

NATURE NOTES

from

CRATER LAKE



1995

Front Cover: Two visitors atop Garfield Peak, ca. 1920. Photo Courtesy of Mrs. Coie Brown.

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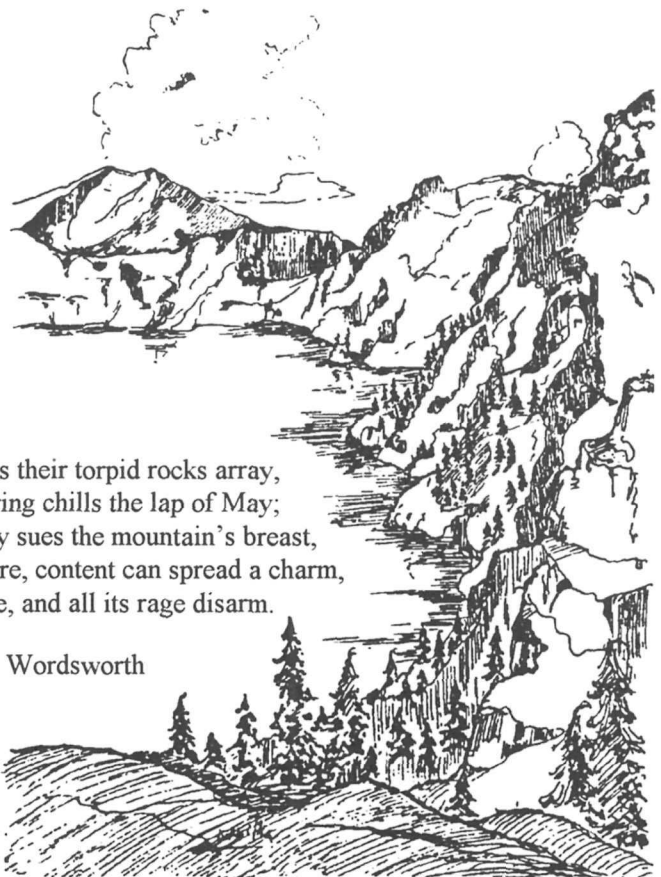
presented by

National Park Service
Crater Lake National Park



Crater Lake Natural
History Association





No vernal blooms their torpid rocks array,
But winter lingering chills the lap of May;
No Zephyr fondly sues the mountain's breast,
Yet still, even here, content can spread a charm,
Redress the clime, and all its rage disarm.

William Wordsworth

NATURE NOTES FROM CRATER LAKE

Volume XXVI - 1995

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Introduction

Present and former park employees have again volunteered their efforts in bringing this volume of Nature Notes to fruition. In addition to thanking the authors, I would like to take this opportunity to acknowledge the efforts of Susan Marvin and Judy Giles in greatly facilitating the editorial process. Intended as an aid to visitors at Crater Lake National Park and Oregon Caves National Monument, this publication contains original research or observations that should be of interest to anyone wanting more than a fleeting glimpse of either park area. Our hope is, of course, to provide some insights about the character and features of both places.

Since the Crater Lake Lodge reopens this year, I thought it appropriate to begin with an article that relates the hotel to its surroundings. This is followed by an eclectic mix of topics such as porcupines, ponds, and the Pacific Crest Trail which may entice park visitors to get away from their automobiles in favor of going further afield. Toward this end we encourage reprinting submissions that appear in Nature Notes from Crater Lake, as long as credit is given to authors and the Crater Lake Natural History Association.

Established in 1942, the Crater Lake Natural History Association's purpose is to aid the National Park Service in its educational and resource management programs at Crater Lake National Park and Oregon Caves National Monument. It therefore sponsors this edition of Nature Notes as well as a number of other publications, research grants, and events. The association operates three sales outlets, with two located in Crater Lake National Park and another at the Illinois Valley Visitor Center in Cave Junction, Oregon. Proceeds from sales items are used entirely to support the association's goals. A list of items available for sale can be obtained by writing to CLNHA's Executive Director, P.O. Box 157, Crater Lake OR 97604.

Stephen R. Mark, Editor

A Naturalist's View of Crater Lake Lodge

By Erik Hendrickson and Steve Mark

The Crater Lake Lodge will reopen in the spring of 1995 after four years of rehabilitation work. There are just 71 guest rooms in the lodge, but all park visitors are welcome to spend some time in the building. They can relax in the Great Hall, have a meal in the dining room, examine a small exhibit room that centers on the lodge's history, or wander around the grounds to contemplate Crater Lake and its surroundings. As you might expect, there are many opportunities for observation and study.

Landscaping adjacent to the lodge is a lesser-known component of a more than \$15 million rehabilitation project. A separate landscape contract has been let in order to restore lodge grounds impacted during four summers of construction. In addition to historic and aesthetic criteria, the landscape plan addresses erosion and species integrity as two other areas of emphasis.

The effects of erosion can be seen just below the caldera rim. Roots of mature trees are exposed where the soil in which they grew has been worn away. Small-scale erosion in areas disturbed during construction and in newly planted beds is being checked by an erosion control blanket. This consists of wood shavings and a nylon net that will degrade in a few years with exposure to ultraviolet light. Concerns that the net might entangle deer have been alleviated upon observations that the animals traverse the blanket without difficulty.

The genetic integrity of plants placed around the lodge became a prime concern of consulting botanists. They insisted that vegetation planted in the restored landscape be limited to the floral gene pool of Crater Lake National Park. This would insure better adaptation for survival in the harsh environment (deep snows, long winters, dry summers, high elevation) of Rim Village, but also might prevent introduction of non-native species or variants which



Young hemlocks curl over as snow accumulates.

eventually could compete with native plants. All of the plants used in this project have been propagated from seed collected in the park, or from local cuttings.

All three tree species evident around the lodge are well adapted to the deep snows that fall at Crater Lake. Mountain hemlock, *Tsuga mertensiana*, with its distinctive droopy leader, is very flexible. Visitors in late fall or early spring might see young hemlocks curling over as snow accumulates, or slowly springing upright as the snow melts. Subalpine fir, *Abies lasiocarpa*, has also evolved to bend with heavy snow and strong wind. Mature trees display a distinctive spire-like silhouette, in part to shed snow and cut wind resistance. Whitebark pines, *Pinus albicaulis*, can be identified by clusters of five needles and very limber branches. They are often perched right at the caldera's edge because their ecological niche permits survival in exposed areas where there is less competition from other species.

Contractors also transplanted a number of shrubs into beds around the lodge. Perhaps more than the trees, shrubs help blend the hotel with its surroundings because they can soften vertical lines imposed by building facades and provide transition between ground and structure. In utilizing a number of well adapted shrubs around the Crater Lake Lodge, this also provides a way to learn something about native plants.

Discovered only in 1896, the Crater Lake currant, *Ribes erythrocarpum*, is found in only a few areas outside park boundaries. This is a creeping shrub, and may form a large mat with copper-colored flowers in July and red berries in late summer. Waxy currant, *Ribes cereum*, by contrast, is more bushy and has smoother leaf edges. It can also be distinguished by white or pinkish flowers and yellowish red berries. Botanists found the waxy currant much easier to propagate from in-park sources than Crater Lake currant, perhaps because of its wide distribution at high elevation in dry, open places.

Pinemat manzanita, *Arctostaphylos nevadensis*, is a low, sprawling shrub that seldom grows more than a foot high. It has red bark on its slender stems, and evergreen, leathery leaves. This type of manzanita is also common along the Cleetwood Cove Trail leading down to the lake. It is one of several shrubs frequently browsed by deer.

Rubber rabbitbrush, *Chrysothamnus nauseosus*, is a relatively small shrub, being six inches to two feet in height. Its yellow flowers appear late in the summer and can be seen along the Garfield Peak Trail and at places like the Wineglass near the caldera's edge.

Sierra willow, *Salix sitchensis*, and Bush honeysuckle, *Lonicera involucrata*, both have long, large leaves, but they are easy to tell apart in the late summer. The willow, which ordinarily prefers wet habitats such as stream sides, develops seeds that give the appearance of small bits of cotton. Bush honeysuckle (which is sometimes called black twinberry) produces pairs of



black twinberry

dark purple berries which are a favorite food of the Clark's nutcracker, *Nucrifraga columbiana*. These berries can stain the bird's beak bright purple, something which is often seen around Rim Village where this species of honeysuckle is common.

Botanists experienced difficulty in locating Mountain maple, *Acer glabrum*, from

which cuttings could be obtained in the park. They eventually found several of these shrubs in a moist area near the east rim drive. As a result, several mountain maples can be seen near the southwest corner of the kitchen.

Mountain ash, *Sorbus sitchensis*, is fairly common around the lodge. Shrubs planted in the 1930s are about five feet tall, and in need of pruning. The leaves of mountain ash are composed of seven to eleven leaflets and have a shiny green color. This shrub produces red berries in the fall that are eaten by migrating cedar waxwings, *Bombycilla cedrorum*.

Although they are the smallest component of the landscape project, perennial wildflowers are, at times, its most colorful. Like the shrubs, these herbs provide an understory for trees and complement the grass-like native sedges. From midsummer until late fall, a number of perennial wildflowers transplanted into beds around the lodge may be seen.



columbine

As its name implies, the pearl-everlasting, *Anaphalis margaritacea*, has a long-lived flower. Its papery-white petals appear in July and last until snowfall. Growing from one to two feet tall, it is commonly seen along park roads where runoff creates moist conditions.

Visitors from the Rocky Mountains who are familiar with the pastel to deep blue of columbines in that region may be surprised

to find the red and yellow Sitka columbine, *Aquilegia formosa*, around the lodge. This species of columbine is the only one in the park, but is common

to forests along the Pacific slope. It is frequently seen during July and August in the Cascade Crest Wildflower Garden near Park Headquarters.

Cascade aster, *Aster ledophyllus* var. *covillei*, has purple flowers with approximately eight radiating petals. This is the most common of the four asters in the park and was easily propagated from seed for transplanting at the lodge. It is often seen from July to September around the rim, usually in dry places.

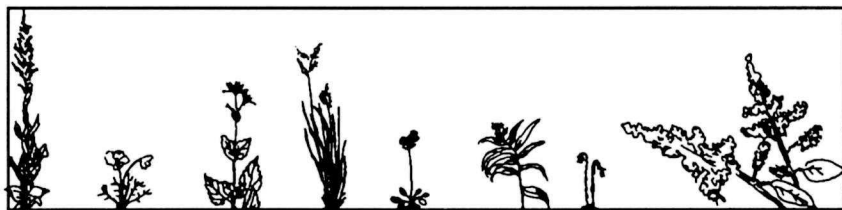
Sulfur eriogonum, *Eriogonum umbellatum*, is found in dry areas throughout the park and is sometimes known as wild buckwheat. This plant has small yellow flowers atop a leafless four to twelve inch stem. Its paddle-shaped, silver green leaves appear at the base. Another member of this genus, *Eriogonum pyrolaefolium* var. *coryphaeum*, is somewhat similar in appearance but has white flowers. *E. pyrolaefolium* is usually known as Dirty socks because of its objectionable odor.



cascade aster

Cliff penstemon, *Penstemon rupicola*, is an attractive woody plant with purplish pink flowers that grows in rock crevices. Often found on ledges along the Garfield Peak Trail, cliff penstemon has been planted in the rocks which help stabilize the rootball of a mountain hemlock transplanted at the east end of the lodge.

As intended, the trees, shrubs, and flowers around Crater Lake Lodge combine to help blend the building with its surroundings. Although they represent only a small part of the park's flora, these species are also useful starting points in demonstrating how organisms adapt to exposed places at higher elevations. If nothing else, the plants adjacent to Crater Lake Lodge demonstrate that life can persist in an environment where natural succession is slow or even absent for long periods after disturbances occur.



The Fretful Porcupine

By Marianne Mills

Measuring up to 2.5 feet in length and weighing thirty pounds, the North American porcupine, *Erethizon dorsatum*, is one of the world's largest rodents. Fossils of porcupine ancestors date back to the Oligocene epoch, about 30 million years ago. It is believed that porcupines originated in South America and are most closely related to the guinea pig and the chinchilla. While porcupines may not be considered great beauties of the natural world, they have proven themselves to be masters of survival. Naturalist Uldis Roze describes them as "a microcosm in the great evolutionary adventure of nature."

Dark in color, they have a somewhat "frosted" appearance because their quills are yellow to white with a black tip. An average of 30,000 quills grow only on their backs, sides, and tails. These modified hairs have tiny scales like a fish, with each scale acting like a tiny barb on a fish hook. It is these scales that hold a quill tightly in a predator's skin. Folklore describes a creature that is quick to fire quills at enemies. In truth, it slaps its victims with its tail only in self-defense and does not have the ability to project its quills, no matter how frightened. Muscle action combines with these scales to work the quills deeper and deeper into the unfortunate's body, becoming very painful. If a vital organ is struck, they can be fatal. A misconception is that a quill will shrink if the end is cut off, making it easier to pull out. The quills are filled with a spongy material, not air, so they do not shrink or soften.

The range of porcupines covers most of the western United States. Their preferred habitat is dense forest, making Crater Lake National Park suitable for a healthy porcupine population. Slow and somewhat awkward, these nocturnal creatures are more graceful in trees than on the ground. They always climb up head first, but will back down a tree tail first. Much of their time is spent in a den which is usually a small cave or deep crevice in a ledge or rock pile, a large hollow in a tree trunk a hollow under a partially uprooted tree, or an abandoned animal burrow. In very cold weather or deep snow, porcupines sometimes stay in their dens for two to three days at a time. Solitary during most of the year, porcupines may band together to share a den and their communal heat. If a porcupine is seen out of its den in winter, it is most likely there to feed, then return to warmth. Possessing some of the poorest eyesight among all mammals, a typical porcupine can see only two to five feet in the distance. Poor vision is offset by excellent senses of smell and hearing. Porcupines vocalize; if disturbed, they may squeak, grumble, groan, or seem to mutter to themselves. They can also emit a high-pitched cry that people have mistaken for a bobcat or mountain lion.

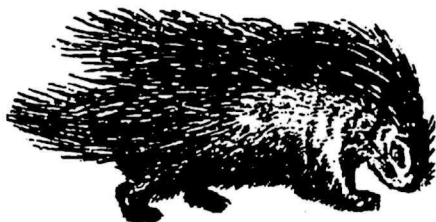
Most often found between 5,000 and 6,500 feet in elevation, porcupines are strict vegetarians. Their favorite food is the inner bark of trees, though they tend to feed on young trees that would most likely be naturally thinned out. They also like leaves, certain grasses, berries, and fruits such as apples. They possess an insatiable love of salt, something which causes them to frequently loiter around highways which get salted during winter. This can lead to the death of many porcupines through being struck by vehicles. Porcupines are also drawn to objects that people have handled so as to lick the salty sweat left behind. Their search for sodium can thereby bring about the destruction of objects such as handrails, steps, and doorways.

Porcupines are somewhat different than most mammals in that the females stake out a territory and fight to protect it, rather than the males. A female porcupine has just one offspring per year and will raise it alone. Baby porcupines are called porcupettes and are comparatively large, being about one pound at birth. They are born with open eyes and soft quills, with the latter hardening within the first ten minutes after delivery. Porcupettes will travel long distances on their own almost immediately, but they do not climb trees for several months. The young porcupettes travel with their mother during night feeding sessions for three to four months when they become independent.

When thinking of the great animals of literature, seldom does the porcupine come to mind. The title of this article is taken from Act I, Scene V of *Hamlet* and reminds us that all creatures have a place in art, as well as science: "I could a tale unfold whose lightest word Would harrow up thy soul ... Like quills upon the fretful porpentine {sic}." A naturalist must also exhibit duality, or lives in two worlds: the world of nature and the world of human ideas. One world is represented by a fallen tree; the other by a library. Each species studied, each theory formed brings the two worlds a bit closer together. We learn through the survivors and speculate on species that have become extinct. The porcupine thus becomes a storyteller of the woods. In its telling, its frets are fewer and its ancient story more eloquent.

Further Information

Uldis Roze, *The North American Porcupine*. Washington, DC: The Smithsonian Institution Press, 1989.



Mimicry Among the Pines?

By Ron and Joy Mastrogiuseppe

The deep blue of Crater Lake is enhanced by the verdure of the coniferous forest around it. Splashes of green unite in harmony with multicolored volcanic bluffs in the caldera landscape. Distance masks the variety of species in these green areas. There is a certain pleasure in recognizing species by name, but even with a close view, walking among the noble conifers, there are striking similarities in the appearance of different members of a genus such as *Abies*, the true firs.

Sometimes these similarities obscure their differences. Such difficulty in distinguishing species is more challenging if seed cones are unavailable at the time identification is made. Since seed cones of the true firs disintegrate at maturity, features such as cone shape, cone scales, bracts, and seeds may not be available for inspection. This lack of essential diagnostic features can frustrate a desire to classify and distinguish a species by name.

Even when the important diagnostic features are present, species distinction may be confusing at times. In the late 1970s it was reported that Jeffrey pine, *Pinus jeffreyi*, occurs in the forested panhandle of Crater Lake National Park. The most northerly known natural populations of this tree occur, however, on serpentine substrates near the Illinois Valley southwest of Grants Pass. The biologists reporting Jeffrey pine in the panhandle (some 100 miles northeast of those Illinois Valley populations) based their determination primarily on seed cones which did not appear like cones of typical ponderosa pine, *P. ponderosa*. Apparently those biologists were unaware of another contender, *P. washoensis*, a rare pine similar to ponderosa but with smaller cones. As it turned out, the ponderosa variants in the panhandle are actually closer to Washoe pine than to Jeffrey pine based on cone length and diameter. There still is the need, however, for additional study of local populations as one part toward understanding variation on a larger geographic scale because the widely-distributed variants of ponderosa pine are so difficult to interpret.

If we shift our attention from three-needled pines to members of the genus whose needles are borne in clusters of five, each life zone (a concept which largely corresponds to elevation in this part of the Cascade Range) within Crater Lake National Park may be characterized by a different species. Sugar pine, *P. lambertiana*, of the mixed conifer forest bears foliage which resembles that of western white pine, *P. monticola*, which typically grows in association with more high elevation true firs such as red and noble fir within the *A. magnifica/procera* complex. When sugar pine and western white pine occur in overlapping habitats, younger trees of both species look alike. We can also

find species very distinct taxonomically but adapted to similar habitats and displaying an amazing degree of similarity in a number of characteristics during each life stage. For example, whitebark pine, *P. albicaulis*, of the upper caldera rim area is strikingly similar to limber pine, *P. flexilis*. Although limber pine is absent at Crater Lake today, it typically occurs in subalpine habitats in the northern Rocky Mountains, much of the Great Basin, and the eastern Sierra Nevada, where there are some areas that whitebark and limber pine grow together. Strangely enough, limber pine is Oregon's rarest conifer, with the state's only known populations occurring in the Wallowa Mountains some 300 miles northeast of the park.

In asserting that many species look much alike, we may wonder what is a species? It is generally regarded as a group of similar individuals which are reproductively isolated from other groups. Although members of a species share many characteristics, variation is inherent. Hidden within the forest canopy are many seed cones nurturing potential trees. Formed through the genetic mystery of reproduction, the seeds bear an awesome responsibility in perpetuating their kind in all its variation. In conifers, the messenger of similarity and difference becomes the wind as it carries vast quantities of pollen to receptive young cones. Differences in timing of pollen release and of conelet receptivity act as barriers to cross-pollination between different species.

Recognition of species is not only rewarding, but also crucial to understanding interactions among trees, their physical environment, and the creatures that depend on the trees. Coevolution is the reciprocal evolution of two species, in that one species adapts to evolution in the other. If, for example, we have a specific insect and a plant on which it depends for food, an evolutionary change in the chemistry of the plant might make it less digestible by the insect species. Those individuals of the insect species which are still able to digest the plant tissues survive and reproduce. Thus the evolutionary change in the plant has led to an evolutionary change in the insect.

Sometimes coevolution or coadaptation results in mimicry. This is the close resemblance of one species to another, stemming from pressures acting to select for those individuals in the "mimicking" species which resemble the "mimicked" species. Mimicry may have various advantages to a species, including protection from predation, thereby favoring their survival. But is this the case in conifers? Pines are subject to predation by a multitude of herbivorous insects which, at least in some cases, identify pine species based on the unique chemistry of their resins. It is unknown at present if there are any cases where resins of one conifer species have, over time, come to include a certain compound or compounds which cause insects to avoid another species. This would happen through the chance occurrence of the compounds in individuals which would then be more likely to survive and reproduce.

In some cases, experts may be faced with perceived differences which do not justify separation into distinct species. This is the challenge facing the biosystematist in evaluating the degree of difference necessary to separate species. The classification of organisms necessarily includes some subjective evaluation because lumping all similar species into one group on some "objective" basis (thereby ignoring their interesting differences) would compromise our understanding of the species' respective ecological roles and the limits of their environmental ranges. With the term "species diversity" becoming increasingly important in discourse about the biological conservation of organisms, it seems obvious that careful thinking and humility are needed when trying to assess ecological quandaries posed by forces difficult to quantify. Those who oversimplify and arrogantly generalize about our world do so at their peril, as Alexander Pope noted almost three centuries ago:

*Go, wond'rous creature! mount where Science guides,
Go, measure earth, weigh air, and state the tides;
Instruct the planets in what orbs to run,
Correct old Time, and regulate the Sun;
Go, soar with Plato to th' empyreal sphere,
To the first good, first perfect, and first fair;
Or tread the mazy round his follow'rs trod,
And quitting sense call imitating God;
As Eastern priests in giddy circles run,
And turn their heads to imitate the Sun.
Go, teach Eternal Wisdom how to rule -
Then drop into thyself, and be a fool!*





Pronghorn: Return of the Native

By Steve Mark

One of the reasons people come to national parks is to see large animals. The most ubiquitous large animals in North American national parks have been called ungulates. Although this classification for exclusively herbivorous mammals with horns or antlers is no longer used, three families comprise the order *Artiodactyla*, or hoofed mammals. Members of two families, *Cervidae* (deer and elk) and *Antilocapridae* (pronghorn antelope), are found in Crater Lake National Park.

A glimpse of the common Columbian black tail deer, *Odocoileus hemionus columbianus*, is enough for many visitors to stop and take a second look. The larger and lighter-colored *Odocoileus hemionus hemionus* whose comparatively long ears give it the name "mule deer" is also often seen. Sometimes it can be difficult to tell these subspecies apart because they can hybridize along the crest of the Cascade Divide, where their respective ranges overlap. Much more rarely seen is the yellow tail deer, *Odocoileus virginianus ochrourus*. It should not be confused with the two subspecies of *O. hemionus* or their hybrid because this animal has a distinguishing and largely white tail.

A bigger member of the family *Cervidae* is the wapiti, though often referred to as elk. The names are a small point of distinction in that wapiti is a Shawnee word from eastern North America, whereas elk originally referred to European moose. Most of them seen in the park are members of a herd which migrates circuitously from the Prospect area (20 miles southwest of Crater Lake) to the northern Klamath Basin. They often utilize the meadows in Munson Valley throughout the summer and into fall. Being no strangers to the southern rim of the Crater Lake caldera, nor even to the top of Crater Peak, the elk can sometimes be seen kicking up dust throughout August and September.

Like the two subspecies of deer, there is reason to believe that the wapiti have undergone some degree of hybridization. This is because of the general belief that hunters greatly depleted the native Roosevelt elk, *Cervus canadensis roosevelti*, by the early years of this century. State game officials brought a

herd of Rocky Mountain elk, *Cervus canadensis nelsoni*, from Yellowstone National Park and released them into the wild near Fort Klamath in 1917. The two subspecies probably interbred because the Roosevelt elk had not been completely extirpated from the west slope of the Cascade Range in southern Oregon. The park thus plays an important role in perpetuating the existence of a large and striking animal--though one not fully native by lineage.

Less evident than deer or elk at Crater Lake National Park are pronghorn antelope, *Antilocapra americana oregona*. As a fully native wild species, the pronghorn is known for its speed (up to 60 mph) and keen eyesight which allows them to spot moving objects three to four miles away. These creatures are generally the size of a small deer and bear cinnamon-buff coloration. Supplying emphatic contrast are black and white markings on the head and neck. Pronghorn have a rump patch which can be spread when the animal is alarmed into a large white rosette, or remain small and inconspicuous when closed. They are not true antelope (in this regard they are like the "elk"), but belong instead to a family of one pronged hollow-horned animals peculiar to this continent. It differs from other hollow-horned mammals by having permanent horn cores. A horn-like sheath covering these bony processes is shed annually.

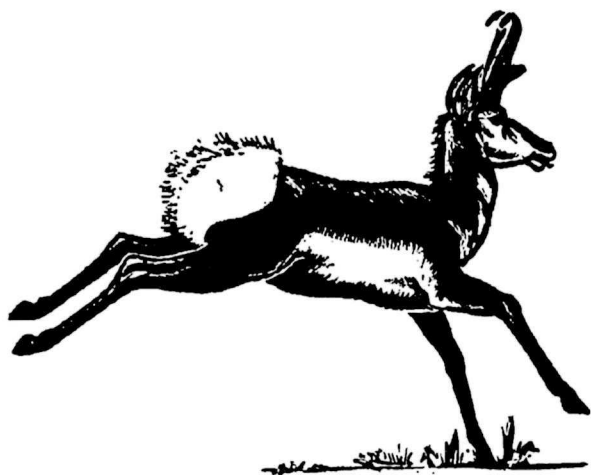
Within the boundaries of what is now Crater Lake National Park, the earliest record of pronghorn is from 1887. During September of that year one explorer encountered sufficiently large numbers of them on the Pumice Desert to name the place "Antelope Prairie." Several hundred pronghorn could still be seen there during the late summer of 1896, but hunting pressures associated with encroaching settlement forced their general retreat into the high desert east of the park shortly thereafter. Despite a report of two antelope on the south rim of Crater Lake in 1931, none had been seen in other parts of their original range (which extended from southeastern Oregon to the Cascade Range and included the Klamath Basin) for several decades. By the 1940s, researchers doubted whether anyone might ever again see pronghorn west of U.S. highway 97.

More recent observations, however, show that antelope use the park each summer by way of the Desert Creek drainage. A disappearing snowpack in this part of the park usually makes June and July the best times to see them, though other times of the year should not be discounted. In recent years several individuals have even been spotted near Roundtop, along Crater Lake's northeast rim. They appear to be part of a herd which migrates from the Fort Rock area, some 70 miles northeast of the park. When they are present, the pronghorn seem to prefer the forested habitat between Pumice Desert and the park's east boundary instead of more open areas. This may be due to the pronghorn's characteristically slow natural return to former range, even when hunting has been restricted for more than 80 years. Upon their return to former range, researchers have noticed the pronghorn's inclination to take up forested

habitat more often associated with mule deer. These areas can offer sanctuary for antelope, though they may be somewhat different from the open places so characteristic of where they roam.

What makes pronghorn reappearance at Crater Lake interesting is that it seems to be part of a general reclamation of their range after being absent in many places for most of the past century. Even in the flat and open country of the Klamath Basin, where sightings had not been recorded since 1886, antelope have reappeared. Several weeks after an acquaintance of mine noticed a herd of 20 pronghorn in an open field ten miles south of Klamath Falls, I came across a single antelope on highway 62 near Klamath Agency. This occurred in December 1994, when a foot of snow sat along the roadside. Since antelope do not hurdle perceived barriers, it started running along the highway's fog line. By the time we reached a road intersection (which resulted in the antelope heading west toward Agency Lake while I continued southward), we were traveling almost 50 mph. There are few things more impressive than antelope in full flight, but speed alone is not responsible for their apparent recovery in this part of Oregon. Restrictions on hunting, accompanied by state and federal agencies managing for pronghorn throughout eastern Oregon, have brought about this success story.

Like the antelope, deer and elk populations within the park appear to be viable, meaning that they are capable of continuing to perpetuate themselves in this habitat. High elevation and winter conditions, however, make the park a refuge for only part of the year. These animals are dependent on management practices outside park boundaries to sustain them, whether this means protection from poaching or controlled hunting for herd reduction so that starvation is averted.



A loping pronghorn antelope. Note the spread rump patch "rosette."

Fire as an Agent of Change

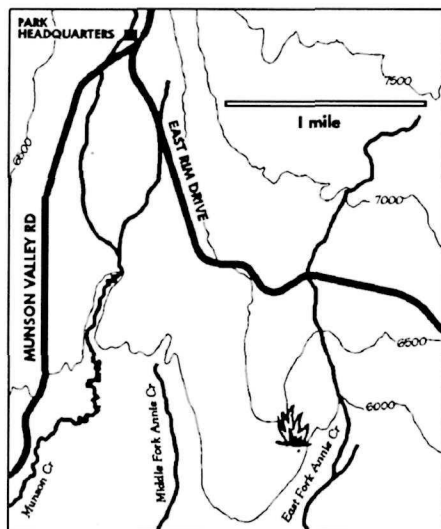
By Doug Lowthian

In 1994, Crater Lake National Park experienced 44 forest fires. These fires occurred throughout the park, from the Boundary Springs area to Sharp Peak and Annie Creek. Contrary to the widely held belief that fire in the forest is devastating and destructive, the fires at Crater Lake were beneficial products of a natural process eons old.

The vast majority of these fires during the 1994 fire season were under one tenth of an acre. A few grew to an acre or two, but less than five surpassed ten acres. One event, known as the Agee fire, was particularly interesting. This fire took nearly a week to find as the lookouts kept losing sight of the furtive smoke. Rugged topography south of the lookouts at Watchman and Mount Scott prevented a clear pinpointing of the smoke. It would pop up in the afternoon for a short time and then disappear, laying down in the tree canopy. When the smoke could be seen, it seemed to be on the southwest flank of Crater Peak.

A team of two firefighters were sent to locate the source of the elusive smoke. After four hours of climbing up and down the steep slopes, pushing through thick stands of snowbrush, *Ceanothus velutinus*, and sliding down scree, they stopped for lunch. In casually scanning the northern skyline, they saw something that made them drop their sandwiches and pick up their binoculars. They found the smoke, but it was not on Crater Peak. Although in line with the lookout tower on Watchman, the fire was on a ridge above the East Fork Annie Creek--over a mile and a half away! Since a deep canyon lay between them and the fire, they ate while hiking out. This turned into a near run so that they could get back to East Rim Drive and revealed itself, less than one and a half mile from headquarters. In an ironic twist, this fire turned out to be one of the closest to home.

Locating this fire on the park map is easy. Place your finger at Park Headquarters and follow East Rim Drive until it crosses the east fork of Annie Creek. Turn south and go about three quarters of a mile. On the west side of the creek, a steep slope runs up from the canyon bottom to the 6,000 foot level. You will see a ridge dividing the middle and east forks of Annie Creek. Along this ridge the fire burned slow but steady through a mature forest consisting of Mountain hemlock, *Tsuga mertensiana*, and Shasta red fir *Abies magnifica-procera*. Upon discovery, the fire covered less than half an acre. The decomposing layer of needles and twigs smoldered and smoked heavily. Occasionally the crackling of burning live needles broke the quiet. Small seedlings, with their branches near the ground, were torching. This sent flames up as high as three or four feet, dying out as quick as they started.



There have been fires around what is now Crater Lake National Park for many thousands of years. Chances are, however, that what became known as the Agee Fire was the first in this part of the forest for quite some time. Far from being static and seniscent, the forest is constantly changing. Agents of change such as wind, precipitation, and fire alter species composition and stand density in the forest. These processes occur with varying frequency, depending on the type of forest. The frequency of fire in a given locale can be averaged to obtain its Fire Return Interval. This number can vary greatly throughout a forested area depending on the species makeup, altitude, aspect, topography, and prevailing weather patterns.

The forest where the Agee fire burned has a mean fire return interval of approximately 40 to 50 years. This means that the fire was burning on land that probably had not burned in the last 50 years or more. The variability among fire return intervals is usually very broad. For example, one researcher may find evidence of fires within the last decade, while another might find that a similar area had not burned for 120 years. The accuracy of these numbers usually depends on the extent of the survey.

The Agee fire burned for about eight weeks before being extinguished by snowfall in early November. During this time, firefighters made efforts to contain the fire within a fixed perimeter. With many other fires burning throughout the park at the same time, people and equipment were stretched thin. The weather remained hot and dry for several weeks after the fire started. Temperatures in the 80's and humidity as low as 13 percent pointed to conditions normally associated with high fire danger. For the most part, however, the fire burned slowly through the underbrush and duff layer.

To study the effects this fire would have on the forest, plots were established in the path of the spreading flames to measure various components of the stand structure. These plots quantified the amount of burnable material, or fuel, and the quantity and density of live trees and shrubs. By reading the plots before and after the fire the change caused by the fire could be measured.

The results of these measurements point to the fact that fire is rarely a devastating event. Even the massive fires at Yellowstone in 1988 were agents of change that led to massive regeneration of the forest. The Agee fire, burning through a period of high fire danger, altered the forest in ways that were not as dramatic as all-consuming fire storms. This fire killed just 13 percent of the trees over ten feet tall, and only 41 percent of the trees under ten feet tall. The fire thinned out the young trees, providing better conditions for the growth of those that remained. What few large trees that were killed now allow for more sunlight to reach the forest floor where grasses and shrubs will sprout next year. During the fire many signs of elk were present and should be again once the forage returns. The large dead trees will also provide valuable habitat for birds, bats and insects. In topping out at 30 acres, the Agee fire left a forest changed but far from devastated.

Another change documented at the Agee fire involved deduction of the fuel load. This is composed of dead and down sticks and logs, as well as duff and needles. From a pre-burn level of 17.96 tons per acre, the fire consumed 14.53 tons per acre of fuel. This 81 percent reduction accomplished several things. Stored nutrients were released, making them available for future plant growth. In addition, such reduction can prevent the unnatural build up of fuels (which can lead to high intensity fires) that results from overzealous suppression of all fires.

Suppression of all fire at Crater Lake National Park was practiced for roughly 75 years. During that time much natural change in the forest has been stymied. When the snow began to fall in early November, there was still heat in the Agee Fire. By this time the fire crews were long gone and the fire cache was closed for the year. Snow fell gently and the temperature hovered around 30 degrees. Standing in the midst of the burn, I warmed my hands over embers in a slowly burning log. I thought about the regrowth, elk, and more fires in the summer of 1995.

Further Information

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Ancient Remnants in Snow Crater

By Steve Mark and Ron Mastrogioiuseppe

Craters are geological features usually associated with composite volcanoes and the top of cinder cones. Found throughout the park, they are generally less than a kilometer ($5/8$ mile) across and formed when volcanic material is ejected through a vent of an active volcano. Calderas, by contrast, represent volcanism far beyond the activity that is typical of eruptions associated with craters. To put this in perspective, the four to six mile-wide depression filled



*Wizard Island has a crater;
Crater Lake is inside a
caldera.*

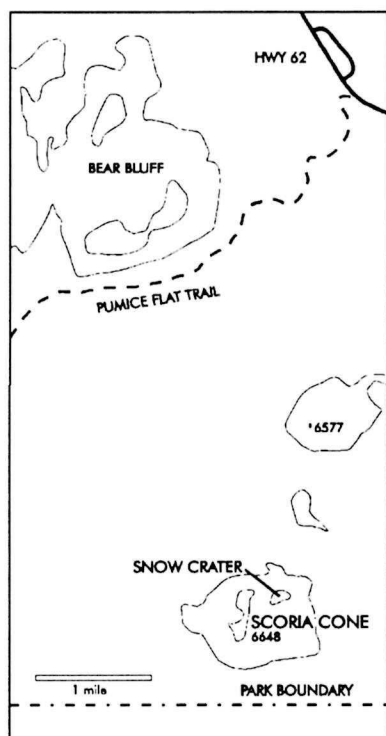
by Crater Lake is a caldera while the crater on Wizard Island's summit is only a couple of hundred yards across. That crater on Wizard Island formed after Mount Mazama's climactic eruption, so it is clearly discernable. Cinder cones such as Crater Peak, Maklaks Crater, Red Cone, and a number of unnamed points on the park map have craters obscured by erosion, pumice and ash because they appeared prior to the cataclysmic event of roughly 7,700 years ago.

Although not abundant, the park contains several post-Mazama craters in addition to the one on top of Wizard Island. One easily reached by a short walk from the west rim drive near Hillman Peak is Williams Crater, sometimes called Forgotten Crater on older maps. Another one is located some distance from any road, near the park's south boundary. Scoria Cone is quite unlike the other two, in that it has an exposed crater-like depression

or what some geologists have described as a pit crater.

Most, if not all, of Scoria Cone resulted from a north-south fissure through which lava extruded 25,000 to 45,000 years ago. It is one of three prominent cinder cones built on well-rounded lava flows whose appearance show evidence of glaciation, much like those in the vicinity of nearby Union Peak. Like many other cinder cones, Scoria Cone has a crater filled with pumice and ash. There is, however, a deep rectangular depression or pit on the north end of the older crater floor. Measuring roughly a hundred yards long and 50 yards across, the pit has precipitous walls dropping away some 130 feet to the top of a snow and ice plug.

In the 1940s one park naturalist noticed that snow in this plug is permanent, even when summer melting in other parts of the park has long dispatched any sign of winter. He named it Snow Crater, not knowing that the snow and ice extended 150 feet down a chimney which once provided the conduit for lava sometime in the past. He could not know because few people are foolhardy enough to try a descent to the plug, let alone attempting to go between the conduit's walls and the ice.



Even so, in 1977, after one of the driest years on record, a team of park rangers explored where no one had ever been previously. They reached the plug's bottom and found several rooms of various sizes. Two of the rangers retrieved pieces of wood entombed in ice from near the bottom of the plug. One of these specimens was subsequently identified as Douglas-fir, *Pseudotsuga menziesii*, by a wood technologist at Washington State University. Its resting place piqued the curiosity of researchers connected with the park, as no Douglas-fir are known to occur presently at 6,300 feet anywhere near Crater

Lake. Although badly degraded, the wood showed breakdown in cellular structure that is caused by hot water or steam. This led to speculation that the fragment might have been in the pit crater while it was still active.

Although radiocarbon dating of this wood held the prospect of providing additional insight to mysteries surrounding volcanic activity at Scoria Cone and the vegetation history of this area, no one could secure funding for necessary laboratory work for the next 17 years. Only in 1994 did a sample specimen finally reach a radiocarbon dating lab for an age determination. After calibration (since radiocarbon years may be tree ring corrected to reflect calendar years) it was reckoned that this piece of Douglas-fir is approximately 3,640 years old. The obvious interpretation of this evidence is that a mixed-conifer forest, as seen today in the park's panhandle (the irregularly-shaped parcel of land near the south entrance), flourished at Scoria Cone during a period of warm-dry summer climate roughly 4,000 years before the present. Since conifers such as Douglas-fir are long-lived, the wood sample may indeed be one of the last of this species to grow near what became Snow Crater at Scoria Cone. The nearest forest of similar composition 3,600 years later is located a few miles downslope, but at 4,500 feet in elevation near the park's south boundary.

Since three of us felt the need to locate any Douglas-fir presently living close to Scoria Cone other than those previously mentioned, we hiked there on August 25, 1994. After 30 minutes on the Pumice Flat Trail, it took another hour or so by traversing cross country to reach the top of a cone just north of our destination. We could find no evidence of Douglas-fir along the way, nor did any appear on the short jaunt to Scoria Cone. Instead we found a subalpine forest of lodgepole pine, *Pinus contorta* v. *murrayana*, western white pine, *Pinus monticola*, true fir (white fir, *Abies concolor*, and red or noble fir, *A. magnifica-procera*), and mountain hemlock, *Tsuga mertensiana*.

Once we reached Snow Crater, it did not take long to realize why the rangers of 17 years earlier felt justified in closing this vent to any future explorations. Remnants of wooden park signs to this effect could still be seen as we walked around the pit's perimeter. It was then that our attention became riveted to a curious three-needled pine clinging to the precipitous north wall some 200 feet above the plug of snow and ice. Just why it is there constitutes an interesting question. Surprisingly enough, what has been called Ponderosa pine, *Pinus ponderosa*, in lower elevation mixed conifer habitats can be found today in small subalpine habitats near Crater Lake's caldera rim, and on warmer southwest slopes of cinder cones within and near the park. In addition to the possibility of this three-needled pine being ponderosa, there are at least two others. These include Jeffrey pine, *Pinus jeffreyi*, whose northern distribution is on serpentine substrates near the Illinois Valley over 100 miles

southwest of Crater Lake, and Washoe Pine, *Pinus washoensis*, a rare and almost unknown species found in the mountains bordering the Great Basin.

Trees can often serve as thermometers with sensitivity to temperature changes induced by fluctuations in climate. Cold abbreviates the length of growing seasons, thereby limiting critical processes such as photosynthesis. The result is a narrow growth ring and long periods without viable seed production. Even cold-hardy ponderosa pines would find survival in the short growing seasons and frequent deep snowpacks of subalpine habitats difficult.

The mixed conifer forest (with Douglas-fir as an associate) seen today within the neighborhood of the park's panhandle has not always been situated there. At the time of Mt. Mazama's great eruption, 7,700 years ago, a climatic interval known as the Altithermal or Hypsithermal Period was underway. It began some 8,000 years ago and persisted for approximately four millennia. Marked by significantly warmer and dryer summers than at present, this time featured climatic changes which altered growing conditions which favored the upslope migration of the mixed conifer forest. Associated advances and retreats of forest community borders along elevational gradients are well documented throughout western North America.

Changes in vegetation zone elevations are affected by shifts in critical growing season temperature and moisture regimes. A shift to cooler, more moist conditions following the Altithermal Period spurred a retreat of the mixed conifer forest to lower elevation habitats over the past few thousand years. Isolated and disjunct stands of three-needled pines within the subalpine zone today represent local pine variants. As relicts of past environments, they may link prehistoric forest assemblages to our time and place. The sentinel pine grasping the volcanic rock for moisture and nutrients above Snow Crater may hold one key for gaining a better understanding of the linkage between past and present. Our visit to Scoria Cone provided an opportunity to interpret the present scene and wonder about the relationships resulting from those geologic, climatic, and biological forces present during the era when a 12,000 foot Mount Mazama dominated the landscape.

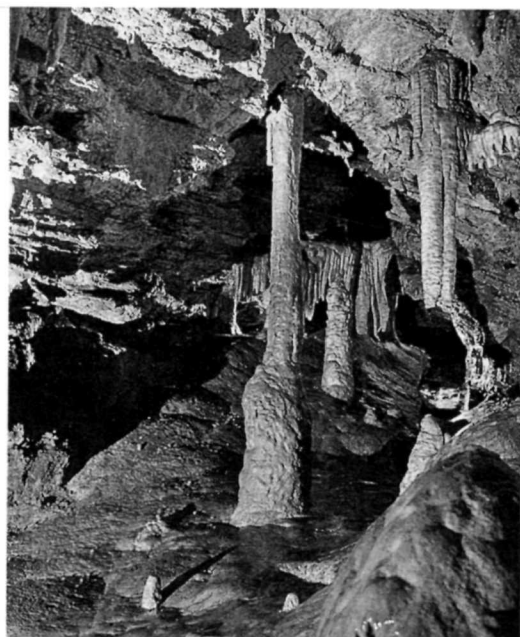


Panorama of Mt. Mazama from the southwest, sketched by Howel Williams.

Moonmilk and Cave-dwelling Microbes

By John Roth

Microbes lie as far from charismatic megafauna such as deer, bears, and bobcats as you can get. Studying these “forsaken fauna” is difficult because you cannot see them. Their geologic equivalent is mud, but even with x-ray diffraction and other high tech methods, the small particle size of muds can challenge the most dedicated researcher. When combined in caves, however, microbes and muds can form sediments known as moonmilk.



formations in Oregon Caves

Even the name has the lure of mystery. Its origin is from the German *Mannlimilch*, meaning “little earth-man.” European peasants used moonmilk for centuries to heal infected cuts in livestock. Some believed that gnomes put this substance in caves for people to use. The white mud seemed to kill infections and speed healing at supernatural rates. Like much of what is in folklore, there is more than a germ of truth in these tales. Much of the calcite moonmilk sampled by investigators contains *actinomycetes*, which are the main producers of antibiotics.

Moonmilk is a textural term for a very fine, white cave material that absorbs a lot of water. Wet moonmilk looks and feels soft and pasty, somewhat like white cream cheese, when rubbed between the fingers. Dry moonmilk resembles talcum or chalk powder, in that it feels hard and crumbly. Moonmilk often contains 40 to 70 percent water, while organic material may make it even more plastic and slippery.

It is likely that organic activity plays a role in the buildup of some moonmilk, especially the calcite kind found in Oregon Caves. Calcite

moonmilk can contain such bacteria as *Macromonas bipunctata*, along with cyanobacteria, fungi, and green algae. This microflora probably assists in breaking down minerals in the wall rock and adding them to the moonmilk. Moreover, researchers have found that the longer it takes water to reach the cave, the more likely it is that some of the organics will be consumed enroute. In general, water dripping into the deeper parts of Oregon Caves has less organic content than water reaching shallower parts.

Humans have impacted bacteria in moonmilk, as well as other microbe populations in Oregon Caves. An inventory done around every survey point in the cave shows a marked decrease in "cave slime" (mostly *actinomyces* bacteria) growing on walls near the cave trail. Decline in these organisms could well be the result of lint and other visitor-induced organics that find their way to cave walls. As a result, non-native bacteria adapted to a high energy food source outgrow and outcompete the slow growing cave slime adapted to low energy foods. Cave slime may also have suffered further adverse effects by visitors touching the cave walls, or through the past practice of spraying those walls with bleach to control exotic plants.

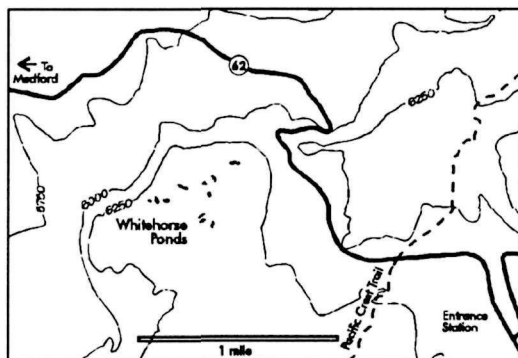
As an example of their value to resource management in the park, microbes have been utilized to reconstruct the size and shape of prehistoric entrances at Oregon Caves. Since the natural openings are now highly modified, an inventory of the directional orientation of popcorn-shaped speleothems was needed so that gates could be built with partial restoration of those conditions resembling prehistoric air flow. The cave inventory also showed that exotic microbes contributing to rounded vermiculations (or "clay worms") are more common near the main trail, while the more complex forms of these lines on cave walls are prevalent further from the trail. Analysis if the rounded vermiculations show high amounts of lint and exotic cyanobacteria. The rounded clay worms will be removed, as they appear to be largely caused by lint and artificial lights.

Deposition of lint, skin, and hair in Oregon Caves does not appear to impact native microbes as much as in some other caves administered by the National Park Service. Knowing this has allowed flexibility in the design of a new cave trail. Rather than having settling "ponds" and a foot-high, lint-trapping curb on both sides of the trail along its entire length, only certain areas will be curbed or have drainage concentrated. If these areas trap substantial lint and non-native organic runoff, then additional curbs, drains, and settling ponds will be added and the areas cleaned more frequently. This system will allow for a more natural flow of water and air across the trail, yet will trap lint and other human-associated organics where they might threaten cave biota. The result should be a better balance between allowing for visitor use and preservation of the monument's primary resource.

Whitehorse Ponds: A Special Aquatic Study

by John Salinas

A short hike from the junction of the Pacific Crest Trail and Highway 62 can take you to the top of Whitehorse Bluff. It can be reached by a relatively easy crosscountry walk and a short climb. The top of the bluff is at 6,200 feet in elevation and a world apart from surrounding areas below it. Hiking across the bluff will also lead you to encounter the setting of forest ponds. Atop Whitehorse Bluff are sixteen ponds, each with its unique inhabitants. During the summer of 1993, I along with David Hartlesveldt and Robert Truitt, received funding from the Crater Lake Natural History Association to survey Whitehorse Ponds. This survey included the biotic, physical, and chemical nature of these ponds.



A reconnaissance of the park's forest ponds by Roger Brandt in 1992 (see pp. 12-13 of the 1993 *Nature Notes from Crater Lake*) served as the precursor to this survey. In visiting the Whitehorse Ponds five times in 1993, our investigation gathered data on the phytoplankton, zooplankton, vascular plants, water chemistry, and other pond inhabitants. Samples were collected with zooplankton nets, Van Dorn water samplers, and special nutrient bottles for chemical analyses. Instruments were deployed to measure *in situ* temperatures, pH, and conductivity. We also analyzed samples for plankton and chemical concentrations.

The authors made their first visit to the ponds on July 14, 1993, when they found the area to be teeming with life. The drone of mosquitos filled the air, while snow melted directly into the ponds. Even with the wet winter season and all the snow, the ponds were about 30 cm below capacity. This may suggest that water levels had not fully recovered from several prior years of dry weather.

Even so, the ponds were found to support healthy populations of dragon flies, water striders and other aquatic insects, frogs, toads, salamanders, moss and other aquatic plants, as well as many types of plankton.

Part of the survey involved comparing the ponds with the waters of Crater Lake, the springs which enter the lake from inside the caldera, and precipitation such as rain and snow. As a result, we found the amount of phosphorus, sodium, potassium, calcium, magnesium, and chloride ion concentrations in these ponds to be similar to precipitation, but very different from the lake and springs.

We also discovered that levels of two nutrients, sulfate and nitrate, in the ponds were far below levels in precipitation and in lake water. This suggests that vascular plants and phytoplankton in the ponds are quickly assimilating these nutrients as they become available from snow melt, rainfall, or through seepage from ground water. Crater Lake has been documented to be nitrate limited, meaning that the lack of nitrate is probably a key factor in limiting plant growth. The relative scarcity of nitrate ions in the ponds may similarly retard plant growth in these habitats.

Other chemical tests conducted include dissolved oxygen, pH, conductivity, and alkalinity. These estimate oxygen concentration, the acid/base level, total salt content, and the ability of water to neutralize acids, respectively. Conductivity data suggest these ponds are mostly rainwater supported with a few added ions from the soil. Alkalinity measurements reinforce the contention that the lake is fed by waters other than just rain or surface snowmelt. Measurements of alkalinity also show that the ponds have little ability to buffer additions of acid. This means that the ponds will most likely be affected if acid rain enters the pond complex.

Since the ponds appear to be fed solely by direct or indirect precipitation, change in the chemistry of the entering precipitation could likely affect their delicate balance. One threat may be from the burning of fossil fuels, which produces carbon, nitrogen, and sulfur oxides. These gases ultimately become carbonic acid, nitric acid, and sulfuric acid, which when combined with precipitation, can lower the pH of surface waters. This anthropogenic input could be a major agent of change for the ponds and lakes throughout the Cascade Range in the coming years.

The ponds were inhabited by several species of phytoplankton and their concentrations varied depending on the time of year. They include three species of Chrysophyta, two species of Chlorophyta, Cryptophyta, Cyanobacteria, and one species of Euglenophyta and Bacillariophyta. During one August visit, one pond sampled for phytoplankton contained mostly cyanobacteria. In another pond on the same day, more than half the phytoplankton sampled were cysts of a Chrysophyta. On a September visit, one phytoplankton sample contained more than 80 percent of one Chlorophyta species.

Identified zooplankton included eight species of Rotifers (a class of microscopic animals found only in fresh water whose anterior cilia give the appearance of rapidly revolving wheels when in motion) and three species of Cladocerans (water fleas). There were also two species each of calanoid copepodes and cyclopoid copepodes. These orders often occur together, but usually feed on different material. We also found one fairy shrimp species. This virtually defenseless organism is often discovered in temporary ponds and is rarely present in ponds with carnivorous insects or fish. In terms of numbers, the most dominate zooplankton was *Diaphanosoma brachyurum* (a cladoceran), while the seed shrimp, *Hexarthra mira*, was the least abundant.

The ponds had a greater zooplankton diversity in early summer, but a greater number of individuals represented fewer species by fall. This suggests that autumn's stressful conditions helped select species which take advantage of greater light intensity and higher water temperatures.

In small and remote places are found pockets of life's communities. The sun, water, and nutrients of the Whitehorse Pond complex create one such niche. Simply walking to one of these ponds to experience helps one to appreciate life on earth because biotic tenacity is so well demonstrated here. By looking under the surface of a pond one finds a web of conditions which allow its inhabitants to survive. Dissolved nutrients support the ponds' green plants, while algae support the ponds' small animals.

Whitehorse Bluff presents scientists and visitors alike with a unique opportunity to study and appreciate a little known, but important, resource in Crater Lake National Park. The data collected in 1993 will provide background or baseline information, thereby securing a chemical and biological setting for the ponds in time. Future surveys will be able to compare data, thus allowing for trend analysis. These trends will help provide managers with better information on how to manage the pond, stream, and lake environments in and around Crater Lake National Park.



A New Pacific Crest Trail at Crater Lake

By Brenda Bridges

The Pacific Crest Trail is a 2,400 mile long trail system that traverses some of the most scenic and remote backcountry wilderness in California, Oregon, and Washington. This very popular trail has an interesting saga and includes Crater Lake National Park as one of its prime destinations.

In 1920, the U.S. Forest Service flagged a trail that extended from Mt. Hood to Crater Lake and dubbed it the Oregon Skyline Trail. By 1928 public interest in a high mountain trail modeled after the "Long Trail of the Appalachians" gave rise to a federally supported endeavor. As a result, the Cascade Crest Trail in Washington became linked with the Oregon Skyline Trail in the 1930s. By 1937 the characteristic Pacific Crest Trail diamond-shaped trail markers extended from the Canadian line to the border with Mexico. In parts of California, however, trail construction was sporadic--sometimes forcing hikers to become masters of improvisation as they forded streams without bridges and followed maps that showed footpaths where none existed. Despite these obstacles, the Pacific Crest Trail is now complete and enjoys continuing public support.

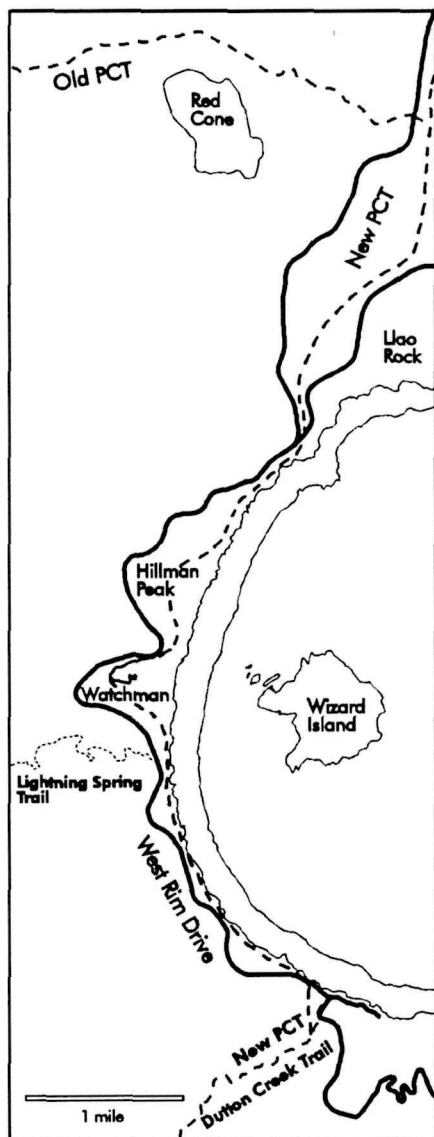
An Alternate Route

Trail users have found that the PCT affords some of the most ecologically diverse and beautiful vistas in the western United States. Even so, the most ardent supporters have long complained that the trail through Crater Lake National Park is one of the weakest links on this nationally important scenic route. It cuts through miles of lodgepole forests and stays several miles away from the rim of Crater Lake. Consequently, many hikers have by-passed this stretch of the PCT and lost hope of an alternate route being provided. After many years of disappointment, however, those hikers are in for an exciting and pleasant surprise. During the summer of 1994 work parties representing the National Park Service and the Friends of Crater Lake completed an eleven mile alternate route that traverses several ecological zones and affords numerous views of Crater Lake from the caldera rim.

The alternate route utilizes existing trails and an abandoned road bed as well as entirely new stretches of trail. Access to the new route from the existing Pacific Crest Trail is gained in two ways. South of the lake, the PCT reaches a junction point with the Dutton Creek Trail. The latter path is part of the new alternate route and by following it on its northerly and direct path to the rim, immediate access to the caldera and adjoining facilities at Rim Village is

possible. If you are traveling the PCT from north of Crater Lake, access to the alternate route can be gained from the trailhead junction just south of the Pumice Desert. The new route travels to the east of the trailhead and skirts along the base of Grouse Hill before climbing to the caldera rim just beyond Llao Rock.

Highlights of the New Route



One of the most pleasant places to relax and get off your feet is at the Dutton Creek junction. This is where Dutton Creek joins other tributaries of Castle Creek, so the area is rich with meadows and streams. As you follow the Dutton Creek Trail north, it winds through grassy areas interspersed with giant conifers. This is a favorite grazing and bedding area for elk and deer. A quiet hiker can usually view these animals in this area, especially at early morning and late afternoon.

Your climb is eased further up the trail by the shade of mountain hemlock, *Tsuga mertensiana*, and Shasta red fir, *Abies magnifica-procera*. This area has been cut by the seasonal streams which run along the length of Dutton Creek, so it is interesting to note how they contribute to this sometimes dry upper portion of the Rogue River Basin. The entire length of Dutton Creek represents a moister, more temperate environment (therefore possessing greater plant and animal diversity) than the demanding conditions evident on the rim.

As the Dutton Creek Trail reaches the Rim Village area, hikers can make use of facilities such as restrooms, a visitor center operated during the summer months, the Sinnott Memorial Overlook, as well as the cafeteria, gift shop, and hotel. The trail route continues along the west side of the caldera and leads to Discovery Point. Interpretive signs point out the discovery of the lake by white miners in 1853 and some of the early history.

Further west, this route encounters the Lightning Spring Trail. At one time a fire control road, the Lightning Spring Trail now serves as an access for stock users who are still confined to the old PCT as they traverse through the park. There is a hitching post for horses, mules, and llamas a quarter mile below this junction so that their users can walk a short distance to see Crater Lake. Beyond the Lightning Spring picnic area, the new PCT follows an old road for five miles to the North Junction. This required no new construction, thereby lessening the impact on fragile soils and vegetation.

As you climb toward 7,500 feet in elevation, the Watchman Lookout becomes more apparent. Completed in 1933, this structure is an active fire lookout that is staffed during the summer months. It is open to visitors and provides a great view not only of the lake, but also the surrounding forests and lakes. Look closely and see how many of the major mountains and peaks you can identify.

Once you descend to the Watchman Overlook (sometimes called “the corrals” because of a fence used to protect the remaining vegetation), the new PCT stays above Rim Drive in rounding Hillman Peak. This affords a relatively easy climb of Hillman, which has the distinction of being the rim’s highest point. From here it is a fairly easy descent to the North Junction, so named because this is where the road to Diamond Lake separates from the Rim Drive which continues east and then back to Park Headquarters in Munson Valley.

Near North Junction the trail takes us away from the caldera rim. At this point you will find a desert-like locality with only a sedges and succulents anchoring the soil. This is similar to the Pumice Desert, an area of the park which the PCT skirts on its way north to Mount Thielson. The soils here are deep enough so that you will sink a little with every step. This effect is magnified by the digging and burrowing of rodents, which is experienced if you drop into holes and tunnels made by these creatures.

The areas of open soil soon give way to mountain hemlock and more sedge. At this point the PCT bids farewell to the abandoned road bed and we find ourselves losing elevation as we continue our northerly trek. As you descend, the ground becomes more level while the trail begins to skirt around the base of Grouse Hill. This is a favorite nesting area for several different birds of prey, sometimes called raptors. Yellow-bellied marmots, *Marmota flaviventris*, as well as smaller rodents such as squirrels and chipmunks occupy

the boulders at the base of Grouse Hill. They can sometimes be heard barking and chirping insults at each other.

A newly-designated camping area for hikers is located near the trailhead, but no water is available here. It does, however, signify an end to the rerouted PCT whereby hikers can continue north to Diamond Lake or reach their shuttled vehicle if on a day trip. The new trail can be followed once the snow has gone and may have areas where washing and erosion are evident. In spite of these imperfections, however, all slopes are moderate and do not represent unusually rigorous hiking conditions in comparison to the rest of the Pacific Crest Trail.



Crew opening the old rim drive near the Watchman in 1917. This is now part of both the Pacific Crest Trail and the bottom of the Watchman trail.

About the Authors

Brenda Bridges has worked as an archaeologist on the Rogue River National Forest and at Crater Lake National Park.

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Steve Mark is the park historian at Crater Lake. He has been the editor of Nature Notes since its revival in 1992.

Marianne Mills was the assistant chief of interpretation at Crater Lake until May 1995, when she transferred to Badlands National Park.

John Roth is the natural resources management specialist for Oregon Caves National Monument.

John Salinas is a former seasonal employee at Crater Lake. He teaches chemistry and physics at Rogue Community College in Grants Pass, Oregon.

Illustrations

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- p. 12 Amy Mark, NPS files.
- p. 13 Shirley Briggs in Arthur S. Einarsen, *The Pronghorn Antelope*, Washington, DC: The Wildlife Management Institute, 1948, p. 1.
- p. 15 Briggs in Einarsen, p. 47.
- p. 22 Howel Williams, *The Geology of Crater Lake National Park, Oregon*, Washington, DC: Carnegie Institution of Washington, 1942, p. 66.
- p. 23 Oregon Department of Transportation photo.
- p. 27 Amy Mark, NPS files.
- p. 31 Earl Russell Bush photo, NPS files.

Maps by Susan Marvin.

Back Cover: Phantom Ship from Kerr Notch in 1936. Homer Marion photo, NPS files.

