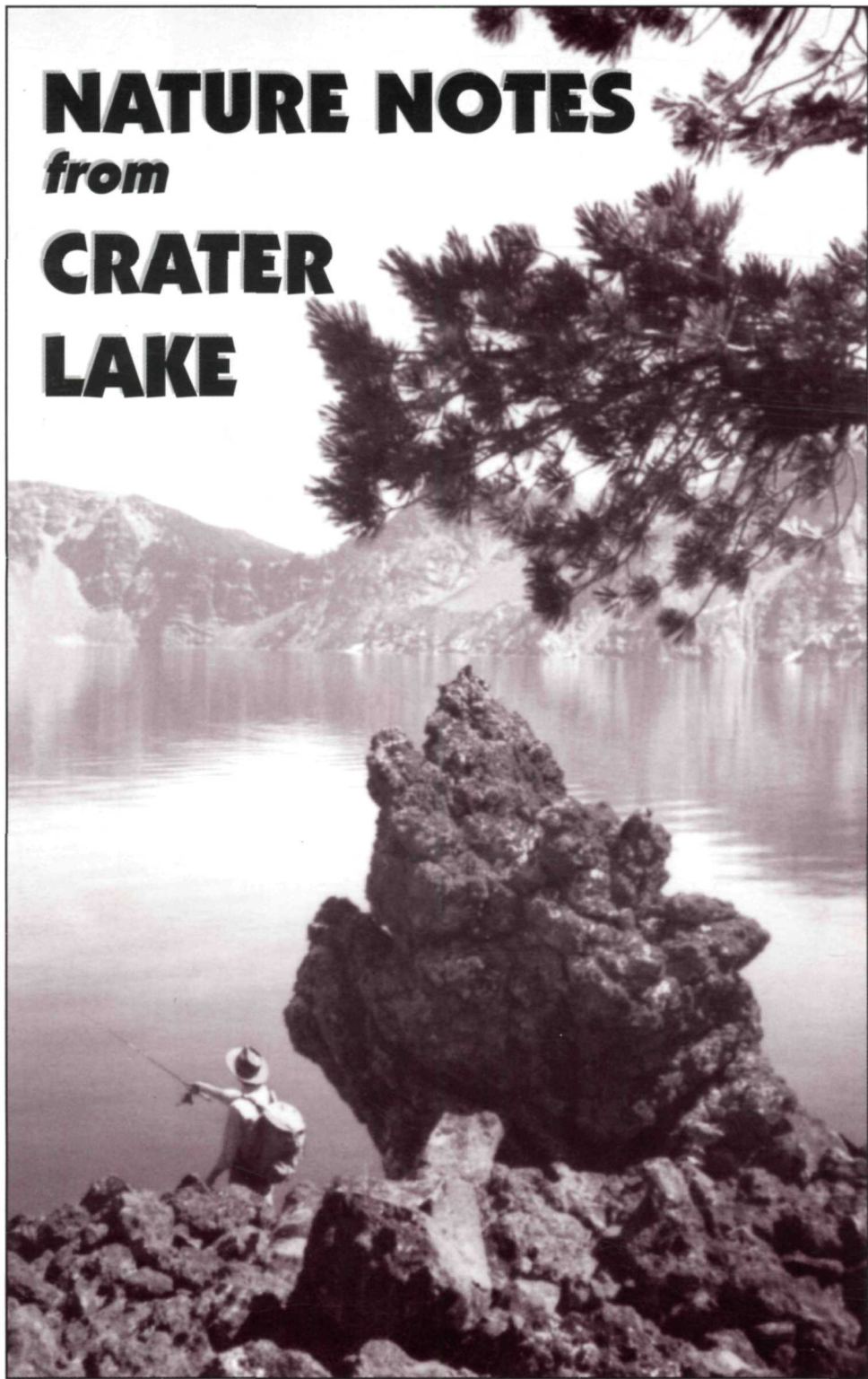
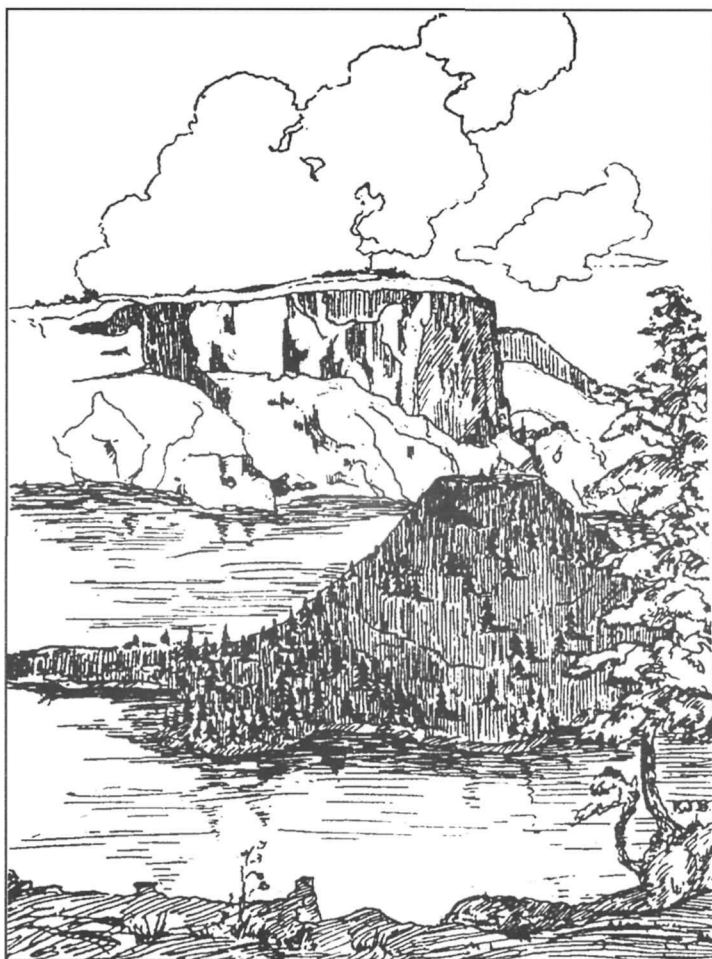


NATURE NOTES

from

CRATER LAKE





Above: Wizard Island and Llao Rock by Karl J. Belser

Front cover: Casting from Wizard Island. Photo courtesy Ann Hartell.

NATURE NOTES FROM CRATER LAKE

Contents

Introduction	5
Answers from the Deep	6
<i>By Tom McDonough</i>	
The Filling of Crater Lake	10
<i>By F. Owen Hoffman</i>	
Sedges Have Edges	14
<i>By Joy Mastrogiuseppe</i>	
The Rare Treasure of Mount Mazama Collomia	17
<i>By Casey Baldwin</i>	
The Microclimates of Crater Lake National Park	20
<i>By Gregg A. Pohll</i>	
Memory and Symbiosis on the Rim	23
<i>By Ron Mastrogiuseppe</i>	
Bears During the War	26
<i>By Joseph S. Dixon</i>	
The Portals on Whitehorse Creek	31
<i>By Steve Mark</i>	
Illustrations	34
About the Authors	37

presented by

National Park Service
Crater Lake National Park



Crater Lake Natural
History Association





*Born of chaos, fire and smoke,
Turbulent nature did'st invoke
Mazama's fall—that thou should'st be
Silent, mysterious, sapphire sea.*

Belle Menefee Meyer, 1941

NATURE NOTES FROM CRATER LAKE

Volume XXX - 1999

National Park Service
Crater Lake National Park

Crater Lake Natural
History Association

Introduction

Work on a new fuel line and the Cleetwood Cove Trail prevented last year's visitors from fishing or taking boat tours, so the summer of 1999 promises a return to Crater Lake. Not since 1952 had a whole season passed without public access to the water, so it seemed fitting to begin this edition of *Nature Notes* with articles about the lake and the spectacular geological story it represents.

As anyone who has experienced the beauty found in its forests, wetlands, and even barren areas will readily attest, there is more to Crater Lake National Park than its central feature. Since each part of the park contains something of interest, *Nature Notes* is devoted to providing visitors with information they might not otherwise obtain on their own. In this edition, for example, there are articles on how to identify the various sedges, a rare wildflower called Mount Mazama collomia, and why weather plays a sometimes defining role in the visitor experience.

Change occurring over the length of one, possibly two, lifetimes is the common thread among the last three contributions. One article touches on the importance of memory to continuity in the park, while another piece about the habits and management of bears is essentially a retrospective. The last article describes what can be found in the seemingly mundane area around Whitehorse Creek in order to emphasize that repeated visits often result in new understanding about a place.

Nature Notes from Crater Lake is made possible by the Crater Lake Natural History Association, now in its 58th year. It sponsors this publication as part of an ongoing commitment to support the educational and resource management programs of the National Park Service. Please join them in this effort by becoming a member of CLNHA and receive a 15 percent discount on items sold in the William G. Steel Center at Park Headquarters or at the summer visitor center located in Rim Village.

Stephen R. Mark, Editor

Answers from the Deep

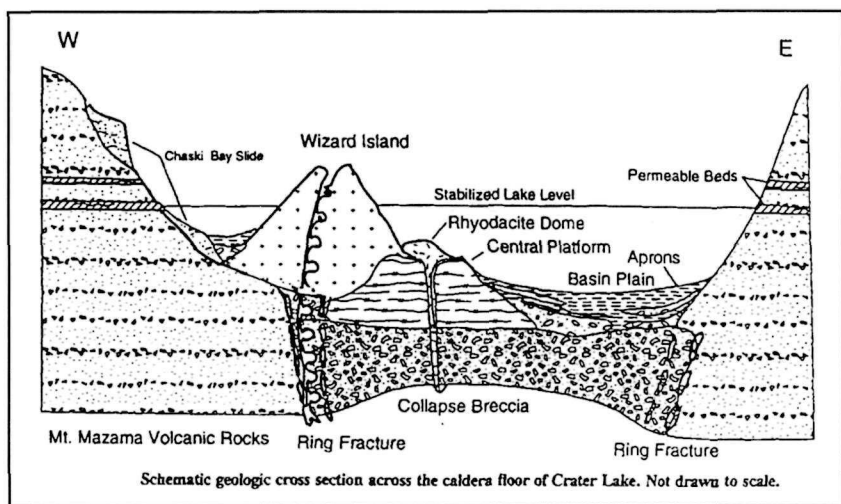
By Tom McDonough

Crater Lake is certainly a sight to behold. It is especially spectacular for those who see it for the first time. Pictures cannot really capture the lake's magnitude and its image seems ageless. The base of the great volcano, which stood here once, properly frames the cobalt blue of the lake. These rugged cliffs are mostly bare, undoubtedly stripped of vegetation by continual rockfall. What of Wizard Island? It somehow seems fitting to have a winged dinosaur fly in circles around the cone. These creatures were long gone, however, when the fires of Mount Mazama first began to burn less than a half million years ago.

The apparent serenity of this lake is somewhat misleading. We must face the reality that this image is fleeting, or in the geologic time scale, ephemeral. Why should we expect Crater Lake to always be the same when it has changed so much in the past? A deep lake with a small volcanic island near one shore are its dominant features, though how each formed has been somewhat of a mystery until recently. By analyzing lake sediments obtained from the bottom, scientists can now tell us much more about what has happened here since Mount Mazama last erupted 7,700 years ago.

This crater (or caldera) holding Crater Lake today was created by a great eruption. That event ended with the collapse of the mountain summit, and was much more catastrophic than the Mount St. Helens incident in 1980. It may have been the biggest occurrence of its kind in North America during the last several million years. During the eruption, Mount Mazama released great quantities of ash and pumice. At least 12 cubic miles of mountain top disappeared as it slumped back into a drained magma chamber located beneath the volcano, now below the lake bottom.

During the summers of 1988 and 1989, a piloted submersible was used for the first time to explore the bottom of Crater Lake. Videos identified active thermal springs on the caldera floor, indicating the presence of heat below. Hot water rises up, in various locations, through layers of lake sediment that have accumulated since Crater Lake formed. Five sediment core samples were taken from selected sites on the lake bottom during these dives. The sample taken east of Wizard Island, on a series of lava domes called the Central Platform, lacks the rock debris covering other sites and therefore better displays the materials that have settled here from above. These include volcanic ash, soot from forest fires, pollen grains, and diatoms layered in a fine mud about five feet in depth. By looking closely at this core sample, geologists can now work out what kind of events have transpired in and around the caldera over the last several thousand years.



At the core's base is mud, whose age indicates that it was deposited very soon after the caldera was formed. Dr. Charles Bacon, a volcanologist with the U.S. Geological Survey, speculates that only 300 years may have been needed to fill the lake basin to its present level. By the time water flowed over the top of the Central Platform, something that took a minimum of 150 years, the lake was already 1,000 feet deep over in the eastern basin. Obviously, winter snow and ground water easily found a repository in the large cavity left by the devastating eruption of Mount Mazama.

Crater Lake was approaching its present depth when Wizard Island appeared. We know this by examining its lava rocks 250 feet below the present water level. This was the water line for the lake when the event that produced Wizard Island occurred. The lava above this point looks different than the same lava below it. The lava, which was forced to cool in water, is left with a somewhat glassy appearance. The same rock, which cooled above the level attained by water at that time, has an oxidized surface and appears rusty red or brown. Since Crater Lake was lower when Wizard Island formed, it was not yet an island. At least several more decades were needed to allow the lake to enter Skell Channel and inundate the lava flows that connected Wizard Island to the caldera walls. Some of this lava made its way into the sediment over the Central Platform. Since the sediment appears near the core sample's base, it provides more evidence that Wizard Island appeared not long after Mount Mazama collapsed.

The core sample extracted from the Central Platform shows that a second volcanic event occurred. Located approximately at the midpoint in the lake sediment is an ash deposit from activity related to creation of the Rhyodacite Dome, a feature situated immediately east of Wizard Island. Organic material within the ash layer indicates this eruption occurred 5,100

years ago. This is possibly the most recent volcanism related to Crater Lake. The absence of other activity since that time, however, does not indicate the volcano's extinction.

Sediments on the lake bottom also contain pollen grains and diatoms. Scientists can broadly ascertain vegetation history patterns and related climate changes over the past few thousand years by studying them. Pollen, carried by the wind, entered the caldera soon after it formed. Even though the local pine and fir forests were decimated during the climactic eruption, other conifers located further away persisted. As water began to accumulate, pollen grains became a permanent part of the lake sediment. The appearance of pollen from *Abies* (true fir) in the core samples may be evidence for the recovery and reestablishment of the local forest. Fir pollen is relatively heavy and does not travel far from its source. It first appeared in lake sediments after a few hundred years, but just as this species became well-established, it and certain pine species began to decline. The pollen record shows that incense-cedar, western juniper, and Douglas-fir (all of which prefer a warmer and drier climate than the true fir) replaced them. These conditions prevailed for a thousand years and affected the entire Pacific Northwest. Pronounced change took place at lower elevations, where Lower Klamath Lake and Tule Lake all but disappeared. What effect the dry climate had on Crater Lake is not known. Currently, 67 inches of annual precipitation are needed to maintain the lake level. Evaporation and seepage would lower the lake level without a steady input from rain and snow. Perhaps Wizard Island was, once again, connected to the caldera walls during this period.



Pollen on lake in Steel Bay

Diatoms in the core samples provide researchers with information about lake water at various times. These microscopic silica skeletons are the remains of a type of algae and there are many different forms. As with other plants, the presence of one species or several related species can tell scientists something about the local environment. Eighteen different species of diatoms were examined from the core samples. Nine of them drift in the water column, whereas the other nine prefer the bottom of the lake.

The first species to establish itself was *Stephanodiscus*, a type of diatom that prefers fresh water. Others requiring a more mineral-rich and basic supply of water slowly replaced them and in abundance. This change may indicate that the lake water was slowly enriched with chemicals from hydrothermal vents, not unlike those seen with the submersible. Diatom concentration reached a maximum about 4,000 years ago following the dome building event that occurred east of Wizard Island. Since then, concentrations have slowly decreased for most species, though why is not well understood. Lake transparency has improved with this decrease since diatoms are effective scattering agents. In large concentrations they prevent light rays from travelling very far. With this in mind, Dr. Hans Nelson, a limnologist with the U.S. Geological Survey, is convinced that the lake's exceptional clarity is a relatively recent phenomenon.

The peaceful setting of Crater Lake at the present time stands in sharp contrast to the violence which produced this picture. In the absence of continued volcanic activity, the water has slowly been purified by an abundance of rain and snow. We are often reminded by geologists that this volcano is only dormant. If the past is any indication of the future, the tranquility we enjoy today is only temporary. A new mountain may stand here someday and it is possible that our descendants may be limited to only imagining the lake we now see. 🏠

References

- C.H. Nelson, et al., "The volcanic, sedimentologic, and paleolimnologic history of the Crater Lake caldera floor, Oregon: Evidence for small caldera evolution," *Geological Society of America Bulletin* 106 (May 1994), pp. 684-704.
- C.R. Bacon, "Geological Observations and Sampling," pp. C1-C3, in Robert W. Collier, et al (eds.), *Studies of Hydrothermal Processes in Crater Lake*, OR, OSU College of Oceanography Report #90-7, Corvallis, May 31, 1991.

The Filling of Crater Lake

By F. Owen Hoffman

It was 30 years ago last summer since I last worked at Crater Lake. From 1966 to 1968 I was a seasonal park naturalist and during that time I conducted research on the vertical migrations of zooplankton in the lake. This research led to a masters degree in limnology and ecology from Oregon State University in 1969. Last August I volunteered for one week as a way to reacquaint myself with the park. I soon realized that I had forgotten many facts and quite a few had been revised since my last time in uniform. This dictated a visit to the park library.

One of the intriguing questions I came across in my brief survey of park-specific literature was: how quickly did the lake form, or how many years did it take to reach the present water level? I looked in the library, but found little or no information about what might seem to be a worthy focus of scientific investigation. The best thing I found was a paper published in 1994, where the authors claim that Crater Lake reached its current level in only 300 years (Nelson, et al. 1994). Being curious, and traveling with my laptop computer, I began to develop a simple mathematical model of the lake aimed at obtaining the answer (if only in an approximate way) to this question.

Methods

My mathematical model was initially constructed on the basic assumption that the hydrological processes of the past are not dramatically dissimilar to those of the present. For starters, I assumed:

- (a) annual precipitation of 30.4 billion gallons (Phillips and VanDenburgh 1968);
- (b) annual average evaporation of 15.2 billion gallons, based on an estimated evaporation rate of 120 cm per year (Redmond 1990);
- (c) subsurface seepage that depends on the amount of water in the lake at any time.

For my initial calculations, I set seepage at 0.33 percent of the lake's volume per year (as derived from a net annual input of 15.2 billion gallons divided by the lake volume of 4.6 trillion gallons). Since evaporation will change somewhat with lake depth, I added an adjustment factor to account for the increase in surface area occurring as the lake filled to its present depth. I included an additional adjustment to the seepage rate to simulate more seepage with increasing depth as the lake filled. This adjustment accounts for both increased pressure from a rising lake level and increased bottom surface area. In the beginning, when there were only 230 billion gallons of water (assumed to have accumulated from ground water and hydrothermal sources), seepage is therefore estimated at 0.03 percent of lake volume.

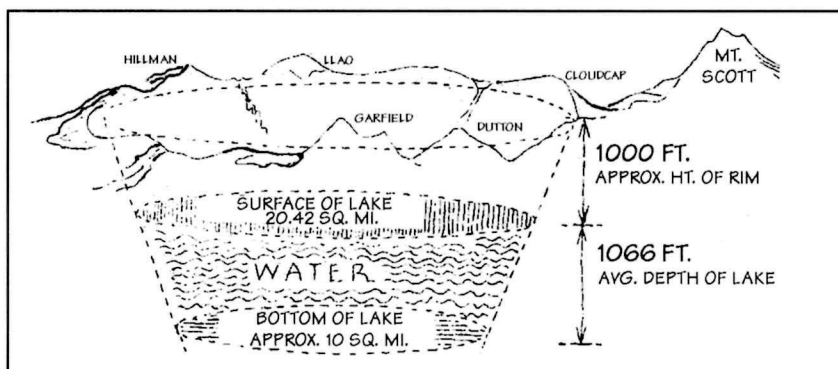


Illustration used by J.S. Brode, estimating water volume in Crater Lake, September 1934

Conversely, when the lake became half full, seepage was about 0.2 percent of lake volume.

The model is based on values for present conditions, but this cannot be assumed over the entire period of lake formation. Analysis of the lake sediment and samples of pollen indicate that, at least initially, the climate was not unlike today (Nelson et al., 1994). It is thought that Wizard Island formed not too long after the collapse of Mount Mazama and that the lake was within 250 feet of its current level at that time. Consequently, I assume that conditions of precipitation and temperature similar to the present day, existed for roughly 400 to 500 years after Mazama's collapse. Soon afterwards, however, a warmer and drier period commenced and lasted as long as 1,000 years. This drier period affected the entire region of the Pacific Northwest. Exactly how dry was it? No one really knows for sure, but to simulate this effect I reduced precipitation during this time period to between 30 and 50 percent of present day averages while also increasing evaporation by 10 to 20 percent.

To simulate the filling of Crater Lake, I used the software package STELLA II which has been specifically designed for the development of models for time dependent phenomena. This software is ideal for examining the effect of different assumptions about climate on the formation of Crater Lake.

Results

Crater Lake was formed in the collapsed caldera of Mount Mazama. Its formation began soon after the collapse, almost as quickly as the caldera floor cooled to the point where water could accumulate on the bottom. The evidence to date suggests that the young lake probably resulted from ground water draining back into the caldera from the surrounding slopes and hydrothermal springs. Since annual precipitation did not vary substantially from that of the present climatic regime, the lake rapidly (in geological

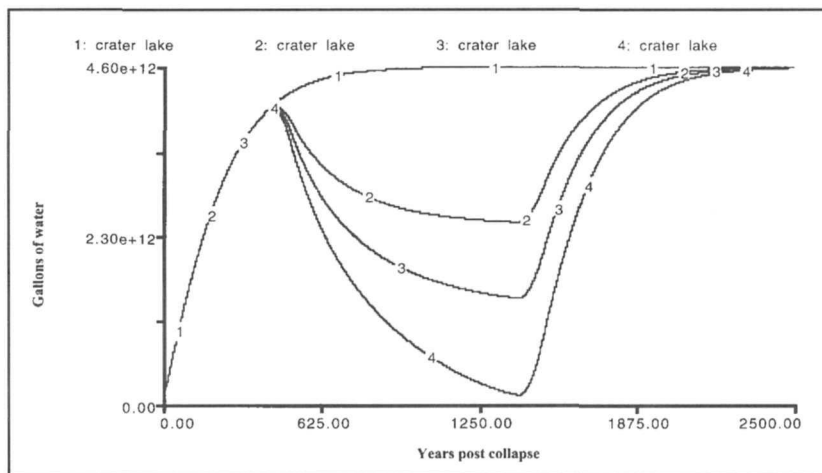


Fig. 1: Four model simulations of the filling of Crater Lake with time. The first simulation (1: Crater Lake) assumes that present day annual precipitation has been constant over time. The second through fourth simulations (2-4: Crater Lake) assume for a 1,000 year altithermal period that prevailed between 500 and 1,500 years post collapse a reduced precipitation rate that is 0.7, 0.6 and 0.5 times that of the present, and an evaporation rate that is increased respectively 10%, 15%, and 20% above the present.

terms) increased in depth—gaining much more than the present net input of 15.2 billion gallons of water per year. The actual gain would depend upon the amount of evaporation, relative to the increase in surface of the lake, with early seepage having a negligible contribution to the annual loss.

Based on these assumptions, Crater Lake probably reached about half of its present size within 150 years (Fig. 1), rising at a rate of some three to four feet per year. After roughly 300 years, the lake would have reached the level that was present at the time of Wizard Island's formation. This also means that at 400 years since the collapse of Mount Mazama, Crater Lake reached about 90 percent of its present volume.

Approximately 500 years after the collapse, a 1,000 year period of drier climate ensued. This caused the lake surface to fall steadily and by the time this “altithermal” or “xeric” period gave way to cooler and more humid conditions (not unlike the present time), the lake could have lost between 40 and 80 percent of the peak volume reached at the onset of the dry period. As precipitation increased, the lake once again started to rise and reached 95 percent of present day volume about 2,000 years after Mount Mazama collapsed. The final stage of filling Crater Lake took another 500 years and required conditions that produced a relative equilibrium among precipitation, seepage, and evaporation. Because of the changes in climate, complete equilibrium among precipitation, evaporation, and seepage did not occur for another 1,500 to 2,000 years thereafter. In other words, it took about 2,200 to

perhaps more than 3,000 years for the lake to reach the present state of complete equilibrium with an average depth of 1,066 feet (325 m) and a maximum depth of 1932 feet (589 m). If it were not for the 1,000 year dry period, Crater Lake would have reached its present level between 1,100 and 1,500 years after Mount Mazama's collapse 7,700 years ago. Due to the 1,000 year dry period, evaporation and seepage exceeded precipitation and the lake fell to more than half its present level (Fig. 1). During this dry millennium it is likely that the lake water would also have been richer in minerals, more biologically productive, and thus less transparent than it is at present.

Crater Lake in the Future

Is the lake always going to stay like it is today? Given enough time, most certainly not. Perhaps the most imminent change, however, will be that of climate and its effect on precipitation. Any change in annual precipitation will have a direct effect on the level of Crater Lake. If precipitation begins to decline as climate changes to a drier condition, evaporation and seepage will again exceed precipitation so the lake level will drop. If precipitation increases, the lake level should rise and perhaps find a new equilibrium. There is no evidence to date that Crater Lake ever reached levels substantially above present. Nevertheless, such changes may occur over the next century or so. Over the next few thousand years, however, pronounced climate changes are certainly anticipated and with these changes will come fluctuations in lake levels. If we project ahead even further in time to, say, one million years or more, then it is likely that renewed volcanic activity or some other process of mountain building will occur. These major processes will dramatically change the appearance and structure of Crater Lake as we now know it. Few lakes on Earth have had a life-span that transcends a million years. 🏠

References

- C.H. Nelson, et al., "The volcanic, sedimentologic, and paleolimnologic history of the Crater Lake caldera floor, Oregon: Evidence for small caldera evolution," *Geological Society of America Bulletin* 106 (May 1994), pp. 684-704.
- K.N. Phillips and A.S. VanDenburgh, *Hydrology of Crater, East, and Davis Lakes, Oregon*. USGS Water Supply Paper 1859-E. Washington, D.C.: Government Printing Office, 1968.
- K.T. Redmond, "Crater Lake climate and lake level variability," pp. 127-141 in E.T. Drake, et al (eds.), *Crater Lake: An Ecosystem Study*. San Francisco: Pacific Division, American Association for the Advancement of Science, 1990.

Sedges Have Edges

by Joy Mastrogioseppe

*"Sedges have edges; rushes are round;
grasses are hollow right up from the ground"¹*



Carex nigricans
black alpine sedge
single spike



Carex luzulina
woodrush sedge
cylindrical spikes

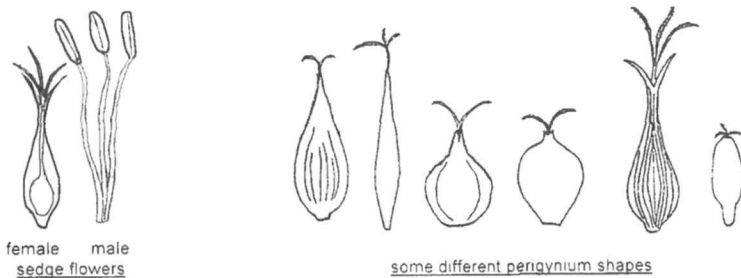


Carex athrostachya
slenderbeak sedge
dense head of spikes

The jewel like wet meadows of Crater Lake National Park owe their rich green color largely to a group of grasslike plants, the sedges (the genus *Carex* in the plant family Cyperaceae). Sedges can be found in many other habitats such as forests, streams, and dry pumice fields. These plants have edges because their stems are triangular rather than being round like grass or rushes. Sometimes the sedge edges are very sharp due to a row of tiny teeth along the stem angles (sedge leaves also have these sawtoothed margins). In fact, the name of the genus *Carex* derives from the Greek word meaning “cutter.” Sedge leaves grow in three rows, one along each side of the stem, so that looking down on a sedge plant from above you see leaves extending outward in three distinct directions. Grass and rush leaves, by contrast, grow in two rows. Furthermore, sedge stems are solid, not hollow, like grass stems.

The flowers of sedges are small and appear greatly reduced from the form of familiar wildflowers such as lilies and violets. Sedge flowers have no petals, with each flower possessing either male or female parts but not both. Male flowers consist of three stamens (the pollen-producing structures), whereas female flowers contain the ovary enclosed within a sac-like structure called the **perigynium** (**peri** = around, **gyn** = female, **ium** = little). Much of sedge identification depends on the size, shape, color, and texture of the perigynia, and looking at these features requires a magnifying lens.

Sedge flowers are borne in dense spikes. Depending on what kind of sedge it is, each spike may contain only male flowers, only female flowers, or both. A few sedge species can have separate male and female plants. Sedge spikes range from short and egg-shaped to long and cylindrical. The arrangement of spikes on the stem usually fits one of the following four general forms: a single spike (only one flowering spike per stem), a dense head (many short spikes per stem, closely crowded into a dense cluster), the “extended head” (a long loose cluster of short spikes), and the “bottlebrush” type. The “bottlebrush” sedges have a few long cylindrical spikes on each flowering stem, and the spikes often look like tiny bottle brushes when the flowers are in full bloom). Three of these types are shown at the beginning of this article.



There are about 40 different species of sedges in Crater Lake National Park, more than for any other genus of vascular plants. Many of these sedges respond vigorously to lower-intensity fire, sprouting and forming dense swards in burnt areas. For example, following surface fire in ponderosa pine forests in the northeast corner of the park, long-stolon sedge (*Carex pensylvanica* , also known as *C. inops*) increases in cover. When people talk about the lush “grass” growth in some of the areas burned by the 1988 fires at Yellowstone National Park, they are usually talking about sedges. Such vigorous regrowth is very important in stabilizing denuded soil and in providing food for wildlife where food supply has been reduced. A variety of wildlife relish sedges and rely on them for nutrition; these include waterfowl, small mammals, as well as the charismatic deer and elk.

Sedges are also important to humans. Their strong, tough fibers, sedges were used by American Indians to make cordage, basketry, and mats. Sedges that have creeping underground stems (rhizomes) were an especially important source of fiber for technology, but whole above ground stems and leaves were also twisted into rope. One late 19th century account refers to the use of commercially-made rope for constructing a building in northern Idaho. The rope frayed and broke, so they made a new rope. This one used locally-growing sedges and did not fail.

Many sedge species look alike and learning them involves looking closely at their characteristics. Sedge identification keys rely on having mature perigynia and knowing the growth habit and habitat of the plants. Identifying sedges is a specialized skill, but once the terminology becomes familiar, learning the plants is very enjoyable and intellectually challenging. 🏠

*“You pull off the parts, and soon feel your age
Chasing them over the microscope stage!*

*You peer through the lenses at all of the bracts
And hope your decisions agree with the facts;
While your oculist chortles with avid delight
As you strain both your eyes in the dim table light.”²*

Notes

¹Anonymous

²Excerpts from a poem in H.D. Harrington, *How to Identify Grasses and Grasslike Plants* (Swallow Press, 1977)

The Rare Treasure of Mount Mazama *Collomia*

by Casey Baldwin

Mount Mazama *Collomia* (*Collomia mazama*) is a beautiful and rare member of the phlox family endemic to Crater Lake National Park and adjacent lands on the Rogue River and Winema national forests. It is a perennial species primarily restricted to the open woods and meadows of the lodgepole pine and true fir forest communities of southern Oregon's Cascade Range. This species was discovered by the noted botanist F.V. Coville along Dutton Creek, just two air miles from Crater Lake, in 1896. Modern day explorers can still observe a healthy population of these plants at this site (called a type locality), though the species is considered threatened throughout its range. There are only 55 known populations, of which 12 (or 22 percent)

occur within Crater Lake National Park.



A Mount Mazama collomia in bloom.

C. mazama is one of eleven species in the genus *Collomia* found in western North America. It is herbaceous and perennial, ranging from 15 to 30 cm tall, with broadly lanceolate leaves having distinctive irregular teeth towards the apex. Flowers are borne in terminal, head-like cymes, and possess funnellform-shaped corollas up to 1.5 cm broad; coloration is lilac, bright purple, deep blue, or violet. Adding to its

beautiful appearance are the exerted stamens with powder blue anthers. The inflorescence is covered with glandular hairs that exude a slight skunky odor. Three small, black seeds are produced per capsule and are explosively dehiscent—where seeds have been observed to disperse up to half a meter. Flowering occurs from June through September.

Two other perennial, blue-flowered *Collomia* species occur at high elevations in Oregon. These are *C. debilis* var. *debilis* and *C. larsenii*. *C. debilis* can be distinguished from *C. mazama* by its larger flowers (1.5 to 3.5 cm) and sprawling habit. It is only found in central and northeastern Oregon. *C. larsenii* is also distinguished by its sprawling habit, and pinnately- or palmately-lobed leaves, as compared to the erect habit and toothed leaves of *C. mazama*. *Collomia larsenii* occurs in the Olympic Mountains and Cascade Range.

Collomia mazama predominately inhabits places at high elevation (4800 to 6300 feet), where it associates with mountain hemlock, red/noble fir, and lodgepole pine. Minor habitats include the mixed conifer forest, the interface of

meadows with incense-cedar, and riparian areas. The largest *C. mazama* population found within Crater Lake National Park is located on the middle fork of Copeland Creek, near the Pacific Crest Trail. White fir (*Abies concolor*), Red/noble fir (*A. magnifica-procera*), lodgepole pine (*Pinus contorta*), incense-cedar (*Calocedrus decurrens*), and mountain hemlock (*Tsuga mertensiana*) are present in the overstory, with thinleaf huckleberry (*Vaccinium membranaceum*), Crater Lake currant (*Ribes erythrocarpum*), and baldhip rose (*Rosa gymnocarpa*) in the understory. Other large populations of Mount Mazama collomia occur along lower Bybee Creek and southwest of Sphagnum Bog along Crater Creek,



Mount Mazama
Collomia

whereas smaller populations occur along the north and south forks of Copeland Creek, Sphagnum Bog, and upper Bybee Creek. The Dutton Creek population, along with those between Sphagnum Bog and the Pacific Crest Trail, occur where lodgepole pine, scattered red/noble fir, and mountain hemlock dominate the forest canopy. In these places grouse huckleberry (*V. scoparium*), two-colored lupine (*Lupinus bicolor*), meadow penstemon (*Penstemon rydbergii*), and long-stolon sedge (*Carex pensylvanica*) largely comprise the understory. The population at Thousand Springs is the smallest (less than 35 individuals) but the most unique in the park, occurring in the drier portion of a riparian zone with associated huckleberry and a sparse overstory of lodgepole pine and red/noble fir.

Concern over the long-term viability of Mount Mazama collomia, as well as the lack

of basic biological information, prompted a cooperative research effort. Personnel from the National Park Service, U.S. Forest Service, and the University of Idaho worked together in developing a comprehensive conservation strategy. At the same time, grants from Canon USA, Stillinger Botanical, and the Mazamas assisted me with gathering data on the plant's genetic structure, reproductive biology, demography, and ecology. The most relevant findings are summarized in the following paragraphs.

A genetic analysis of 20 populations from Crater Lake National Park and surrounding national forest lands was conducted using starch gel electrophoresis. The overall genetic diversity turned out to be low, with only 2 of 22 loci exhibiting more than one allele. Most of the genetic variation is contained between populations (particularly the northern versus southern, with Red Blanket Creek being a rough dividing line). In all likelihood, the distinction is due to random genetic drift. This is probably due to small population sizes

sometime in the past, a characteristic common to many species of rare plants. Populations within and immediately adjacent to Crater Lake National Park contain the highest levels of genetic diversity within the species and thus represent a valuable genetic resource.

Another study tracked demographics (birth, growth, death, and reproductive success) of eight *C. mazama* populations that occupy the range of habitats in which this species is typically found. Over 4,000 individuals were located, marked, and measured over a four year period. Research results indicate that a large number of seeds may be produced during a given year (up to 750 seeds per square meter) but the rates of germination and survival are extremely low. No more than ten percent of seeds will germinate the following year, with a mortality rate of 50 percent in each of the successive growing seasons. Seedling growth averages one centimeter per year, with flower and seed production beginning at a height of 5-10 cm, or at an estimated age of 7-12 years. Up to 50 percent of the plants flowering in a given season will not flower the following year, and approximately 10 percent of the population will be dormant for a full growing season. Additionally, predation by deer appears to play a significant role in the population dynamics of this species, with up to 45 percent of a population being eaten before setting seed. Taken together, these factors indicate that the rarity of this plant may be due to the combination of low survivorship, slow growth rates, and predation.

Restoration efforts

According to one survey, several *C. mazama* populations have been impacted by activities associated with the trail system in Crater Lake National Park. Both seedlings and vegetatively propagated clones are being evaluated so as to find the best way to restore these populations. Due to the relatively slow growth rate of seedlings, it was thought that the use of material propagated from mature plants would result in better reestablishment. Results from the propagation of seedlings and vegetative clones in a greenhouse environment showed that both grow at the same rate, flowering after reaching a height of 7 cm. Flowering is a function of plant height, whereas the growth rate seen in seedlings is the result of environmental conditions. Field trials were initiated in the latter part of 1997 to evaluate the establishment of seedlings and vegetative clones on compacted and non-compacted sites in both spring and fall plantings. The only observed difference so far is that spring plantings have a higher mortality rate due to predation by deer.

Efforts to restore Mount Mazama collomia within Crater Lake National Park are promising, yet this rare plant continues to face a variety of threats throughout its limited range. We can hope, however, that the research and conservation efforts made by scientists, land managers, and volunteers so far will continue making headway. *Collomia mazama* is a botanical treasure, one to be enjoyed now and by future generations. 🏠

The Microclimates of Crater Lake National Park

by Gregg A. Pohll

Visitors at Crater Lake are better informed climatologically speaking than they used to be, but many are still surprised at how the weather varies from place to place in Oregon. Weather systems generally move from west to east across the state. As they do, the systems must cross the Coast Range and Cascade Mountains. Eastward movement lifts moisture orographically to enhance precipitation totals at the highest elevations. Upon crossing the Cascades, the systems begin warming and drying as they descend the eastern slopes of these mountains. This is a “rain shadow” effect and it has created two distinct parts of Oregon. Most populated locations in western Oregon (especially the northwest portion) are notoriously gray and receive 30 to 60 inches of precipitation annually. On the other side of the Cascades, much of eastern Oregon collects a mere 10 to 20 inches of annual precipitation.

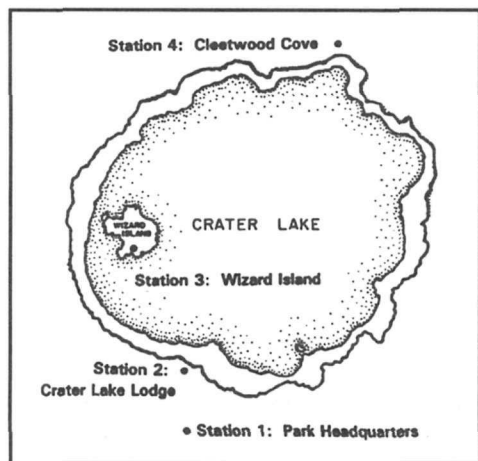
Depending upon where you are and when you visit, Oregon’s soggy reputation is misleading. It is true that from October through May, the

state can be battered by one Pacific frontal system after another. In the wettest locations, including Crater Lake National Park, several storms can pass without an observable break in the weather. During the summer, however, a dry regime dominates. Several weeks may pass without so much as a drop of rain.

Crater Lake National Park is a microcosm of Oregon. Located along the

crest of the Cascade Range in southern Oregon, the park receives heavy precipitation during the winter months at nearly all locations within its boundaries. Annual precipitation amounts at individual stations, however, vary widely depending upon elevation and, to some extent, aspect.

The chart compares four years when nearly complete data allowed comparisons of certain stations within Crater Lake National Park. It shows that the collecting station near the Cleetwood Cove parking lot is the driest of the four. It averages 50 percent less precipitation each year than the



Comparison of Precipitation in Crater Lake National Park Areas

Location	Elevation	1988-89	1989-90	1990-91	1996-97
Crater Lake HQ	6475	71.63	52.00*	59.18**	81.48
Crater Lake Lodge	7076	85.34	60.67	50.13	98.42
Wizard Island	6188	72.54	62.54	63.23	111.87
Cleetwood Cove	6850	47.73	34.23	38.09	53.15

* Measurement for March was not available, so the average precipitation of 8.22 inches was included to represent a more accurate account of the year's actual precipitation.

** Measurement for July was not available, so the average precipitation of 0.63 inches was included to represent a more accurate account of the year's actual precipitation.

Reliable comparative data for other years is unavailable for one or more of the above locations.

Sources: National Park Service, Crater Lake Division of Natural Resources
Oregon State Climate Service, Oregon State University
Climate of Crater Lake National Park, G.L. Stemes, 1963

wettest station among the other three. Wizard Island collected the most precipitation in three of the four years listed, perhaps because this location is very prone to storms from the west and southwest.

Although very prominent in the eyes of visitors, the four stations listed on the chart are probably not good indicators of how varied the weather can be at different places in the park. Watchman Lookout, for instance, is at the very zenith of orographic lift in this section of the Cascades. The weakest of summer rain storms can damage the trail connecting the lookout and Rim Drive, but at the same time not affect visitors enjoying the eastern side of the park. The Pinnacles Overlook may have the honor of being the driest location in Crater Lake National Park, though there is no way to tell without situating weather stations there and in areas like Sharp Peak. The latter is familiar to only the heartiest of backcountry hikers, but the park's firefighters spend an ample amount of their time around it during July and August.

Storms are infrequent throughout the summer and usually lack the intensity of their winter counterparts. During these events people often crowd into visitor centers, Crater Lake Lodge, or other dry places. What most visitors do not understand is that they could probably be enjoying the outdoors if they only knew the park better. A storm will often only affect the southwest-facing and highest locations, though a view of Crater Lake cannot usually be obtained from Rim Village and the West Rim Drive since these locations are the most likely to be obscured by clouds and mist. There is, however, a 50 percent chance that areas along the East Rim Drive (especially from Cleetwood Cove to the Palisades) will have broken overcast skies and 10 miles or more of visibility.

There are clear advantages to knowing about the effects of microclimates in a place like Crater Lake National Park. You may have more than just a few options during summer days when the weather seems to be less than ideal. It is worth remembering that knowing *where it is raining* may be more important than knowing *whether it will rain!* 🏠



Thunderheads over Crater Lake

Memory and Symbiosis on the Rim

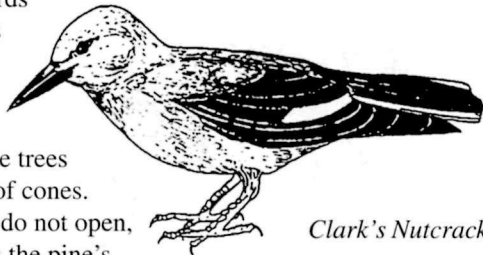
by Ron Mastrogiuseppe

Visitors to the rim of Crater Lake can experience something special that was noted by the Lewis and Clark expedition nearly 200 years ago. When the Voyage of Discovery came to a place called Lemhi Pass in the Bitterroot Mountains (along the border of present-day Montana and Idaho), William Clark recorded the following in his journal on August 22, 1805:

I saw today a Bird of the woodpecker kind which fed on Pine Burs—its bill and tale white, the wings black, every other part of a light brown, and about the size of a robin.¹

This entry is the earliest known written description of a Clark's nutcracker and the whitebark pine. The nutcrackers and whitebarks still live at Lemhi Pass. A few of the pine trees may even be the same individuals that bore witness to Lewis and Clark's Voyage of Discovery; others may have been planted by the very birds the explorers were watching.

Clark's nutcrackers are certainly popular with visitors to the rim of Crater Lake. This bold crow marked with gray, black, and white contributes as much entertainment to their experiences as the golden-mantled ground squirrels. The nutcrackers especially favor peanuts and collect as many as visitors will provide despite the "no feeding" regulation. Any nuts not promptly consumed by the birds are placed into storage caches for winter food. This caching behavior is the same as nutcrackers employ with whitebark pine seeds when the trees produce sufficient quantities of cones. Mature whitebark pine cones do not open, and the foraging nutcracker is the pine's primary seed dispersal agent.



Clark's Nutcracker

Clearly, the nutcracker is a keystone species since it plays a role in perpetuating several different kinds of pine. A keystone species is one so closely connected with other organisms that if the keystone species becomes rare or extinct there will follow other losses and negative effects in food webs. Whitebark pine is an important food source for squirrels and bears as well as for nutcrackers. The endangered grizzly bear in the northern Rocky Mountains utilizes whitebark cones as a critical food source prior to winter hibernation. Whitebark pine also is a pioneer species in subalpine areas, often being the first tree to establish itself in what will become tree islands or atolls.

Whitebark pine populations are in trouble. Glacier National Park, for example, has already lost over 90 percent of its whitebark pines. These woodlands, as distributed in the northern Rocky Mountains and at high points throughout the Cascade Range, are threatened for several reasons. First is an exotic fungus called white pine blister rust (*Cronartium ribicola*), that produces spores on the leaves of gooseberry and currant shrubs (the genus *Ribes*). These spores germinate in the bark of pines and eventually girdle the tree. Since Crater Lake's whitebarks are often skirt by the local endemic Crater Lake currant (*Ribes erythrocarpum*), a potential source of infection is close at hand. During periods of low clouds with high humidity, weather conditions favor fungal growth including the production and dispersal of spores. Secondly, the suppression of low-intensity fires has, over the long term, increased whitebark pine mortality from catastrophic burns racing upslope into the subalpine zone. Such an event occurred in August of 1978 on top of Crater Peak. Thirdly, mountain pine beetle (*Dendroctonus ponderosae*)



Whitebark Pine

infestations initiated in lower-zone lodgepole pine forests also threaten upslope whitebark pine woodlands. Lastly, the trend toward global warming will force whitebark pine woodlands upslope, where less habitat is available. This migration can only occur if cone production allows Clark's nutcrackers to cache seeds in higher habitats as timberline advances upwards.

I can remember helping to trap and band Clark's nutcrackers at the rim more than 30 years ago. This project continued work begun a decade earlier, when among the results from banding was the recovery in 1957 of a nutcracker banded at the rim. Just six weeks later it had been

killed by an owl on the slopes of Mount Adams in Washington.²

Another fond memory of Crater Lake involved spending an autumn night in the Watchman Lookout and waking at dawn to the sight and sound of a nutcracker flock prying open an abundant crop of whitebark pine cones. Thirty years ago, healthy whitebark pines graced Wizard Island's summit

crater, but today they are reduced to bleached, weathered skeletons. When I visit Wizard Island I remember those awesome pines, but visitors can now only experience them as nonliving relics.

National parks provide an opportunity to learn about nature and the idea of coexistence with other living organisms. The loss of any species brings with it the likelihood that future visitors will not understand what has vanished. Loss of keystone species is doubly distressing, since it can also damage any hope that the native biota can ultimately be perpetuated. As links in the food chain and in memory, the Clark's nutcracker and whitebark pine play a vital role at Crater Lake National Park. Without them, there is serious danger that misconceptions about nature and even ourselves may arise. 🏠

“A land without memories is a land without history.”

(Author unknown)

Notes

¹Quoted in R.M. Lanner, *Made for Each Other: A Symbiosis of Birds and Pines*. (New York: Oxford University Press, 1996), p. 22.

²Donald S. Farner, *The Birds of Crater Lake National Park* (Lawrence, KS: University of Kansas Press, 1952), p. 88.

Bears During the War

by Joseph S. Dixon

*As we greet the new millennium, it is time to reflect upon all the changes that have taken place throughout the 20th century. Bears have been a frequent management concern ever since the National Park Service assumed administration of Crater Lake National Park in 1917, mainly because garbage disposal took place next to Park Headquarters. Thankfully, negative interactions between people and the genus *Ursus* seem to have decreased in the 55 years since a National Park Service wildlife biologist wrote the following report. Garbage is now hauled away, though visitors may yet have the rude surprise of encountering a bear at a carelessly kept campsite—Editor.*



A hungry bear sniffing the tantalizing fragrance of stew cooking in a nearby cabin.

From May 11th to June 9th, 1944, I made a special study of bears at Crater Lake in relation to domestic livestock. Bears had been reported destroying newborn calves and lambs in the important cattle producing area adjacent to the park's south boundary.¹ The study was made at the critical time when the calves and lambs were small and most vulnerable to attack. The bears were then also hungriest, having just come out of hibernation. However, only one valid instance was found in which a bear had killed a calf and the actual loss found was light, being much less than reported.

During August and early September the relation of bears to people living in the park was investigated. Because of war time restrictions on travel, gasoline, tires, and owing to its distant location far from centers of

population, relatively few campers visited Crater Lake this year. The huckleberry crop was poor and because of the failure of both garbage and berry crops, the bears at Crater Lake seldom had full stomachs. Because of this shortage of both natural and artificial foods, the open-trench garbage pit was visited daily by the bears.²

Due to the large visitor attendance during 1941, and the resultant increase of garbage and refuse, the bears gathered around our headquarters area garbage pits in ever-increasing numbers.³ This naturally caused considerable overflow of bears into camp grounds, residential areas, and along the main highways. Crater Lake was fast becoming a "bear" park in the worst sense of the term. Forty bears were counted at one time in and around the garbage pit that summer. Limited funds have dictated that the pit or trench type of disposal would be continued until a more efficient method of garbage disposal can be worked out and put into operation.

The outbreak of the war brought considerable relief through a decline in visitor attendance and a consequent reduction in garbage. The bear problem was thus reduced in the actual tonnage of garbage involved, but the bears that remained were ones that had become badly addicted to a garbage diet and lived largely on this unnatural food. Several bears learned that much of the present garbage originates in the garbage cans kept at the cabins occupied by park employees. These are located a scant quarter of a mile from the open garbage pit, and naturally the bears proceeded to exploit this food supply.⁴ One bear invaded a cabin and refused to be driven away from the bacon and other food that it found on the kitchen shelves. This bear became a menace to the women and children, refusing to be driven away from food that it found in the houses, and so it was permanently removed.

During August 1944, I found that certain bears spent much of their time at the open garbage pit. It measured 120 feet long and 12 feet wide, and these bears fed daily on the garbage. Six bears were seen at the garbage pit at one time but rarely were more than three adults in the pit at the same time. Daily observations revealed that one large old "boss" male bear always drove the other bears away from the fresh deposit of garbage until he had pawed it over and selected and eaten the choicest portions. Having eaten the best snacks, this bear usually retired to a cool shady spot beside the road where he waited to beg contributions of candy or other food from the occupants of the private automobiles that regularly made the quarter mile side drive from the main highway into the garbage pit. Traffic was always better over the weekend, with Sundays bringing the greatest number of cars to the park and over the little loop service road that lead to the garbage pit. The National Park Service gave no publicity to the bears at the pit, but counts made on various Sundays showed that about 30 percent of the cars that came into the park on the main highway drove down to the garbage pits. A check on the automobile license plates showed that most of the cars visiting the garbage pit were Oregon

licenses and evidently belonged to local people. Very few "out of state" cars visited the garbage pit and apparently few of them knew of its existence.

Certain bears shared their garbage and permitted other bears to feed unmolested within a few feet of them, but in the majority of instances the biggest bear ate his fill first then the next largest and so on down the line. The yearlings and the cubs waited either up a tree or at the end of the line.

In order to keep the bears from raiding the residential area, garbage was kept in the cabins and not placed in the garbage cans until just before the garbage truck made its daily rounds at 2:30 in the afternoon. This helped to



*Bears at garbage pit, Park Headquarters.
This is now the site of a residential complex
called Steel Circle.*

keep down bear depredation but it had its drawbacks. One bear made life miserable by coming around just ahead of the garbage truck and raiding the garbage in the cans. Experiments showed that bears can detect the presence of "fragrant" garbage such as cantaloupe rinds, at a distance of 70 feet under favorable wind conditions.

Keeping the garbage in the cabins was a dangerous invitation to all hungry bears to break into the cabins for food kept there. One bear in particular hung around the

housekeeping cabins, and on many occasions when a meal was being cooked, the bear would sit a few feet distant sniffing the tantalizing odor. One day while I ate lunch in our cabin, a bear came up and tried to claw the screen off the cabin door. This bear later tried to open our cabin door while I was sitting six feet away from it and may have been the one that broke into and seriously damaged an empty, parked and locked car.

It should be stated that the 1944 huckleberry crop was poor at Crater Lake. I followed various bears about for many hours while they sought huckleberries. Although these bears worked diligently, they were able to gather relatively few berries but not enough to satisfy their hunger. It was their usual custom to locate huckleberries through the sense of smell. Having located the berries, the bear then grasped the huckleberry branch loosely in its mouth and by a twist of its head dragged the branch through its teeth, thereby securing several berries plus some green leaves. Examination of bear feces indicated that the bears swallowed some entire huckleberry branches without chewing them.

In order to see how the bears were behaving on the national forest lands adjacent to and comparable with park lands, I made a trip to Huckleberry Mountain which lies west of Union Peak and just outside the park. Here, on August 25th, I found that people in the Forest Service camp ground were having considerable trouble with bears. Investigation revealed that there were



*The huckleberry crop was short this season
and the bears worked hard for a few berries.*

many extensive patches of huckleberry, but that the berry crop was light and spotty. Tracks and droppings showed that most of the bears had given up the berry patches in favor of the garbage that they found at the various camp grounds. I found some places where garbage had not been properly disposed of, but had been thrown into squirrel holes and under stumps. It was dug up and eaten by bears, who thus proceeded to raid the food supply of the campers. Three well trained dogs had been unable to keep the bears out of one camp ground after the bears had started raiding the food supplies of campers. One large bear had been killed, but the depredations continued. Garbage draws bears just as honey attracts bees and there is little doubt that as long as garbage is dumped in an open trench as at Crater Lake, there will be a bear problem.⁵ 🏠

Notes

¹This is the Wood River Valley north of Fort Klamath.

²The site is now a residential area called Steel Circle, located south and slightly west of the Castle Crest Wildflower Garden.

³Annual visitation set a record that year at 273,564, but plummeted to 42,385 in 1944 because of World War II. It presently averages 500,000 annually.

⁴The cabins were located in an area called Sleepy Hollow, but all have been replaced by newer structures.

⁵Construction of a new incinerator and pit in the lower end of Munson Valley during 1945 simply shifted the problem a little further south. The hauling of garbage outside the park finally commenced in 1972 and has resulted in far fewer difficulties with bears.



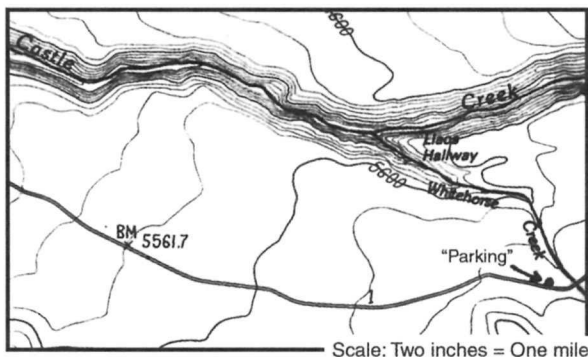
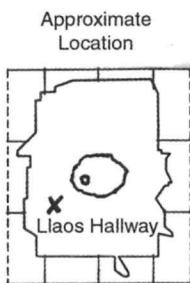
The Portals on Whitehorse Creek

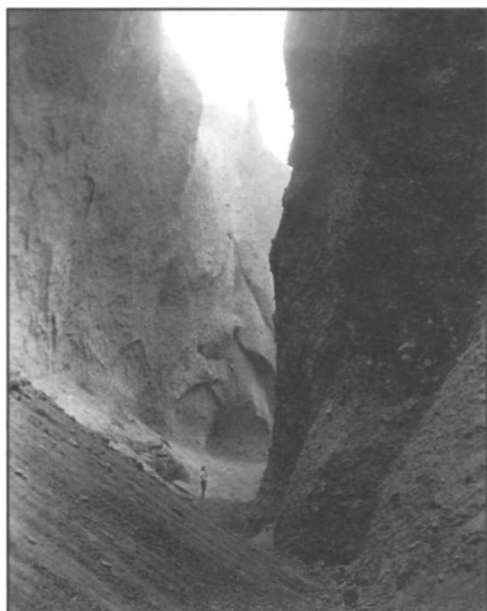
by Steve Mark

Llaos Hallway is a portion of Whitehorse Creek where the stream has cut through many feet of pumice on its way to Castle Creek, a tributary of the Rogue River. The “hallway” is no different from other stream canyons in the park, except for the fact its walls tower 125 feet above a narrow gorge for several hundred yards. It is named for Crater Lake’s special guardian (called *Llaos* or *La-o* by Klamath Indians) who is thought to dwell in the underworld.

Hikers descend into Llaos Hallway by way of the stream channel, and in one place have to place their feet on opposite sides of a chute. Any journey there is made more interesting and perhaps uncomfortable when there is water in the creek. Snow can linger until relatively late in July, thereby inhibiting an early season trek to the Music Shell—the culmination of most journeys down the hallway. The more adventurous, and those with more than an hour or two, may wish to use Llaos Hallway for entry into Castle Creek Canyon. It contains a number of oddly shaped pinnacles rivaling the more renowned fossil fumaroles in Wheeler Creek or Godfrey Glen. This makes for an interesting walk, whether upstream or down. I remember a hike on Labor Day 1990, when three of us saw water tinged with sulphur spouting from a canyon wall on our way to finding a deer trail that led us out of what seemed to be an enclosed wilderness.

It would, of course, be foolhardy to attempt climbing out of the canyon on anything less than such a trail, given the unstable nature of the walls. Wet feet and dirty clothes might be the worst things suffered on such a trip, but Castle Creek and Llaos Hallway are not for those who hike alone. So few people go there that an injured person by themselves may not be found for weeks, especially if their vehicle is not parked close at hand.





Laos Hallway

Wearing good boots, along with a helmet during periods of rockfall (which can last most of the summer in Laos Hallway) are two good precautions for those who want to explore this area.

To reach Laos Hallway, find Whitehorse Creek (unsigned) located about 3.5 miles west of the Annie Spring junction (Highway 62 and the road to Crater Lake), or roughly 4.5 miles east of the park entrance sign on Highway 62.

An unpaved parking spot north of the highway accommodates one

vehicle. It is less than 100 yards from the creek, around a small bend if coming from Annie Spring. The forest here is an unremarkable mix of lodgepole pine and mountain hemlock. Down wood obscures the largely barren ground underneath the canopy, though pinemat manzanita can be found here and there in the open pumice. Only in the drainages might there be small bunches of dwarf huckleberry and occasional clumps of moss, but most of the stream passing through Laos Hallway is completely barren.

The urgency of the few who hike into Laos Hallway every year causes them to overlook the area where Highway 62 crosses the creek. All the passing motorist sees is a bend in the road, but this place once represented a potential stopping point to early travelers. Soldiers building a wagon road from Fort Klamath to Jacksonville in 1865 named Whitehorse Creek. Their commander, F.B. Sprague, identified a spot lying to the south of Highway 62 as "Soldiers Camp" where plenty of water could be found, but little or no feed for horses. Observant visitors will find a remnant water line along the stream south of the highway, something that initially stumped a team doing archeological survey in the summer of 1997. Where, we wondered, did this pipe go? Why was it installed? We followed it several hundred yards upstream and obtained little in the way of answers.

Discovery of a campground on the *north* side of Highway 62 in 1998 was unconnected with the ongoing archeological survey. It occurred during an inventory of disturbed sites conducted by biotechnician Jamie Halperin.

He not only solved the waterline mystery, but also found a standing wood frame outhouse about 50 yards from Whitehorse Creek. Upon seeing it, the outlines of a former automobile campground immediately began to become clear to me. Privies and associated features usually function as orientation points to occupation sites in archeology, but I walked through the camp without seeing it. In retrospect, I never saw what seemed to be the obvious in numerous journeys to Llaos Hallway.

The point of this story is that you often find only what you are seeking. We now wanted to map the locations of old campgrounds, especially those located along a 19th century wagon road that once brought visitors to Crater Lake (see pp. 16-19 of the 1997 *Nature Notes*). None of these camps are particularly rich in artifacts, but they have distinctive characteristics reflecting patterns of travel and past visitation when seen collectively. Even if the only physical remains appear relatively subtle (generally in the form of blazed trees, pieces of wire, or glass fragments), they contribute to the significance and integrity of a road “system” now more than a century old. The campgrounds on Whitehorse Creek can also remind present day visitors that others have lingered here and perhaps embarked upon a journey to Llaos Hallway. Since only a handful of people venture this way every year, it is still possible to experience the same sense of solitude and envelopment that has always captivated the adventurous only a short distance from the road. 🏠



*Hikers preparing for a trip
into Llaos Hallway*

Illustrations

(Introduction)

- p. 4 NPS photo by George Grant, 1936.

(Answers from the Deep)

- p. 7 Diagram courtesy of U.S. Geological Survey.
p. 8 NPS photo.

(The Rare Treasure of Mount Mazama Collomia)

- p.17 Photo by the author.
p. 18 Drawing by Charles F. Yocom, ca. 1951.

(The Microclimates of Crater Lake National Park)

- p. 22 NPS photo.

(Memory and Symbiosis on the Rim)

- p. 23 Drawing by Mike Cook, 1992.
p. 24 Drawing by Karl J. Belser, 1935.

(Bears During the War))

- p. 26 Photo by the author.
Dixon's photos also appear on pp. 28-29.
p. 30 Drawing by L. Howard Crawford, 1934.

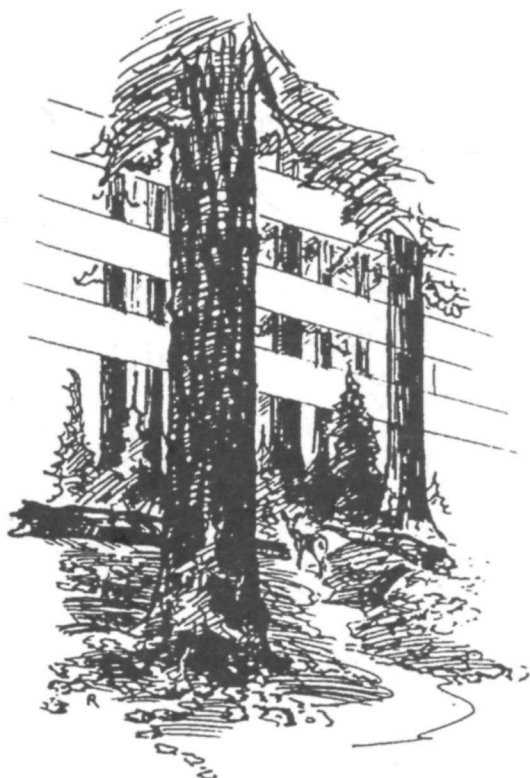
(The Portals on Whitehorse Creek)

- p. 31 Excerpt from USGS Quad Map
p. 32 NPS photo, ca. 1931.
p. 33 Photo by the author.

(Opposite)

- p. 35 Drawing by Walter Rivers.
p. 37 Drawing appeared in the September 1932 edition of *Nature Notes from Crater Lake*.

HEMLOCKS



A grove of hemlocks sloping to the west
Like a full tide in calm majestic flow
With sunlight burning gold along each crest
And dark still pools of shadow flung below.

Ernest G. Moll



*Drawing appeared in "The Community House,"
Nature Notes from Crater Lake, 5:3 September 1932.*

About the Authors

Tom McDonough teaches science at Chemeketa Community College in Salem, Oregon and began working seasonally at Crater Lake National Park thirty years ago.

F. Owen Hoffman spent the summers of 1966 through 1968 as a seasonal naturalist at Crater Lake. He volunteered at the park for one week in 1998.

Joy Mastrogioseppe has specialized in the study of sedges at Washington State University ever since she worked as a seasonal employee at Crater Lake in the 1970s.

Casey Baldwin is a doctoral candidate at the University of Idaho and the principal author of a conservation strategy for Mount Mazama columbia.

Gregg Pohll is a seasonal naturalist at Crater Lake who teaches at an elementary school in Chiloquin, Oregon.

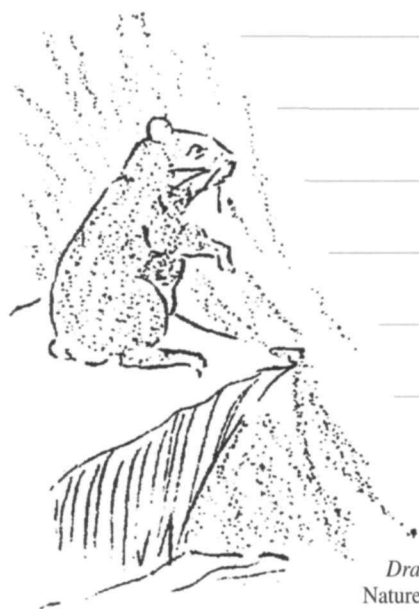
Ron Mastrogioseppe started his career as a forest ecologist at Crater Lake and has become a leading contributor to *Nature Notes* since retiring from the National Park Service in 1993.

Joseph S. Dixon served as a roving wildlife biologist and naturalist for the National Park Service before his death in 1952.

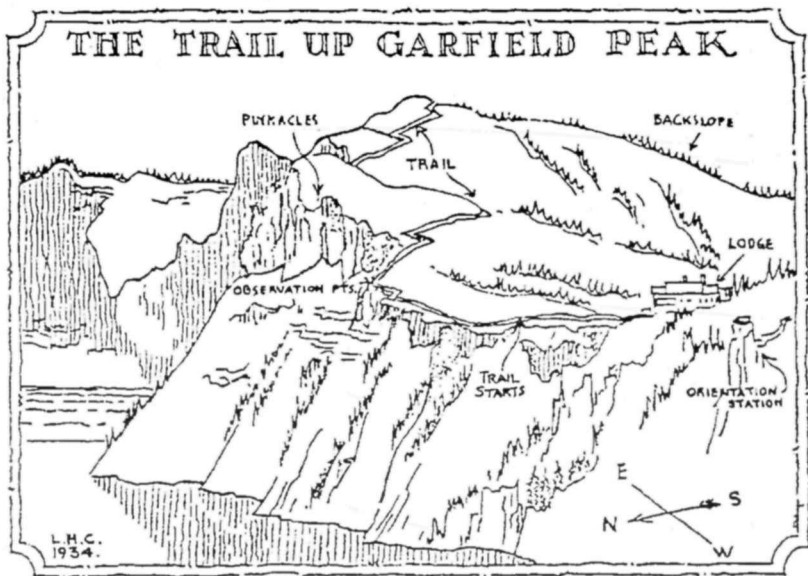
Steve Mark is a National Park Service historian who has been the editor of *Nature Notes from Crater Lake* since its revival in 1992.



Notes



*Drawing appeared in article titled "Haymaker,"
Nature Notes from Crater Lake, 5:3, September 1932.*



Above: Diagram of Garfield Peak Trail by L. Howard Crawford, August 1934.

*Back cover: Oregon State Highway Commission photo, 1947.
Courtesy of Crater Lake Museum and Archives Collections.*

Nature Notes from Crater Lake, 1999

National Park Service
Crater Lake National Park

Crater Lake Natural
History Association

Graphic Design by: Savage Photo•Graphics (541) 512-8926

