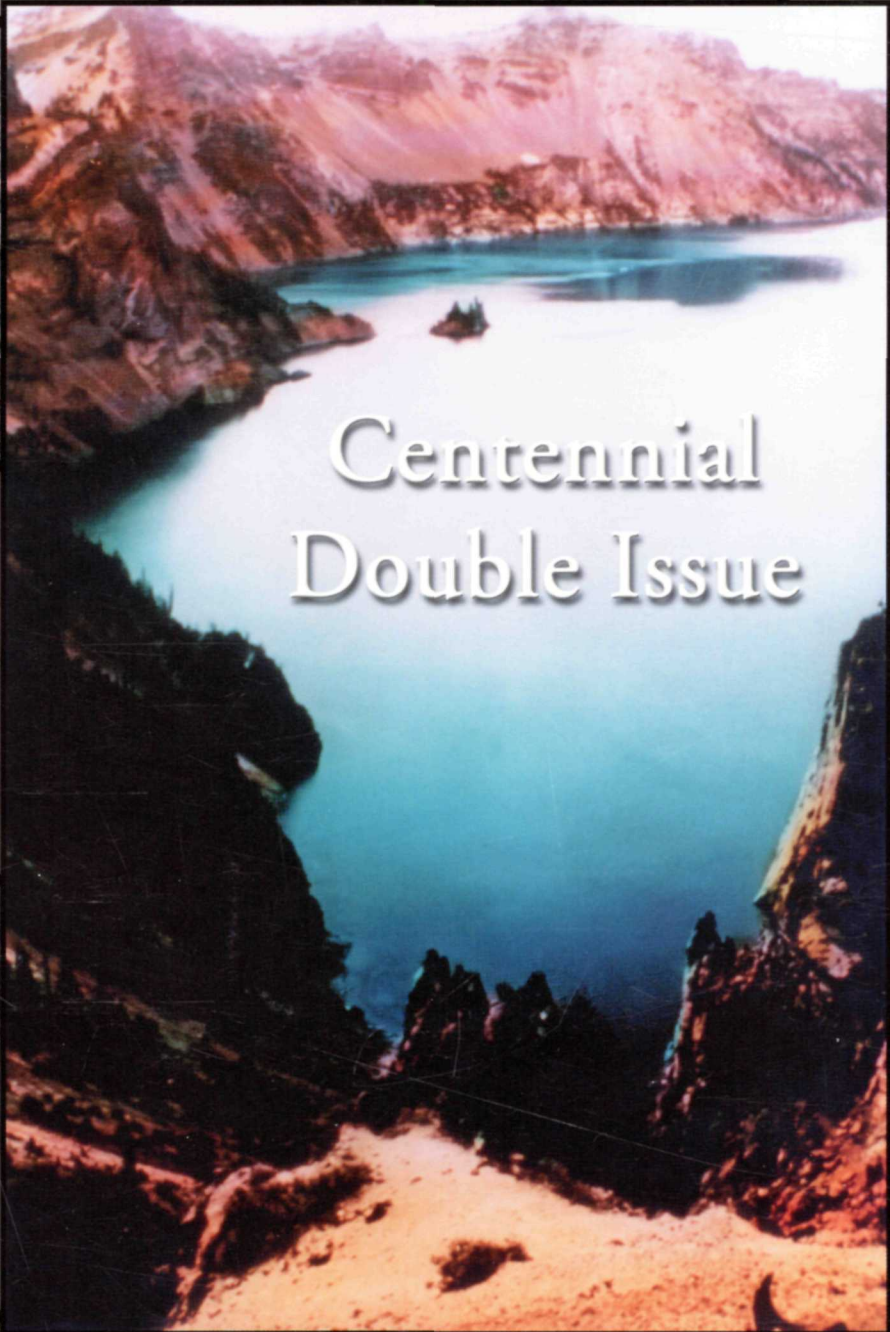


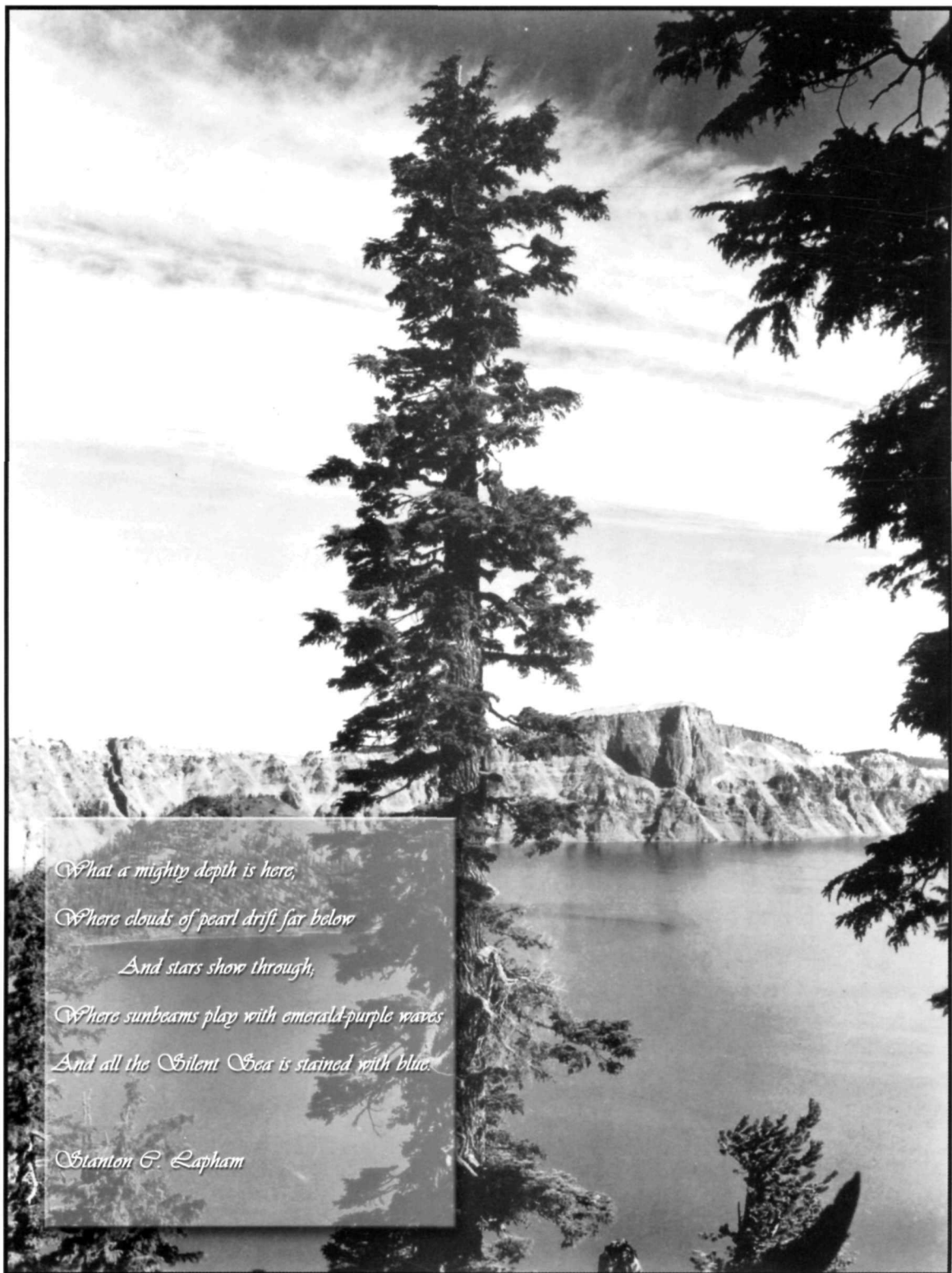
NATURE NOTES

from



Centennial Double Issue

CRATER LAKE



*What a mighty depth is here,
Where clouds of pearl drift far below
And stars show through,
Where sunbeams play with emerald-purple waves
And all the Silent Sea is stained with blue.*

Stanton C. Lapham

Above: Mountain hemlock with Crater Lake in the background.

Front cover: View of Crater Lake and Phantom Ship from Reflection Point. Tinted lantern slide, ca. 1910. Additional photos around the edge appear in Nature Notes from Crater Lake, 2000.

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National Park Service
Crater Lake National Park

Presented by



Crater Lake Natural
History Association

The Sea of Silence

*Now gather friends of every race
Who hold this as a sacred place
This ring of mountains strong and fair
Cradling blue beyond compare
Sky and water's pure refrain
Pray us worthy to remain
Guardians for these hundred years
Where Evening Star and Coyote's tears
Became the Sea of Silence*

*Now to the Sea it must seem strange
How every season brings so much change
So many Guardians here and gone
Who loved her well and then moved on
How many lifelines here have merged
And with the Sea's great soul converged
But in our hearts She sure must know
Remaining though we come and go
There dwells the Sea of Silence*

*So to the dawning century turn
And ask Her what we yet may learn
From mountain hemlock's whisperings
And from the song the junco sings
From canyons deep and lofty peaks
Of nature's treasures oft she speaks
Then pray our children find them still
And ever young hearts drink their fill
Around the Sea of Silence*

Chris Tempest

NATURE NOTES FROM CRATER LAKE

Park Centennial Edition
Volumes XXXII-XXXIII (2001/2002)

National Park Service
Crater Lake National Park



Crater Lake Natural
History Association



Introduction

Great names rise to the big occasion, or so goes the old adage. Several authors in this edition were intrigued by the idea of a double issue to mark the centennial of Congress acting to establish Crater Lake National Park. Others responded once they knew that the writer intends to retire as editor of *Nature Notes from Crater Lake* with the appearance of this publication for the tenth consecutive time since 1992. Whatever their reasons for contributing, authors have once again offered an engaging mix of topics for the largest issue ever published.

This edition will cap an experiment that began as part of a symposium held over three days in May 1992 to celebrate the 90th anniversary of Crater Lake's designation as a national park. I wanted to find out how long a publication focused on natural history at the local level might last, given that all the contributions would have to be volunteered. The hiatus in printing *Nature Notes from Crater Lake* had lasted for more than three decades, with the end of a second string of publishing it on an annual basis coming at a time when ranger naturalists (later called seasonal interpreters) still had project time to complete their submissions.

The relative luxury of interpreters having project time to produce articles for *Nature Notes* had long since disappeared by 1992 due to a variety of factors, so I had to cast a wider net to reach potential contributors. Some of the interpreters responded, as did employees in more specialized resource management positions. Several park alumni became a mainstay for contributions and often produced exceptional submissions in giving certain issues a more robust quality than ones solely dependent upon what paid staff could produce on their own time. Authors who had never worked for the National Park Service gave a few volumes the necessary variety of topics and a fresh perspective. To everyone who helped I wish to extend a most sincere thank you!

This third series of *Nature Notes from Crater Lake* was not possible without an audience whose support allowed the Crater Lake Natural History Association to, in some measure, come close to breaking even on printing costs. With most volumes now out of print, I heartily recommend the park's official website for those interested in reading back issues. Please visit www.nps.gov/crla, then go to "Park History" and click on "Nature Notes." Randall Payne, Jamie Halperin, and June Jones deserve the credit for making this kind of access to the archives possible.

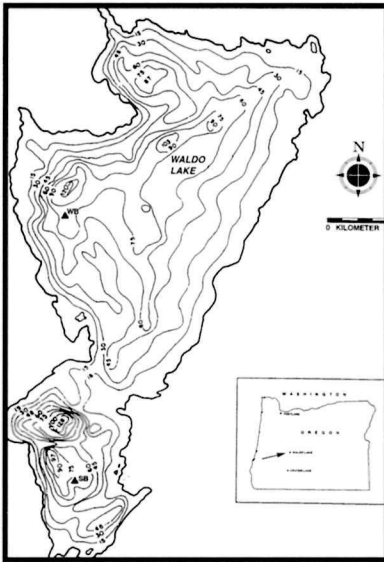
The Crater Lake Natural History Association sponsors this publication as part of an ongoing commitment to the educational and resource management programs of the National Park Service. Please join them in this effort by becoming a CLNHA member and in the process receive a 15 percent discount on all items sold by the association at Crater Lake National Park and Oregon Caves National Monument. A list of these items is available from the Business Manager, Crater Lake Natural History Association, P.O. Box 157, Crater Lake OR 97604; (541) 594-2211, ext. 498.

Stephen R. Mark, Editor

Oregon's Two Largest, Deepest, Bluest, Purest Lakes: A Comparison

By John Salinas

The Cascade Range holds lakes unmatched in the world. In comparing two of its more prominent lakes, Crater Lake in the southern part of Oregon and Waldo Lake in the central part of the state, there are some superficial similarities but also distinctive differences. The latter become readily apparent as each lake gradually becomes more familiar to visitors, though the significant attributes of each lake can be set apart from most other lakes anywhere in the world. As exceptional oligotrophic (nutrient-poor) bodies of water, Crater Lake and Waldo Lake are well worth the cost and effort to ensure their protection “for all people, for all time.”

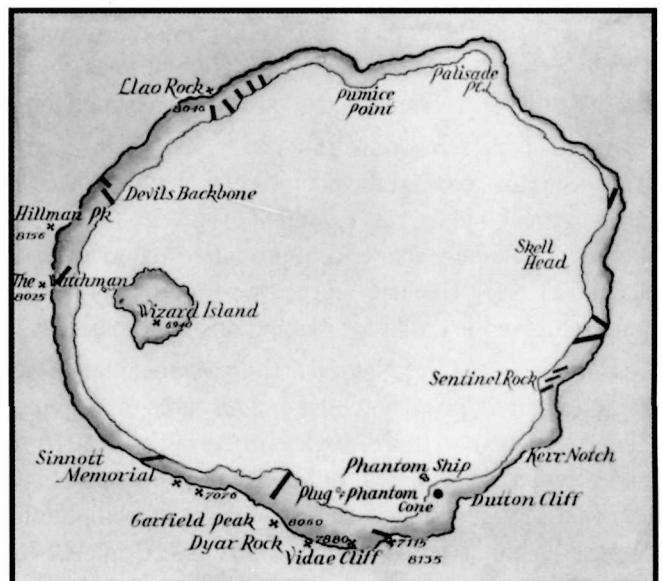


Bathymetric map of Waldo Lake with depth contours in meters.

Locations

Waldo Lake is situated about 190 km south-southeast of Portland, Oregon, at an elevation of 1650 meters above sea level. It is 9.6 km long and has a surface area of 25.5 square kilometers. Its bottom is gently sloping to a maximum depth of 128 meters on the lake's western side. Water received into the lake falls on an area about twice as large as the lake itself. Soils are organically poor and well drained, with bedrock less than two meters below the pumice and rounded boulders. The forest surrounding the lake contains lodgepole pine, western white pine, mountain hemlock, western hemlock, Douglas fir, noble fir, true fir, and Engelmann spruce. Management of the area is the responsibility of the U.S. Forest Service staff on the Willamette National Forest. The western shores of the lake adjoin the Waldo Wilderness Area. The northern tributaries of the Willamette River's middle fork flow from the northwest of Waldo Lake.

Crater Lake is located 130 km northeast of Medford, Oregon. Vertical cliffs surround the lake and are remnants of the collapsed Mount Mazama volcano. The lake basin is enclosed in a caldera and composed of varying amounts of andesite, pumice, rhyodacite and other igneous or volcanic materials. The adjoining forest includes mountain hemlock, Shasta red fir, lodgepole pine, western white pine, and whitebark pine. The National Park Service manages Crater Lake. Most of this national park area is *de facto* wilderness except for several road corridors and developed areas devoted to administrative functions and visitor facilities. No known surface streams flow out of Crater Lake.



Crater Lake with key features around the rim.

Geological settings

At the grandest scale, the High Cascades of Oregon are a product of plate tectonics. As plates of the Earth's crust subduct off the Oregon coast, crustal material melts and these magmas are found again on the surface as volcanoes. Waldo Lake rests in an area of the High Cascades in a basin composed of basaltic andesite that flowed about 750,000 years ago. It was produced from a group of volcanoes named Waldo Mountain, Cupit Mary Mountain, Fuji Mountain, Mount Ray and The Twins. These lavas however, have been reworked by glacial ice. The area is covered with a fine powder left by ice as it grinds against rock. The glacier that excavated Waldo Lake moved in a northward direction, originating in the highlands between Mount Ray and Fuji Mountain.

Material pushed by a glacier is called a moraine and can sometimes provide barriers for a lake to form. Ice, like water, flows downhill. At the time the Waldo Lake basin was formed, a geologic fault existed just along the west edge of the present lake. The glacier mostly flowed north, but a tongue of ice headed west into the Black Creek drainage as the glacier gained height. It followed the north-south trending fault, marking the western edge of the High Cascade graben (a depression bounded by faults on at least two sides). The glacier did the actual work of excavating the lake, but the fault controlled where that work would take place. If the main glacier had headed into the Black Creek drainage, there would be no separation of the lake basin from the creek drainage and Waldo Lake would not exist. Waldo Lake filled the basin as the glacier melted, suggesting that this water body is 10,000 to 12,000 years old.

Crater Lake is located in the caldera of a collapsed volcano, Mount Mazama. The mountain is also a part of the High Cascades, but in southern Oregon. The overlapping shield and stratovolcanoes that today contain Crater Lake began to be formed about 420,000 years ago. About 7,700 years ago, in a cataclysmic eruption that may have lasted for days, the volcano spewed 50 km³ of ash and pumice into the air covering much of the Pacific Northwest. The magma chamber feeding the eruption was eventually depleted of most of its contents so it could not support itself and collapsed. This feature is termed a caldera. What is unique about this feature is that it contains the deepest caldera lake in the world.

The collapsed volcano continued to erupt, sealing the floor of the caldera. Two cinder cones were formed on the caldera floor, with one (Merriam Cone) being formed below the lake's surface and the other (Wizard Island) forming above the surface. The lake began to form within 500 years of the mountain's collapse. Heat from Mount Mazama's magma chamber still affects the water of Crater Lake. Not that the heat is enough to alter the surface temperature of the lake, but water circulates down toward this heat reservoir and returns containing chemicals from the

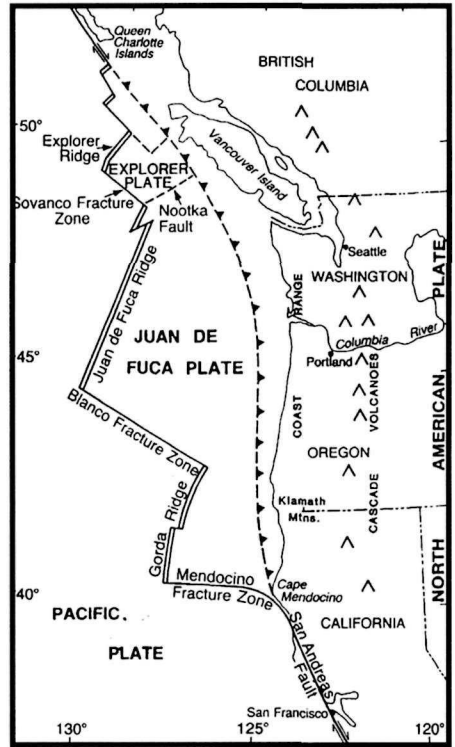
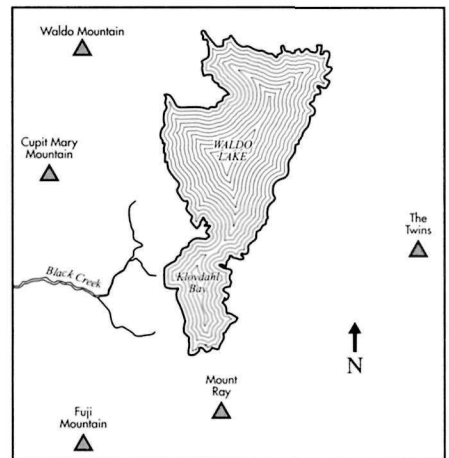


Plate tectonics relative to the Pacific Northwest.



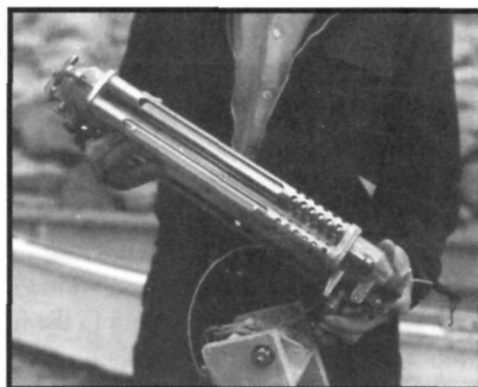
Geographical features in the vicinity of Waldo Lake.

geothermal sources located below. Rock on the lake floor is altered by this hot water, and this circulating water chemically alters the lake. This makes Crater Lake fundamentally different from other lakes in the High Cascades.

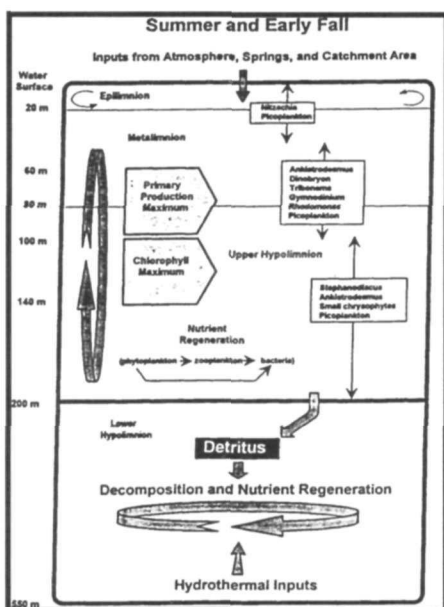
Physical aspects of the two lakes

Both Waldo Lake and Crater Lake have very small watersheds. Crater Lake occupies a little more than 78 percent of its watershed, meaning that most of the rain and snow input falls directly into the lake from the sky. Waldo Lake occupies about 32 percent of its watershed, suggesting that almost two thirds of the precipitation falling in the Waldo watershed arrives indirectly, by way of land. Waldo Lake would take 30 years to fill with water, given present rainfall and the evaporation rates. That period of filling for Crater Lake would be somewhere between 200 and 300 years. Water falling as rain or snow allows these lakes to exist, but water quality is also affected by the particular characteristics of the respective lake basins.

Water levels of both lakes have remained relatively constant due to three processes: inflow, outflow, and evaporation. The inflow at Crater Lake is almost totally precipitation. In 1985, when the author helped to survey the caldera walls for springs, he was astounded to find 51 surface water inflows into Crater Lake. Few of these springs flow throughout the year, though some include wonderful waterfalls that sometimes drop directly into the lake. Trying to collect water from this type of spring has led to my being 'soaked to the bone.' Waldo Lake has no creeks flowing directly into it throughout the year. Ground water, however, flows into the lake thereby offsetting the lake's outflow.



Equipment for measuring light in Crater Lake, 1940.



Simple model of the vertical distribution of selected physical, chemical, and biological components of the limnetic zone of Crater Lake. Curved arrows in the epilimnion indicate a zone of circulation and mixing.

Swimming in Waldo or Crater Lake is a thrilling experience, largely because of their temperatures. The warmest surface temperature recorded in Crater Lake is 19.2° C, but the maximum some years does not get above 15° C. The same surface temperatures may be measured at Waldo Lake. A lake's upper stratum near the surface (called the epilimnion) is the warmest layer because lakes absorb heat from the more direct sunlight during summer. Just below this warm layer is a layer of water that changes from the warm surface to the cooler deep water. This transition zone is called the metalimnion, or thermocline. Both lakes share similarities in this zone, one beginning at about 20 meters in depth and extending to roughly 50 meters. There is low heat absorption below 50 meters, so temperatures remain between 4 and 6 ° C at Waldo. This deep-water zone is termed the hypolimnion and at Crater Lake the temperature remains between 3.5 and 3.7° C. It is in this zone where the two lakes display a marked difference. Some geothermal heat enters Crater Lake from the caldera in which the lake rests, so the water of Crater Lake increases slightly in temperature below 300 meters.

As winter approaches, lakes begin to cool. The cooling of surface water causes this layer to increase in density and sink. The sinking and mixing with deeper water allows chemicals deep in the lake to become available to plants and animals in the shallower parts of the lake, thus a fall ‘bloom’ may occur. As the lakes cool further, ice may form. It is just as unusual for Waldo Lake to not freeze in a winter season as it is for Crater Lake to freeze. The single difference here is depth. Crater Lake is over eight times deeper (using its average depth) than Waldo Lake. This great reservoir of water (and heat) can keep the surface of the lake from freezing. As the surface of a lake cools, it becomes denser—though sinking cool water is offset by rising warmer water. At Crater Lake this can go on all winter. The rising ‘warm’ water at Waldo Lake does not carry the same amount of heat, so the lake will cool below the freezing point of water.

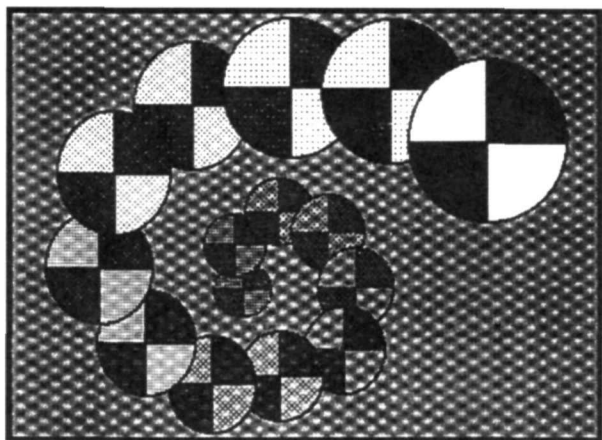
The two lakes appear blue because of the interaction of sunlight with the water. A lake will appear colored due to materials suspended in the water (mud, algae), the reflection of sky or clouds, and because of certain colors in the spectrum of sunlight being absorbed by the water. These two lakes have very little suspended material in the water, and so appear clear. Water around the shore appears clear with rocks and sand easily visible. As the water gets deeper, the bottom appears green or blue green the lake absorbs the red, orange, yellow colors of sunlight more readily than the green and blue colors. If the water is more than 60 meters deep, the water appears blue.

Research staff at Crater Lake purchased an underwater spectral irradiator in 1995. This device measures the light spectrum reaching down to 200 meters in the lake. Red light is quickly absorbed, but the lake transmits blue light of precisely 478 nanometers in wavelength in the deep water. This is the color of Crater Lake that one sees. The irradiator has not been used in Waldo

Table I. Comparative Features of Crater Lake and Waldo Lake

	CRATER LAKE		WALDO LAKE	
Elevation	1882 m	6170 ft	1650	5410 ft
Maximum Depth	589 m	1930 ft	128 m	420 ft
Mean Depth	325 m	1070 ft	39 m	128 ft
Surface Area	53.2 km ²	20.5 mi ²	25.5 km ²	9.85 mi ²
Volume	17.3 km ³	4.15 mi ²	0.949 km ³	0.23 mi ³
Annual Precipitation	1.71 m	67.3 in	1.8 m	70.9 in
Water Retention Time (yrs)	150	150	30	30
Length	9.7 km	6.0 mi	9.6 km	6.0 mi
Width	8.2 km	5.1 mi	4.3 km	2.7 mi
Watershed Area	14.6 km ²	5.6 mi ²	53.5 km ²	20.7 mi ²
Watershed (%)	78.5		32.3	
Surface Outflow	None		North Fork, Middle Fork, Willamette River	
Nitrate ion (mg/L)	1 - 17 (low on surface)		0.2	
Ammonia (mg/L)	2 - 4		2.4	
Total Phosphorus (mg/L)	22 - 28		2.9	
Dissolved Phosphorus (mg/L)	11 - 15		0.9	
Conductivity (mS/cm)	116		3.5	
Alkalinity (mg/L)	25 - 31		0.58	
Sulfate ion (mg/L)	10		0.11	

Lake, but is expected to return similar data. Light in a lake or an ocean eventually becomes so low with increasing depth that one would admit that it was dark. When one investigator took a submarine to a depth of 450 meters on Crater Lake floor, however, he turned all the electric lights off and was able to “see” a slight amount of sunlight from the surface. This is the mark of a lake with incredibly clear water.



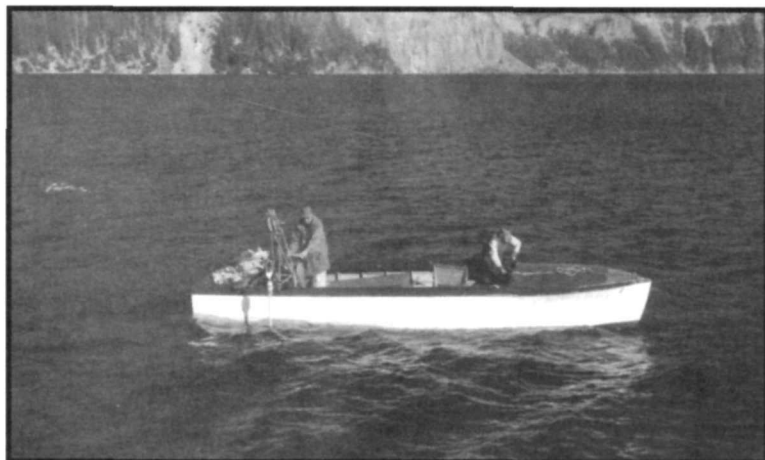
Artist's rendition of a Secchi disk on its descent into the water.

The simplest test of clarity of a lake is to use a “pie plate on a string” or, officially, the Secchi disk. This 20-cm diameter metal or weighted plastic disk is usually quartered black and white. It is lowered into a lake and the depth at which it disappears is recorded. The Secchi clarity depth at Crater Lake was recorded in June of 1997 at 43.3 meters. At Waldo Lake the deepest Secchi depth was measured to be 41.3 meters in July 2001. This “eyeball” test of a lake’s water clarity greatly depends upon the sky conditions and the lake surface. If clouds obscure the sun or the lake is ruffled by wind, the disk will prematurely disappear. To put this test in per-

spective, many lakes with large watersheds seldom have Secchi depths of greater than 10 meters. Muddy water may have a Secchi depth of less than one meter. In this case, two world-class lakes are being compared and can be seen to be very similar in clarity. It should be noted, however, that Waldo Lake does not currently host a full-time research effort while Crater Lake does. It is very difficult to record the best Secchi clarity depths on a part-time basis. Visiting the lake for a day or two each month lessens the chances that the sky and lake surface conditions will be ‘perfect’ for viewing the disk.

Management concerns

Crater Lake attracts an average of 500,000 people each year. Roughly 10 percent of these visitors walk down a relatively steep trail that serves as the sole access point to the lake in order to swim, go fishing or take the tour boat around the lake. Impacts to the lake from visitors are relatively minimal as far as is known, but long term trends or effects are still imperfectly understood. Waldo Lake attracts fewer visitors, but the lake is ‘at their campsite.’ Visitors can park a few feet from the lake, swim, launch a boat or camp. The 14 mile gravel road to Waldo Lake was paved in 1964 and visitor use increased dramatically. By 1982 visitor-use days reached 50,000 and that figure climbed to 103,000 visitor-use days by 1998. Waldo Lake appears to be more sensitive and at risk of being more impacted than Crater Lake, though restroom facilities near the shore are being replaced by composting toilets and more rustic campgrounds are being eliminated around the lake.



Research on Crater Lake in August, 1960.

Crater Lake has enjoyed a National Park Service sponsored research program since 1982. Between 1978 and 1981 some limited support helped to start a lake monitoring and research program. Crater Lake now has several full-time biologists and ecologists actively collecting data and working on research questions with an infrastructure of offices and laboratory facilities. A boat house on Wizard Island allows for research activities in winter as well as temporary living quarters and laboratory space. The two research boats on Crater Lake are similar to the research vessels used on Lake Tahoe and are versatile enough to be employed in a wide range of studies.

Waldo Lake is not so well supported, though the Forest Service has stretched its limited watershed monitoring funds. The Oregon Department of Environmental Quality has also funded some limited research on the lake. There is no full-time limnologist or ecologist assigned to the monitoring efforts at Waldo Lake, though the writer has enjoyed some support for his involvement at Waldo Lake since 1986. The Forest Service has no boat, laboratory, nor equipment to monitor Waldo Lake and so must contract with others to do this work.

It should be said a research program involves measuring a wide array of chemical and biotic indicators for these two pristine lakes. Interested readers should examine the accompanying table for some of the indicators used as a basis for comparing Crater Lake with Waldo Lake. The references below are included for those wanting more specific information about past and present studies.

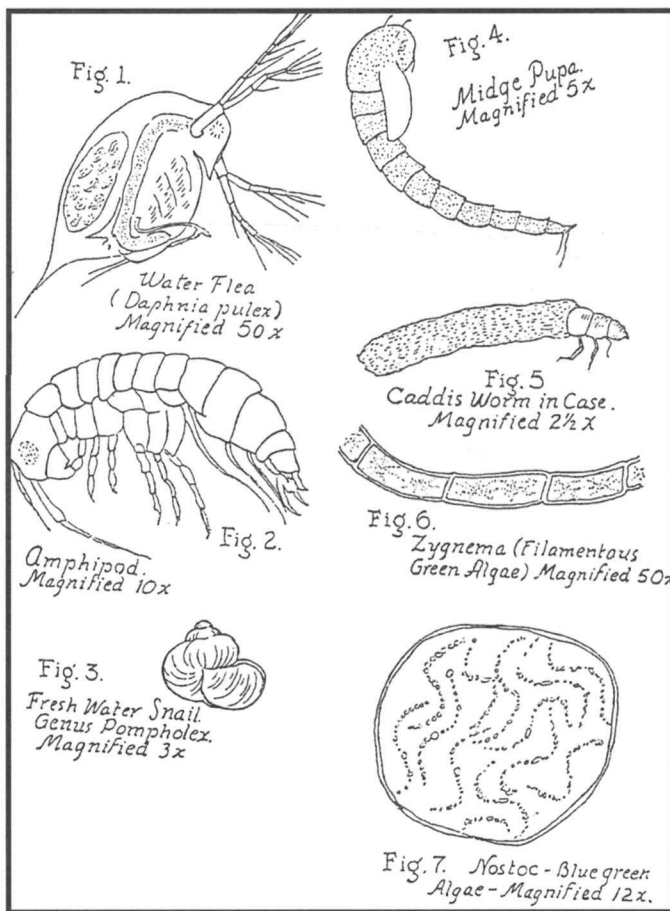
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Biota of Crater Lake

Fish in Crater Lake: Their Size and Number

By Scott Girdner



Ranger-naturalist Arthur Hasler showing a rainbow trout to visitors in 1938.

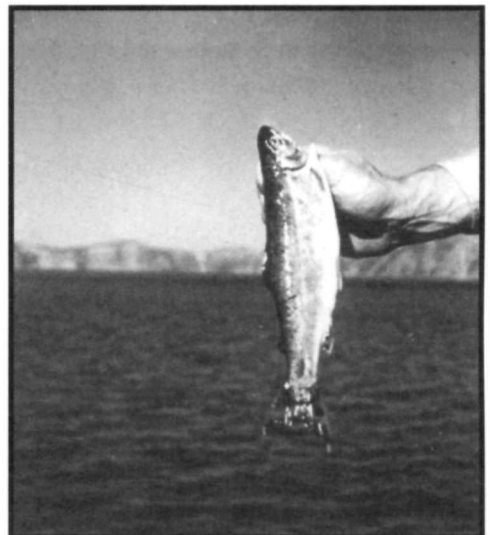
Anglers who routinely ‘wet a line’ in Crater Lake have learned that fishing success as well as the size of kokanee salmon and rainbow trout in the lake can fluctuate dramatically from year to year. Analysis of fish length and fish population size over the last 15 years provides insight into the patterns of change and may help anglers appreciate the ups and downs of fishing Crater Lake.

Crater Lake was naturally barren of fish until park founder William Steel first stocked Crater Lake with trout fingerlings in 1888 to “improve” recreational opportunities. Despite altering the lake’s natural condition, introductions of non-native fish continued until 1941, when stocking the lake ended. In all, five species of salmonids, totaling nearly two million fish, were introduced to the lake over the intervening 53 years. Brown trout (*Salmo trutta*), cutthroat trout (*O. clarki*), coho salmon (*O. kisutch*), kokanee salmon (*O. nerka*, a landlocked sockeye salmon), and several stocks of rainbow trout (*O. mykiss*) including steelhead were intro-

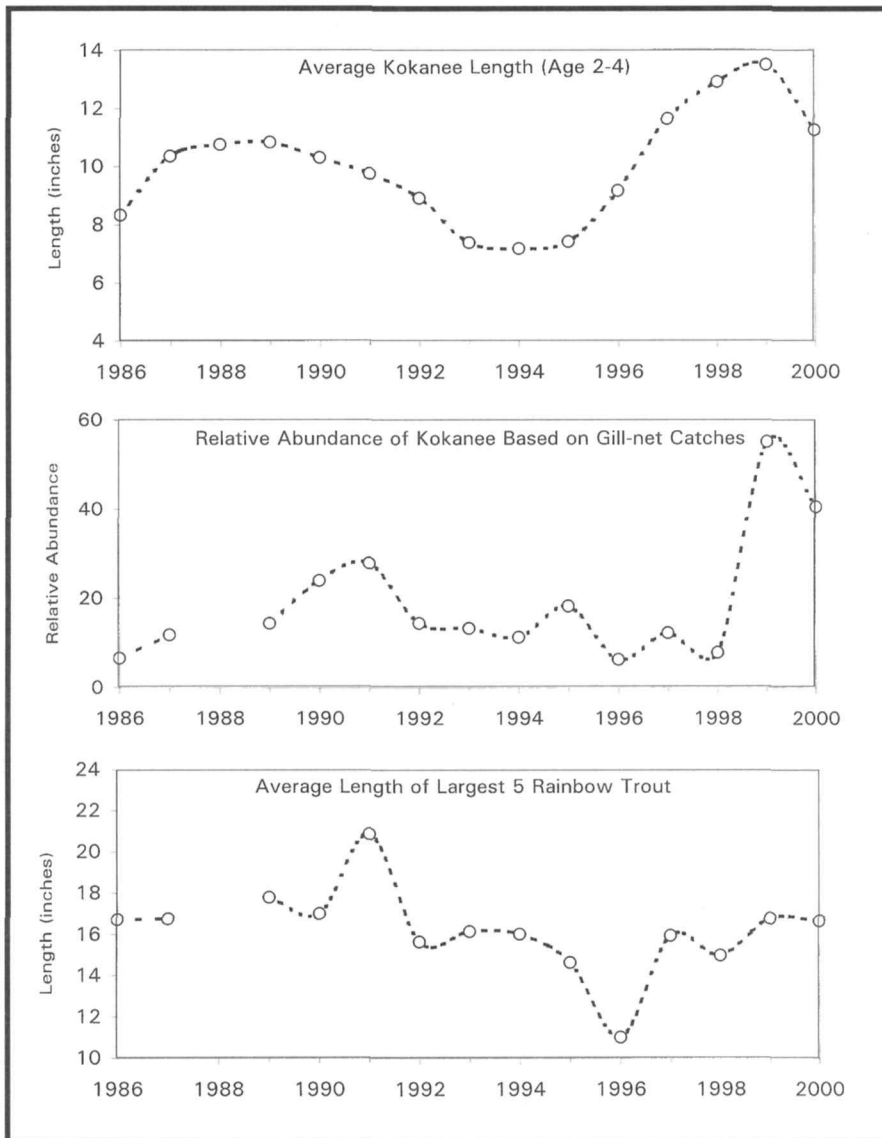
duced during this period. Only the self-sustaining populations of rainbow trout and kokanee salmon persist in the lake today.

Detailed annual fish population estimates using high-tech acoustic systems were initiated in Crater Lake in 1996. The largest fish population observed in Crater Lake since that time occurred during the summer of 2000 when biologists estimated the total number of fish in Crater Lake at 633,000—a density of 48 fish per acre. Lake Billy Chinook near Bend, by contrast, is estimated to contain between 530 and 5500 kokanee per acre depending on the year. Coeur d’Alene Lake in Idaho typically fluctuates around 1400 fish per acre. The lowest number of fish in Crater Lake occurred in 1998 when only 8,400 (less than 1 fish per acre) were observed. Just two years later the fish population in Crater Lake increased by an astounding 7450 percent!

The relative abundance of kokanee has been monitored with gill nets since 1986. Population size and the average length of individual kokanee salmon cycles over a period of approximately ten years (see the first two graphs in Figure 1). According to fisheries studies around the Pacific Northwest, fluctuations in kokanee population size and fish length are fairly common in unproductive bodies of fresh water such as Crater Lake. Large increases in kokanee population size that occurred in the lake during 1990-91 and 1999-2000 could therefore be expected.



Kokanee Salmon



Biologists studying Crater Lake believe that at low population size, food is plentiful for the kokanee and a fewer number of fish eventually reach larger size. These large and healthy adult fish reproduce successfully leading to an increase in fish numbers. As the fish population increases, the primary food of kokanee (microscopic animals in the water column called zooplankton) decreases to the point that the lake can no longer support such a high population of fish. The kokanee population size then falls through time, allowing the zooplankton population to recover so that the cycle starts over again. In water bodies other than Crater Lake, the patterns in kokanee size and number are subject to more variables such as fluctuations in water level (this is especially pronounced in reservoirs), water temperature, fish stocking density, the timing of stocking, and harvest pressure from anglers.

Rainbow trout do not feed on zooplankton like kokanee do, but instead rely mostly on aquatic insects near the lakeshore as well as those that land on the lake surface. Large rainbow trout will also eat small kokanee. The length of the largest rainbow trout caught in Crater Lake over the last 15 years has varied similarly to that of kokanee, but delayed by 1-2 years (compare the upper and lower graphs in Figure 1). Large rainbow trout were prevalent in 1991 (see Table 1)

and have been increasing in number the last few years. Not surprisingly, the presence of exceptionally large rainbow trout appears to be associated with the presence of large numbers of small kokanee.

Research has shown the ecology of Crater Lake to be very dynamic and the fish population is no exception. Recent studies suggest that the quality of fishing in the lake for the foreseeable future will fluctuate depending upon the year. The extremely large increase in kokanee numbers during 1999 and 2000 will probably result in their population crashing (probably due to over exploitation of their food resources) in the next few years. This was already becoming apparent in the summer of 2000, given the dramatic increase in kokanee numbers over the previous two years.

With numerous small kokanee salmon present, the summer of 2001 could turn out to be a great time to catch that big rainbow trout in Crater Lake. Although the density of fish in Crater Lake will probably never be high like other more productive lakes of the Pacific Northwest, some days at Crater Lake still promise to be very good fishing. Other days may not be so good, but if you are going to experience a bad day of fishing I cannot think of a better place to go than beautiful Crater Lake.

Note: Fishing access at Crater Lake is fairly limited because of the steep and dangerous caldera walls encircling the lake. A quarter mile section of shoreline is accessible at the base of the Cleetwood Cove Trail for fishing. Anglers can reach Wizard Island in the tour boat operated by the park concessioner, a service allowing passengers to disembark and fish on a day use basis. Devices such as float tubes and rafts are not allowed on the lake due to erratic winds, jagged rocks, and steep shorelines.

Crater Lake National Park's Long-term Limnological Monitoring Program assesses many chemical and physical aspects of Crater Lake's ecology. Part of monitoring the fish population involves setting nets to collect fish for analysis. Each fish collected in the nets is measured for length, weight, sex, and maturity level. Scales are collected from each fish to determine fish age. The stomach contents of the fish are preserved for later analysis. The monitoring program also uses a scientific-grade acoustic system (a fancy "fish finder") to accurately estimate the population size in the lake and assess fish distribution within the water column.

Table 1: Length (inches) of largest fish caught in nets by biologists between 1986 and 2000.

	Kokanee		Rainbow	
	Largest fish caught	Average length of largest 5 fish caught	Largest fish caught	Average length of largest 5 fish caught
1986	10.5	9.4	17.8	16.7
1987	13.5	12.3	18.9	16.8
1988				
1989	15.6	14.5	18.9	17.8
1990	16.1	12.3	17.8	17.0
1991	11.2	10.9	23.1	20.9
1992	10.8	10.5	17.3	15.7
1993	11.0	9.5	21.4	16.2
1994	9.4	8.5	16.7	16.0
1995	8.8	8.5	16.8	14.6
1996	10.3	10.2	13.5	11.0
1997	16.3	13.9	19.1	16.0
1998	14.7	14.1	17.5	15.0
1999	14.2	13.4	18.7	16.8
2000	15.2	13.9	19.9	16.7

Witness to a Catastrophe

By Tom McDonough

The eruptive collapse of Mount Mazama represents the biggest volcanic event to occur in North America over the last 10,000 years. Massive deposits of scoria and pumice blasted the volcano's slopes and still continue to fill the stream drainages in the surrounding region. Remains of an ancient forest can still be seen beneath this material in many of the road cuts around the park. It is evidence of destruction involving 12 cubic miles of ash and pumice. A caldera resulted from this destruction about 7,700 years ago, replacing an edifice that may have reached 12,000 feet high. Few places were left unaffected by this catastrophe, but one peak fared better than most.

Following Mazama's climactic eruption, the summit of Mount Scott became the highest point in the immediate vicinity with an elevation of 8,929 feet above sea level. Mount Scott was named in honor of Levi Scott, a man who explored southern Oregon in the middle of the 19th century. Its name in the Klamath language is *Tum-sum-ne* or *Tomsandi*. The geological origin of this peak has been re-examined in recent years, with improved dating techniques allowing Dr. Charles Bacon of the U.S. Geological Survey to better fit this peak into the broader story of Mount Mazama.

Dr. Howel Williams, who wrote *The Geology of Crater Lake National Park* some 60 years ago, believed that Mount Scott developed late in the history of the great volcano. He described Mount Scott as a "parasitic" cone that owed its existence to the larger Mazama. Modern radio-metric dating methods have allowed Dr. Bacon to amend Williams' assessment. Not only is Mount Scott now believed to be a part of a complex of cones that combined to form Mount Mazama, it is possibly the oldest member of this complex.

The silica-rich lavas of Mount Scott have been dated to 420,000 years, roughly 20,000 years older than any other rocks found immediately around or within the rim of Crater Lake. The great age of these flows has helped to explain why the cone is so eroded in its appearance. Seen from the east, Mount Scott has a conical shape. When seen from other directions, however, a broad amphitheater quickly becomes apparent. With its central core missing, it is easy to wonder about the cause of such great alteration in what was originally a great cone.

Mount Scott, like all other surrounding features, was blasted by avalanches of hot pumice and scoria during the climactic eruption of Mount Mazama. The real dint to its shape, however, took place centuries prior to the big blast. During at least three, and possibly four extended periods, glaciers advanced over this and other peaks in the Cascade Range. Ice slid down and created the west slope that geologists call a cirque. The abrasive effect of these mile-thick rivers of ice should not be trivialized. The broad slopes surrounding Mount Thielson, located north of Mount Scott, are missing altogether because of what the glaciers carved. The same can be said for Union Peak, a promontory situated some 10 miles to the southwest of Mount Scott.



The view from Mount Scott.



Whitebark pines

The pumice and scoria now covering flanks of Mount Scott eventually became a suitable habitat for subalpine trees. Whitebark pines (*Pinus albicaulis*) are especially adapted to the higher elevations. Their flexible limbs bend easily under the weight of the heavy winter snow pack. Clusters of needles, five in a bunch, are assembled at the ends of branches and give each the appearance of a bottlebrush. As you ascend the Mount Scott Trail, take notice of how these trees become visibly shorter with elevation. A reduced growing season has both depressed the numbers of these trees and their size. The prevailing wind has also

shaped their appearance, especially within the cirque. Trunks and limbs all bend back and away from the strong winds that come across Crater Lake from the west.

A splendid view from the top rewards everyone who climbs to the top of Mount Scott. Looking east, across the Klamath Marsh, observers often see expanding cumulus clouds on warmer summer days. The Three Sisters, located a hundred miles north, display icy tops just barely visible to the left of Mount Thielson on clear days. The best view by far, and one that draws considerable attention, is the view of Crater Lake. Nowhere else in the park do observers see the entire display of island, rim, and water as well as from Mount Scott. Perhaps the combination of being up high enough, and a bit removed from the rim of Crater Lake, allows for a new perspective on the decapitated mountain.

As previously indicated, Mount Mazama was not a single cone. Just as the Three Sisters and Broken Top are considered a volcanic complex, so too was the Mazama volcano. The difference here, however, was that most of the units that combined to form Mount Mazama were so close together that their lava overlapped. The exception, of course, was Mount Scott. All members of the Mazama complex derived their fluids from the same magma source beneath the surface. Mount Scott formed first and others followed to the west of it.

Fortunately for those who appreciate Mount Scott in the present, it was located too far east to collapse into the same magma chamber as Mazama had 7,700 years ago. During the climactic eruption, however, an observer on Mount Scott would have been in great danger. Avalanches of hot pumice and scoria raced down the slopes of Mount Mazama and boiled over the top of Mount Scott. Fall out from a four-mile high plume of pumice also landed on the top of this cone.

It is difficult, when standing on top of Mount Scott, to comprehend the catastrophe that occurred here almost eight millennia ago. The peaceful setting of this place adds to a deceptive illusion of permanence. It is worth remembering that geologists have determined that the source of Mazama's climactic eruption is still intact, and fully capable of building new volcanic edifices here in the future.



Mount Scott from Rim Drive, where the glacial cirque is plainly evident.

Cinder Cones in Crater Lake National Park

By K.R. Cranson

Visitors to this national park marvel at the spectacle of a large volcano that collapsed nearly eight thousand years ago to produce a basin now filled with indescribably blue water. Indeed, the geological story of what happened to produce the Crater Lake basin that we see today may be the best description of a “young” caldera in the world. There are, however, numerous other interesting volcanic features in the park. At least 20 cinder cones have been identified within the boundaries of Crater Lake National Park. And, of course, Wizard Island, the most famous of these, rises more than 700 feet above the lake’s surface near the western shoreline and is well known to all visitors.

Cinder cones as landforms

One simple method of classifying volcanoes groups them into three categories: shield volcanoes, strato-volcanoes, and cinder cones. Shield volcanoes are massive, low, dome-shaped features produced primarily by fluid lava flows, and usually composed of basalt. The islands of Hawaii are examples of these huge volcanic features but only a small portion is visible above sea level. A strato-volcano is constructed layer by layer of more or less alternating lava flows and pyroclastics (loose fragments erupted during explosive activity) that tend to be large features on land with relatively steep slopes. They are the subjects of picture postcards and calendars. In the Cascade Range, Mount Rainier and Mount Shasta are good examples of strato-volcanoes.

Cinder cones are the “baby” members of the volcano family listed above. They seldom exceed a mile across at the base and a thousand feet high. Unlike the shield or strato-volcanoes, this smallest member of the volcano family have an extremely short life span—being active for just days to a few months in most cases. Only in rare occasions does their activity extend for a year or more. From a geological perspective, this is like an instant or a snapshot in the volcanic record of an area. Due to their origins, cinder cones are called “monogenetic,” with the entire feature built during one eruption episode from one source of magma.

A typical cinder cone eruption begins by venting magma rich in gas that expands, producing solid fragmental volcanic products like blocks, bombs, scoria, ash and dust. This ejected material, the pyroclastics noted above, accumulates at a single location to build an inverted cone around the vent. The larger and heavier particles collect closest to the vent, while smaller and lighter ones drift farther—or are carried away by the wind. As the cone grows, a central region may develop composed of the larger pieces (blocks, bombs and scoria) mixed with more fluid magma that

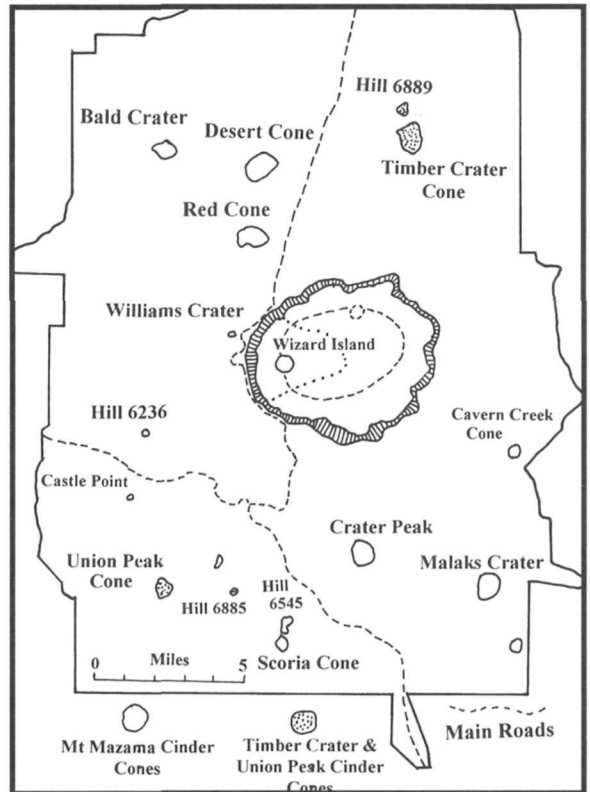


Figure 1: Location of the major cinder cones in Crater Lake National Park, Oregon. The dashed line inside the caldera represents the location of Merriam Cone and the ring fracture zone where post caldera eruptions reached the surface. The Central Platform is outlined by the dotted line.

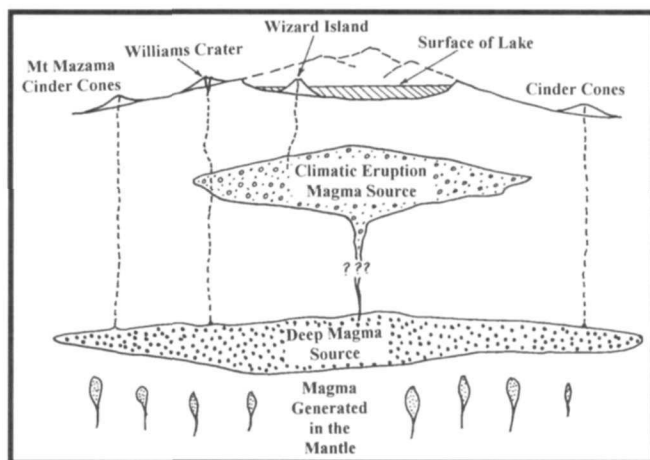


Figure 2: Schematic cross section of magma sources for cinder cones and the climatic eruptions at Crater Lake National Park. The outer margins of the Climatic Eruptive Magma Source defines the shadow zone, that portion of Mount Mazama that collapsed to form the caldera. ■

ops, associated lava flows may actually contain up to ten times more volcanic material.

Since cinder cones are relatively small features, they are often overlooked. They are, however, the most abundant kind of volcanic cone—being common worldwide and numbering in the thousands. One report suggests that at least 400 cinder cones have formed in the Oregon portion of the Cascade Range alone. Most of those in Crater Lake National Park are associated with the construction of Mount Mazama. Wizard Island, of course, was formed in the caldera following the collapse of Mazama's summit.

Cinder cones generally develop in volcanic areas that do not have larger volcanoes, or are associated with more massive volcanic cones. Those related to larger volcanic features, like shield and strato-volcanoes, usually develop along weak areas in existing rock. Such zones are often referred to as basement fractures and tend to be radial to the larger volcano—something like the spokes of a wheel. Although this is not obvious for the cinder cones at Crater Lake, connecting certain pairs does produce a crude radial pattern. Examples are Desert Cone and Red Cone, or Scoria Cone and the adjacent Hill 6545.

Cinder cones in the park

The cinder cones in Crater Lake National Park fit into two categories: those associated with the small basaltic shield cones of Union Peak and Timber Crater, and all the others that are related to Mount Mazama. Hill 6902 and the cinder cone on its summit appear to be part of the Timber Crater shield volcano in the northern portion of the park. In a like manner, the south-western quadrant holds Castle Point and its summit cones, along with several smaller cinder cones belonging to the Union Peak shield volcano.

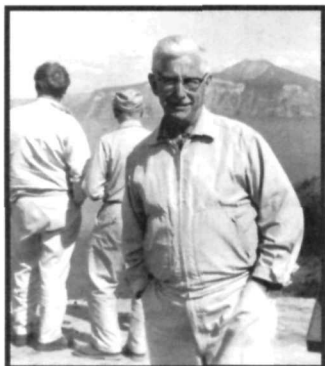
Red Cone and Desert Cone, clustered in the Pumice Desert in the northwestern section of the park, are good examples of cones related to Mount Mazama. Both appear symmetrical when viewed from the North Entrance road, a distance of about a mile. As with most other cinder cones throughout the park, both have a symmetrical appearance when viewed from above. Other promi-

hardens into a rigid core. On a young cone this core is seldom seen as it is usually buried by additional pyroclastic material blown out of the vent later.

In time, the gas dissolved in the magma that powered the explosive initial eruption is exhausted and magma reaches the surface as lava. When this happens, lava flows may break out from the base of the cinder cone and flow away from the volcano. Magma forming cinder cones is typically basaltic or basaltic-andesite in composition. Lavas with this composition tend to be relatively hot and flow readily, sometimes for great distances. Although the most prominent part of these small volcanic features is the cone that devel-



The southern flank of Williams Crater along Rim Drive on the west rim of the caldera. Basaltic magma rising to the surface vent here appears to have "tapped" some magma from the Climatic Eruptive Magma Source to produce "mixed magma" rocks.



Howell Williams at Crater Lake in 1965.

nent Mount Mazama cinder cones include Bald Crater, Crater Peak, Scoria Cone and Maklaks Crater—the latter is called Diller Cone on older maps.

The cinder cones associated with Mount Mazama exhibit a large range in volume. Of the eight more prominent cones for which a volume has been determined, Crater Peak is the largest with a volume of just under a tenth of a cubic kilometer. Hill 6545, near Scoria Cone, is the smallest measuring somewhat less than a tenth the size of Crater Peak. Wizard Island's volume falls about midway between these extremes.

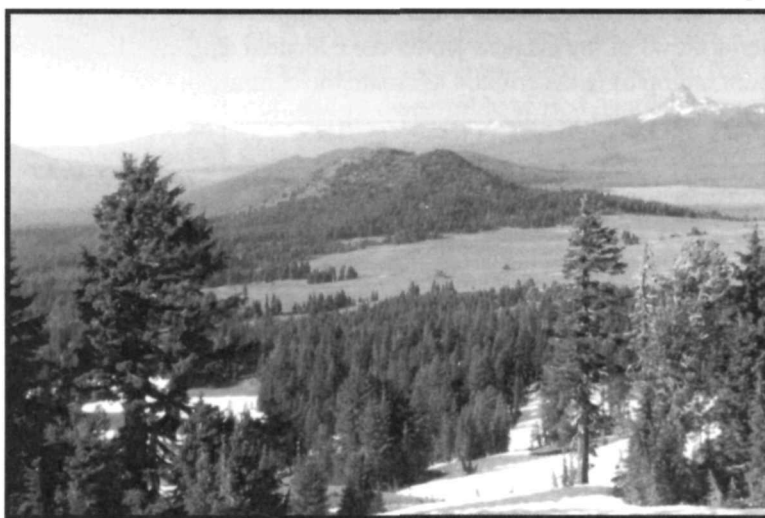
Unlike the typical cinder cones described above, cinder cones located away from the caldera exhibit few lava flows. Since all of these cones predate Mazama's climactic eruption, it could be that the flows are buried by eruptive material. The tendency to erode easily is another factor since the edifice of cinder cones is composed of loose debris. Older cinder cones are thus more rounded with lower slopes that result from erosional effects. In a like manner, summit craters are typical in younger cinder cones, like the crater nearly 100 feet deep on Wizard Island. For the other Crater Lake cones, however, only shallow depressions remain of any craters that may once have been present.

All of the Crater Lake cinder cones are similar in composition. One method of describing and comparing the composition of volcanic rocks is expressed by how much silicon (Si) and oxygen their rocks contain. Reports of chemical analysis combine these two elements and express them as the percentage of SiO_2 . The great majority of cinder cones found in the park have a SiO_2 range of between 52% and 58%, thus producing igneous rocks called basalt or basaltic andesite.

Based on the amount of weathering, soil cover, erosion and a few radiometric dates (the measurement of geological time by means of the rate of disintegration of certain radioactive elements), most cinder cones in Crater Lake National Park appear to be less than 50,000 years old. Radiometric dates (using the potassium-argon method of dating, or K-Ar) have been made on rocks from four cones: Timber Crater, Red Cone, Scoria Cone and Desert Cone. Only the results for Desert Cone indicate an earlier formation with a date of about 200,000 years. It should be noted, however, that the ages resulting from such techniques have a very large range. For example, the age for Red Cone rocks is recorded as 36,000 years before present, plus or minus 12,000 years.

Williams Crater & Wizard Island

Just outside the west caldera rim a small cinder cone can be found called Williams Crater, previously labeled as "Forgotten Crater" on older maps. This feature may provide an interesting insight into the nature of the magma sources that produced Mount Mazama and the climatic erup-



Red Cone illustrating pyroclastic debris and forested northern slope. This cinder cone is typical of the small monogenetic volcanoes related to Mount Mazama outside the caldera.

tions. Some erupted materials appear to be formed from “mixed magmas” and contain both low and high SiO_2 compositions. These have been interpreted as a mixing of the two different magma sources associated with the Mount Mazama region - the deep magmas and the climatic eruption magma source. Based on glacial erosion and other evidence, Williams Crater appears to have been active between 22,000 and 30,000 years ago.

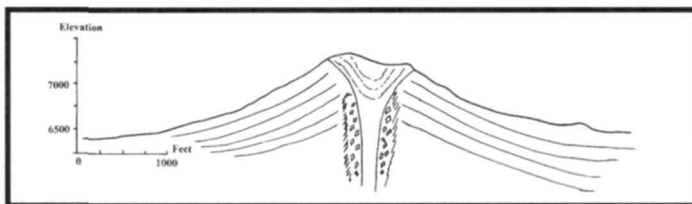


Figure 3: This east-west profile of Red Cone illustrates the typical shape of cinder cones at Crater Lake. Slopes for cones outside the caldera suggest some decrease from the original shape due to erosion. Angles for young, fresh cinder cones tend to be about 30° , similar to that of Wizard Island which has a slope of 29° .

All the volcanic features on the floor of the Crater Lake caldera developed after the collapse of Mount Mazama. Soon after the climatic eruption and collapse that created the caldera, renewed volcanic activity formed the central platform, Merriam Cone, Wizard Island, and other features. An estimated 3 km^3 of post caldera volcanic material was erupted through a ring fracture system - most of it part of the Wizard Island edifice. Merriam Cone, rising some four hundred meters above the caldera floor, has the general appearance of a small cinder cone. Recent evidence, however, suggests it was formed below water. Wizard Island's cinder cone rests on top of a pile of lava flows that extend eastward over the central platform.

Several research devices and techniques were used to map the topography of the caldera floor and investigate the nature of the rocks and sediments that occur in the Crater Lake basin. Rock samples collected from some 250 feet below lake level, on the flanks of Wizard Island, appear to have been in place under water. The composition of these samples is identical to the youngest sub-aerial flows of the island's cinder cone located above them. All this suggests that Wizard Island was built on top of lavas erupted to create the central platform in the rising waters of Crater Lake.

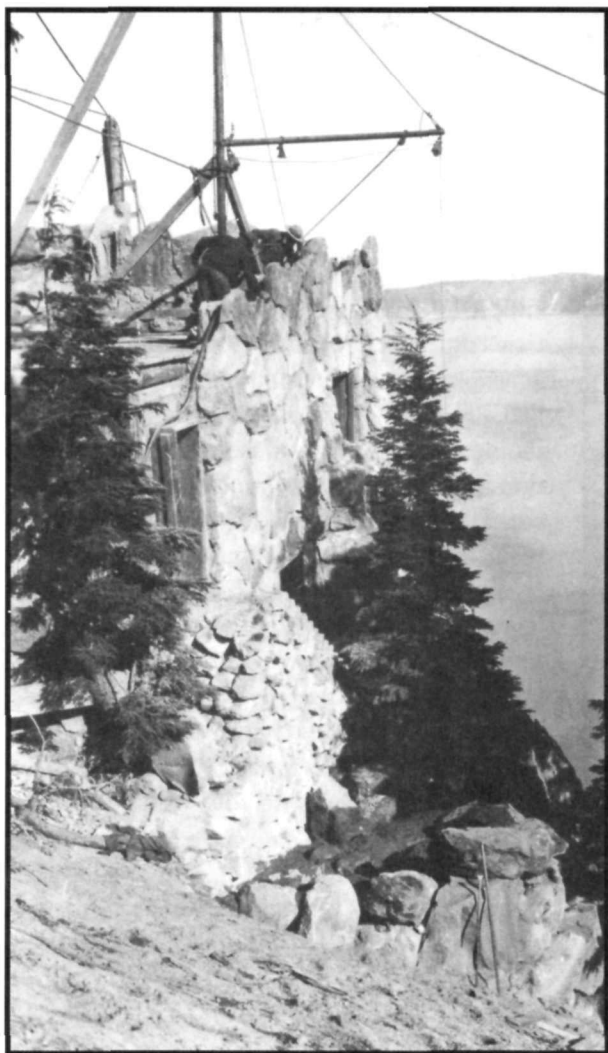


Timber Crater across Pumice Desert as viewed from the North Entrance road. This cone, resting on the summit of a small shield cone, is the largest cinder cone in Crater Lake National Park.

remnant volcanism, the lava flows at the western base of Wizard Island may represent the most recent volcanic activity in the park.

Over the past 20 years, a large number of publications have resulted from intensive geological fieldwork. These efforts have concentrated on the construction, climatic eruptions, and ultimate collapse of Mount Mazama, resulting in the Crater Lake caldera. This is, of course, the geological story to be presented at Crater Lake National Park—the very reason the park was established. Other geologic features, such as the cinder cones, however, are also worthy of further investigation.

The maximum age of Wizard Island and Merriam Cone is constrained by the date of Mount Mazama's collapse a little less than eight thousand years ago. There are various estimates of how long it took for the lake to fill to its current level. Other evidence suggests that Wizard Island formed very early in the history of the basin. Using radiocarbon (C-14) dates for the collapse, and allowing a few hundred years for the lake to fill, places Wizard Island's age at about 7,000 years before the present. Its conical shape gives Wizard Island the look of a young feature, having suffered little erosion. Since there are no “hot” areas outside the caldera to suggest



Construction of the Sinnott Memorial, 1930.

though it is a confined space with a sheer drop of some 900 feet to the shoreline, this building combines two functions. The first provides a venue for interpreting what transpired to produce a lake of such magnificent beauty, while the other is aimed at enticing visitors to explore the park.

The Sinnott Memorial (opened in 1931) is designed to present Crater Lake in a naturalistic way. In this case, such a structure should fit into the surroundings as a sign of human subordination to the scale and grandeur of the scene. The designer (landscape architect Merel Sager) went so far as to spend hours in a rowboat on the lake, doing so in order to devise ways to make the building virtually invisible against the inner caldera wall. It started as a “rest” dedicated to its namesake, an Oregon congressman who chaired the House Appropriations Committee prior to his death in 1928, but quickly evolved into a more ambitious project. John C. Merriam, conservationist and a leading advocate for interpreting the national parks, envi-

Observation Station No. 1

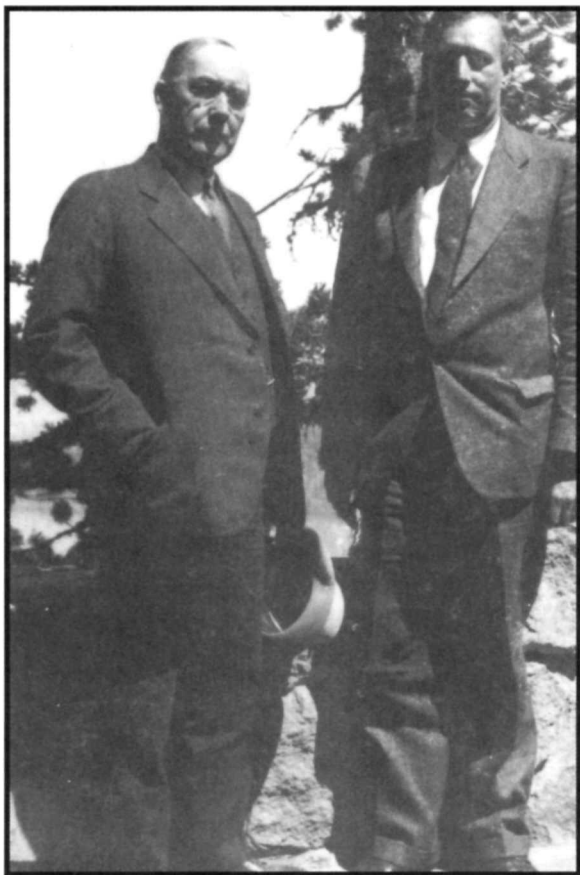
By Steve Mark

Photographs and documentary evidence show that the site known as “Rim Village” has served as the park’s main visitor use area since the late nineteenth century. It might appear to first time visitors as dominated by two parking lots located on opposite ends of a roadway, and where randomly placed buildings lack any overarching architectural theme. That impression may hold true until visitors use the walkway defining the northern edge of Rim Village. Bordered by a masonry wall on one side, the promenade was intended by its designers to furnish a safety feature and consistent foreground from which to behold the sublime “picture” of Crater Lake.

Just below the Kiser Studio (the structure utilized as a ‘visitor center’ during summer) is an overlook reached by walking down a short trail from the promenade. It is not readily discernible at first, since the trail was planned to yield only partial views of the lake and a structure sitting atop Victor Rock. Once inside the Sinnott Memorial, however, visitors find that its parapet provides a spectacular and unobstructed view of Crater Lake and surrounding peaks. Even



Naturalist giving a talk on the Sinnott Memorial parapet, 1957.



Merriam and Bryant at the rim in 1934.

sioned a sheltered overlook whose porch or parapet might facilitate better visitor orientation to the park story.

As a former professor of paleontology, Merriam recognized the educational value of a short talk about the origins of Crater Lake, but in a spot where visitors could both see and understand. A museum needed to be simple and not separate people from the park they came to experience. Toward this end Merriam and several other leading scientists had already established the precedent of combining a parapet with museum at Yavapai Station in the Grand Canyon. Unlike Yavapai, which is situated a mile east of where visitor services are centered in Grand Canyon Village, the Sinnott Memorial is part of Rim Village and therefore close to where most visitors congregate at one time or another. The building's location away from the promenade and roadway conversely provides isolation, a quality that reinforces visitor acceptance of the Sinnott Memorial as both viewpoint and classroom.

As part of capitalizing on the opportunity presented by this venue, Merriam orchestrated funding for volcanologist Howel Will-

iams to produce what is still considered to be a classic work on the geology of Crater Lake National Park. With only slight revisions since its first publication in 1941, this study has served as the primary reference for naturalists giving talks in the Sinnott Memorial.¹ Consequently, it may not be surprising that Merriam first considered utilizing the adjacent museum room to provide more in depth information on the park's geological story. He even went to Europe in 1931 and found film footage of volcanic eruptions, but changed his mind about a theme by the time this exhibit area finally opened seven years later.

Merriam's approach to the museum centered on the lake's beauty being so exceptional that it provided a way to see the underlying unity in nature. Most images presented in the museum were photographs, but he also donated several paintings such as the one depicted on page 2 of this *Nature Notes* volume. Harold Bryant, one of Merriam's proteges who was chief of research and education in the National Park Service at that time, articulated the rationale behind this effort:

*The dispensing of knowledge about park features was a goal, important and useful, but it was hoped that the park visitor could be taught to think great thoughts, could be sent home actually inspired. Based on what was seen and heard a visitor could be aroused to contemplate the origin and evaluation of the world we live in, the laws which control it and the interrelations of its parts. If Crater Lake represents an outstandingly beautiful landscape, how can the visitor be helped to appreciate it?*²

Although it was intended to play a key role, aiding the appreciation of nature went well beyond the confines of the Sinnott Memorial. One of the aims, for example, behind reconstruction of the road around Crater Lake starting in 1931 involved better presentation of what Merriam and others felt were the top points of interest. Specially chosen pullouts or “stations” were designated along the new “Rim Drive” to highlight geological and scenic focal points seen from the road, with walls and other features such as planting beds taking their cue from precedents established in Rim Village. Merriam’s convention of calling the Sinnott Memorial “Observation Station No. 1,” was adopted for a time since the overlook and museum represented a logical starting place for visitors traveling a circuit 33 miles in length.

Rim Drive continues to hold its place among the nation’s most notable scenic roads, one regularly rated among the top ten by the American Automobile Association. It even served as the showpiece for the Volcanic Legacy Scenic Byway (a route running well beyond park boundaries) being named as one of the few All-American Roads in 1998. The stations and substations designed as part of the Rim Drive still exist, though several have since suffered unflattering “improvements.”³ Few of the pullouts are signed as such and none are presently linked with the Sinnott Memorial in wayside exhibits or the park brochure.

Visitors can still hear regularly scheduled talks during the summer season at the Sinnott Memorial. These presentations emphasize geological and limnological aspects of the park story, just as they always have. Non-personal interpretation in the museum and for the parapet exhibits has taken several different courses over the years, generally overlooking Merriam’s observation that:

Just as all who see the lake come under the spell of its beauty, so there are few for whom the story of its coming to be does not take on increasing importance as acquaintance grows. The sublimity, power, and orderly operation expressed in this process of creation



Reflection Point, a substation on the east Rim Drive.

*develop in us a sense of appreciation corresponding to influence of reactions produced by other elements which we recognize as beauty and harmony.*⁴

The foregoing statement is worth considering in light of the average visit consuming less than four hours, as well as the high likelihood that a large number of these visits will not be repeated. If there is little or no formal linkage between the beauty which initially draws people to Crater Lake and interpreting the origins of park features, then how can visitors ever find them meaningful when they return home?

Whether Merriam was successful or not with his approach to helping visitors appreciate nature can be debated, especially since it hinged so much on his concept of unity. On one level there is visual unity, of the kind where landscape architecture harmonizes with an awe-inspiring spectacle such as Crater Lake. This goal may lead to what is best about experiencing Rim Drive, but is secondary to a unity best characterized as conviction. The latter does not detach art from science, since each has a role in grasping larger meanings in nature that are the stuff of inspiration. Merriam once described the value of this kind of unity in an article about the Grand Canyon:

*Through such visualization of nature seen as a whole we come often to the realization that, even when enlarged by the lens of knowledge, the picture indicates the presence of something beyond that vision does not fully reach. So, in various other ways, artist and writer have presented the idea that, in looking upon these great examples of unity in nature, what we see may only be the shadowy expression of things greater still, which neither eye nor mind has yet been able to define.*⁵

UNITED STATES
DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary
OFFICE OF NATIONAL PARKS,
BUILDINGS, AND RESERVATIONS
Arno B. Cammerer, Director

A BRIEF GUIDE
to the
PARAPET VIEWS

SINNOTT MEMORIAL
CRATER LAKE NATIONAL PARK

The views from the parapet of Sinnott Memorial, if observed in order as numbered, present a picture of great forces in the past which have helped to develop the beauty seen today.

The story of Crater Lake on the following pages is copied from labels describing the views seen through the instruments.

This leaflet was prepared by a committee of the National Academy of Sciences and the Carnegie Institution of Washington as an aid to the visitor.

Leaflet written by Merriam and distributed at the Sinnott Memorial.

Notes

¹Williams, *Crater Lake: The Story of its Origin* (Berkeley: University of California Press, 1941). His full study is *The Geology of Crater Lake National Park* (Washington, DC: Carnegie Institution of Washington, 1942).

²Harold C. Bryant, "The Beginning of Yosemite's Educational Program," *Yosemite Nature Notes* 39:7 (July 1960), p. 165.

³The greatest distinction between stations and substations was that stations were visited as part of a naturalist-led Rim Caravan, a service discontinued by the early 1950s.

⁴Merriam, "Crater Lake: A Study in the Appreciation of Nature," *The American Magazine of Art* 26:8 (August 1933), p. 361.

⁵Merriam, "The Unity of Nature as Illustrated by the Grand Canyon," *Scientific Monthly* 33 (September 1931), p. 234.

“Lake Majesty” through the Photographer’s Eye

By Peter H. Meyers



Fog in the caldera late fall 1958.

There is a physical sense of envelopment when standing on the rim of Crater Lake. It is as though one becomes part of the circumference of the lake and you are connected to it like the arms from your shoulders.

Needless to say, the beauty of Crater Lake has drawn some big names in fine art photography over the past century. Both Ansel Adams and Edward Curtis worked at the lake as well as many, many others. For me to find my own artistic voice here was a real challenge. For one thing, the caldera is about six miles across at its widest point and the sheer walls fall one to two thousand feet. It is a HUGE physical space, where all that geometry and scale must be reduced down to a small, two-dimensional picture.

For the fine art photographer, our tool is light. We can use light from the sun to create a sense of geometry in order to represent the presence of what we are photographing. To do so on such a large scale as this lake requires extraordinary light. For me that light typically comes as the first winter storm clears, leaving a fine powder of white snow on the caldera walls. This highlights the geological formations in its volcanic form. The rolling of the storm clouds as they clear create modulating moods, filtering the sun.

Later on in winter, the annual accumulation of snowfall (44 feet on average) results in less geometry—as more and more of the surfaces are blanketed in white. My hope through this work was to impart a sense of the size, grace, and envelopment that one senses when standing on the caldera’s edge. As two major storms cleared, I made about 300 exposures on the films I carried away from the park. At one point I even used a rock climbing harness and rope, anchoring myself to trees while shooting on the snow covered slopes of the caldera.

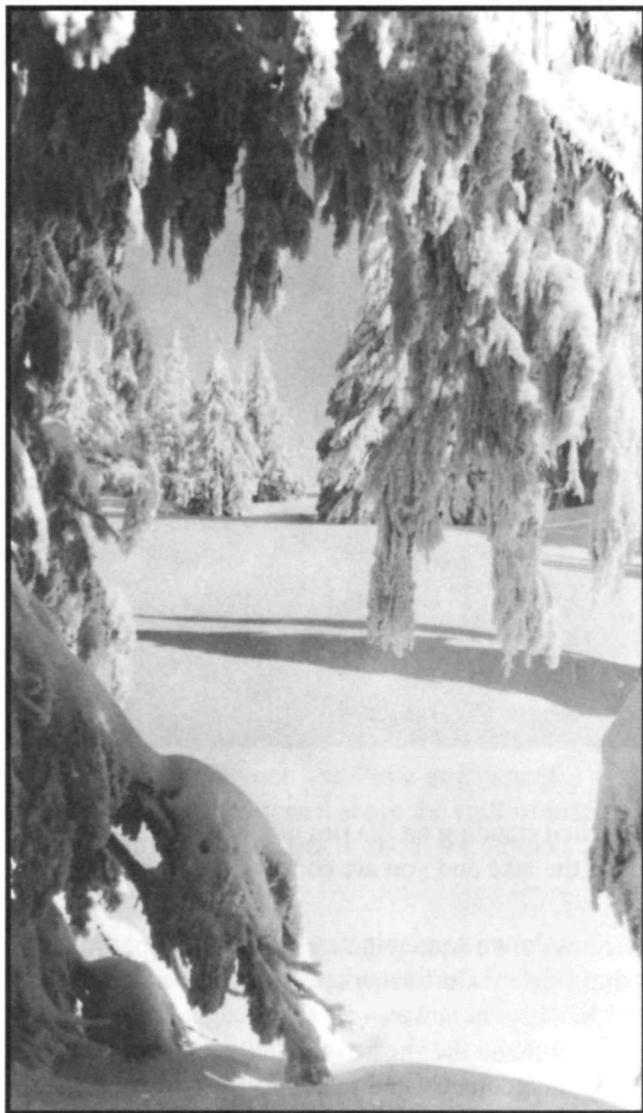
My work has taken me all over the western United States, deep into remote wilderness areas. I have seen and photographed many incredible views of the West and what makes us “West-

erners,” but few of my travels have touched me personally as much as this lake. After one discovery by white men in the nineteenth century, it was named “Lake Majesty.” Perhaps that is the

most fitting name of all. The sky, its clouds, and the sun’s warmth somehow seem to extend from this lake in awesome majesty as though this was the center of the world. For one brief moment I felt connected to it all and insignificant as its witness.

Did I make an image through the lens of my camera that captures the spirit of this lake? I don’t know yet. At the time of writing, the negatives are still in a drawer. After time has passed and I forget the physical pain associated with taking each shot, I will select my best negatives and the work will begin in earnest. For it is at this stage that I try to coax out a work of art, one that reflects what I saw and felt in my mind’s eye at the time of creating each photograph. I pull the finished work out of the raw negatives, much like a diamond cleaver cuts the jewel from raw stone.

Hopefully you will see the results of my work at Crater Lake as part of the park’s centennial celebration. It has been a great challenge for me and the outcome is uncertain, but what I take away from here in my heart is not. I felt wonderment at having been a part this magnificent place for a brief moment. May you have the same experience.



Winter scene at Crater Lake, 1931

The author wishes to thank the staff at Crater Lake National Park for their hospitality during his working residency that took place in November 2000. Images by Peter Meyers can be viewed by visiting www.petemyers.com

Presenting Crater Peak and the Pacific Crest

By Steve Mark

It is hardly worth repeating that Crater Lake plays a central role in what most people experience in this particular national park. Roads provided the main access for seeing the lake even during the first decade after the park's establishment in 1902. By 1919 a "rim road" of some 35 miles allowed visitors to drive completely around the edge of a caldera holding Crater Lake. This route was superseded by construction of a more modern "Rim Drive," an almost 33 mile summer thoroughfare which persists to the present. While the latter road has become one of the top scenic drives in the United States, it also made seeing Crater Lake so easy that for the last 60 years or so the average visitor spends a little less than four hours in the park.

Trails have always been of secondary concern to managers over the past century, especially when compared to the attention given park roads. One observer commented in 1932:

I was told at the Park that little money will be given for trails because few people use the trails. It is more important to build trails for the few who have interest enough to use them than to build roads for the many. It is of little value to run thousands of people up to a scenic point and then hurry them past it to another point. Nature speaks only to one who has ears and time to listen.¹

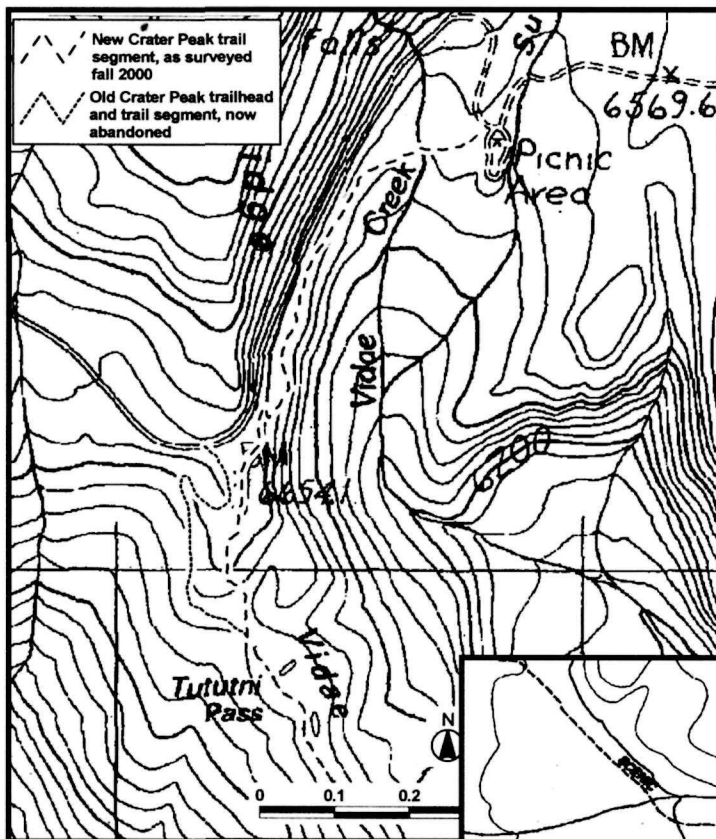
Indeed, most of the park's trail mileage consists of old fire access roads (sometimes called "motorways" or "truck trails") which formerly allowed firefighters the ability to respond quickly once lookouts spotted lightning caused blazes from The Watchman or Mount Scott. These roads were maintained as such until 1971, when managers started to treat much of the backcountry as wilderness that exhibited characteristics to some day qualify for legal designation under the Wilderness Act.

Advent of the Fee Demonstration Program in 1997 allowed for a hard look at the fire roads currently in use as trails. Entrance fees to the park for most vehicles were raised from \$5 to \$10, with 80 percent of that increase to be retained by the National Park Service for various projects. One of these focused on providing a better visitor experience on the old fire roads. Highest priority treatments were to be aimed at addressing safety concerns or improving segments irreparably damaged by past use as roads, such as drainage problems defying any solution attempted in annual trail maintenance efforts.

After conducting a review of all fire roads used as trails in the park, two projects involving short re-routes headed the list of possible projects to be funded by a Fee Demonstration account. One was connected with traffic safety at the trailhead (a blind curve on Rim Drive), damaged tread stemming from closure as a fire road in 1971, as well as a picnic area badly in need of revegetation and rehabilitation of its



The old giving way to modern means of experiencing national parks, 1942.

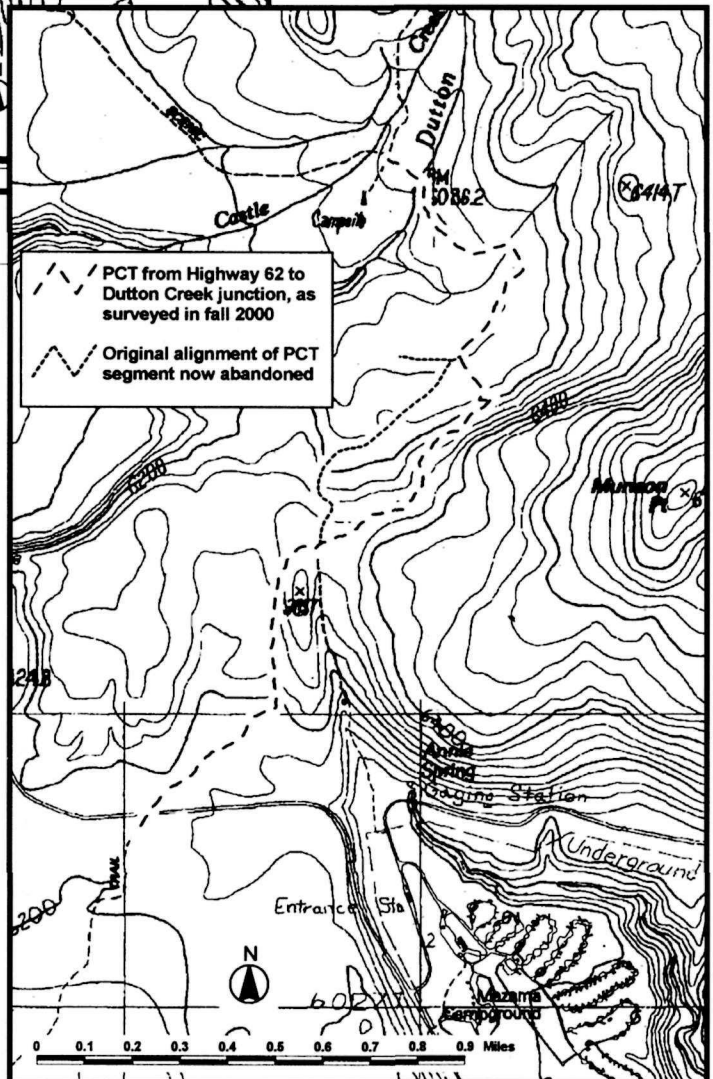


Above: Annie Spring/PCT reroute.
Right: One map for Crater Peak Trail.

gentle switchbacks toward Castle Creek's tributary of Dutton Creek.

Planning for both projects started with extensive reconnaissance over ground to weigh the merits of alternative routes. A landscape architect then produced a site plan for the Vidae Falls Picnic Area, to be followed by specialists who conducted surveys for rare plants and archeological resources in the corridors chosen as preferred options for reroutes. Recommendations for revegetation covered several miles on both the Crater Peak and Pacific Crest trails. This report aimed at giving specific guidance to those who were going to undertake the laborious task of removing scars left by the old fire roads. Crews needed to know, for example, where to recontour road berms in order to narrow the trail to a footpath some

vehicular circulation system. A big question behind making a new trailhead for Crater Peak at the Vidae Falls Picnic Area lay in the feasibility of placing trail on the old rim road route, especially in the section involving a climb up a talus slope full of boulders. The other project seemed less complex, as the bulldozer creating the fire road in 1929 also produced a chronic drainage problem. This section is located west of Annie Spring, where the Pacific Crest Trail drops into the Castle Creek drainage, something best avoided by a proposed reroute heading north along the divide posed by Munson Ridge, then descending on



18 inches wide and what vegetation to salvage as they did so.

With all of the planning and surveys completed in 1999, implementation came about the following summer. Work began in August, when the Friends of Crater Lake assisted the park's trail crew in constructing the first quarter mile or so of tread from Vidae Falls Picnic Area. Enrollees from the Pacific Northwest Youth Corps then assumed the difficult task building trail through a boulder-strewn section in order to connect the path from the picnic area to the existing route leading to Crater Peak. The PNYC also labored to make the short reroute of the Pacific Crest Trail near Annie Spring a reality by Labor Day.



Crater Peak in the distance.

Anyone who reaches the junction of where trails from Annie Spring and Highway 62 join on the Cascade Divide will no longer follow an old fire road to make an immediate descent. They instead follow a winding path for an enticing view of a dry meadow located up slope of the trail, followed by a ridgeline panorama featuring The Watchman and Hillman Peak in the distance. Some easy switchbacks are encountered shortly thereafter, ones traversed with little effort before rejoining the old PCT en route to crossing Dutton Creek.

An even more stunning transformation awaits those who head for Crater Peak. The new trailhead at Vidae Falls Picnic Area allows hikers an opportunity for contemplation at the shaded crossing of Vidae Creek, followed by a climb where the spectacular canyon of Sun Creek can be seen from the trail for the first time. This route then winds its way up the talus slope and finds a natural rock wall located on the saddle that allows the old trail to bring hikers toward the base of Crater Peak. The new trail eliminates a series of "tank traps" near East Rim Drive and a wandering traverse that produces neither a view of the canyon nor hardly a glimpse of the cinder cone.

Both reroutes are attempts to provide hikers with a better trail experience than afforded previously by the fire roads. Success in this respect is fairly subjective, but weighing trail design against the following experiential characteristics that make for a good walk might help in judging projects such as these. *Mystery* is where landscapes give the impression that one could acquire new information by traveling deeper into the scene. Good trail layout accentuates mystery and features a winding path, where constantly shifting views of vegetation and the landscape sustain interest. *Legibility* allows for extensive exploration in an environment that looks easy to discern if a person goes further into it; trails can therefore utilize landmarks and periodic openness to reduce anxiety about getting lost. A *prospect* often highlights the hike, by providing a vista that extends for miles, even if in just one direction. *Refuge* describes places on or near the trail that provide seeing without being seen, whereby information is gained without giving any away.²

Whatever the verdict, good design should mean that no one might notice what took place to improve the trails. That is, of course, unless you take the time to look closely at how nature is presented.

The author wishes to thank Cheri Killam-Bomhard and Amy Mark for their review and comment on the draft of this paper.

Notes:

¹Worth Ryder, Report on Crater Lake [to John C. Merriam], August 1932, p. 4.

²Tony Hiss, "Reflections (Experiencing Places—Part 1)," *The New Yorker* (June 22, 1987), pp. 63-64.

Others Have Passed This Way

By Steve Mark

Annie Creek, which forms a dramatic canyon along much of highway 62 coming to Crater Lake from the South Entrance, is called *Tiwi* in the Klamath language. This name arose in past centuries as people walked from the Wood River country in late summer toward their seasonal encampments at Huckleberry Mountain. In a time before wagon roads and highways, many preferred to reach patches located in the high Cascades south of Crater Lake by staying on the west edge of the canyon as they slowly climbed toward a small pass found just above Annie Spring. From there the general line of travel went west along Castle Creek, until those in search of berries veered south to follow the trail up the mountain.



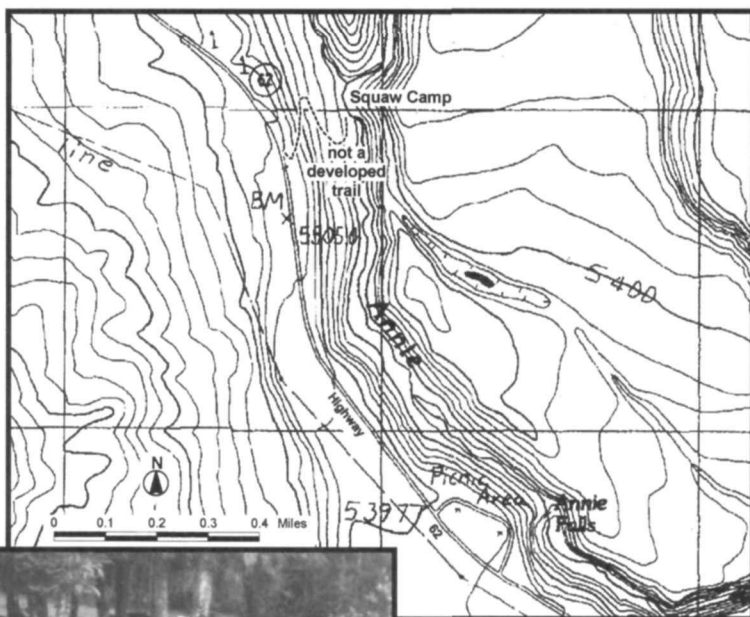
Remnant wagon road of 1865 above Annie Spring.

Army road builders used portions of the Indian trail network in the Annie and Castle creek corridors to link Fort Klamath with Jacksonville in 1865. Their commanding officer, F.B. Sprague, subsequently wrote a series of newspaper articles for the Jacksonville *Sentinel*. One of the pieces gave particulars about the new road and included suggestions for where to camp along it. Knowing where stock could be watered and fed was crucial to any trek across the mountains. Having more than one or two options along the road could also reduce friction between parties who might otherwise need to share relatively limited resources. Distances traveled by wagons over several days or a week also necessitated that a number of potential overnight stops be available. As transportation became more efficient, many of these stopovers showed signs of decreasing use. Present day visitors are allowed to camp at only one of those overnight stops associated with the wagon road while in Crater Lake National Park. This site is along Dutton Creek, not far from the Pacific Crest Trail.

Other sites along the old wagon road, some situated just yards from Highway 62, were investigated by a team of archeologists and historians who conducted a reconnaissance survey on

an intermittent basis each summer from 1998 to 2000. Participants found some 14 miles (of a possible 22 within park boundaries) of the old wagon road to be intact, even though highway realignments and widening chopped the road into segments above Annie Creek Canyon. A number of the old stopping places, however, become evident to anyone approaching at walking pace. These can also serve as launching points for hikers who have the time to see a little more of the park.

Waterfalls attract people for numerous reasons. Annie Creek Falls, for example, can be seen from a distance at a picnic area located about midway between the South Entrance and Annie Spring on Highway 62. About a mile north of the picnic area is a fairly long paved pull out placed along the eastern margin of the highway. It is rather nondescript, being surrounded by thick “dog hair” stands of lodgepole pine (*Pinus contorta*), although northbound



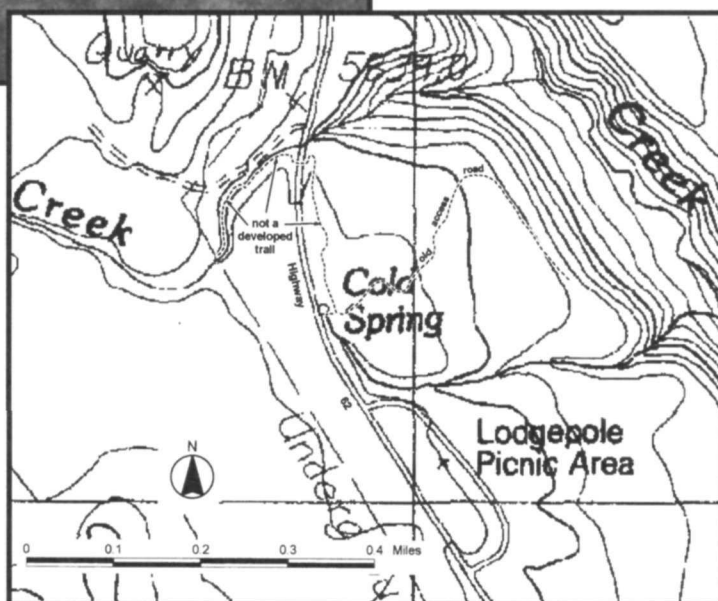
Above: Map of Squaw Camp vicinity.



Left: Cold Spring in 1937.

Below: The Cold Spring area.

travelers can see Arant Point ahead for the first time since entering the park. This dull, dry forest changes abruptly upon making a short descent below the highway toward Annie Creek. Wet areas fed by seeps and small springs in the canyon support far greater plant diversity than what motorists see at the pull out. Those hikers with a keen sense of smell may detect the odor of wild onion (*Allium validum*) growing in several places not far from the bottom.





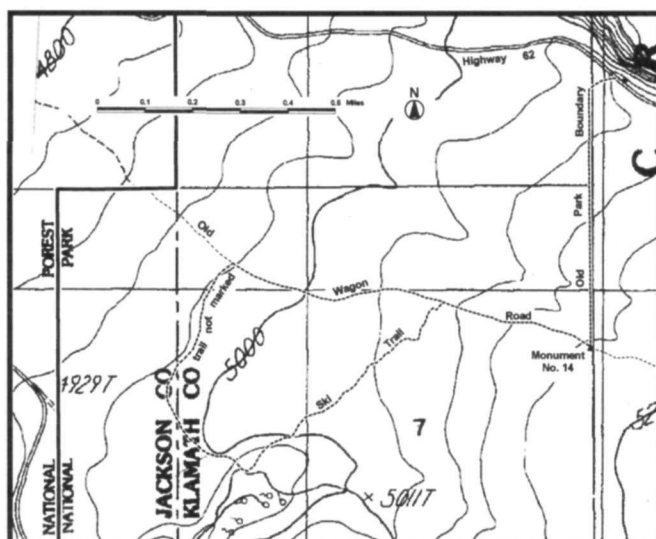
Blazed trees, such as the one at right, are evident along portions of the wagon road.

A map printed in 1908 enticed the survey team to investigate this locality since it referenced “Squaw Camp” in the canyon. Sure enough, what might have represented a respite from hard travel to tribal members passing through the park a century ago is evident on both sides of the stream. These secluded terraces make what are perhaps the best campsites in the entire canyon. Just a short distance upstream is an impressive waterfall with a shallow pool below it. An even more imposing cataract

can be seen if one follows the east fork of Annie Creek from its confluence with the main branch. This cascade and the other waterfall can be seen simultaneously if the viewer finds the right position.

Those visitors wanting a hike with less climbing can drive about a mile north from the paved pullout to the next picnic area. Park at the upper end and walk along the eastern side of the highway for a short distance, going along the small stream drainage. Its source is not immediately discernible amid another lodgepole thicket, but Cold Spring quickly becomes evident upon entering the small wetland where common (yellow) monkeyflowers (*Mimulus gattatus*) bloom in July and August. Surrounding the spring are older trees, many of them blazed by hatchet or axe at a time when horses and wagons were brought here. Those who wander a short distance may begin to see the outlines of a larger campground, one built by the National Park Service in 1937 and used into the 1960s. Sharp-eyed hikers will eventually spot a masonry fireplace, the last of its kind in the park, left mostly intact by crews who “restored” the area following closure of Cold Spring Campground about 30 years ago.

Two short treks are possible from the Cold Spring locality. An old service road leaves the campground heading east, then south, but remains high above the canyon. The other option requires crossing Highway 62 in order to follow the course of Polebridge Creek upstream. A hundred yards or so from the highway are bridge remnants where wagons once crossed. Follow the path out of the drainage, one that takes you south and west along a bench allowing for fine views of the creek and wetland. A couple of blazed trees indicate camp spots of long ago, just shy of the power line access road. There is a small huckleberry patch in the vicinity that may provide another reason to linger.



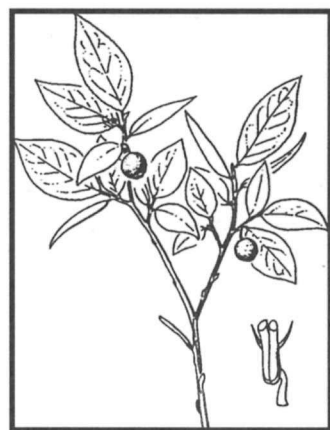
Map of the Thousand Springs vicinity.

A half day adventure is possible for those who are inclined to explore the Thousand Springs vicinity. To reach it from the wagon road, start at the old West Entrance—this is located about one mile east of the present park boundary on Highway 62, or roughly seven miles from Annie Spring. There is a small paved parking area on the south side of the highway, near where the sign is suspended on a metal pole that dictates a 45 miles per hour speed limit. At the time of writing a .75 mile hike is necessary to reach the wagon road, so use a compass to avoid wandering too far off line.

The wagon road route will be obvious and permits comparatively easy walking in a westerly direction, to the place where a placard with an arrow is nailed to a tree containing a blazed arrow. These arrows indicate where a Nordic ski loop diverges from the wagon road, one that follows an older route leading to water. A meadow containing a number of blazed trees will be reached after walking about .5 mile on the spur trail. Close inspection reveals an elk wallow near some camas (*Camassia Leichtlinii*), a lily with an edible bulb, prized by Indians who once gathered the bulbs in large quantities. Continue west through a dark forest growing on a wide terrace above the main tributary of Union Creek. Keen eyes are necessary to locate what is perhaps the largest tree in Crater Lake National Park, a Douglas fir (*Psuedotsuga menziesii*) measuring 25 feet in circumference.

The ski trail eventually leads to a path heading down slope to the tributary created by Thousand Springs. After a short meander in the wetland you may decide to retrace your steps by using the ski trail, or continue toward the present park boundary. If opting for the latter course, you can loop back to the wagon road by taking a compass bearing set to north. Once on the wagon road, follow it to make a gentle climb going east for about a mile to the old park entrance marked by a concrete monument. The walk back to where you parked on Highway 62 is easier if a small swath cut along the old boundary is followed going north.

Once back at the car, consider going west on the highway several miles to Thousand Springs Sno-Park at milepost 62. From there follow signs on the graveled Forest Highway 60 toward Huckleberry Mountain. A rather dispersed U.S. Forest Service campground is situated near the top, where an abundant supply of huckleberries is usually available at harvest time. You may even encounter tribal members who continue to use this place for berry picking and family gatherings. Please respect their privacy, since these reunions (which can last an afternoon or several days) are vitally important to the people concerned. Not only does the berry harvest serve as a means to gather food, but it also provides an opportunity to tell stories which pass knowledge from one generation to the next. This activity is especially important to the persistence of Klamath tribal identity because the stories are a living link with those who previously passed this way.



Big Huckleberry,
Vaccinium membranaceum.

*The writer gratefully acknowledges Doug Deur and Kelly Kritzer
for their review and suggestions.*

Notes:

¹See "On an Old Road to Crater Lake," in *Nature Notes from Crater Lake* 28 (1997) for more detail.

²Two of these sites were described in previous articles by the writer in *Nature Notes*; these are "A Pause in the Panhandle," (1996), p. 27, and "The Portals on Whitehorse Creek," (1999), pp. 32-33.

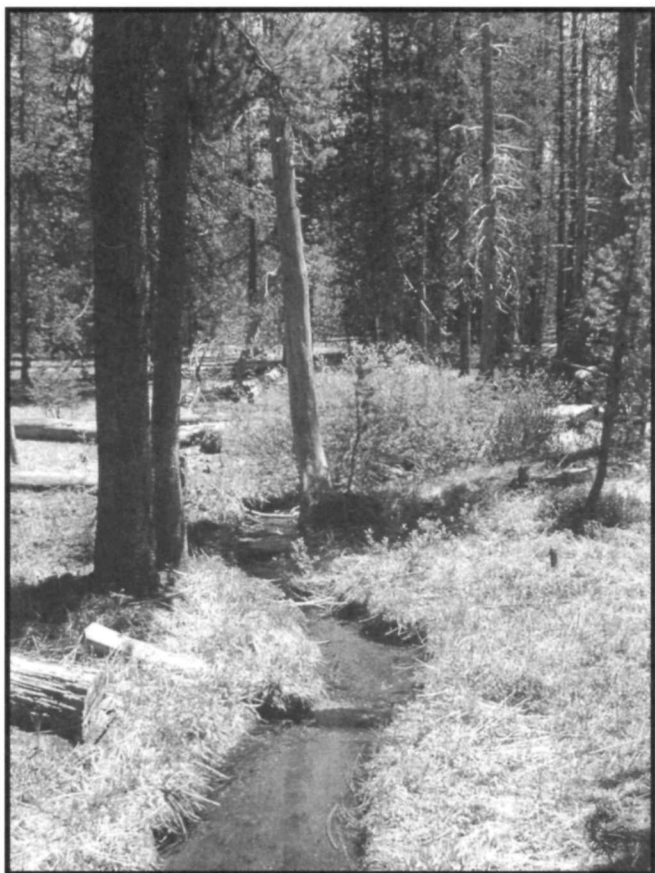
³One can view this raging cascade up close by descending through the trees. Do not, under any circumstances, attempt to traverse the bare slopes (composed of loosely consolidated pumice and ash) that form the canyon.

⁴John W. Lund, *More Southern Oregon Cross Country Ski Trails* (Klamath Falls: the author, 1990), pp. 131-133 has more route detail.

'Lost' Lost Creek

By Phil Kelley

Southeast of Crater Lake, not far above the confluence of Wheeler and Sand Creeks, is a small stream called Lost Creek (see figure 1). Most park visitors are unaware of its existence. Those who take note of it typically do so when stopped at the Lost Creek Campground where they find the small stream flowing quietly through the woods immediately west of the camp area.



Lost Creek

Lost Creek pours full-blown from a spring on the face of a steep slope about one kilometer northwest of the campground. It flows unpretentiously through the woods past the campground until the stream vanishes completely into the porous soils of the area located another kilometer to the south-southeast of the campground. Over its course Lost Creek receives no flow from tributary streams, and the fact that it disappears from view before joining another stream presumably accounts for the 'Lost' in its name. The spring from which the creek comes serves as the water source for the Lost Creek campground, and the stream itself hosts a small population of native bull trout that were introduced in the late 1990s (visitors should note that fishing in Lost Creek is prohibited). The banks of the creek, especially in its lower reaches, display a goodly collection of local wildflowers at appropriate times of the year.

This stream can also be characterized as 'lost' in ways other than just its hydrographic character. Lost Creek (or at least some stream, if not the one we see

today) appears on early maps of the area. The second illustration (figure 2) shows the vicinity highlighted on the first figure as presented on the United States Geological Survey's map of 1911. This map showed the park at a scale of 1:62500, and was based on plane table surveys in 1908 and 1909. The creek in question is the diagonal line passing through the large capital 'R' from mid-section 18 through the upper right corner of section 19 and into section 20 to the lower right. The intermittent stream that goes from west to east through the text '18', terminating at its presumed confluence with Sand Creek, should draw a discerning eye. At this point also notice the short creek paralleling our assumed Lost Creek, from just above the 'er' at the end of 'Wheeler' down to an intersection with Wheeler Creek. Which of these three creeks, if any, is really Lost Creek?

The next illustration (figure 3) shows the same area as presented on the USGS 1:62500 sheet *Crater Lake National Park and Vicinity, Oreg.*, published in 1956 but based on the same survey as was the 1911 map and augmented by work in 1933. Here the map looks sharper, but upon close inspection one finds that all that has been added is typography, roads, and a bench mark; the

same three streams we saw in the 1911 information are still there, and the contour lines remain unchanged.

Figure 4 shows the same area compiled from the USGS's Digital Raster Graphic (DRG) editions of the 1:24000 quadrangle maps *Crater Lake East* and *Maklaks Crater*. These maps were originally published and distributed on paper, but the paper and digital editions are essentially identical; the paper editions were published as Provisional Edition sheets (whence the crude typography and overlaid symbology) in 1985. Both are derived from aerial photography done in 1981 and 1982, with field checks conducted the latter year. There is but one creek on these sheets: the two small ones shown in earlier editions of the maps (the one in the upper part of section 18 running into Sand Creek and the one in the east-center of section 19 running into Wheeler Creek) are now gone. The stream named Lost Creek has been repositioned and is shown running into Wheeler Creek through the tributary canyon previously occupied by the smaller unnamed creek. Lost Creek is wandering around in the woods now, obviously lost.

Park staff conducted field survey work in the Lost Creek vicinity using high-quality differential global positioning systems techniques early in the summer of 2000. The work was originally initiated to clarify the actual position of Lost Creek so that a zone could be defined around it within which the use of fire-retardant chemicals as a fire-control measure would be prohibited. This measure is aimed at protecting the bull trout population in Lost Creek in the event of wildland fire in the area. We found Lost Creek and some other lost creeks in conducting this survey.

Figure 5 shows stream structures revealed by the survey. For the first time we can see what is actually the case in that area: there are three streams after all, and only one of them (the most southerly of the original three) is more or less correctly placed. It was shown correctly on the 1911 and 1956 maps, only to be abandoned on the 1985 versions. This illustration contains road and contour line data derived from USGS Digital Line Graph (DLG) data sets, and is information based on the same surveys used for the 1985 1:24000 quadrangle maps noted above. The streams from the 1985 sources are shown as dashed lines, and the stream positions from our field work are shown as bold lines. Lost Creek is named according to official nomenclature, but we have added unofficial names for the other two flowing streams in the vicinity: "Hopelessly Lost Creek" and "Mason's Creek." The latter are strictly local names bestowed by the surveyor, and are not designations approved by the National Park Service or the U.S. Board on Geographic Names.

It seems that the stream we have called Hopelessly Lost Creek is the same as the one shown in that location on the 1911 and 1956 publications. Mason's Creek has not previously ap-

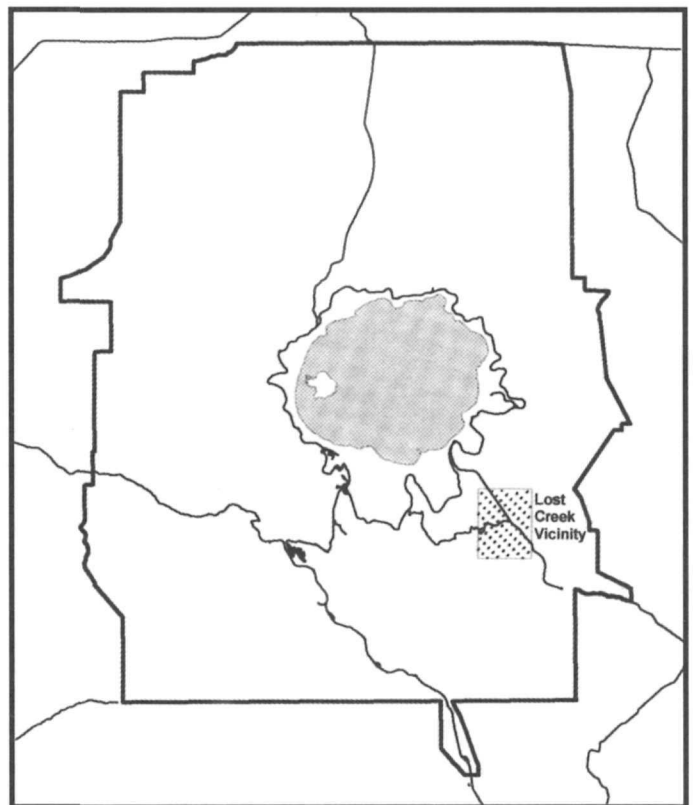


Figure 1: Lost Creek in relation to Crater Lake National Park.

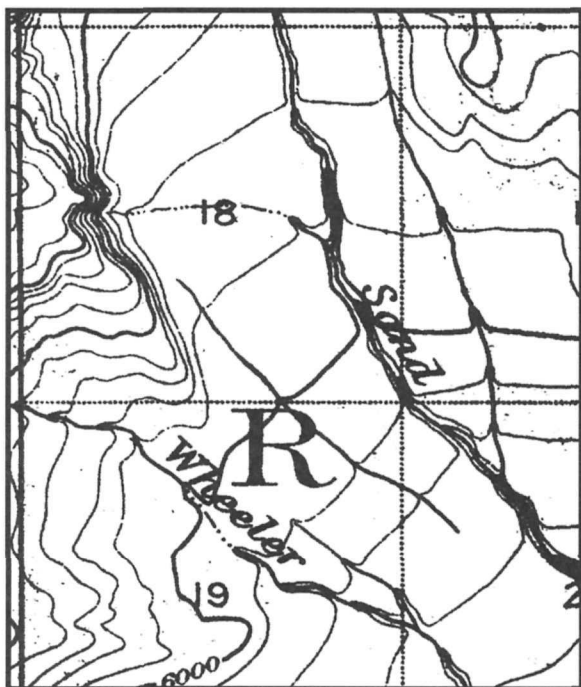


Figure 2: Lost Creek vicinity as depicted on the USGS map of 1911.

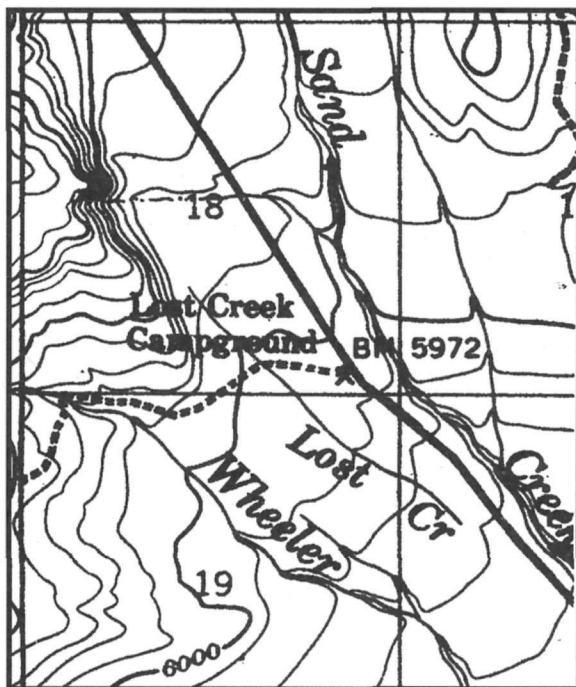


Figure 3: Lost Creek vicinity as depicted on the USGS map of 1956.

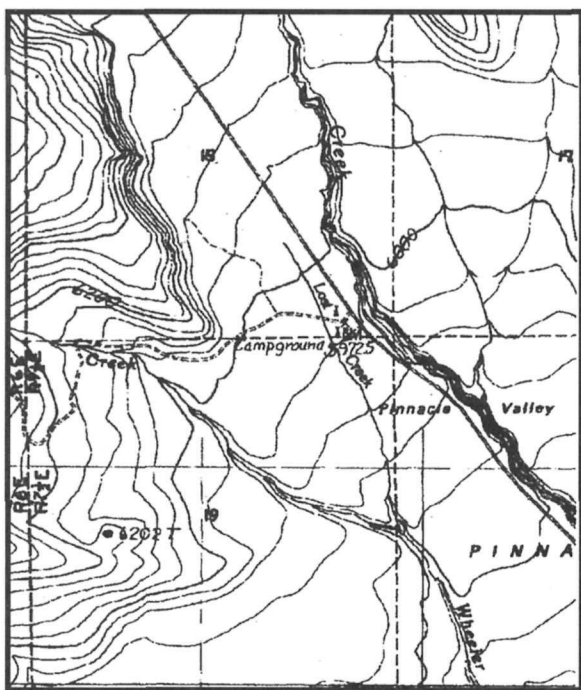


Figure 4: Lost Creek vicinity as depicted on the DRG (Digital Raster Graphic) edition of 1985.

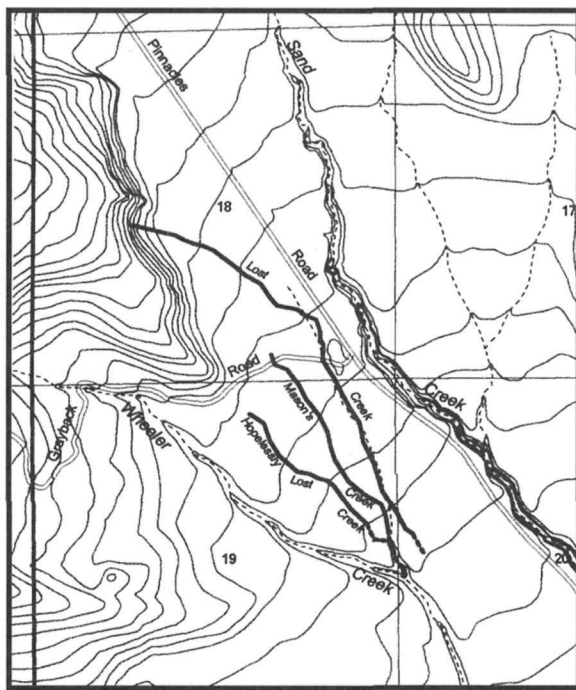


Figure 5: Shows stream structures revealed by park staff survey work.

peared as an identifiable stream on any USGS map. Lost Creek is there, all right, but its upper and lower extremities differ markedly from the information shown on published maps. The northernly unnamed stream shown first in 1911 is not a part of the complex of creeks in the Lost Creek area. Its source, as shown in 1911, is actually the source for Lost Creek.¹

Results from this latest survey illustrate some of the problems associated with the making of accurate maps. The surveys of the late nineteenth and early twentieth centuries in the American west were conducted by real people. They took with them significant quantities of moderately heavy equipment, and surveying with a plane table and rod took a lot of time to cover significant areas. Not all areas got surveyed with equal attention to detail. In this case it seems reasonable to believe that the survey crew perhaps passed up the north side of the Wheeler Creek gully, and in so doing, mapped the southerly small creek with some care. They then went on without looking carefully for other details. This or another crew might have also passed up the west side of Sand Creek, and subsequently inferred the details of the supposed drainage into that gully. None of them explored with care the interfluvium between Wheeler and Sand Creeks, but someone must have passed through the area and noted the presence of what subsequently came to be named Lost Creek.

Oddly enough, the ability of surveyors to see small things on the land diminished considerably as technology evolved. Instead of actually sending people with mules out to look at the ground, aircraft were used to photograph the ground from above. To a large degree, the things that cannot be seen on such photographs are not featured on the resulting maps. As a case in point, we have three small streams that are not wide enough to be seen as an open stream on such photographs as were used for the 1985 maps. These streams are sufficiently narrow that they do not even create a consistent opening in the vegetative canopy overhead.

Lost Creek is by far the largest (in terms of flow volume) of the three streams, at least along its upper end. Nevertheless, it has no significant drainage channel cut down into the landscape downstream of the uppermost few hundred meters of its course. As a result, there is no incised channel associated with it (either at actual ground level or reflected at the top of the vegetative canopy) that might be detected by the photogrammetric means used to create contour lines from aerial photography. The vegetative cover associated with the stream banks is the same as that found away from the streams, and thus there is no consistent tone or color distinction to be made between the near-stream vegetation and the surrounding vegetation that might hint at the presence of a stream. Unlike Lost Creek, however, both Mason's Creek and Hopelessly Lost Creek do have significantly incised drainage channels from their heads down to their combined confluence with Wheeler Creek.

By studying the 1911 map (Figure 2) we see that the channel for Hopelessly Lost Creek is reflected in the shapes of the contour lines across which its course passes. The topographic expression of that channel is much subdued in the 1985 mapping, but it is still there albeit with no stream. The Mason's Creek channel is not discernable as a topographic feature on any of the maps.

Prior to our survey, local wisdom in the park seemed to suggest that Lost Creek was, in fact, connected to Wheeler Creek, and that at times of high water, it might actually have flowed freely to Wheeler Creek. There is no evidence on the ground that Lost Creek has had a direct connection to Mason's Creek, and thus to Wheeler Creek, in historic time. A superficial Lost Creek channel can be traced for several hundred meters below the present termination of typical spring-time high surface flow, but this channel wanders down the high ground above Wheeler Creek by staying essentially parallel to the Wheeler Creek channel axis. The lack of a previous connection between Lost and Mason's creeks seems surprising, given that the two come within approximately 50 meters of one another at their point of closest approach. There is, however, simply no



The dry stream bed of Mason's Creek.

hint of any cross-connection ever having been present in this vicinity. Lost Creek appears to have always been perched above Wheeler Creek, situated there all by itself—and indeed lost.

What you often see on maps is not necessarily what you will find if you go there. There are very good reasons why this can be true. The Lost Creek vicinity at Crater Lake National Park provides a tidy case study of how and why the differences can occur. There are also other questions that could be studied here, for those so inclined. One should be why, if Lost Creek is the largest of the three creeks, is its drainage channel not incised into the land to any degree? Another relates to why, if Mason's Creek and Hopelessly Lost Creek have significantly developed incised channels, do they each have minimal flow—to the point of being dry over most of their lengths during much of the year? It is also worth asking why, with its source springs and seeps right next to the Greyback Road where the old trail to Mason's camp sets off, did Mason's Creek never appear on published maps?

Notes:

¹Our survey did not go north of the Lost Creek springs. There may well be something draining from further north into Sand Creek at the confluence location shown.

Pumice Desert Revisited

By Elizabeth Mueller Horn

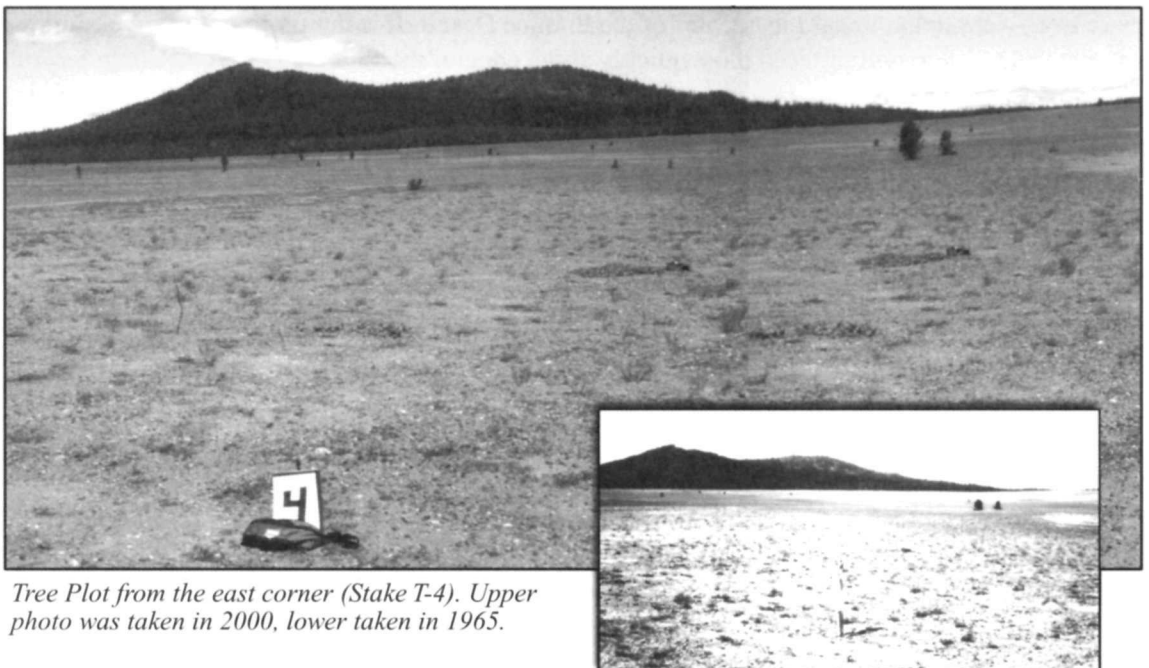
“There’s nothing growing there.” “It is so barren.” These are the comments usually heard from visitors who travel along the North Entrance Road of Crater Lake National Park and pass through the Pumice Desert.

The Pumice Desert is a flat, open area that conspicuously contrasts with the surrounding forest of lodgepole pine (*Pinus contorta*). A wedge-shaped opening about 5 1/2 square miles in size, the Pumice Desert is covered with material ejected from ancient Mount Mazama. Gaseous materials filled the valleys and depressions surrounding the flanks of the mountain. The depths of deposits covering the Pumice Desert may be some 200 feet thick. Although it appears flat, small washes are scattered throughout. The two benchmarks probably represent the highest and lowest elevations: 6010 and 5962 feet, respectively.

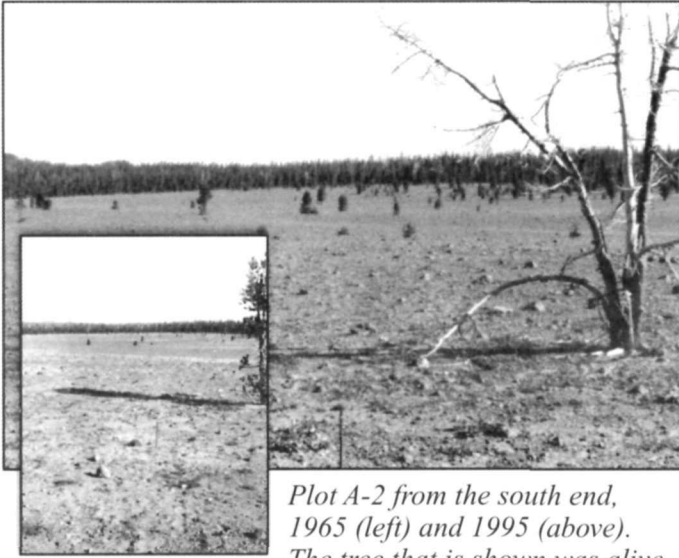
Why has it remained virtually treeless? That was the question posed to me by park staff who suggested that it would be a good project for my masters’ thesis. I therefore initiated an ecological study of the Pumice Desert’s vegetation in 1965. Nine strip plots or transects were marked for future observation. A larger 100-acre plot for tabulating the number of lodgepole pine was also established.

Initial perceptions that nothing will grow in the Pumice Desert are not accurate. It could be said, however, that the vegetation composition is very simple...and very sparse. Some 600 different plant species occur within the boundaries of Crater Lake National Park, but I found only 14 of these growing in the sample plots. (A small lupine, *Lupinus lepidus*, occurs along the road’s edge, but was not found on any of the research plots).

The plants in the vegetative strip plots were sampled in 1965, 1977, and 1995. Although the numbers of individual types of species varied somewhat, the totals did not show a significant trend. The numbers for most species increased in 1977, yet the totals for 1965 and 1995 were very similar. The total coverage was nearly the same for each of the three years: 4.9 to 5 percent of the surface area.



Tree Plot from the east corner (Stake T-4). Upper photo was taken in 2000, lower taken in 1965.



Plot A-2 from the south end, 1965 (left) and 1995 (above). The tree that is shown was alive in 1977, but had died when the plot was visited in 1995. Note the increase of trees in the background.

Many factors can influence the establishment of new plants. A few of them are summarized below:

Soil. Measurements in 1965 showed hot soil temperatures and sterile soil. The deep pumice deposits that filled the valley northwest of Crater Lake make for very poor soil. Compounding this problem is that fact that soil temperatures can be very severe. Although the temperatures of air and at the surface were similar on cloudy days, the soil absorbed a lot of heat on sunny days. During one such day in July, for example, the air temperature did not exceed 83°F—but the soil surface averaged 102°F during a period of six hours. The Pumice Desert was

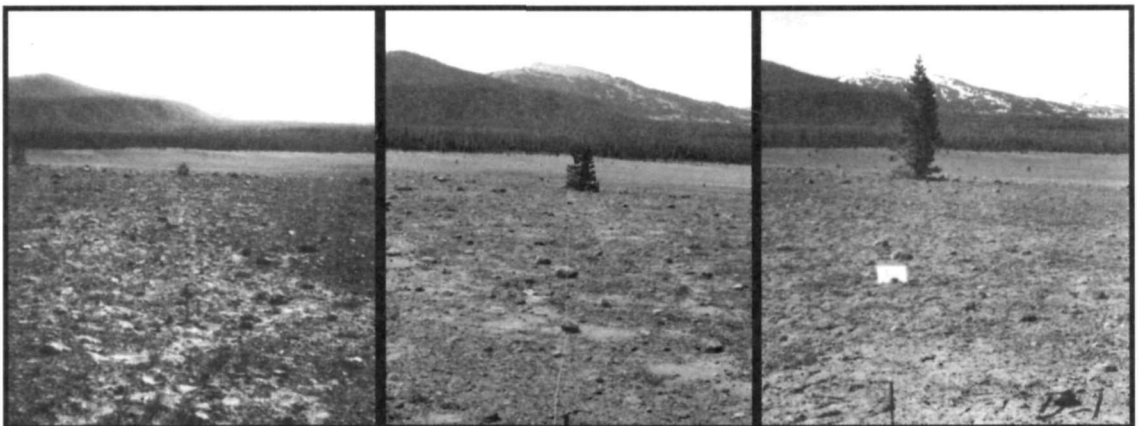
also found to be nutrient deficient compared to pumice soils elsewhere in central Oregon, though soil moisture does not appear to be a controlling factor.

Rodents. An abundance of rodent activity was noted during all fieldwork. Given that gophers are known to destroy the root system of young seedlings where trees are placed in plantations, the sparse vegetation on the Pumice Desert would be an easy food source for the ubiquitous western pocket gopher (*Thomomys mazama*).

Elements. The climatic extremes and growing season on the Pumice Desert is harsh. As noted above, soil temperatures can be severe. It is reasonable to think that young seeds, whether from lodgepole pine or herbaceous growth, must be able to sprout and survive on the hot, infertile soil and then become established during the short growing season.

Seed source. The majority of new trees observed were relatively close to the forest margin; fewer trees were found toward the center of the Pumice Desert. It is therefore logical to assume that plant succession will proceed most quickly at the edge of the Pumice Desert.

Reproduction. During fieldwork conducted during the summer of 2000, only one tree seed-



Plot D-1 from the north end, 1965 (left), 1977 (center), and 1995 (right). The lodgepole pine in this plot is the only one remaining of the three originally found in the vegetative strip plots.

ling was found in the strip plots. Once established, the seedling must survive wind, ice, pocket gophers, and other threats. No seedlings were found in the strip plots during fieldwork seasons of 1965 and 1977. Succession cannot proceed when seedlings do not become established.

I found only three lodgepole pines in the strip plots during the initial vegetation survey in 1965. Two of these trees were found in 1977, with a third small tree found in one other plot. Another of the original 1965 trees was dead in 1995, but the new tree found in 1977 could not be located. By 2000 only one of the trees seen in 1965 remained.

All four of the corners on the 100-acre tree plot were marked for future reference in 1965. The plot contained 27 trees that year, with the average tree height being 4.6 feet. The tallest was 9.8 feet, whereas the smallest stood only 8 inches. Many of the trees possessed multiple trunks with soil mounded at the base. There was also much evidence of pocket gopher activity.

When I reexamined the 100-acre tree plot with some colleagues in 2000, we found 47 trees. Most of the increase in tree numbers occurred at the plot's southeastern end in contrast to the central and northwestern portions of the plot, where little change was evident. Average height of the trees in 2000 was 8.9 feet, a substantial increase in size and indicating good growth over the intervening 35 years. Heights ranged considerably, with the tallest tree being 49 feet and the smallest less than an inch. As in 1965, many of the trees had multiple stems. Over half of the trees showed mounding of some kind. Only one seedling was found, and it was growing in the drip line of a larger tree.

Many of the trees (29 of 47, as of 2000) in the 100-acre plot showed soil mounding at the base. Mounding can be caused by several factors such as wind-blown soil deposition, frost heave, or animal activity. Most of the Pumice Desert mounds can probably be attributed to wind-blown pumice since the wind blew small granules of pumice across the surface almost constantly during fieldwork. Like sand blowing around plants on a sand dune, fine-grained pumice collects around the base of the trees. Pocket gopher activity might account for some mounds, since distinct signs of these rodents were observed within four feet of roughly half the trees in this plot.

Several trees were cored to determine their age. The four trees drilled were 60 years, 50 years, 66 years, and 40 years of age. Their heights were 19 feet, 23 feet, 18 feet, and 14 feet, respectively. The trees are not easy to age, however, since the tree aged to be 40 years estimated to be 60 years old if the whorls were counted. Similarly, the single remaining tree from the 1965 strip plot had 13 whorls in 1965 and 18 whorls in 1977. If each whorl represented a year's growth, the tree should have had 25 whorls in 1977.

Species of the Pumice Desert

The line strips surveyed in 1965 revealed only 14 species growing within the Pumice Desert.

Achnatherum occidentale – Needlegrass

Arabis playsperma – Rock cress

Arenaria aculeata – Pumice sandwort

Aster shastensis – Shasta aster

Carex breweri – Brewer's sedge

Carex halliana – Hall's sedge

Calyptidium umbellata – Pussypaws

Elymus elymoides – Squirreltail

Eriogonum marifolium – Mountain buckwheat

Hulsea nana – Dwarf hulsea

Lomatium martindelei – Lomatium

Pinus contorta – Lodgepole pine

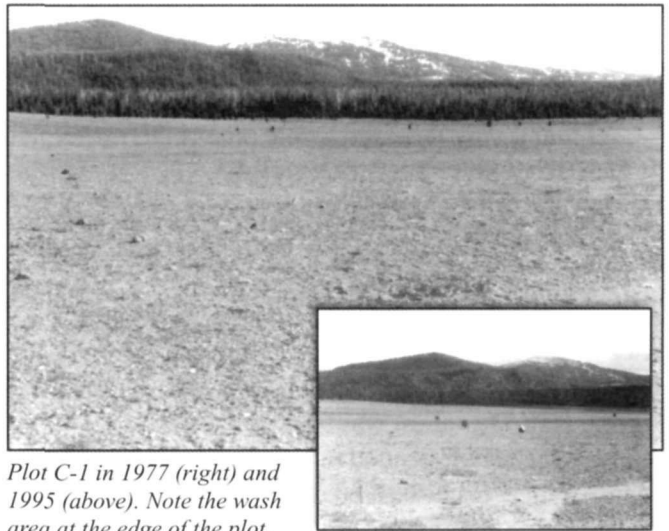
Polygonum newberryi – Newberry knotweed

Viola venosus – Mountain violet

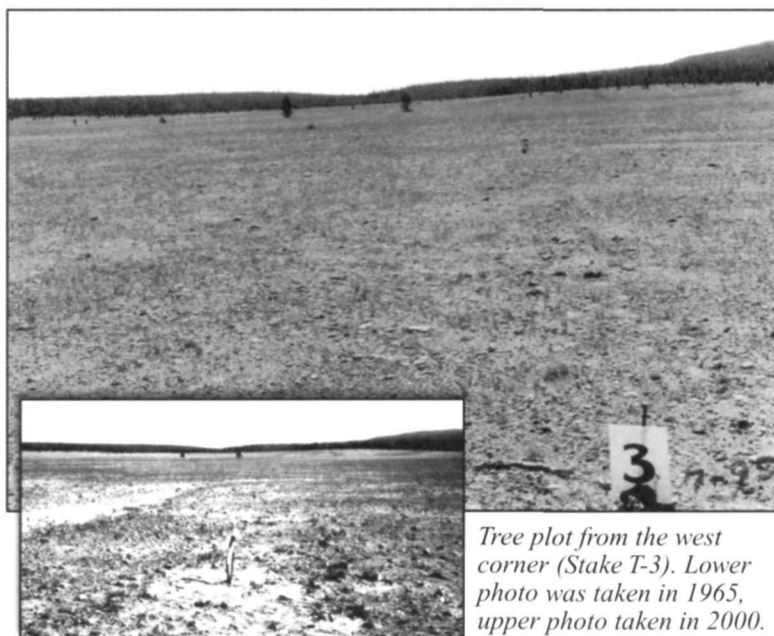
Many of the trees possessed multiple stems or trunks. Within the 100-acre plot, 31 of the 47 trees displayed this trait. There could be several causes for this characteristic. A rodent could cache seeds that sprout together, or pocket gopher damage on a young tree might lead to multiple branching of an injured stem. Wind and ice damage could injure a young sprout, thereby killing the apical meristem and thus allowing lateral meristems to grow. One of the small dead trees showed a swollen base where wind had removed the surrounding soil. The swollen base is consistent with injury to cambium damaged by wind-driven sand and ice particles. Examination of the broken, swollen base revealed abundant pitch, indicative of a plant trying to seal off an injury and protect the remaining live tissue.

In summary, plant succession on the Pumice Desert is slow but it is indeed proceeding. The number of trees established on the 100-acre plot, for example, has increased by nearly 75 per cent in the 35 years I have been visiting the area. Climate and the elements assure that change will be slow. As soil is built up and existing plants nurture and protect new seedlings, however, it is only a matter of time before the Pumice Desert makes the transition to being forest.

The author would like to acknowledge the assistance of park staff in 1965 for their help with fieldwork, construction of permanent markers, and photographs. Without this cooperation, the project could not have been possible. Special thanks go to Kirk M. Horn, Fred Hall, and William Hopkins for their help, suggestions, and companionship while doing follow-up work on the Pumice Desert in 1977, 1995, and 2000.



Plot C-1 in 1977 (right) and 1995 (above). Note the wash area at the edge of the plot.



Tree plot from the west corner (Stake T-3). Lower photo was taken in 1965, upper photo taken in 2000.

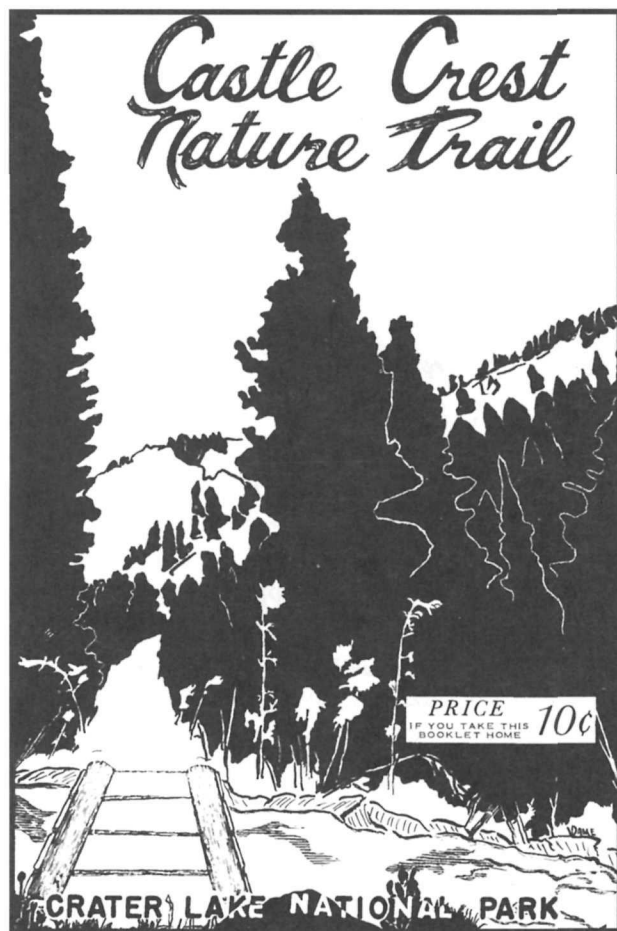
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Castle Crest After Dark

By John E. Butler

For several years after the 1956 edition of Nature Notes finally went to press in 1961, the Crater Lake Natural History Association hoped to produce issues on an occasional basis. This serial did not appear again until its revival in 1992, but a number of potential articles remained in park files. What the author describes is timeless, even though his last season on the naturalist staff was the summer of 1962—Editor.



The trail guide printed in 1962.

Located one-fourth mile east of Park Headquarters on the Rim Drive is one of Crater Lake National Park's most beautiful visitor attractions. Castle Crest Wildflower Garden provides an array of color and picturesque landscape seldom equaled. A gently tumbling mountain stream and numerous springs provide not only moisture necessary for the wildflowers, but also add a touch of beauty themselves. This is Castle Crest during the day; but what happens after dark?

Instead of the chromatic schemes of the day, a moonlit night reveals a terrain of black silhouettes against a dark blue sky. If you were to enter Castle Crest on such an evening during the month of July, your greeting could be the vibrations produced by the friction of an insect's legs—the chirping of a cricket. The bubbling of an invisible mountain stream in the background seems louder than during the day.

Far to the west, the hooting of a horned owl can be heard, and just above this distant sound, the celestial giant Arcturus twinkles its reddish light.¹ Ahead on the trail, the columnar shape of subalpine firs stand like temple spires against a lighter background where Cygnus continues its

flight down Munson Valley on the trail of the Milky Way.² As we cross the little log bridge by sign post number 10, the mountain hemlock trees on the distant northeastern hill identify themselves with their drooping tops—weary, so it seems, from the duties of the day.³ Just above this hill, the “W” of Cassiopeia seems to stand for water, which appears to have its source in that direction.⁴

Farther along the trail, we carefully step through the darkness from one flat rock to the next. It might become easy to be aware that nature's feathered acrobat during the day has been replaced by an equally specialized member of the mammal group. Twisting and darting through the night air, using its natural radar to find the way, a brown bat seems to assume the role played by the rufous hummingbird in the sunlit hours.



Naturalist staff in 1962. Author is in the middle row, third from left.

As we peer toward the southeast sky, Jupiter's glow appears second only to the full July moon. Outlined below these two brilliant spectacles, the Scorpion seems to suggest the direction in which an animal could be found.⁵ Within this beautiful constellation our eyes catch Antares' light which has aged some 400 years before it reaches us.⁶

Upon completing our circle of Castle Crest Wildflower Garden, a snapping twig tells us that ours are not the only eyes enjoying this beautiful scene. Casting a flashlight in the direction of the disturbance, we see the eyes of a black-tailed deer shining like two jewels in the dark forest. The background noise of crickets, a mountain stream, and the horned owl have gained a new member in the occasional grunt of a Cascade frog as we return to our starting point on the trail loop. This is Castle Crest after dark, an example of nature's ever-changing panorama that does not always require the light of day to reveal its beauty.



Castle Crest Wildflower Garden in the daylight, 1963.

Notes:

¹The most brilliant star in the evening skies of late spring and summer. It can be found by following the curved handle of the Big Dipper (Ursa Major) onward along an arc of approximately 30 degrees.

²A constellation containing a group of stars known as the Northern Cross.

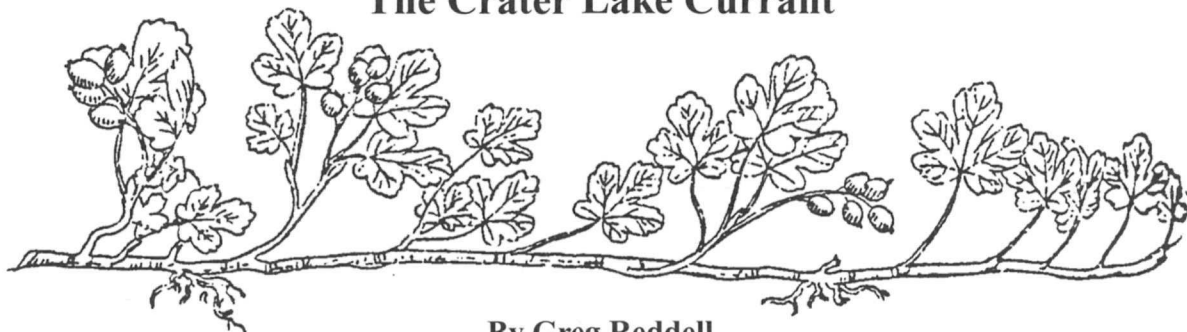
³The stops have since been renumbered.

⁴Cassiopeia is a constellation lying on the opposite side of the North Star from the handle of the Big Dipper.

⁵Scorpius or scorpio is seen near to the horizon in the continental United States.

⁶This star is often called "Heart of the Scorpion" due to its brightness.

The Crater Lake Currant



By Greg Reddell

A shrub limited in distribution to the Cascade Range in southwestern Oregon is the Crater Lake currant (*Ribes erythrocarpum*). The heart of its distribution is Crater Lake National Park, but this plant is found as far to the west as Rabbit Ears and Huckleberry Mountain, then south to Four Mile Lake near Mount McLoughlin. To the east it occurs on the summit of Yamsay Mountain, a peak located beyond the Klamath Marsh.¹

Some plant lists for the park have identified nine species of currants in the genus *Ribes* to be found within its boundaries. Crater Lake currant is a trailing shrub with copper colored flowers and red berries. This species was first identified and described in 1896 by Frederick Coville and John Leiberg. These men were among the first to make detailed botanical investigations in this part of Oregon. They and others found the Crater Lake currant to be common everywhere in the subalpine areas of the park. It is the dominant shrub in the mountain hemlock forest, where its creeping stems carpet large areas, but is less abundant in the lodgepole pine thickets and infrequent among the whitebark pines that occur near the rim.

Crater Lake currant is interesting because of its limited range, but also because of widespread concern about the ultimate fate of whitebark pine. A pathogen, *Cronartium ribicola*, was introduced from Europe in the early twentieth century and is commonly known as white pine blister rust. Currants and gooseberries serve as an alternate host of *C. ribicola*, a fungus that causes white pine blister rust. The rust is not a threat to currants or gooseberries, but it is a very serious disease of five needled pines. North American white (or five needled) pine species include bristlecone, limber, sugar, eastern white, southwestern white, western white, and whitebark. All of these species are highly susceptible to white pine blister rust, a disease that causes significant damage in pine forests by forming cankers on the branches of white pines. These cankers ultimately kill the trees.

The forests of Crater Lake National Park contain several species of the five needled pines: western white pine (*Pinus monticola*), sugar pine (*P. lambertiana*), and whitebark pine (*P. albicaulis*). Western white pine is fairly common at middle elevations and is found scattered among other tree species. Sugar pine is interspersed among ponderosa pine, lodgepole pine and Douglas-fir stands in lower park elevations. Whitebark pine extends from about 6500 feet elevation on East Rim Drive to the top of Mount Scott, at 8,929 feet the highest point in the park. The whitebark pine habitat type is more of an open woodland than a forest and is usually not as interspersed with other species.

Whitebark pine is a distinctive and critically important tree of high mountain ecosystems in western North America. Its large nut-like seeds are a high-quality food for several species of birds and mammals. Whitebark pine ecosystems are primary catchment zones for late-lying snow fields, so their condition is important for water quality and watershed protection. This tree species has varied and picturesque growth forms which provides a unique aesthetic experience for human

visitors to this high mountain ecosystem. For many years the commonly held solution to white pine blister rust in North America was to eradicate all *Ribes* species. With a massive national campaign launched to save five-needled pines, all currants and gooseberries within identified control areas were targeted for removal. Between 1930 and 1971, 14.3 million native *Ribes* plants were extirpated from Glacier, Yellowstone, Grand Teton, Rocky Mountain, and Mount Rainier national parks. By 1936 it was evident that white pine blister rust was rapidly approaching Crater Lake National Park. It was determined

that protection of the Cloudcap area and its homogeneous stands of whitebark pine was imperative. Accordingly, the Cloudcap Blister Rust Control Unit was established as a cooperative venture with the Bureau of Entomology and Plant Quarantine of the U.S. Department of Agriculture in 1937. Within three years more than 133,600 alternate host plants (*Ribes* sp.) were eradicated in a control unit of 3,632 acres.²

Elmer I. Applegate, then curator of the Dudley Herbarium at Stanford University and a seasonal naturalist at Crater Lake, wrote a letter in July 1937 to Park Superintendent David Canfield about the prospective eradication work:



Cloudcap at center. Note the whitebark pines lining the ridges.

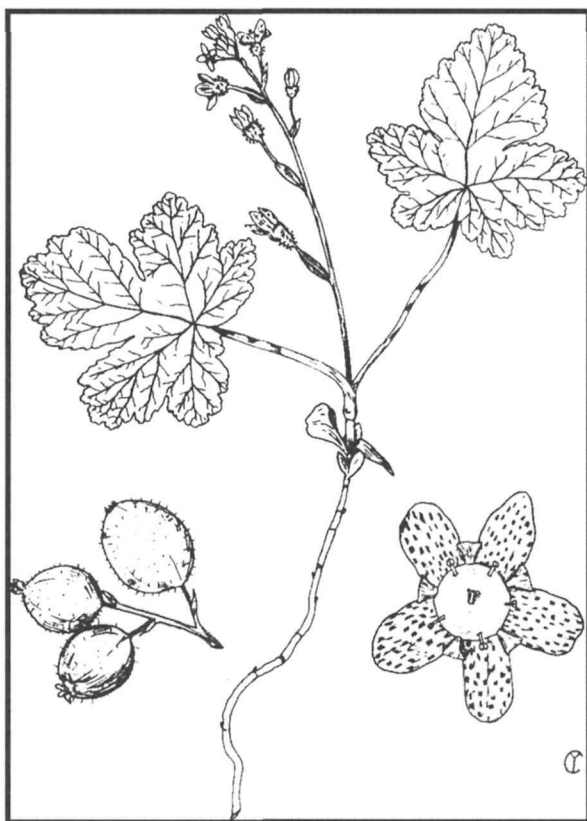


*It seems to be the plan to begin eradication work sometime during the present season, starting in the White-bark Pine area on Cloud Cap. This threatens our prize currant, *Ribes erythrocarpum*. I am hoping that something can, or will be done to head this off, at least until we can be shown that the blister is present and the susceptibility of the plant can be studied.³*

As indicated by Applegate's 1937 letter, the early effort to control white pine blister rust illuminates a larger issue, that being whether national parks should try to save one native species at the expense of another, or at the risk of environmental contamination. These remain difficult questions since forests at the park still have a component of five needled pines. Although whitebark pine is normally a long-lived tree, in recent decades it has suffered heavy mortality as a result of the white

pine blister rust in parts of its range and is now being evaluated. White pine blister rust is found in virtually all areas near Crater Lake with whitebark pine. Surveys found an average infection rate of 52 percent in whitebark pine. Investigations conducted in the immediate vicinity of the park discovered 10 percent mortality among the whitebark, with blister rust being the most frequently encountered cause. The surveyors encountered only one *Ribes* plant amid the whitebark pines. This indicates white pine blister rust can be carried in the wind for long distances.⁴

Although whitebark pine is normally a long-lived tree, in recent decades it has suffered heavy mortality as a result of white pine blister rust throughout the Pacific Northwest. Southwestern Oregon and northwestern California have long been recognized to be an area of tremendous biological significance because of the many species and species that are unique to selected areas. The Crater Lake currant is a one of these species that adds to the biological significance of the region, though its management in the park has been interwoven with two of its companions—the five needled pines and *Cronartium ribicola*, the exotic invader that threatens the riches of the forest.



Crater Lake Currant, Ribes erythrocarpum.

Notes:

¹Elmer I. Applegate, "Plants of Crater Lake National Park," *The American Midland Naturalist* 22:2 (September 1939, p. 272).

²Crater Lake National Park Master Plan, Development outline, Forest Protection: Tree Disease Control [1941].

³Applegate to Canfield, July 2, 1937, copy in Applegate file, Crater Lake National Park.

⁴Ellen Goheen, et al., the Status of Whitebark Pine Along the Pacific Crest Trail, Umpqua National Forest, Oregon, *White Pine Blister Rust Meeting Abstracts*, September 1999.

Weeds: The New Arrivals

By Ron and Joy Mastrogioseppe

Crater Lake National Park will celebrate its centennial in 2002, so it is worth reflecting on the past century of human use. Some present-day travelers view this national park as a vignette of the regional landscape that existed when Europeans first encountered the native peoples. Changes occurred in the local flora, however, as the new arrivals became more numerous along with their domestic livestock. Hidden in the hay and other livestock foods were seeds of plants not native to this region. During the late nineteenth century human travel accelerated and soon became a primary vehicle for alien plants to extend their range into new habitats, especially in campgrounds and along roads where soils were exposed and churned.

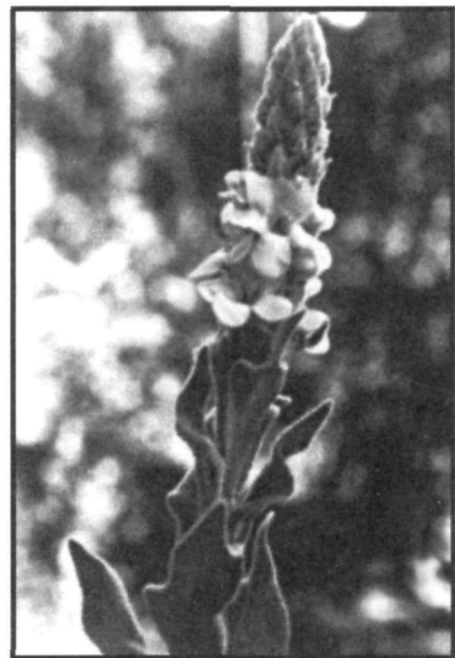
The number of successful alien or weedy plants in Crater Lake National Park is relatively small compared to other park areas that have sustained major human-induced disturbances over long periods. Important reasons for the low numbers here are the abbreviated growing season and the attendant snow pack that covers the ground for long periods. Disturbed habitats at the park are mostly limited to visitor use areas, including road and trail margins. These areas are in a continual state of disturbance and will always harbor an array of weeds that have naturalized and reproduce successfully in their new habitats. Along trails, pack stock or other livestock bring in alien seeds and thus introduce weeds to trail corridors and meadows. There was sheep grazing in the high meadows prior to Crater Lake gaining the status of a national park, and trespass cattle grazing has also occurred intermittently. Recently burned forest areas are also susceptible to weed invasions, especially near roadways where seed sources for weeds are readily available. As an example,

common plantain (*Plantago major*) is believed to have entered the Panhandle area via deer and elk trails originating from cut over lands lying outside the park.

What is a weed?

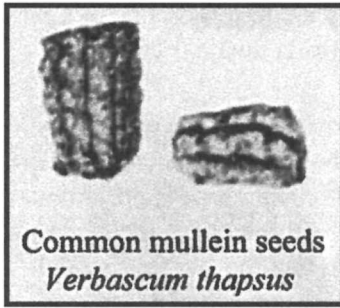
The word “weed” suggests an undesirable plant, a nuisance, something unsightly. These characterizations are all subjective, of course. Sometimes the word “weed” is a misnomer such as in fireweed (*Epilobium angustifolium*), a native species and not a weed. One simple definition has it that a weed becomes a weed by growing in a place where people desire something else. Often the word “weed” is used to suggest a plant out of place; that is, one not planted by the gardener. As Ralph Waldo Emerson wrote, “What is a weed? A plant whose virtues have not yet been discovered.” In the biological sense, however, a weed is very much in place because of its myriad adaptations made to insure survival.

As the late Ron Taylor said, “The weediness of a plant depends on the time and place that it is found: the attractiveness is in the eyes of the beholder.” Some weeds produce showy, colorful flowers and may be very



Mullein

attractive to the traveler who is blissfully unaware that these plants are relatively new arrivals not seen in places like the park a century ago. Exotic grasses, for example, tend to blend in visually with native species and remain inconspicuous except to the keen observer.



Biologically speaking, a weed is a relatively aggressive, competitive plant, and generally not native to the region. Weeds are highly adaptable and have a diversity of survival strategies; the common dandelion (*Taraxacum officinale*), for instance, does not require pollination or fertilization to produce seed. Cheatgrass (*Bromus tectorum*) is a quintessential weed. It was first observed in western North America about 1916 and has invaded rangelands throughout the west in only a few decades. Fortunately it does provide some nutritious forage before flowering, but this species has the potential to spread rapidly.

Cheatgrass gains a competitive advantage by germinating and beginning its growth in the autumn. When indigenous species germinate in the spring, cheatgrass plants are already established and growing vigorously. Since this annual grass matures early and cures by the first part of summer, it has become a major flash fuel type in many range habitats. The fire regime in many western habitats has been thus altered by the introduction of this grass.

Despite their being firmly rooted, weeds have mobility through their propagules (seeds and vegetative tissues) that may be carried to new localities by hikers, pets, domestic livestock, and vehicles. Once weeds have become established, a weed seedbank develops. Seedbanks may contain vast libraries of seed adapted to a wide range of environmental conditions and ready to germinate once appropriate conditions arise. Buried weed seeds may remain viable for tens of years or even several hundred years. Legume seeds are among the record holders for longevity and in a few cases have approached a millennium.

Weed control

Roadsides are highly disturbed areas and they will continue to be disturbed through maintenance activities and traffic use. Continual or repeated disturbance creates conditions that invite invasion and repeated re-invasion by weeds. Use of herbicides along roadsides may be toxic to water supplies and wildlife, and such toxic chemicals do not accomplish the objective of long-term elimination of weeds. Roadside treatment with herbicides can actually favor weeds by creating conditions that make it very difficult for native species to establish and maintain populations.

One potentially effective method of weed control is to employ a biological agent that is host-specific. It could be aimed at weakening the target weed's growth or adversely affecting its seed production. The primary natural enemies include arthropods, vertebrates, and pathogens such as fungi, viruses, bacteria, and nematodes. An example is the biological control of St. Johns-wort (*Hypericum perforatum*), which invaded extensive areas of rangeland but has now been contained through the introduction of several insects: the beetles *Agrilus* and *Chrysolina*, the moth *Aplocera*, and the aphid *Aphis*. Roadside populations of St. Johns-wort still remain obvious since the insects are not as effective along road margins.

Another easily seen weed along road margins is common mullein (*Verbascum thapsus*), conspicuous because of its height that often exceeds one meter. Seeds of this weed actually made their way to Wizard Island, and at least one mullein plant developed near the boat dock. Mullein seeds are tiny and resemble squares in shape, having a textured surface that would help the seeds



Cheatgrass

cling to clothing or fur. Other weeds to arrive on Wizard Island and the western shoreline of Crater Lake are woods groundsel (*Senecio sylvaticus*) and two thistles: Canada thistle (*Cirsium arvense*) and bull thistle (*C. vulgare*).

Other national park areas provide a more in-depth learning experience with the weedy elements of the flora. Many are not aggressive aliens displacing natives, but there are notable exceptions worth examining. Coastal regions with long, mild growing seasons often have more serious weed problems than mountainous areas. Just south of Crescent City, California, lies an old coastal prairie described in the diaries of Jedediah Smith in 1828. He remarked that the site was a plentiful source of forage for his horses, for at the time this prairie was entirely composed of indigenous grasses and forbs (herbaceous flowering plants). Little of the original native flora exists in this prairie today due to 150 years of disturbance (including relatively recent agricultural use occurred prior to these lands becoming part of Redwood National Park).

One of the first natural resource projects carried out at Redwood National Park was focused on containing the spread of tansy ragwort (*Senecio jacobaea*), a European weed toxic to livestock. Tansy ragwort became very aggressive along the Pacific Northwest coast during the early 1980s. Some containment was achieved through mowing which prevented prolific seed production. The introduction of the tansy flea beetle (*Longitarsus jacobaeae*) and the cinnabar moth caterpillar (*Callimorpha jacobaeae*) proved the only effective control since both are herbivores that greatly stress the plants. Once these biological control agents gained success, however, the niche formerly occupied by the tansy ragwort was quickly filled with ox-eye daisy (*Chrysanthemum leucanthemum*), another alien plant. Both of these weeds are very attractive in flower, and they produced a grassland dominated by yellow (tansy ragwort) followed by white (oxeye daisy). Visitors to the coastal beaches admired these plants despite them being aggressive alien invaders.



St. Johnswort *Hypericum perforatum*, grazed by a *Chrysolina* beetle.

Surveillance

A weed monitoring protocol focused on disturbed areas is essential in a park's vegetation management program. As long as disturbance occurs through travel activities, invasive weeds and other alien new arrivals are inevitable. To date, small and manageable populations of the following recent arrivals are known to occur in Crater Lake National Park: cheatgrass, smooth brome (*Bromus inermis*), bulbous bluegrass (*Poa bulbosa*), mullein, spotted knapweed (*Centaurea maculosa*), and Dalmatian toadflax (*Linaria dalmatica*). Such small infestations may be hand pulled or mowed until the seedbank is reduced. Of all weed species that occur in the park, there are four which have the potential to spread rapidly and may be regarded as aggressive problem weeds: cheatgrass, bull thistle, St Johnswort, and spotted knapweed.

Co-existing with weeds requires a practical, effective, and environmentally safe means of keeping their numbers minimized. Understanding future weed management issues and dynamics will depend, in part, on our definitions and a practical weed control program.

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Banding Clark's Nutcrackers

By Neal Bullington

In June of 1964 I joined the National Park Service at Crater Lake as one of 13 seasonal interpreters employed that year. As part of our regular duties, each of us was required to spend four hours a week on a research project of our choice. I learned that the park had a bird banding permit and that Clark's nutcrackers had been banded here sporadically in the past. Since I had been banding birds in my home state of Illinois, I decided to make that my project.



Clark's Nutcracker

The Clark's nutcracker (*Nucifraga columbiana*) is a large, noisy gray bird with black wings. This species is related to crows, magpies, ravens, and jays. It can be seen in large numbers along Rim Drive in the areas where people congregate. The birds were well aware of visitor use patterns. Before 10 a.m. and after 4 p.m. there was scarcely a nutcracker to be seen. When the first wave of cars entered the parking lot at Rim Village each day, the birds suddenly appeared. They perched themselves on trees along the promenade and looked for handouts.

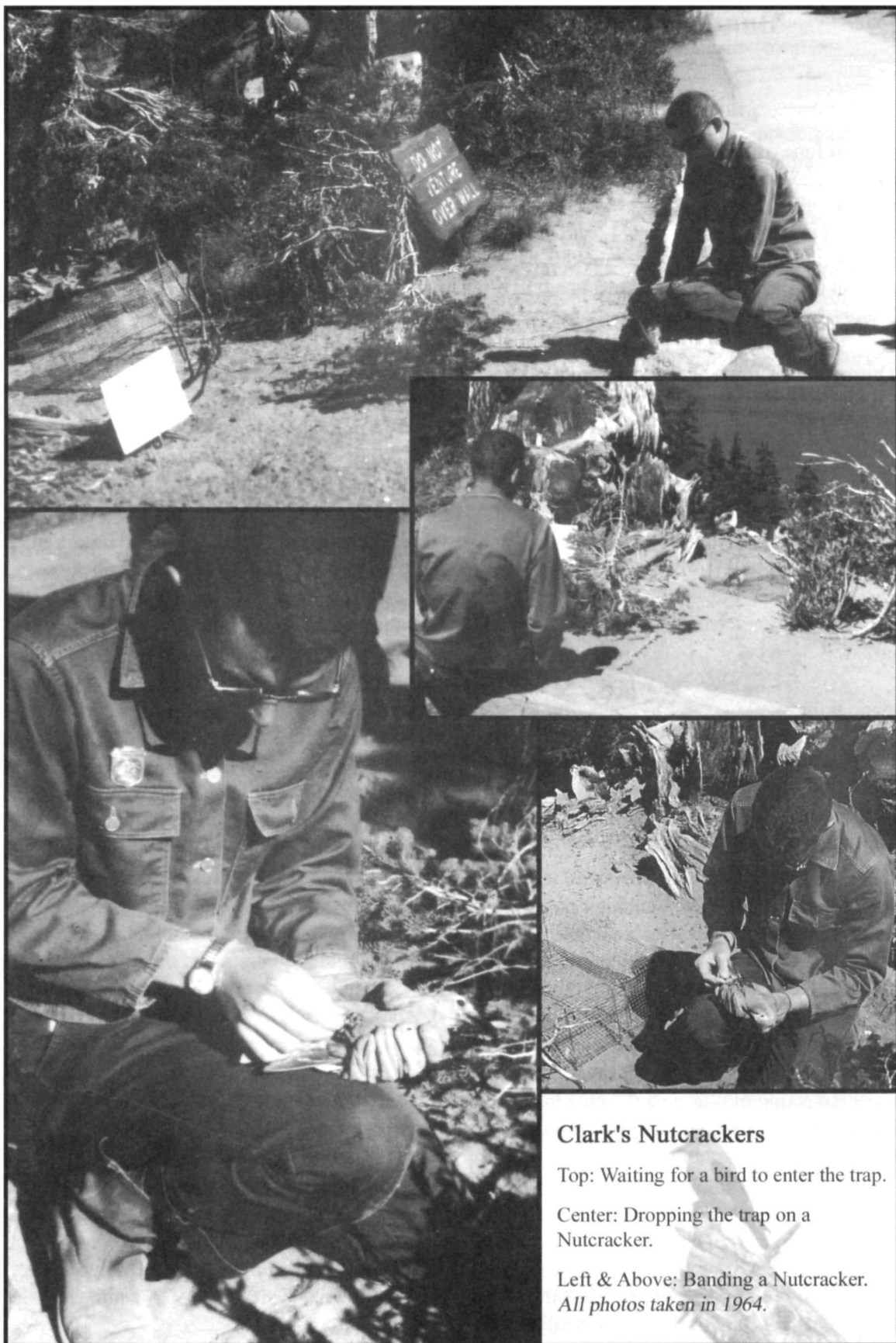
Like other species of the *Corvidae* family, nutcrackers are highly intelligent. I had no information on what methods others had previously used to band birds at Crater Lake, and it took me almost a month to figure out how to catch the birds. I tried several kinds of traps with no success. The nutcrackers refused to step on any kind of trigger mechanism or enter any small opening. It was therefore understandable that the only things I caught with traps were the golden mantled ground squirrels.

One day a fellow interpreter jokingly suggested that I should try the traditional Boy Scout method of trapping. This involved dropping an orange crate over them by pulling on a string. After thinking about this for a while, and wondering if it would work, I decided it was worth a try. I thereby took a large woven wire trap with a sliding door and removed the floor from it. Next, I whittled out a stick about 10 inches long with a notch on one end, and tied a string to the middle of it. I then set one side of the trap up on the stick, and sat a few feet away while holding the end of the string.

I baited the trap with bread and waited, but nothing happened. The birds were all around, eyeing the bait, but they would not go under the trap. I sat there for a while, watching visitors throw peanuts to the nearby birds, and thought "why not?" This prompted me to go to the store inside the cafeteria and buy a can of peanuts. I placed them under the trap, and the birds immediately started to swoop down to get the nuts.¹ It was easy to pull out the stick and drop the trap on them. I could now reach inside the sliding door and pick up the bird. At this point it was relatively easy to place a band on the bird's leg and then release it.

I had no trouble catching several birds in a couple of hours using this technique. It was always the action of throwing the nuts that motivated them; they would not come to food that was already on the ground upon their arrival. One capture was enough to teach them a lesson, however, so I never caught the same bird a second time.

When I first started trapping, visitors became very indignant because they assumed that I was trying to catch "chipmunks." It never occurred to them that I might be after the birds. Since I had to watch the trap closely, I could not always turn around and explain what I was doing. I therefore started bringing a small sign that outlined what was happening and this usually satisfied the curiosity of human visitors. The birds would often fly down and sit on the sign while waiting for peanuts, a behavior that seemed rather fitting given the circumstances.



Clark's Nutcrackers

Top: Waiting for a bird to enter the trap.

Center: Dropping the trap on a Nutcracker.

Left & Above: Banding a Nutcracker.
All photos taken in 1964.

The main obstacle to banding was the seemingly endless supply of hungry golden mantled ground squirrels. They would run under the trap and take the peanuts. As long as the squirrels were there, the birds would stay in the trees and wait. I had to feed the squirrels first in order to get them to take the food back to their caches, then wait until they were all out of sight before throwing more nuts to attract the birds. This wasted a lot of time, to say nothing of running up my bill for the peanuts. By the end of the season I had trapped for a total of 17 days, banded 89 birds, and had seen many other unbanded nutcrackers. As Labor Day came and went, visitation dropped off drastically. Most of the birds disappeared, apparently moving to greener pastures.

The nutcrackers I saw had not been banded for eight years or more prior to my work. I was intrigued to see a few grizzled old birds that had double metal bands on one of their legs. They were frequent observers of the trapping, but for several weeks did not participate. I was finally able to catch two of these “old timers,” and by comparing their band numbers to park records, found they had been banded by Don Farner 12 years earlier.² The double bands had originally been color-coded to make it easier to track the movements of these birds, but the color had long since worn off by the time I saw them.

Why band the nutcrackers? As with all bird banding, the object was to determine basic life history information such as longevity and patterns of movement. Chief Park Naturalist Dick Brown continued with the banding in subsequent years and eventually published a summary of his findings. He found that two birds he re-trapped were well past 16 years old, a new longevity record for the species.³



Golden Mantled Ground Squirrel

Notes:

¹Feeding wildlife is, of course, against park regulations.

²See pp. 83-89 in Donald S. Farner, *Birds of Crater Lake National Park* (Lawrence, KS: University of Kansas Press, 1952) for information on Clark's nutcrackers and banding.

³Richard McP. Brown, "Clark's Nutcrackers at Crater Lake", *Western Bird Bander* 43:2 (April 1968), pp. 15-17

See America First!



Panel from an exhibit brochure: Superintendent C.G. Thomson greeting visitors about 1927.

Our Sponsor

By Steve Mark

Anyone entering the visitor contact stations at Crater Lake and Oregon Caves will probably notice shelves filled with books for sale. Proceeds from these and other sales items ultimately benefit the National Park Service, but are generated through the nonprofit Crater Lake Natural History Association. Merchandise sold allows CLNHA to fund a variety of endeavors that include park newspapers (*Reflections* at Crater Lake and *Underworld* at Oregon Caves), booklets on various educational topics, a program of research grants, and this publication.

The 1946 volume of *Nature Notes from Crater Lake* appeared as part of the association's launch as a "scientific and historical society to further the educational program of Crater Lake National Park." Its main source of revenue that year was not *Nature Notes*, but instead a book published by the University of California Press titled *Crater Lake: the Story of Its Origin* by Howel Williams. Publication of Williams' classic geological work spurred formation of the association in 1942, but wartime exigencies did not permit CLNHA to begin operation for another four years.

Limited inventory carried by CLNHA in its early years made for modest sales, even with a steady increase of visitors coming to Crater Lake in the aftermath of World War II. The association confined itself to sponsoring *Nature Notes* and some illustrated lectures at first, waiting until 1952 to pursue a book project. Donald Farner's *Birds of Crater Lake National Park* ultimately proved to be a successful venture, though Chief Park Naturalist George Ruhle loaned CLNHA the necessary amount for it to be printed by the University of Kansas Press. The "scholarly" approach taken by Farner dictated slow sales for *Birds*, but Ruhle's *Along Crater Lake Roads* became an immediate hit when the association published it in 1953.

Another nine years passed before CLNHA embarked upon any new projects. Even *Nature Notes* experienced a hiatus by 1961, though some authors continued to submit articles in hopes that the serial might reappear when the time was right. Sales of commercially produced publications allowed for slow, but steady growth in association finances. Visitation increased to the point where one sales outlet, located at Lava Beds National Monument, broke away to form an inde-

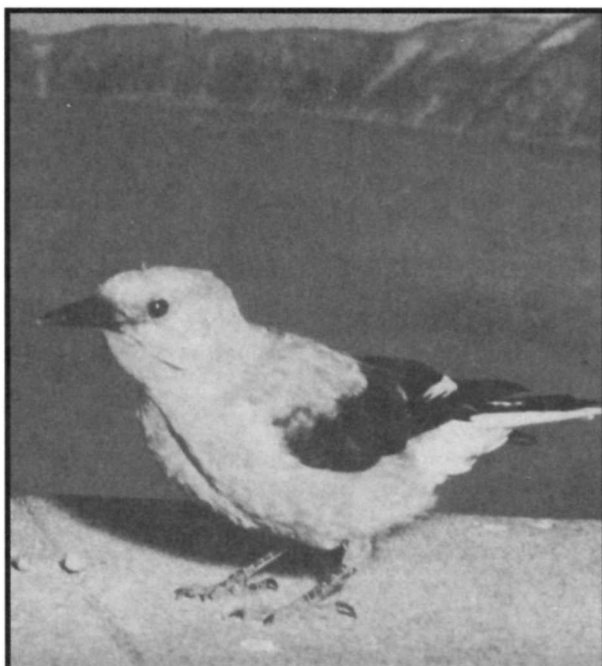
pendent association in 1962. (CLNHA even loaned LBNHA a sum of \$500 to get started). Both organizations often expressed the desire to publish on topics specific to their parks, even though these usually possessed limited commercial appeal. Being conscious of costs helped to prevent disaster for CLNHA, and it benefited from moves like distributing publications to libraries in order to defray printing costs.

Once four CLNHA booklets appeared from 1962 to 1964, the next hiatus in publishing lasted for more than a decade. The association's sales grew slowly during the intervening 11 years, but by 1975 CLNHA supported new undertakings like the first surveyed map of Oregon Caves and a newspaper for Crater Lake. The paper quickly became the dominant beneficiary of CLNHA donations to the National Park Service, far outstripping older programs like aiding the park library.

Direct NPS participation in the management of CLNHA came to an end in 1978 when the office of executive secretary (usually held by the chief park naturalist or his equivalent) became simply a liaison with the association instead of running day to day operations. A business manager was hired by CLNHA for the latter duties, though spouses of NPS employees usually filled this position. The association's board, often dominated by park officials in CLNHA's early years, counted only four NPS employees among its 11 members by 1962. Over the ensuing two decades this body completely weaned itself of NPS affiliation. Board members control the association's affairs and are presently 13 in number. Some have opted to serve only for a short time, though one has rendered continuous service since 1962!

By 1986 CLNHA made annual donations of a little more than \$6,000 to the programs at Crater Lake and Oregon Caves. That figure quadrupled over the next four years with opening of a new visitor contact station in the rehabilitated Rangers Dormitory at Park Headquarters. Year round operations for CLNHA became possible, and allowed for the board to consider new ways to aid the educational and resource management functions of the NPS. One happened to be research grants, where a program modeled on one administered by the Mazamas (the mountaineering club started by park founder William Gladstone Steel) came into existence. Another endeavor was the revival of *Nature Notes* once the association sponsored a symposium celebrating the 90th anniversary of Crater Lake National Park in 1992.

Nature Notes from Crater Lake has operated on a break-even basis over the past decade, being entirely dependent upon contributions from past or present NPS employees and those offered by friends of the park. It has appeared on an annual basis



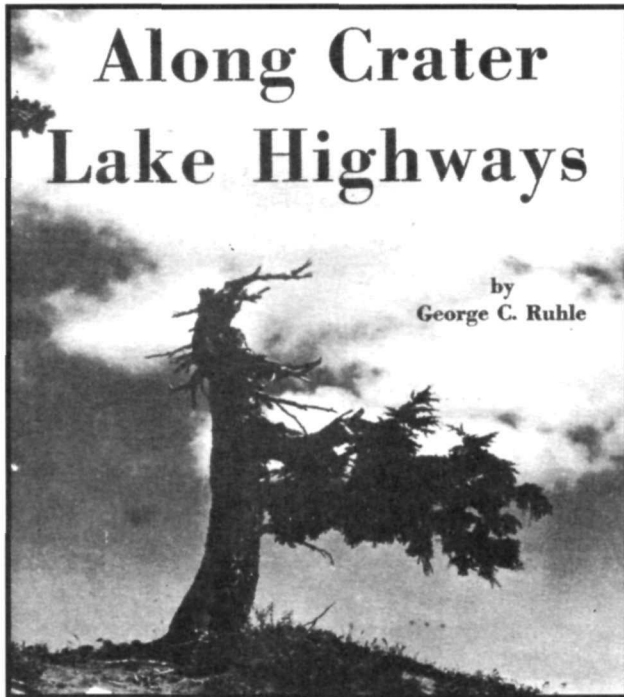
THE BIRDS OF CRATER LAKE NATIONAL PARK

by

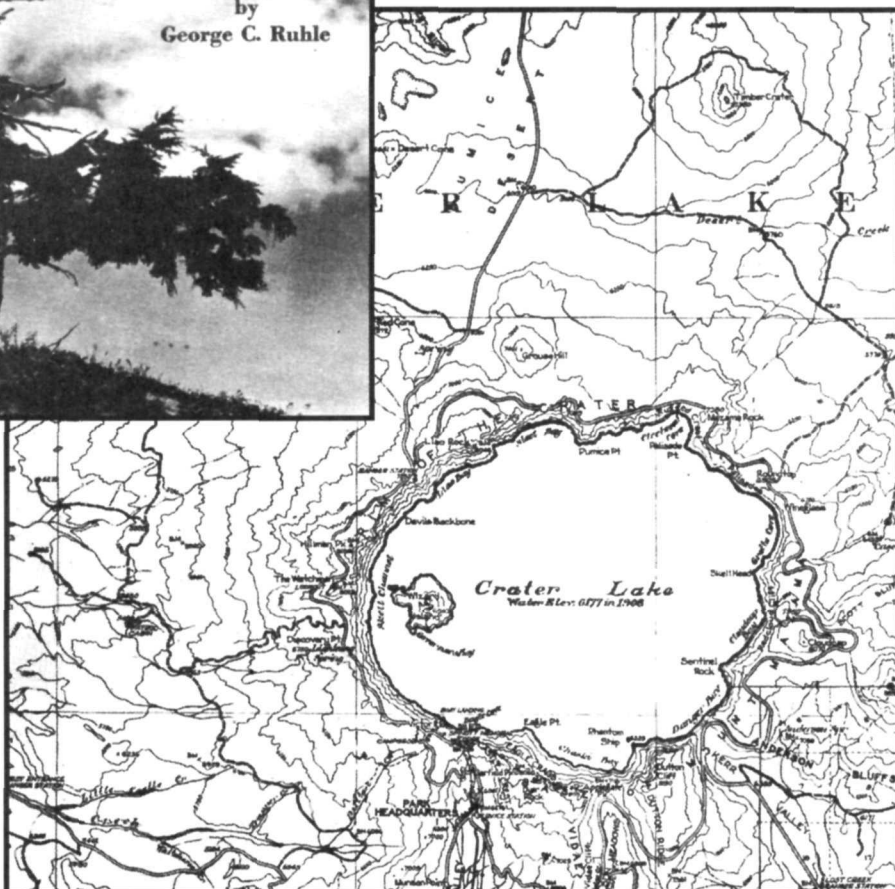
DONALD S. FARNER

Along Crater Lake Highways

by
George C. Ruhle



Publications of the
Crater Lake
Natural History Association



**GRAYBACK
RIDGE
MOTOR
NATURE
TRAIL**



over the past decade, a significant achievement since the only compensation authors received came as several free copies of the issue containing their article. CLNHA business managers Abi Buktenica, Judy Giles, and Laurie Pohll kept *Nature Notes* on the shelf, while Claire Cross, Susan Marvin, and Robin Savage supplied production assistance by doing layout. Board members deserve thanks for continuing to support publications whose sales potential rarely goes beyond being a public service. In this regard, CLNHA publications are listed below:

Donald S. Farner, *Birds of Crater Lake National Park* (1952)

George C. Ruhle, *Along Crater Lake Roads* (1953, rev. 1964)

Richard M. Brown, *Castle Crest Nature Trail* (1962)

G.L. Sternes, *Climate of Crater Lake National Park* (1963)

Roger J. Contor, *The Underworld of Oregon Caves* (1963)

Charles F. Yocum, *Shrubs of Crater Lake National Park* (1964)

Steve Knutson, *Oregon Caves*, survey map (1975)

Ruth Kirk, *Exploring Crater Lake Country* (1975)

Thomas McDonough, *Grayback Ridge Motor Nature Trail* (1976)

Dick Follett, *Birds of Crater Lake National Park* (1979)

Constance M. Toops, *Crater Lake National Park Trails* (1980, last rev. 2000)

Ron and Becky Warfield (eds.), *A Trail Guide to Annie Creek*, as well as booklets on Castle Crest and Godfrey Glen (1983)

Ron Warfield, *A Guide to Crater Lake: The Mountain That Used To Be* (1985)

Steve Mark, *See America First!* exhibit brochure (1991)

Lee Juillerat, *Lodge of the Imagination: The Crater Lake Lodge Story* (1995)

Steve Mark, *Park Headquarters Historic Walking Tour* (1999)

Crater Lake Reflections newspaper, 1975 – present

Oregon Caves Underworld newspaper, 1986 - present

Nature Notes from Crater Lake 1946-1956, 1992- present; includes a special number by Ralph R. Huestis (1951)

About the Authors

Neal Bullington started his career as a seasonal naturalist at Crater Lake in 1964. He is currently the Chief of Interpretation at Sleeping Bear Dunes National Seashore in Empire, Michigan.

John E. Butler served as a seasonal naturalist at Crater Lake National Park during the 1961 and 1962 seasons.

K.R. "Rod" Cranson is a geologist who worked at the park twice, 1967-68 and 1978-82. He is currently in the midst of preparing a third edition of his book, *Crater Lake: Gem of the Cascades*.

Scott Girdner is a fisheries biologist with the National Park Service who has studied Crater Lake since 1995.

Elizabeth Mueller Horn recently retired from the U.S. Forest Service, but began her career with the National Park Service as a seasonal naturalist at Crater Lake. She is the author of *Wildflowers 1: The Cascades* (Beaverton, Oregon: Touchstone Press, 1972).

Phil Kelley formerly taught geography at Mankato State University, Minnesota, but is currently the Geographic Information Systems Specialist at Crater Lake National Park.

Tom McDonough first came to work at Crater Lake as a seasonal naturalist in 1969 and has taught science at Chemeketa Community College in Salem, Oregon, since 1975.

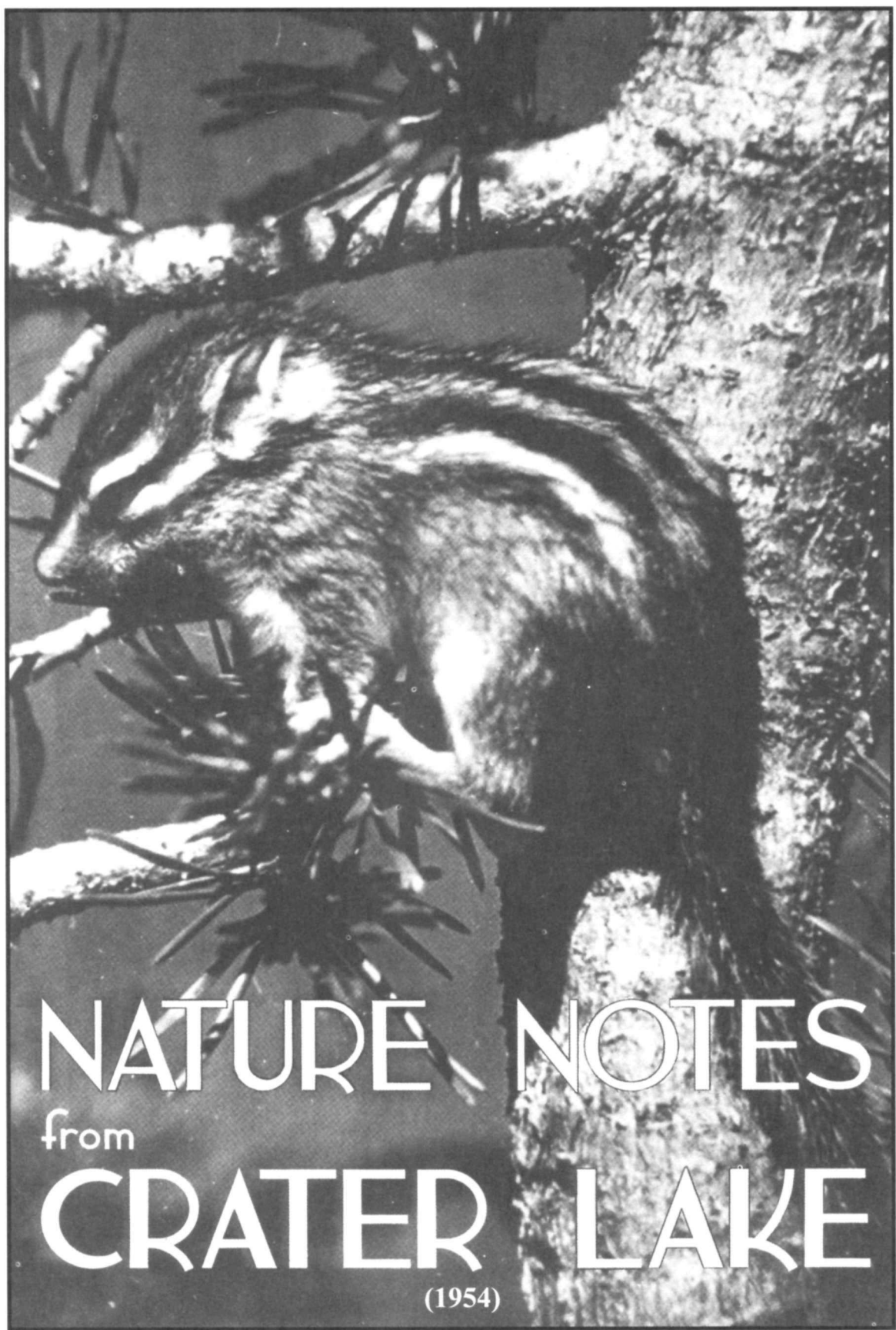
Steve Mark is a National Park Service historian who serves Crater Lake National Park and Oregon Caves National Monument.

Ron and Joy Mastrogiuseppe are founders of the Crater Lake Institute. Their love affair with Crater Lake began by collaborating on a study of sedges in the park.

Peter Meyers of Santa Fe, New Mexico, participated in a program facilitated by Southern Oregon University to produce art for the centennial of Crater Lake National Park.

Greg Reddell works for the Bureau of Land Management from its Klamath Falls Resource Area office and has served as president of the Friends of Crater Lake National Park.

John Salinas studied lakes throughout Oregon after being inspired by Crater Lake as a seasonal naturalist. He teaches science at Rogue Community College in Grants Pass, Oregon.



NATURE NOTES
from
CRATER LAKE

(1954)



Yellow-bellied marmot, 1952.

My Notes from Crater Lake

Date:

Who came here with me:

I chose to come here because:

The weather was:

My favorite view was:



Hillman Peak from the Watchman Trail, 1960.



Crater Lake and its northeastern rim from Skell Head.

The best part of this trip was:

Some interesting people I met along the way:

Nature I caught a glimpse of (animals, plants, etc.):

Some new things I learned:



Wizard Island and Liao Rock from the Discovery Point Trail.

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*Mother bear and cubs near Park Headquarters, 1942.
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*Back Cover: Lady of the Woods, 1997.
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LADY OF
THE WOODS