Crater Lake

Klamath County

Klamath Basin

Location

Area	13,139 acres (5,317.4 hect)	**Elevation**	6,176 ft (1,882.4 m)
Type	natural lake	**Use**	recreation
Location	in Crater Lake National Park		
Access	via Ore Hwy 62 from Medford, Ore Hwy 97 from Klamath Falls USGS		
USGS Quad	Crater Lake East (24K), Crater Lake (100K)		
Coordinates	42° 54' 19" N, 122° 05' 37" W		
USPLSS	township 30S, range 5 1/2E, section 10		

Source: Oregon Department of Transportation

Drainage Basin Characteristics

Area 26.5 sq mi (68.6 sq km)		**Relief** very steep		**Precip** 60 in (152 cm)		

Land	Forest	Range	Water	Agriculture Irrig	Agriculture Non Irrig	Urban	Other
Use %	-	-	77.5	-	-	-	22.5
Notes	Other - Rock outcrops						

Lake Morphometry

Area	13,139.0 acres (5,317.4 hect)	**Depth**	Maximum: 1,932 ft (588.9 m)	Average: 1,078ft (328.6 M)	
Ave/Max Depth Ratio	0.560	**Volume**	14,164,057 acre ft (17,496.79 cu hm)		
Shoal area	2%	**Volume factor**	1.67	**Shape factor**	1.42
Length of Shoreline	21.8 mi (35.1 km)	**Retention time**	150 yr		
Notes	-				

Water Quality

Trophic status	oligotrophic				
Sample date	average	**Temp**	62.6F (17.0C)	**Diss. Oxygen (mg/l)**	-
Transparency	95.1 ft (29.0 m)	**Phosp (mg/l)**	0.017	**Cholorophyl a (mg/l)**	0.4
Alkalinity	40	**Conductivity (umhos/cm)**	108	**pH**	7.2

Major Ions	Na	K	Ca	Mg	Cl	SO4
Ions	11.0	1.8	9.3	2.7	9.0	12.4
Notes	Data are representative, several sources					

Crater Lake is one of the scenic wonders of the American West. The clear blue lake is situated in a volcanic caldera where the top of a larger mountain, Mt. Mazama, collapsed to form a deep depression. The lake is certainly the best known water body in Oregon and lies entirely within Crater Lake National Park, Oregon's only national park. The elevation of the surface is 6176 feet above sea level, and it is the deepest lake in the United States. Maximum depth is reported to be 1932 feet. The highest point on the rim surrounding the lake is Hillman peak, 8156 feet above sea level. Crater Lake was discovered on June 12, 1853, by John W. Hillman and a party of prospectors, and was christened Deep Blue Lake. It has been know at times at Mysterious Lake, Lake Majesty, and other similar names. On August 4, 1869, it was named Crater Lake by a party of visitors from Jacksonville, Oregon. It was not until 1902 that the area received national park status. By 1918 a rough road was completed around the lake, and visitor use increased dramatically -- over 20,000 visitors in 1920. Comfortable, hard-surfaced roads have long since replaced the early, rough roads and more than 600,000 people now visit Crater Lake National Park annually.

The geologic origin of Crater Lake has been discussed in many publications. Howell Williams (1942) described ancient Mt. Mazama as :, stratovolcano, formed from lava flows alternating with layers of ejecta from explosive eruptions. In a well-illustrated monograph he depicts ancient Mt. Mazama as a peak rivaling Mt. Hood and Mt. Adams in size, perhaps 12,500 feet in height. Glaciers were present during the Wisconsin stage of the Pleistocene Epoch and eroded U-shaped valleys, now represented by notches on the crater rim. A series of explosive eruptions and readjustments in the magma chamber caused subsidence of the peak, which literally fell in. There were probably many individual adjustments rather than one continuous movement. Carbon-14 dating of charred wood beneath the pumice shows that the climatic eruption occurred approximately 6600 years ago (Baldwin 1976). Subsequent flows of lava covered the bottom of the lake. Later volcanic action and the dying phase of volcanism produced the small cinder cone known as Wizard
Island, a volcano within a volcano. There has been some reinterpretation of the eruptive history of Mt. Mazama and of the formation of Crater Lake caldera. Bacon (1983) presents evidence that Mount Mazama actually consisted of a glaciated complex of overlapping shields and stratovolcanoes, each of which was probably active for a comparatively short interval.

Crater Lake is unusual in a number of respects, not the least of which is the hydrologic regime as described by Phillips and Van Denburgh (1968). The topographic drainage basin is defined by the rim of the caldera, a surface area of 26.2 square miles. The water surface is 20.5 square miles or 78 percent of the basin. The floor of the caldera is probably underlain by lava flows somewhat less permeable than the volcanic ejecta of the caldera walls. The new lake probably increased rapidly in depth until it reached a level at which its annual water supply was substantially balanced by losses from leakage and evaporation. The level of the present water surface was attained sometime between 1000 and 4000 years ago. Thus, water is supplied primarily by direct precipitation. No perennial streams flow into the lake and there is obviously no surface outflow. In summer, the melting of accumulated snow produces many rivulets that course down the steep caldera walls into the lake. These streams are not constant in flow, but vary with changes in the rate of snowmelt. Water also enters the lake via springs near the shore and via underground percolation.

Water is lost from the lake by seepage and evaporation only. The points where the waters of Crater Lake are lost and where they reappear at the surface are unknown. Large springs emerge at levels lower than the lake in the basins of the Rogue and Umpqua Rivers and in the tributaries of the Klamath . River (Annie Creek, Wood River, and Williamson River). The total flow of these springs is many times the amount of water lost by seepage from the lake. Most of the springs have very steady flow; all are cold and clear, and the streams they feed are low in dissolved-solids content, as is the lake water. However, no direct evidence of hydraulic connection between the lake and any of the springs has been made. The best estimate is that most of the seepage from the lake mingles with underground waters that feed springs in the Klamath River Basin. Changes in lake level are a response to climatic differences from year to year. The highest level ever attained was 6187.4 feet (date unknown), based on botanical evidence. An elevation of 6172.5 feet appears to be the lowest; thus the maximum range in recent centuries is about 16 feet. Total volume of Crater Lake at its average elevation of 6176 feet is 13 million acre feet; that volume represents about 150 times the average annual water supply.

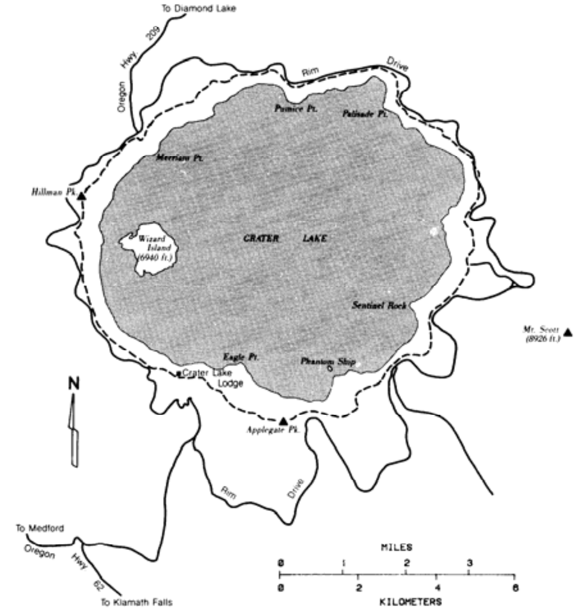
Another unusual characteristic of Crater Lake is the shape of the lake basin itself. The basin is nearly circular, and a bathymetric survey in 1959 disclosed a rather flat lake floor more than 1500 feetbelow the water surface from which a conical hill (Merriam Cone) rises to within 500 feet of the surface. The lake has a depth of at least 1920 feet over an area of one square mile. It is the deepest lake in the United States, the second deepest in the western hemisphere (Great Slave Lake in Canada is the deepest), and the seventh deepest in the world.

The water chemistry of Crater Lake is also unusual. Concentrations of chloride and sulfate are anomalously high compared to other lakes in the region. It is thought that the high concentrations of these two anions result from an influx of geothermal water deep in the lake. However, the ratio of chloride to sulfate in the lake is about 1:1 (by weight), whereas this ratio is much higher (3:18) in hot springs in the Cascades. The nutrient chemistry is also unusual. The concentration of nitrate is exceptionally low, seldom exceeding one or two micrograms per liter except very deep in the lake. The concentrations of phosphorus (0.010 to 0.015 mg/l) and silica (10 to 20 milligrams per liter) are much higher, indicating that the phytoplankton in the lake are nitrogen limited.

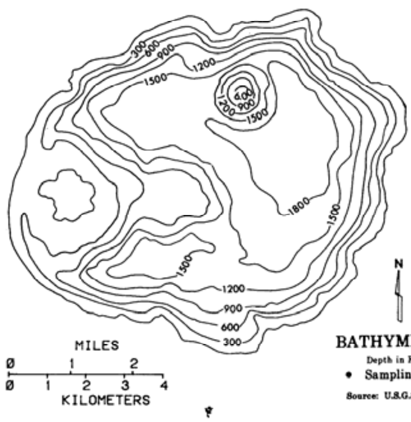
The thermal properties of Crater Lake do not fit standard limnological definitions (Williams and Herzen 1983). During summer the lake develops a warmer surface layer, as expected, although it seldom exceeds 15 degrees Celsius at any depth. On occasion the surface water is vigorously mixed by storms. Temperature profiles in summer indicate that water temperature below the surface decreases approximately exponentially, falling to 39 degrees Fahrenheit (4 degrees Celsius) between 130 and 300 feet (40 and 100 meters) deep. Below 1000 feet (300 meters), however, water temperatures increase with increasing depth. The lake is deep enough that adiabatic temperature changes are significant, and the influx of geothermal water and the warming of the bottom water by geothermal heat further influences water temperatures and vertical mixing. Water chemistry data indicate that the lake is well-mixed, further suggesting the influence of thermal convection. The lake rarely freezes in spite of its altitude and long winters.

Water transparency is much above average, with Secchi-disk observations usually between 82 and 130 feet (25 and 40 meters). The characteristic blue color of the water is primarily due to the optical properties of pure water itself. Pure water is most transparent to blue light (wavelengths of 4000 to 5000 Angstroms), and blue light is also most strongly scattered. Water containing very little particulate or organic matter, such as that in Crater Lake, is characteristically blue.

As implied by the transparency, the population of plankton in the surface water of the lake is low. An unusual feature of the phytoplankton is the depth at which it is found. Among the common phytoplankton, most are found in greatest abundance between 260 and 600 feet (80 and 200 meters) depth, including the common genera Muogeotia, Tribonema, and Stephanodiscus hantzschi. Among the common species, only Nitzschia gracilis is found in greatest abundance in the upper 80 meters (Geiger 1983, personal communication). In addition to those common species, the lake contains an unusually diverse array of less common species of phytoplankton, primarily diatoms. Measurements of productivity by carbon-14 uptake indicate that the highest productivity occurs at greater depths than observed in most lakes (Larson 1976). Measures of productivity per unit volume, oxygen saturation, water transparency, and plankton abundance all clearly indicate that the lake is distinctly oligotrophic. If productivity is added up over the active water column, the productivity per unit area is somewhat greater than is characteristic of ultraoligotrophic lakes, because primary productivity occurs over such a large range of depths. Although the transparency of the surface water would classify the lake as ultraoligotrophic, the other data indicate an oligotrophic classification.



DRAINAGE BASIN
--- Basin Boundary



BATHYMETRY
Depth in Feet
• Sampling Site
Source: U.S.G.S. 1956

Photo Caption

1. Crater Lake
2. Diamond Lake
3. Mt. Thielsen
4. Mt. Bailey
5. Klamath Marsh

Source: NASA, 1974. Vertical photograph.

TEMPERATURE AND OXYGEN