see a V-shaped series of ripples on the surface of the water. Look closely and you will see the nostrils, eyes, and ears of a beaver swimming silently. If you are careless in your approach all you will hear is a loud whacking sound as the beavers hits the water with its tail and dives for cover.

Spotting a River Otter

Many animals within the Mid-Columbia region are as rare as the river otter (*Lutra canadensis*), but none is more engaging or as entertaining to watch. The river otter has a large graceful body about 3 feet long with a thick somewhat flattened tail that tapers to a point. Its head is rounded with short ears, large soft eyes set high on the forehead with prominent whiskers. Its legs are short, and its four feet are webbed to aid the otter in swimming. The fur of river otters is thick and soft, brown in color and very durable. Consequently, river otters, like beavers, have been much sought after by hunters and trappers.

River otters belong to the family of mammals called the Mustelidae. Other family members include weasels, mink, martens, fishers, wolverines, badgers, and skunks. Their closest cousins are sea otters. However, sea otters are a different species entirely, spending nearly their whole life at sea and rarely, if ever, coming ashore. The river otter is called by different names in different places, including common otter, land otter, and Canada otter.

Although the river otter is generally thought to be a nocturnal creature, it often can be observed hunting for food or "playing" during the daytime. A favorite form of "play" involves sliding down a stream or lake bank into the water. The otters climb up the bank and slide down over and over, much like a human child enjoying a game at a favorite swimming hole. The slides can be 25 to 30 feet long and about a foot wide. They are easy to spot.

River otters are good swimmers. Sometimes they swim in a leisurely fashion with just the top of their head and eyes out of the water. At other times, they undulate through the water like a dolphin or swim entirely under water, only occasionally surfacing for a quick breath of air. In the water, the river otter paddles with its hind feet and sculls along with its tail. These animals also are quite adept on land where they display the distinguishing loping gait of the weasel clan.

Otters are good hunters and feed on a variety of prey including worms, insects, frogs, small turtles, crayfish, and occasional small birds and fish. However, most fish they consume are the "rough" fish and not the game fish so prized by human fishermen.

River otters mate in late winter or early spring and have two to four young from 10 to 12 months later. The young, called kits, are born toothless and blind and are helpless for the first 6 weeks or so of life. They then become very active and are soon coaxed into the water by their mother where she teaches them to catch and eat their food.

There are not as many river otters now as during the past. In addition to pressure from hunting and trapping, river otters have proven to be very sensitive to pollution. Although at lower numbers, river otters have been found along waterways throughout all of the lower 48 states, through all of Alaska except the extreme north and they also occur within all of the Canadian provinces.

I frequently have seen river otters while conducting ecological studies along the various streams and rivers of northwestern Wyoming during my graduate student years, but I have never seen

one in the Columbia Basin. They do occur here and have been seen frequently within the Hanford Reach of the Columbia River. Bill Rickard, a senior scientist at Pacific Northwest Laboratory, has seen otters several times along the Hanford shoreline over the last 5 years and believes they have now taken up permanent residence in the area.

River otters move a great deal, often covering 50 or 60 miles during the year, so it's difficult to predict where they might be found at any given time. When out on the rivers or along shorelines watch for signs of slides along areas with high, sheltered banks. Also watch for their tracks along the shoreline. The tracks of a river otter cannot be mistaken for any other animal in our region They have five toes, all with claw marks and with webs between the toes clearly visible. Don't overlook the ponds and marshy areas as they too are favorite spots. And count yourself lucky if you see this most engaging member of our Mid-Columbia wildlife.

Lizards Link Web of Life

Lizards are also one of the most important vertebrate groups inhabiting arid regions of the world where they provide important links in food chains. Unlike birds and mammals, lizards are ectothermic animals, which means they obtain their body heat from outside sources, either directly from the sun or from the soil and air.

During cool early morning hours, lizards frequently can be seen sitting on rocks with their bodies positioned to obtain maximum heat from the sun. In the heat of the day, they frequently sit in shady areas beneath sagebrush plants or within nearby animal burrows.

You should have little difficulty finding lizards in the Mid-Columbia's native shrub-steppe community during spring and summer months. Some lizards run so rapidly they appear almost as a blur as they attempt to catch their prey. It is easy to see why most of their predators such as shrikes, hawks, and the yellow-bellied racer snake are also very fast moving animals.

If you attempt to capture one of these fast-moving lizards, be careful that you don't simply grab one by its tail. If you do, the tail will pop off and lay wiggling wildly while the lizard escapes. The lizard will soon grow a new, one so it's no problem for the lizard, but it is certainly quite disconcerting to you (or a predator).

Only three species of lizards are known to occur in our immediate area. These include the side-blotched lizard (*Uta stansburiana*), the sagebrush lizard (*Scleoporus graciosus*) and the short-horned lizard (*Phrynosoma douglasii*).

- The side-blotched lizard is the most abundant species found on ALE. This species is easily recognizable by the black spot behind its front leg. It is a small lizard, no more than 2 inches long, not counting its tail, and occurs in most areas with habitats ranging from sand dunes and sagebrush flats to areas dominated by sagebrush-bunchgrass. It does not occur at the higher elevations on ALE.
- The sagebrush lizard has a blue stomach and is slightly larger than the side-blotched lizard. Locally, sagebrush lizards are only known to occur at low elevations and in sandy areas.
- Horned lizards (sometimes called horned-toads) are the slowest moving lizards. Several different species of horned lizards exist throughout the western United States, but in our area, only one lives, the short-horned lizard (*Phrynosoma douglassi*). This large bodied, flat, short-tailed, and spiny looking lizard has short horn-like projections on each side of its head. These lizards are reluctant to run even when approached, and when they do, they move so slowly that almost anyone can catch them.

The short-horned lizard is not very abundant and it also blends in well with the background, so if you want to see one in nature you may have to spend some time looking. Ants are their favorite

food, especially harvester ants. Harvester ants (*Pogonomyrmex owyheii*) can be recognized by their large size and by the pebble mounds they build in the center of an area cleared of any vegetation. If you're looking for horned lizards, it's a good idea to check near any ant mounds. The short-horned lizards will often sit for hours alongside an ant mound, occasionally snapping up a passing ant.

One interesting aspect of the short-horned lizard is that it gives birth to living young. The litter size may be quite large, with as many as three dozen youngsters. The young blend into their background like their parents, and because of their small size, are very difficult to see except when they move.

When you see any of these inoffensive creatures basking on a rock or scampering amid sagebrush, rocks, and bunchgrasses it's best to leave them to their own devices. Although it is tempting to try and collect them and keep them as pets, they normally do not do well in captivity and almost always ultimately die or escape only to perish in the unfamiliar surroundings of our streets or lawns where they are not adapted to survive.

Dragons of the Air

Rattlesnake Springs. This forbidding-sounding place is actually an oasis nestled among the willows at the foot of the Yakima Hills—north of Rattlesnake Mountain—within the ALE Reserve at Hanford.

Although the stream flows above ground for only 1 mile, it is an area where hawks and the occasional golden eagle soar, and elk and deer come to browse on the willows and drink their fill from the spring-fed stream. It is also a wonderful place to observe abundant birds and insects, especially those tied to aquatic habitats.

During summer months, dragonflies and damselflies can always be found flying up and down the stream corridor or resting quietly on nearby vegetation.

Adult dragonflies and damselflies are easy to recognize. They have two pair of elongate wings that are nearly the same size and with numerous veins. They also have huge eyes that often cover most of the head area and an abdomen that is long and slender.

Dragonflies and damselflies belong to an ancient order called the Odonata. The name is derived from a Greek word that means the toothed ones and refers to the serrated teeth located on their chewing mouthparts or mandibles. Damselflies are smaller and more fragile-appearing than the dragonflies. They also differ in the way they hold their wings at rest. Dragonflies hold both pairs of wings straight out from their body, airplane fashion, while damselflies fold their wings tent-like above their body.

All Odonata, both adults and immatures, are predators. The adult dragonflies terrorize the skies, snatching and eating insects on the fly. Sometimes they are referred to as mosquito hawks, but they capture a wide variety of prey, including midges, mosquitoes, moths, bees, butterflies, or even other dragonflies. They are ancient hunters, roaming the Earth during the time of the dinosaurs and before. Today, our largest dragonflies are about 2 to 3 inches. About 300 million years ago, dragonflies were buzzing about with wingspans of about 2 feet, the size of present-day crows and ravens.

Despite their brilliance of color, abundance, and daylight activity patterns there is still much to be learned about the Odonata. New species are being reported every year. One reason this order of insects is so poorly known is many dragonflies are difficult to capture. They fly fast, up to about 60 mph, can stop on a dime, hover, zip 20 feet straight up, or slip sideways in the blink of an eye. Needless to say, attempting to capture one can be a humbling experience. Damselflies are easier to capture as they are weaker fliers and tend to spend more time resting on vegetation.

Dragonflies usually mate in flight. The eggs are deposited in or near the water surface where the young, called nymphs, develop. The nymphs vary somewhat in habits, but all are aquatic and all are voracious predators. They lie in wait and grab their prey with a special structure modified from the lower lip. This structure resembles the arm of a backhoe and is tucked beneath the head. When a small tadpole or other prey swims by, the nymph quickly thrusts the arm forward, grabbing the hapless prey.

When fully grown, the nymph crawls up out of the water, usually in the early morning and rests on a plant stem or nearby rock. There it undergoes its final molt, emerging as an adult. After about 1 hour it will have reached its full adult size and be ready to take flight and repeat the cycle of life. Adult life may be fleeting, often lasting no more than 4 to 6 weeks.

The close ties between the Odonata and wetland areas also places them at risk for the future. Not all wetland areas are as well protected as Rattlesnake Springs; in fact, wetland areas represent some of this nation's most battered habitats. This raises the possibility that some species may be lost before they are ever known, placing even greater importance on the maintenance of protected areas within our natural world.

Wildlife and Technology

Today's environmental problems have made protecting and managing wildlife a major challenge. In the Columbia Basin, the Hanford Site has become an important refuge for many wildlife species over the last 50 years.

During those early years, ecologists learned much about how wildlife such as waterfowl, birds, deer, and fish used the Hanford environment. However, information on wildlife behavior, movement, and habitat use has been difficult to obtain because of the problem of identifying and keeping track of individual animals.

"Space-age" technology has helped solve this problem by providing a tool capable of monitoring individual animal movements over long time periods. For about the last 15 years, ecologists have used miniaturized radio transmitters to track various wildlife species.

The late Les Eberhardt and Dick Fitzner were both pioneers in the use of radio telemetry in wildlife studies. Les studied the effects of oil development activities on wildlife around Prudhoe Bay in Alaska in the mid-1970s. He used the radio-tracking technique to monitor the home range of Arctic foxes as well as their feeding, resting, and denning activities.

This technique involved capturing a number of foxes in live traps and placing a collar containing a small radio transmitter

around their necks. When released, the foxes resumed their normal activities and Les could locate them using a direction-finding radio receiver.

Les also incorporated this technique into the study of resident elk and deer herds at Hanford. These studies are now under the direction of Larry Cadwell. Scientists capture a small number of elk and deer each year in February or March. Animals are fitted with radio collars or solar-powered transmitters and released. Scientists then monitor deer and elk remotely using aircraft, permanent tracking stations, or by portable hand-held antennae.

The information gathered by radiotracking has provided new insight into how deer and elk use habitat, the animals' movement patterns, herd sizes, causes of mortality, and age structure.

One surprise we noted from radiotelemetry studies is that elk spend most of their time on the ALE Reserve. They occasionally leave ALE along the western boundary, but seem never to travel east toward the river, which looks like good elk habitat to me.

Most of the earlier radio-tracking studies were conducted on larger wildlife species like deer and elk. This was because the radio transmitters and batteries were fairly large and heavy. In recent years, miniaturization has allowed radio tracking to be conducted on many smaller animal species. The late Dick Fitzner, for example, attached radio collars to several different species of nesting raptorial birds (hawks and owls) to determine which parts of Hanford were important to the birds as hunting areas, their peak activity periods and general behavior.

Bob Gray and other fisheries biologists also have used transmitters for a number of years to study fish movement and migration in the Columbia and Snake rivers. These researchers tracked several different fish species (chinook salmon, steelhead, bass, and sturgeon) with the transmitters to determine how they coped with environmental changes as a result of Hanford Site and other activities. The studies showed that fish, like other animals, can detect and avoid conditions that may be detrimental to their survival. These studies also provided valuable information on behavior, daily and seasonal movements and spawning locations of these fish.

Miniaturization also has allowed researchers to gather information other than just the location of an animal such as body temperature and heart rate, useful data when attempting to determine how a species is being affected by human encroachment.

It's possible to buy transmitters small enough (a fraction of an ounce) that can be used on snakes, small birds, and rodents. They can be attached as backpacks, leg mounts, or attached to collars. (No collars don't work too well on snakes. The transmitters usually are implanted or ingested with no harm to the snake.) This is just another example of how engineering and science are being combined to enhance knowledge about and protection of our natural world.

Ground Squirrels on Lookout

Ground squirrels always appear to be on the look out for danger. This is probably because they have a lot of enemies. Hawks, owls, snakes, coyotes, badgers, and probably bobcats, all prey on ground squirrels.

Ground squirrels are frequently referred to as sage rats or gophers and are often confused with chipmunks. Several species of ground squirrels live in Washington, but only a few exist in the Mid-Columbia region. Townsend's ground squirrel (*Spermophilus townsendii*) occurs throughout most of the Great Basin and is the only ground squirrel abundant in the Tri-Cities vicinity. It is a brownish-gray ground squirrel about 8 to 9 inches long with a short bushy tail.

The Washington ground squirrel (*Spermophilus washintoni*) looks similar to Townsend's ground squirrel, but its fur is darker, and it has white spots along the sides and upper back. This species occurs east of the Columbia River. You can find it around Connell or in the Scootenay Reservoir area. The life history and habits of both squirrel species are similar.

Ground squirrels are burrowers. Their burrow system, which they dig themselves, may consist of several openings several feet deep and as long as 50 feet. These animals produce only one litter of young per year with somewhere between four to 10 young produced per litter.

These animals also are hibernators. During hibernation their body temperature drops, their heart beats slower, and breathing drops to only a few breaths per minute. In this way, ground squirrels reduce energy demands on their fat reserves, enabling them to avoid both the hot, dry summer and cold winter months when little food is available to them above ground.

Depending on the weather, ground squirrels emerge from their burrows sometime in early February. They then spend most of the time foraging for food. They usually disappear below ground again sometime in June or early July just as the green vegetation they depend on begins to dry up. Their period of dormancy will last about 7 months, until the next spring. However, if they don't have enough food, and they can't put on enough fat they may remain above ground longer before becoming dormant.

Several years ago Ken Gano, a fellow scientist, and I were conducting a census of small mammal populations on the ALE Reserve at Hanford. We noticed that whenever the captured animals were handled they would defecate. This gave us the bright idea to take small glass vials to the field with us and collect their droppings for analysis. Microscopic comparisons of the partially digested materials in their droppings allowed us to identify the kinds of plant materials they ate. We found that Sandberg's bluegrass (*Poa sandbergii*), a small native grass species, was their preferred food.

Ground squirrels are not truly colonial like the prairie dog. They do, however congregate in favorable habitats and can become quite abundant. They eat voraciously and occasionally become pests in agricultural areas, especially around alfalfa or wheat fields.

The best time to look for ground squirrels in the Mid-Columbia is during the early morning, because they are only active during daylight hours. Walk out into the shrub-steppe and listen for a soft, tuneless whistle that is hard to locate. This bird-like whistle is their warning call and is sure to indicate that ground squirrels are in the area, and they have spotted you.

Mid-Columbia Muskrats

It's possible to catch sight of a muskrat while walking, boating, or fishing in the Mid-Columbia. Muskrats are mostly nocturnal, but sometimes you can see them during daylight hours, especially in early morning or late evening.

Their food consists mostly of aquatic vegetation such as cattails and grasses, but they also eat small amounts of crayfish, mussels, and small fish. They thrive in ponds or slow-moving streams.

Muskrats are small. Their heads and bodies average a combined length of about 12 inches in length with the tail extending another 8 to 10 inches. They are well adapted to aquatic life with small front feet and large partially webbed hind feet for paddling, and a flattened, scaling and hairless tail that acts as a rudder.

Only one species of muskrat (*Ondatra zibethicus*) exists, and it occurs throughout most of North America. The animal gets its name from the musky odor that comes from the musk glands.

Mid-Columbia Basin animals, including the muskrat, face drought conditions in summer and extreme temperatures during winter and summer months. Muskrats avoid the hot, dry, and cold conditions of the Basin by living in close harmony with the permanent waters of the rivers, lakes, and marshes.

Muskrats build two different kinds of shelters. Along streams, they usually burrow into the bank. The entrance is below the water and extends several feet into the bank. The living quarters are located above the high water mark of the stream.

In marshes or ponds, muskrats often build a dome-shaped structure out of cattails or other vegetation. I have seen several of these "muskrat houses" in the Burbank Slough area along the Columbia River but you need a canoe or shallow draft boat to get close to them.

Muskrats are prolific. They usually have five to nine young per litter and may produce several litters per year. The animals are hunted by many predators, including coyotes, mink, hawks, and owls. Their greatest enemy is humans.

They have a thick, glossy and very durable fur, and consequently, have been one of the most valuable fur bearers in North America.

The high price of $1 per pelt tempted many a young man of my generation to become "trappers" during the late fall and winter months. I grew up in southwest Iowa and mostly trapped a 5-mile stretch of the Nishnabotna River. Sometimes, I was able to persuade others to come along and help. This was especially important after a couple of weeks of arriving late to school. Maxine, my girlfriend at the time, went along on a few occasions. Years later, after we were married, I was surprised to learn she hadn't really enjoyed getting up at 4:00 a.m. to wade around in an icy river.

Watch for muskrats in marshy or shallow stream areas. Often, you will find slides along the bank they use to return to the water after feeding on nearby vegetation. If the water is still and you find lots of vegetation clippings floating about on the water, you can be certain muskrats are around.

Summer

A Sea of Shrubs

Shrubs abound in Columbia Basin natural areas. They occur in seemingly endless variety across this arid land, forming miniature forests of single species where conditions are most favorable. Sagebrush, greasewood, rabbitbrush, bitterbrush, and hopsage are all abundant in our area. They compete with each other for space, water, and nutrients.

Big sagebrush (*Artemisia tridentata*) is the most common shrub in the Columbia Basin and ecologically the most important. This species grows on silty and sandy soils all across the Columbia River plain and on the slopes of the adjoining hills. Other species of sagebrush grow here as well. Three-tip sagebrush (*Artemisia tripartita*) grows along the crests of the Rattlesnake Hills in scattered patches, and stiff sage (*Artemisia rigida*) grows on rocky outcrops on Gable Mountain, the Saddle Mountains, and Umtanum Ridge.

A distinctive feature of sagebrush is its pungent odor. Indians living in the Mid-Columbia used it for medicine, as well as for rope and sandals. Early pioneers traveling along the Oregon Trail described the scent as a mixture of turpentine and camphor. The aromatic compounds that give sagebrush its scent may help protect the shrub from being eaten by grazing animals. In addition, the decay of fallen leaves can release toxic materials, thereby limiting the growth of competing plants.

Lewis and Clark described sagebrush in an account of their journey through the area. These explorers used sagebrush to build their campfires while traveling along the Columbia River near the Tri-Cities. Since the Lewis and Clark expedition, the number of shrubs in the area has greatly declined. Settlers have replaced sagebrush stands, especially those occupying valleys and gentle slopes, with dryland wheat and various other crops. Ranchers also have often eradicated sagebrush from their lands to encourage the growth of grasses palatable to livestock.

Battelle-Northwest's Bill Rickard has studied the ecology of the Hanford Site for over 30 years. According to Rickard, the site's ALE Reserve is the last remnant of unspoiled sagebrush habitat in Washington. The establishment of the Hanford Site in 1943 has protected this untouched land from humans, grazing, and plowing.

Nevertheless, the sagebrush on ALE still is susceptible to natural threats. Naturally occurring wildfires have been a major factor in the removal of sagebrush shrubs on the site. Wildfires ignited by lightning strikes usually occur in our area in July or August, when sagebrush and its associated plants are dry from summer drought.

Sagebrush plants are easily killed by burning. Natural recolonization of burned areas by new sagebrush plants occurs from seeds dispersed from surviving parent plants. Sagebrush seeds are not well equipped for long-distance dispersal by wind—most seeds fall to the ground near the parent plants. As a result, large burned areas devoid of patches of surviving plants may go a long time before being recolonized by sagebrush seedlings. Some large burns that occurred on the Hanford Site in 1957 are still devoid of sagebrush plants.

Sagebrush plants bloom in late summer or early fall to take advantage of the rains of autumn. However, the yellowish tinge that the tiny yellow flowers give to the gray-green foliage may not be detected by a casual observer.

The general decline of sagebrush in North America over the past 200 years appears to have resulted in a corresponding decline in certain native birds that characteristically build their nests in the shrubs. In the absence of shrubs many of our native animals would cease to exist.

Sagebrush, for example, is life itself to the sage grouse, which eats its leaves, and the sage sparrow which builds its nest in the bushy cover. Birds that nest in sagebrush shrubs on the Hanford Site also include the sage thrasher, Brewer's sparrow and loggerhead shrike. Land-bound species, such as the pygmy rabbit and sagebrush vole, depend upon sagebrush habitat for cover.

There is state-wide concern for the preservation of existing sagebrush habitats to maintain diminished populations of these animals. On the Hanford Site and elsewhere, efforts are being made to protect stands of sagebrush and to restore sagebrush to damaged habitats. Doing so will help ensure future breeding populations of these birds and of other native wildlife species.

Rabbitbrush is probably the most common shrub in the Columbia Basin. Rabbitbrush is often mistaken for sagebrush by the casual observer. Both plants frequently occur together and are medium-sized shrubs. They have a gray-green appearance and bloom in the late summer or fall. Rabbitbrush, however, lacks the strong sage odor and has narrow, singular, unlobed leaves. In

addition, rabbitbrush has bright yellow flowers, as opposed to the tiny and inconspicuous flowers of the sagebrush.

Two species of rabbitbrush are common to our area. Common rabbitbrush (*Chrysothamnus nauseosus*) is hairy and appears to be slightly gray. Green rabbitbrush (*Chrysothamnus viscidiflorus*) lacks the hairy surface, is greener, and has sticky stems and flowers.

Both species of rabbitbrush, as well as sagebrush, are plentiful along the hiking and biking trail near the junction of Highway 182 and Road 68 near Pasco. A few bitterbrush (*Purshia tridentata*) shrubs also occur along the bike trail. Bitterbrush has dark green leaves, but its small yellow flowers can't be seen until spring.

The Tenaciousness of Junipers

Most of our shrub-steppe landscape originally was considered to be treeless. Native shrub-steppe plant communities of the Columbia Basin were dominated by grasses and shrubs, but were not completely treeless. When early-day settlers and explorers arrived here, mostly from the eastern United States, they certainly must have encountered cottonwoods and willows along streams and rivers that flow through the shrub-steppe from the mountains. But the immigrants left very little in the way of written records as to the nature and distribution of trees, and trees, to them, meant timber suitable for lumber or at least to build log-cabins and barns. The early settlers must have noted the occasional western juniper (*Juniperous occidentalis*) woodlands along the ridgelines of the Blue Mountains and along the Snake and Columbia river valleys.

Western juniper is a tough little tree. It seems unaffected by our cold winters and summer droughts, by poor soils or occasional high winds of the area. It appears to revel under the most inhospitable conditions and frequently can be found growing precariously from some rocky outcrop along a ridge line. The western juniper ranges from southeastern Washington through northeastern and central Oregon, to western Idaho on southward through the whole length of the Sierra Nevada range of California.

It can grow to be 60 feet tall in the southern parts of its range but 25 to 30 feet is more common here. Its leaves are not "leaf-like" at all but resemble small gray-green scales of about one-eighth inch long. This kind of "leaf" is, of course, one way the tree has adapted to the area, by reducing water loss through the leaf

surface. The juniper trunk is heavily covered with branches and, consequently, the wood is too knotty to have much value as lumber. It makes good fence posts, though, and has been cut for that purpose since the early days of settlement. Small, leathery and berry-like fruits also are produced that are edible and sought by rodents, birds, and deer.

Juniper trees have a slow growth rate and may live to be as much as 1,000 years old. Several years ago we conducted an environmental assessment of an area in eastern Oregon, south of the Columbia River. Several sparse stands of juniper were present. By coring the trees and analyzing their growth rings, we found them to be between 100 and 125 years old, a long way from their maximum possible age. The presence of charred stumps and logs in the area we studied provided evidence of the presence of past wildfires. Wildfire is believed to be a major factor in limiting the distribution of juniper trees in the shrub-steppe region. Current populations of juniper trees tend to be located where escarpments or topographic breaks provide some protection from wildfire.

The western juniper reaches its northern-most limits in the Columbia Basin. These trees can be seen as you drive along Interstate 84 toward Portland. Just look up along the cliff and ridge lines, and you can spot individual trees clinging tenaciously to the rocky terrain. However, you can see on level land, closer to home at the Juniper Dunes Wilderness area just a few miles east of the Tri-Cities.

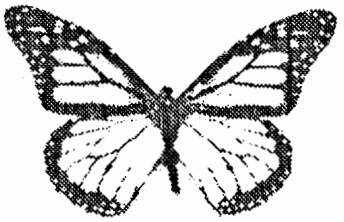
Juniper Dunes is one of the smallest wilderness areas with about 7,000 acres, but it contains some of the largest sand dunes

and greatest concentration of western juniper trees in the state. The dunes are mostly covered with native wildflowers, grasses, and shrubs.

To reach the Juniper Dunes Wilderness area, take the Kahlotus Highway from Pasco to the Snake River Road (23 miles); turn left, and continue for another 3 1/2 miles to E. Blackman Ridge Road. Turn left on this gravel road, and continue for about 2 1/2 miles to Joy Road. Turn left again; go 2 miles farther, and park at the end of the road. You will have to go through a gate, across a field, and through another gate.

I prefer visiting Juniper Dunes area in the spring (April or May), when the wildflowers are blooming, but it's an interesting place anytime of year. A wilderness permit is required, and access is limited during some summer and fall months. Contact the Spokane Bureau of Land Management (BLM) office at (509) 353-2570 before making the trip.

Migrating Monarchs



Almost everyone has heard about Monarch butterflies, the burnt-orange beauties with black veins and wing margins, but did you know this is the largest butterfly species in the Mid-Columbia region? With a wingspan of up to 4 inches, this brightly colored butterfly is a striking sight to see gently wafting across the lawn or nearby waterway.

The adult Monarch deposits its eggs on milkweed leaves, and the larvae spend their youth feeding and developing on the milkweed plant. Because the larvae feed on the milkweed plant, they may be provided a degree of protection throughout their life because the plant's noxious juices are believe to concentrate in the tissue, making them distasteful to birds and other predators.

Other butterflies, such as the Viceroy, have come to mimic the color patterns of the monarch, and thereby receive some degree of protection through association, even though they are nonpoisonous.

The life of the monarch butterfly is distinctive because it is the only butterfly known to make annual north and south migrations. By the end of summer, all monarch populations in North America will have begun to drift south, in small numbers at first but eventually by the thousands.

Populations west of the Rocky Mountains fly in a general southwest direction to winter congregation areas along the Pacific Coast. Each year, thousands of migrants collect on the trees and

shrubs on the Monterey Peninsula, California, often causing branches of trees to bend and break under their weight.

Migrating monarchs east of the Rockies fly south or southwest, eventually crossing into Mexico. Their wintering grounds were only recently discovered high in a mountain valley in central Mexico where millions of butterflies congregate in an area of only a few acres.

In the spring, monarchs start north again, to reoccupy the vast regions of North America they abandoned the previous fall. Along the way, they stop to deposit eggs on any milkweed plants they find. These eggs hatch, the larvae develop, and the adults continue to migrate. The migrating butterfly populations contain members of many generations, although single individuals have been known to make the entire round trip.

Dr. Fred Urquhart, now retired from the University of Toronto, spent much of his professional life working out the general migration patterns of monarch butterflies in North America. He developed a method of marking individual butterflies by attaching a small label to their wing. Eventually, thousands of volunteers participated in his project, helping him tag butterflies, track their flight patterns, and note overwintering sites. Dr. Urquhart has told his story in a charming book called *The Monarch Butterfly: International Traveler*, which should be available in your local libraries.

The best place to look for monarchs is in areas where milkweed grow. The Yakima River Delta is one such place in the Tri-Cities. Another is McNary National Wildlife Refuge. If you're interested in seeking out monarchs, take Highway 12 east toward

Walla Walla. Watch for the refuge headquarters sign after crossing the Snake River bridge. Park your car in the designated area along South Lake Road, and hike the mile-long wildlife trail.

There is still a lot to be learned about the migration of western monarchs. Research is continuing under the direction of Professor Walter Sakai, Santa Monica College, Santa Monica, California, and entomologist Dan Hilburn, Oregon Department of Agriculture, Salem, Oregon. Volunteer taggers are needed. Anyone who enjoys being outside observing nature is invited to join the project. Patty Ensor is coordinating the effort in the Tri-Cities. If this sounds like something you would like to get involved with, give her a call at 735-6254.

Business of Bees

The abundance of winter and springtime precipitation results in a spectacular display of wildflowers on the hills and surrounding wild lands of the Mid-Columbia. But why are these flowers so bright and showy?

A visit during mid-day when the temperature is warm and the winds calm may give you a hint. The flowers will simply be abuzz with insects of various kinds. Butterflies, wasps, moths, flies and even some beetles will likely be present, but the bees will be especially well represented—big fuzzy bumble bees and small native bees of several different species. Honey bees are usually the most numerous.

Honeybees are quite willing to go about their business while you observe them "up close and personal" as they fly from flower to flower. As long as you don't sit on or otherwise squash a bee, there is virtually no danger of being stung. Their stinger is only used to defend the hive.

As nearly every school child knows, bees are going about their business gathering nectar and pollen. The nectar is "sucked up" into the bee's honey stomach and transported back to the hive where it is placed in a cell and eventually converted to honey.

You can see individual pollen grains packed onto the bee's hind legs where it looks like a couple of yellow clumps. The bees take the pollen back to the hive where it is mixed with honey and fed to the larvae or baby bees.

Although bees and other insects are busy collecting nectar and pollen, they also are serving a very important function for plants—cross-pollination. For most plants to grow good, viable seeds, it is necessary that the pollen grains produced by one flower be transported to another flower of the same species. For some species, the wind blows the pollen around until some of it happens to land on other flowers of the same species. But for many plants, especially ones with bright flowers, insects are essential.

The bright flowers initially attract the attention of the pollinating insects. Over 70 years ago, an Austrian by the name of Karl Von Frisch challenged the then-prevalent belief that bees were color blind. He thought that the brightly colored flowers pollinated by bees had to have a purpose.

In a classic experiment, he conducted tests in his garden by using different colored cards to attract bees, thereby proving they could see colors.

Of course flower color isn't the only thing that attracts the pollinating insects. When they get close to the flower, they also use their sense of smell. And when they get really close, they frequently follow special patterns of color on the flowers that guide them to the nectar.

You see, many flowers have special honey-guides that point to the very site of the nectar sources. Sometimes these honey-guides may be patterns of dots or lines that converge at the nectary.

Other flowers may have rings of a different color that surround the nectar source. All of this helps guide pollinating insects into a position that will assure the transfer of pollen from flower to flower.

What would our Mid-Columbia region be like if insect pollination suddenly ceased to exist? Well, the wind-pollinated plants—grasses, sagebrush, peas, corn, beans and wheat—would be unaffected. But apples, cherries, carpets of wildflowers, watermelon, apricots, zucchini, cucumbers, pumpkins and most of the flower gardens around our houses and farmsteads would be gone. We would also lose many of the soil-stabilizing plants, so soil erosion and blowing dust would be worse than ever.

Now, with what you know, your assignment for today, should you care to accept, is to find a flower, even a dandelion, and count the number of different kinds of pollinating insects that visit. You may also want to see if you can find the special markings on many flowers (not dandelions) that serve as honey guides.

Basin Honeybees

Bee pollination is vital to the Mid-Columbia's native and agricultural plants. Although there are other pollinators such as beetles, moths, butterflies, bugs, and flies, most of the work falls to honeybees.

Common native bees include bumblebees, alkali bees, leaf-cutter bees, and mining bees. Most native bees of the area nest in underground burrows. Unlike the honeybee, most of them do not store honey. Except for the bumblebee, the native bees of the region are not social. They live solitary lives, making individual nests where they collect and store pollen and lay their eggs. The nests may be located close together, however, so they appear as colonies.

All the native bees sting. Unlike the honeybee, which dies after stinging, our native bees can sting repeatedly. Native bees and wasps have a smooth stinger, which they can withdraw after stinging. The stinger of a honeybee, however, has small barbs that prevent it from being withdrawn. After stinging the honeybee tries to fly away, tears away the tip of the abdomen, and dies. The torn-off part contains the poison gland, which continues to pump poison into the wound. Efforts to pull the stinger succeed only in squeezing more venom into the wound. Fortunately honey bees rarely sting unless defending their hive.

Because its entire livelihood is tied to the collection of nectar and pollen, the honeybee is preeminent among pollinators in North America. This wasn't always so. Honeybees were first introduced

into America from Europe in 1622 by early colonists. Once introduced, these foreigners spread rapidly throughout the continent. When colonists brought honeybees across the ocean, native bees were extremely numerous. Since then, many of the native pollinator populations have been reduced by the clearing and plowing of agricultural lands and, more recently, by the use of chemical pesticides. Gradually, honeybees have taken over much of the pollination required by both native and agricultural plants.

Honeybees are semi-domesticated, and are easily moved about in their hives. An average honeybee colony contains 50,000 to 60,000 bees. Each colony is inhabited by one mature queen, 50 to 100 male drones, and throngs of sterile female workers. Each day, the queen lays several thousand eggs that hatch within 3 days. The tiny, white legless larvae are fed by nurse bees, which bring honey and pollen from storage cells to feed the young. After about a week of nursing, the larvae are sealed up by worker bees in individual cells. The immature bees remain encased in these cells for 12 days, emerging as full-grown adult bees ready to work.

During the first 2 weeks of a honeybee's life, its duties are those of a nurse. Once its wax glands mature, the bee spends its time building and repairing wax combs and cleaning the hive. At about 3 weeks, it starts to work as a forager, flying out to seek sources of nectar and pollen for the hive.

Bees from a particular colony tend to forage from a single species of flower at any one time. This is what makes them such efficient pollinators of flowers. Foraging bees communicate the location, source, and distance to particularly attractive foraging areas to other foragers within the hive.

During hot periods, foraging bees also bring back water, which cools the hive as it evaporates. Most foraging however, is for pollen and nectar. Making a single thimble of honey requires about 100 nectar flights. The foraging bees stick pollen to their hind legs in what are called pollen baskets. You can often see bees working flowers with bright yellow balls, sometimes a quarter of an inch in diameter glued to their legs.

As the hive becomes crowded, the bees may swarm. Leaving the hive to a new queen, the old queen flies out to find a new home with about one-half of the hive's population. The swarming horde may temporarily land nearby until they can decide just where to go.

I receive many calls each year from people who, knowing of my fascination with bees, want me to come and remove a swarm from the side of their house or nearby tree. This is always fun. Having gorged on honey right before leaving the hive, the bees usually are so docile I can just pick them up, stick them in an empty hive, and drive away with them.

How remarkable is the relationship that has developed between bees and flowering plants—and it's all there for you to observe. All you have to do is sit quietly among the wild flowers, and see what you can see.

Bee Talk

Honeybees are able to communicate sources of nectar to other bees within the hive. They do this by performing one of two different types of "dances" on the vertical surfaces of the honeycomb. The round dance is the simplest. When a foraging bee returns to the hive from a nectar source located within 100 yards of the hive, it whirls about in a tight circle. Other foragers within the hive sense its movements and pick up the flower scent with their antennae. They then leave the hive to search for that species of flower within 100 yards of the hive.

If the nectar source is located more than 100 yards away, a tail-wagging dance is performed. This more complicated dance indicates both the direction and distance to the flowers. In this dance the successful forager makes a figure 8 pattern with a straight line between the loops that acts as a pointer. If the nectar source is located directly toward the sun the bee lays out its figure 8 dance so that the straight-line run points toward the top of the comb. If the nectar source is to the left of the sun then the straight-line run is at a corresponding angle from the imaginary sun at the top of the comb and the new recruits search in that direction.

The speed at which the bee conducts the dance and wags its abdomen indicates the distance to the source. The new recruits then take just enough honey to provide them with the energy to reach the nectar. Sometimes though the bees encounter unexpected winds, or for some other reason expend all of their energy before finding the flowers. When that happens they are unable to fly. A mixture of sugar and water offered in a teaspoon will soon have them zooming off to resume the search.

Living Soil

"Dirt is inert but soil? Ahhh that is something quite different. The soil is a living system." I can still hear one of my former professors describing the difference between what most of us think of as dirt and the system teeming with life called soil.

Far from being static, the soil system is ever changing, eroding away through the actions of wind and water, slowly being replenished through gradual weathering of rock.

Patches of brightly colored lichen on rock reflect the presence of several different species, each using its corrosive powers to remove various minerals from the rock's surface. The lichens' activities slowly contribute to the build up of soil, which allows higher order plants and animals, including humans, to flourish.

Columbia Basin native plants such as bluebunch wheatgrass, Sandberg's bluegrass, and lupine thrive because of the richness of the soil system. But these plants also contribute to maintaining the richness of the soil. For most plants, as much as 70 percent of their tissue exists below the surface of the ground where delicate root systems draw nutrients and water so critical for life. In exchange for this nourishment, plants anchor the soil against erosion and fertilize it with organic matter when they die and decompose.

What we know as topsoil is made up, in large part, of cavernous openings or pores left when the plant roots decompose. These pores separate soil particles and help air and water— so essential to plant growth—penetrate the soil.

Decomposition works something like this: When a leaf or blade of grass falls to the ground, a multitude of tiny organisms immediately attacks it. The organisms are part of an extensive food chain that includes 1,000 or more species.

Tiny insects such as springtails feed on the leaf or grass, breaking it into smaller pieces. Then bacteria and fungi go to work on it to further decompose the matter. Mites use the narrow pore spaces as runways to transport some of the decomposing plant matter below the surface enriching the deeper soil layers.

Microscopic nematode worms also abound in the upper layers of soil. They cluster about the plant roots where many parasitic species feed on plant nutrients. The nematodes, in turn, are preyed on by mites and other predatory micro-invertebrates.

The end result of this complex soil food chain is the creation of humus. Although humus accounts for five percent or less of our native soils, without it we would exist in a barren moonscape and wonder where our next meal was coming from.

Spider's Silk

Spiders. The mere thought of them sends some people reeling. Many dislike spiders because they think all spiders are dangerous. That certainly is not so. Of the 30,000 known species of spiders, only a few are considered hazardous to humans.

Spiders are a large and easily recognizable group of the animal kingdom. They resemble insects in some ways, but they are not insects. Spiders have eight legs while insects have only six. And while insects have three body parts—a head, thorax (where the legs are attached), and abdomen—spiders only have two body parts. The head and thorax of spiders are fused into one section called the cephalothorax. That is why whenever a spider wants to look at something, like its prey, it must turn its whole body. Most spiders have eight eyes located on the front of the head, but some have less. The number of eyes and the way they are arranged are used to identify particular families of spiders.

All spiders are predators. Their prey usually is killed by poison injected through the spider's hollow fangs. Spiders mouths are very small. They can't swallow bites of food whole, so instead they inject digestive juices directly into bodies of their prey, which turns their insides into a fluid the spider easily sucks out.

Spiders generally lay eggs in a silken sac that is either hidden in some crevice, attached to twigs, or in some cases, carried about. The eggs usually hatch rather quickly. The young spiders look like miniature adults because there is very little change (metamorpho-

sis) during their development. Although spiders do not have wings, young spiders often do "fly." They climb to some high point and spin out some silk. The wind catches the silk and away they "fly."

Most spiders spin out a silken thread everywhere they go. This thread serves as a dragline that allows the spider to retreat rapidly in case of danger. It also supports the spider when it jumps from one high place to another.

The webs built by spiders to capture prey are of several different types, and each type is usually characteristic of a particular spider group. For example the house spider builds an irregular net where the strands of silk extend in every direction. Sheet-web spiders make a tightly woven web that is usually horizontal. Funnel-web spiders construct a web, as the name suggests, like a funnel. The orb-web spiders are most common. You easily can find their spiral webs attached to bushes and plants around your home or garden.

Although the majority of spiders capture their prey in webs, not all of them do. For example, hunting spiders—some of the most interesting—capture their prey by either laying in ambush or stalking and pouncing on them. The crab spiders (Thomisidae) lay in wait, often on flowers, for a bee, their favorite prey, to visit. They have very long front legs and walk sideways or backward, and therefore, look somewhat like a crab. Crab spiders use their long front legs to grab the bee until they can quickly bite it. They usually are yellow or whitish in color. If you look carefully, you will find crab spiders in almost every flower garden.

Jumping spiders (Salticidae) are hunters too. They are some of the most common spiders found in houses here in the Tri-Cities.

They are easy to recognize as they move with quick, jerky motions and sudden leaps. Jumping spiders have rather short legs for a spider and two very large front eyes. Their bodies are hairy and usually brightly colored, even iridescent. They seem to be unafraid of humans and will often continue their hunting forays even while being closely observed.

The wolf spiders (Lycosidae) are hunting spiders that chase their prey. Most of them are light brown or gray, and their legs are longer than the jumping spiders. The female wolf spider carries the egg sac around with her. After the spiders hatch, they climb up and ride around on the mother's back. If a baby spider falls off, it simply climbs back up one of mother's legs to resume the ride. Wolf spiders have four small eyes in a row, two large eyes in the second row, and two small eyes in a third row. Wolf spiders are not commonly found in houses but are abundant in nearby natural areas such as sagebrush/bunchgrass communities. Turn over a few rocks or search a few clumps of bunchgrass, and you will be sure to find a wolf spider. Wolf spiders also adapt well to captivity and make very interesting pets.

Spiders have many enemies, besides humans, including other spiders, birds, scorpions, and some predatory insects. Most spiders will not bite humans, even when coaxed to do so. The only common spider in this area dangerous to humans is the black widow. It is easily recognizable by its dark black color and by the red hour glass figure on the underside of the abdomen. The sedentary female spends most of her time sitting in her web waiting for prey. She will attempt to escape if molested but will bite when cornered. The smaller male does not bite and spends most of his time wandering.

In some parts of the country, brown recluse spiders are also a threat to humans. The brown recluse is easily recognizable by the backward pointing violin shaped figure that starts near the front of the head. This spider commonly lives in basements and crevices in houses. It is so reclusive that it is seldom seen even in the southern portions of the United States where it is abundant. The brown recluse does not occur naturally here, but may have been transported here in household goods on rare occasion.

So, the next time you see a spider, remember that the creatures generally do a lot more good than harm, and they are an interesting part of our natural environment.

Raccoons

Raccoons (*Procyon lotor*) are one of the most fascinating creatures of our Mid-Columbia wildlife species. They occur all across North America and have been closely associated with many major events that have occurred during the discovery and settlement of America.

Native American tribes have mentioned the raccoon in their tales and legends, referring to the cunning and cleverness of these animals. Columbus was the first explorer of the New World who left written records of raccoons. None other than Captain John Smith from the Virginia Jamestown Colony was the first to use the Indian name "raccoon" in a description of the fur hides used extensively by the Algonquin indians. Early day settlers and explorers depended heavily on raccoons to provide both food and clothing. The coon skin cap, for example, became an essential article of clothing for early settlers, explorers, and for soldiers of the Revolutionary Army as they struggled to survive the cold northeastern winters.

You can recognize a raccoon by its unique markings. The dark-colored face mask is the most noticeable characteristic, but raccoons also have a distinctive bushy tail with 5 to 10 black rings. Their forepaws are somewhat hand-like and provide a human-like grip on objects they want to pick up and observe. This ability may be the reason raccoons have developed a reputation for being so inquisitive and good at solving dexterity problems.

While a graduate student at the University of Nebraska at Omaha I learned first hand about the raccoon's inquisitive nature. I was helping conduct a study of the hearing range of raccoons. My job was to train them to push a lever and receive a pellet of food whenever they heard a high frequency. The frequency of the tone was gradually increased over time until the raccoon could no longer hear it and would ceased to respond. Things went well until I forgot to remove the test equipment one evening. By the next morning, the two raccoons I had been testing had removed every spring, screw, and bearing they could reach. Perhaps they were conducting a little research of their own.

Raccoons tend to be nocturnal, and consequently, are seldom seen. In the Columbia Basin, I have frequently noted their distinctive hand-like tracks along our irrigation pond but have yet to see the originator. Most raccoons spend the day snoozing in a nearby den. I suspect this one is probably holed up in one of the nearby cottonwood trees.

Raccoons are not true hibernators, but they do go into a winter dormancy. They survive the coldest part of winter by sleeping away days and nights in a favorite den, often in the company of other raccoons. During spells of warmer weather, they may leave the den, and forage for food.

Raccoons are true omnivores, eating whatever happens to be available. Mostly, they eat invertebrates, fruit, and berries. Crayfish are a preferred food, but grasshoppers, beetles, crickets, cicadas, caterpillars, and earthworms are readily eaten. Frogs also are a favorite prey as well as small fish. Raccoons also take a toll on mice and snakes, and they prey on small birds. Raccoon raids on

the chicken house and the sweet corn patch as well as their scavenging of garbage has frequently brought them into conflict with suburban neighbors.

Most raccoon cubs are born from April through June. There can be as many as seven young born but four or five is more typical. The young are blind for the first 3 weeks and stay in the den for the first 8 to 10 weeks. After that, their mother begins taking them on short trips through the neighborhood. Often, you can see the mother in early evening with several young trailing along. Young raccoons can be readily tamed as pets, but it's not a good idea as their natural inquisitiveness and food hunting usually gets them into trouble. In addition, they carry disease pathogens that can be transmitted to humans.

Raccoons have few natural predators. Bobcats, eagles, great horned owls, and coyotes may take a young raccoon if the opportunity presents itself, but they rarely tackle a full grown adult. Humans are the raccoon's only real enemy. Speeding cars, hunting, and trapping account for some loss to the animals, but the real danger to the population is from a loss of wetlands habitat.

For those who would like to learn more about this interesting mid-Columbia inhabitant, I suggest reading *A Natural History of Raccoons* by Dorcas MacClintock. It should be available in most libraries.

Rambling Rodents

Rodents are the most numerous of all the mammals. Somewhere between one-third and one-half of all land mammals belong to the order Rodentia. Animals belonging to this order are mostly small and characterized by a long pair of chisel-like teeth projecting from the front of their mouths. The rodents with which most people are familiar include various species of rats and mice, squirrels, chipmunks, pocket gophers, beavers, and porcupines.

How animals adapt to arid regions such as our shrub-steppe are nicely illustrated by rodents. Most of these small creatures lead secretive lives. Since they are mostly nocturnal, the casual observer is rarely aware of their abundance or impact on the natural system. Many native rodents are well adapted for digging. This is especially true of pocket gophers, badgers, and ground squirrels. Their burrowing activities help cultivate the soil, thereby providing small localized areas for plant germination and growth. Rodents also play a significant role in controlling insect populations, and they serve as a food base for larger predators in the shrub-steppe food chain.

Several species of native rodents exist, and their habits provide an indication of the environmental complexity of the shrub-steppe. Some years ago, we conducted a live-trapping study of small mammal populations along the slopes of Rattlesnake Mountain as part of Department of Energy arid land studies. We found five rodent species to be fairly common, including pocket mice, ground

squirrels, deer mice, grasshopper mice, and sagebrush voles. We also found the northern pocket gopher within the study site, evidenced by their mounds, but gophers are not easily captured in live traps, so they were not included as part of this study.

- The pocket mouse (*Perognathus parvus*) belongs to a group of mice with fur-lined cheek pouches or pockets, long tails with a tassel at the end, and long hind legs. This mouse can jump several times its own length, which helps it escape from predators. The mouse's pouches are stuffed with seeds when it is out foraging—handy containers to hold the seeds until the mouse is back in its den.

Our study showed that pocket mice were above ground from March through September and remain below ground during the cold winter months. They are nocturnal creatures, thereby avoiding the heat of the day. They rely primarily on seeds as a source of both food and water since they mostly live some distance from water. This is the most numerous mouse present on the ALE Reserve with about 4,000 individuals present per square mile.

- One of the most common and beautiful rodents throughout North America is the deer mouse (genus Peromyscus). Its large bright eyes, smooth, silky gray bodies with a white belly, long ears, and gentle nature makes it a favorite of mine.

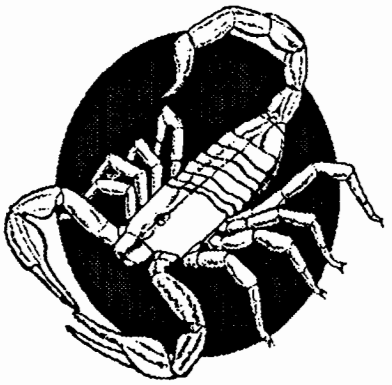
The deer mouse is active year-round. Its diet is varied and includes insects as well as plant materials. We found about 800 deer mice per square mile during the ALE study.

- Grasshopper mice (*Onychomys leucogaster*) and sagebrush voles (*Lagurus curtatus*) are not as numerous as the other

species. Grasshopper mice burrow or sometimes live in the abandoned burrows of other animals. They are small mammals with short tails. They are predators and live mostly on insects. When eating a beetle or other insect, the grasshopper mouse holds it in its front paws and starts eating it head first. The grasshopper mouse is an interesting species but not a favorite of mine. They are not as docile as either the pocket mouse or deer mouse and they smell bad. We found fewer than 100 grasshopper mice or sagebrush voles per square mile during our ALE study.

There are several different species of ground squirrels, but the only one common in our local area is Townsend's ground squirrel (*Spermophilus townsendii*). Ground squirrels feed during the day. They eat only new plant growth and seem to prefer the tiny Sandberg's bluegrass. They are active aboveground from March though May or early June which also corresponds to the time when their favorite food is most abundant. The rest of the time they spend in a torpid state in their burrows below ground. In this way they avoid both the hot summer drought period and the cold winter months when there would be little of their favorite foods available. The distribution of ground squirrels can be spotty. There are parts of the ALE reserve where no ground squirrels live at all, while in other locations there may be as many as 3,000 individuals per square mile.

Scorpions



Scorpions are typical dwellers of desert regions. Within North America they are most numerous in the true deserts such as the Sonoran and Chihuahuan deserts of the Southwest, but there is at least one species that lives in the Columbia Basin (*Vejovis boreus*).

Scorpions are arthropods, a category of creatures closely related to spiders, mites, insects, and other such creatures. You can easily recognize them by their four pairs of jointed legs and lobster-like claws, called pedipalps, they hold out in front of them. Their claws make scorpions look as if they have five pairs of legs. They also have a segmented abdomen that ends in a long tail with a bulb-like stinger at the tip. This tail is what most of us think of when we picture a scorpion.

When disturbed, scorpions face their intruder with claws raised and stinger curved up over their back. Like most of nature's "fearsome" creatures, they hastily retreat, if possible, and sting only as a last resort. I probably have captured several hundred scorpions over the past 20 years while conducting population studies as part of arid land ecology studies at Hanford and never have had a scorpion seriously attempt to sting me. Although a couple of scorpion species exist in the Southwest that are highly venomous, in general, the scorpion's sting has been highly overrated.

You rarely see scorpions because they are active mostly at night, spending daylight hours burrowed beneath rock or boards.

It's not uncommon to find scorpions nestled beneath old fence boards or other debris. Their tan color blends in with the light-colored soils in our area, so you'll need to look closely to see them.

Scorpions are part of the complex natural foodweb. They feed on spiders and a variety of small insects such as ants, beetles, moth larvae, and grasshoppers. I have frequently noted the presence of scorpions in the castings of burrowing owls. Technically, scorpions do not actually eat their victims. They tear their prey apart and suck the juices into their mouths.

Scorpions are known to engage in a strange courtship dance before mating. Although I have never personally observed this phenomena, the male supposedly grasps the female's claws and walks back and forth while she follows. Baby scorpions are born alive and may climb on their mothers' back to be carried for the first few weeks of life.

Another arthropod in our area frequently mistaken for a scorpion is the sun spider or solpugid. Solpugids are very quick and dash about at high speed as they search for small insect prey. Because they are so active, they are much more likely to enter houses or other buildings than are scorpions. Solpugids lack the long tail and stinger of the scorpion and are not poisonous. Solpugids have a unique four-part jaw that forms a beak and makes them look particularly fearsome. Both solpugids and scorpions have been around a long time. Scorpions have been found fossilized within geologic deposits more than 400 million years old.

Our arid region supports an abundance of arthropod species, and like scorpions and solpugids, they have all developed interesting

adaptations to our Columbia Basin environment. Each also contributes in some way to the ecological functioning of natural areas through their roles as predators, scavengers, plant eaters, burrowers of soil, or as prey for other consumers.

Rattlesnakes

Although you'll rarely encounter one, the Columbia Basin boasts an abundance of snakes: gopher snake, western yellow-bellied racer, striped whipsnake, desert night snake, common garter snake, and the rattlesnake.

In general, all snakes of the region share similar habits. They "hole up" for winter in places where the temperature will not get below freezing. Usually, this is below ground in an animal burrow or in natural cracks or crevices, but they also select protected areas of human design such as cellars, cisterns, grain bins, and silos.

During the first warm days of spring snakes move away from their denning areas and set about finding food and mates. After mating, each snake goes its own way to forage for food for the rest of the year. With the coming of cooler weather, snakes leave their summer feeding grounds and travel to places where they will hibernate for the winter.

Although the gopher snake may pretend to be otherwise, it is the most gentle snake of the region. This snake becomes quite placid when handled, intending only to escape quietly. But when threatened, the gopher snake coils in defense and may imitate the rattlesnake. It will even flatten its head and neck to further the charade. It even might shake its tail, and in a brushy area this will sometimes produce a rattle sound of sorts. However, I never have had one of these gentle creatures go so far as to actually bite.

The region's rattlesnake (*Crotalus viridis*) has to be the most spectacular snake in the Basin. Smaller than most rattlesnakes, this species, known by several different common names (western rattlesnake, prairie rattlesnake, Northern Pacific rattlesnake), is less fearsome than most people imagine. Generally, I have found rattlers to be less aggressive than the harmless yellow-bellied racer or even the garter snake.

We even had a "pet" rattlesnake for several years at ALE. Its established territory was a pile of fence posts, railroad ties, and so forth. The snake would sun itself in early morning, and as the day warmed, it retreated to coolness beneath the wooden posts. If you ventured near its territory, you would verify the snake was in its accustomed place [near the posts] and then go about your business. (The snake was easy to spot—Ken Gano, a former colleague, painted the tip of its tail bright orange.) Stretching to about 3 feet, this rattlesnake was the largest I have seen in the area.

In all the rattlesnake encounters my arid-land research has provided, never have I had cause for alarm. Most snakes didn't even rattle after I had discovered them. They simply remained coiled and motionless, trying quietly to escape if possible.

Beware, however, a rattle of warning does not necessarily precede a rattlesnake strike, especially should you step on one. But by exercising even a minimum amount of caution, you'll keep your chances of being bitten remote. For example, when hiking, avoid dense shrubs, and wear boots that provide protection above the ankles. (Of course, reaching a hand into a hole in the ground is not advised.) Climbing onto a rocky ledge can be hazardous, rattlesnake-wise.

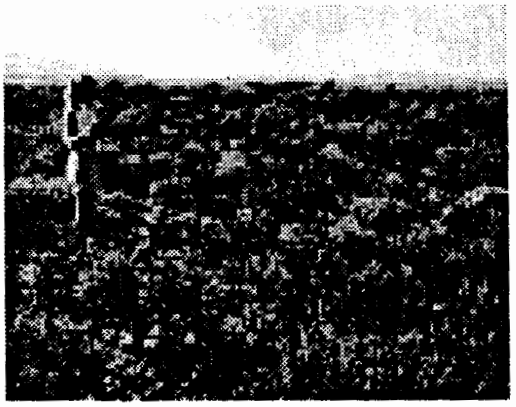
Adult rattlesnakes consume only warm-blooded prey, consisting mostly of small mammals such as deer mice, shrews, voles, rats and perhaps small rabbits. Their poison allows them to capture their prey with a minimum of risk to themselves. Rattlesnakes have heat sensing pits located on either side of the head between the eye and nostril that aids in detecting the presence of warm-bodied prey and helps guide the strike.

Once struck, the prey does not die immediately but runs off in panic only to drop a few feet away. The rattlesnake then uses its sense of smell to find its prey. The tongue is flicked in and out picking up odors from the ground and enabling it to track its victim. I once watched a prairie rattlesnake trail a small mouse after the strike. The snake started trailing the mouse the wrong way. After a few feet it apparently realized that it was following a cold trail and turned around and soon located its victim.

In nature "red in tooth and claw," rattlesnakes, too, have their enemies. Common predators, especially of young snakes, are coyotes, hawks, eagles, and owls. The late Dick Fitzner, a colleague who studied the region's snakes and red-tailed hawks for 20 years or so, found these birds to be one of the major consumers of Columbia Basin rattlesnakes.

The most serious threat to rattlesnakes, however, is posed by humans. If you see one of these inoffensive creatures basking in the sun, I hope you will leave it to its own devices. Rattlesnakes, like other wild creatures, are integral to the complex ecology of arid lands. If we decimate the region's rattlesnake population, soon our sagebrush country no longer will be the same, and we will have lost another part of our natural heritage.

Future of Wildlife Habitat



Habitat is the place we live in both human and ecological communities. Soils, climate, topography, and plants all determine habitat, but plants are particularly important for wildlife. They depend on plants for food, concealment, protective cover, and, for some species of birds, for nesting. The types of plants (vegetation) determine the number and kinds of wildlife that live in our area.

In the semi-arid Columbia Basin, we describe habitat broadly as shrub-steppe. It includes sagebrush or other shrubs such as spiny hopsage, bitterbrush and greasewood, and native grasses. Riparian habitat in our area consists of reeds and deciduous trees that grow along the wetted shorelines of rivers and streams.

Shrub-steppe vegetation once covered more than 200,000 square miles of the West, making it the largest non-forested ecoregion in North America. Under natural conditions, shrub-steppe is covered with grasses and shrubs, mostly big sagebrush with an understory of perennial bunchgrasses. Driving through sagebrush country you may think you see a lot of shrubs, but the days of seemingly abundant sagebrush are history.

Shrub-steppe habitat has been rapidly replaced in the Columbia Basin since Lewis and Clark first explored our area in 1805 and described a landscape covered with shrubs, grasses, and herbs.

Until 100 years ago, shrubs and native grasses (such as Sandberg's bluegrass) dominated the herbaceous vegetation. However, as a result of expanded human development, much of the native vegetation has been eliminated, fragmented, or else the kinds and mix of plants has been altered by the influx of non-native plants introduced to the region by European settlers.

Although change is a natural part of landscapes, such a rapid change had to have had a severe impact on the wildlife of the entire ecosystem. The conversion of so much shrub-steppe to farmland and homesteads caused soil erosion to increase sharply, not only eroding the soil, but burdening the land with blowing dust and waters with increased loads of silt. Many animal habitats were reduced considerably or eliminated.

Sagebrush is one of those plants that is misunderstood and much maligned. It's been yanked out, burned, poisoned and driven over. To those of us raised in cities and states where green trees and grasses are the predominant plant communities, it is often hard to understand why sagebrush is important. We may be inclined to think because sagebrush country is grayish-hued instead of Kelly green it's not healthy. We would be mistaken.

At first glance, sagebrush may not seem like much, but it is the fulcrum of the shrub-steppe community, well adapted to our land of little rain and extremes of cold and heat. In many ways, sagebrush is eastern Washington's old-growth forest. Some shrubs have been growing for 100 years, a long time to survive on this hard land.

The beauty of sagebrush is subtle, something you have to look closely to see. And though these plants seem tough, like other

segments of the natural community, they are fragile. Sagebrush does not naturally come back easily after human disturbance—urban and agricultural development—or wildfire. It takes years, perhaps lifetimes, for sagebrush to fully reestablish.

The sagebrush/bunchgrass community is valued as a remnant of natural diversity in the state and is included in the state of Washington *Natural Heritage Plan*, an effort to preserve segments of our unique natural resources for present and future generations. National conservation organizations have deemed the sagebrush/bunchgrass community as the state's second most endangered ecosystem.

We are lucky in the Tri-Cities because we have around us remnants of what the shrub-steppe used to be when Lewis and Clark first arrived. The ALE Reserve on the Hanford Site contains the last remnant of relatively unspoiled sagebrush habitat in the state, according to Battelle-Northwest biologist Bill Rickard, who has studied shrub-steppe habitat for 30 years.

Disappearing Wildlife

As sagebrush and native grasses have decreased, so have certain native animals. Wildlife populations in our area that depend on sagebrush for food and cover include such birds and mammals as sage grouse, loggerhead shrikes, sage sparrows, sage thrashers, white-tailed jackrabbits, and pygmy rabbits. Several of these species currently are now candidates for state sensitive, threatened, or endangered listing or are already listed as sensitive, threatened or endangered species in Washington.

Historically, sagebrush/bunchgrass habitat provided nesting sites for sage grouse, a once-abundant bird in the western United States. Now, one of the only two remnant populations of sage grouse remaining in the state of Washington exists on the Yakima Training Center where birds mate in sagebrush stands, and nest and rear their broods in sagebrush habitat.

The white-tailed jackrabbit, also once very abundant in the Columbia Basin, is seldom seen any more. The conversion of large tracts of shrub-steppe habitat to agriculture and other uses has reduced their populations and may eventually result in the elimination of this large and beautiful hare from Washington State. The pygmy rabbit, a species reported to occur on ALE, has not been seen in recent years either. Large wildfires that burned much of the Hanford area eliminated large stands of sagebrush, thereby reducing the available habitat for this species.

As part of Pacific Northwest Laboratory's Wildlife Resources Monitoring program, scientists Janelle Downs and Larry Cadwell and University of Montana student John Nugent have created vegetation maps to help them determine the extent of existing sagebrush habitat and other native vegetation on the Hanford Site.

These maps will help PNL scientists in their wildlife research and management of particular wildlife species of concern and in identifying sensitive and critical habitat areas on the Site. The maps were developed from aerial photographs (supplied in part by Benton County) using the Geographical Resources Analysis Support System (GRASS).

The Washington Department of Wildlife also has mapped critical wildlife habitats in the region and all over the state under their Priority Habitat and Species Program. Biologist Lisa Fitzner says city and county planners, including those in the Tri-Cities, have access to these computerized maps to help them in making land-use planning decisions.

Riparian Habitat

The thin band of trees and shrubs, mostly mulberry and cottonwood, that line local waterways support another type of habitat in the Columbia Basin. Riverine and riparian habitats provide food and nesting sites for a wide variety of birds. Shoreline trees provide nesting habitat for birds, including northern orioles, Swainson's and red-tailed hawks, great horned owls and great blue herons, those long-legged birds with six-foot wingspans you occasionally see in Leslie Groves Park.

According to Janelle Downs and colleagues, willow thickets along the Columbia River trap food for shore birds, such as killdeer and spotted sandpiper, and provide nesting habitat for a number of other species. Studies of the Columbia Reach show that beaver and muskrats rely on shoreline habitat for foraging and denning materials. Mink, otter, raccoon, and osprey feed on fish. In fall and winter, bald eagles feed on spawned salmon along the Hanford Reach.

Preserving portions of shrub-steppe and riparian habitats is important in maintaining the natural history of our community and region for present and future generations. Although millions of acres of native habitat currently are protected from development,

and will surely enrich future generations, none protects shrub-steppe habitats. Perhaps it is time to provide protection for them as well.

Family, respect, ethics, diversity, and interrelationships are important words in human communities. They also apply and are important in natural communities. Understanding the relationships between habitat and wildlife is an important first step in designing development that allows humans to live with wildlife in the Columbia Basin.

How we treat the streamsides, wooded areas, and grassland habitats will have a tremendous influence on the attractiveness of the Columbia Basin to future generations. Having wildlife habitats located near our living and working areas is a valuable resource for both now and the future. A resource that has been largely lost from most metropolitan areas.

In may ways, we are in the midst of a redefinition of our social and environmental priorities. There will be many decisions that will need to be made in the future concerning habitat protection and development. Such decisions are too important to be left strictly in the hands of bureaucrats, politicians, and activists. You, as part of an informed public, will need to be involved as well.