BACKCOUNTRY WATER

Backcountry use at Crater Lake is being promoted and with the increase of use, we need to be more aware of the quality of our backcountry water sources. The following is a proposed water testing plan for the summer of 1980. The table indicates testing sights and frequency for testing of the backcountry water sources. In addition to these streams, the lake should be tested twice a month and the Munson Creek which follows the power line should also be tested. With this data we will be able to make management decisions as to future testing locations and frequency.

CRATER LAKE 2/MONTH
MUNSON CREEK 2/MONTH (POWER LINE ROAD)

Priority	Location	testing frequency	Distance from trailhead
1	LIGHTNING SPRINGS	2/month	1 mile
1	ANNIE CREEK	2/month	.75 mile
1	VIDAE FALLS	2/month	0 on rim drive
2	RED CONE SPRINGS	1/month	4 miles
2	DUTTON CREEK	1/month	2.4 miles
2	BYBEE CREEK	1/month	4 miles
2	RED BLANKET CREEK	1/month	5.5 miles
3	BOUNDARY SPRINGS	1/month	8.3 miles
3	COPELAND CREEK N.	1/month	6.5 miles
3	COPELAND CREEK S.	1/month	6 miles
3	COPELAND CREEK mid.	1/month	6 miles
4	CASCADE SPRING	1/summer	1.6 miles
4	MAKLAKS SPRING	1/summer	3.3 miles
4	CRATER SPRING	1/summer	1.7 miles
4	OASIS SPRING	1/summer	3.6 miles
4	TRAPPER CREEK	1/summer	2.9 miles
4	CASTLE CREEK	1/summer	1 mile
5	BEAR CREEK	1/summer	0 on boundary
5	E. FORK SAND CREEK	1/summer	1.5 miles
5	W. FORK SAND CREEK	1/summer	1 mile
5	SUN CREEK	1/summer	.5 miles
5	CREEK S.E. OF CASTLE POINT	1/summer	2.5 miles

In an attempt to insure the quality of the water samples, the following discussion, in addition to providing complete instructions for proper water collection, offers a short explanation, federal water quality standards and the procedures implimented to make sure that these standards are met.

Testing Water Quality

In Crater Lake National Park, as in most public facilities, the sanitary quality of drinking water is determined by what is termed a "total coliform analysis" (5). This analysis tests the presence of infectious organisms in the water by way of a biological indicator: a common group of bacteria known collectively as coliform. The principal species in this group are Escherichia coli (E. coli) and E. enterobacter.

These bacteria are native to the intestinal tracts of warm-blooded animals (including humans) and enter water with fecal discharge. While themselves relatively harmless, they are typically found with other pathogenic organisms such as those responsible for typhoid fever, cholera and dysentery. Moreover, coliform usually survive longer than these disease-producing organisms thus, once the coliform have died off, the danger of infection is normally past.

The analysis for the presence of coliform bacteria consists of a simple procedure in which 100 ml of the water sample is filtered through a special filter which traps bacteria. The filter, which is treated with a fuschin dye, is then placed in a petri dish which contains a nutrient medium and allowed to incubate. The coliform bacteria will ferment the milk sugar, lactose, found in this nutrient medium and in so doing produce an acid by-product. This by-product, in turn, combines with the fuschin dye to form an iridescent green coating over the growing colonies. This allows for easy counting and identification. Each colony on the filter represents a single bacterium previously suspended in the water sample.

Further Tests

A more refined test which is used when total coliform analysis indicates contamination, is the "fecal coliform analysis" (6). Done in much the same way as the total coliform test, this procedure distinguishes those coliform which grow mainly in the intestines of warm-blooded animals from other forms of the coliform group which can come from a variety of non-fecal sources, including soil run-off. The distinction between these two is made by way of the fact that fecal coliform have a tolerance for higher temperatures. Consequently, incubation in this case is done at a higher temperature, thereby killing the non-fecal bacteria present in a mixed coliform culture.

Safe Drinking Water Act Requirements

The United States Public Health Service has set standards for the sanitation of public drinking water (6). While these are not directly applicable to backcountry water supplies, we can use them as a guideline for our studies. The law reads, "coliform shall not exceed 1 (colony) per 100 ml for the average of all monthly samples, or 4 per 100 ml in more than one sample if less than 20 samples are examined per month." (8).

Sampling Time Schedule

The above tests are currently run by Crater Lake's Water Treatment Operator on the drinking water within the park. These tests, which are performed in a lab upstairs in the Community Center, are run two days a week only. It is therefore necessary for our sampling schedule to coincide with this testing schedule. For example, this year (1979) analyses were done on Monday and Thursday of each wee, the cultures being checked after 24 hours and again after 48 hours of incubation. Since it is necessary for each water analysis to be done within 30 hours of the time of collection, this year water would have had to have been collected Sunday (or early Monday morning) and Wednesday (or early Thursday morning) to coincide with the schedule. In other words, samples should be taken the day before, or the morning of the testing day...so plan accordingly.

Sampling Procedure

When taking water samples, the following procedure should be used:

1. Do not remove cap from bottle until just before filling. Also, leave foil "hood" on bottle at all times before and after sampling.

2. Sodium Thiesulfate (white crystals) has been added to sample bottles. Do not discard.

3. Do not touch inside of cap or neck of bottle with fingers.

4. Label bottle with location, date, and time of collection.

5. Without rinsing bottle, carefully remove cap, invert bottle and lower several inches from the surface (but high enough from the creekbed so that sediments aren't introduced).

6. Invert bottle again (to upright position) and allow to fill, slowly moving the bottle upstream through the water. (Make sure that at all times your hand is downstream from the bottle mouth.)

7. Shake off about 1" of water so that bottle is filled to shoulder.

8. Recap bottle (and refoil) and transport in cool and dark if possible. (Maximum recommended transport time is 6 hours.) (5)

9. Deliver sample(s) as soon as possible to Water Treatment Operator. Analysis must be run within 30 hours of the collection time. Record time of delivery.

10. If practical, two samples should be taken at each location.

Disinfection of Water

Preliminary findings in 1979 have indicated that all non-treated water in the park (including lake water) should be disinfected before being used for drinking, tooth brushing, etc. Disinfection can be achieved by chemical treatment with

chlorine or iodine. But, according to the most recent study by the U.S. Environmental Protection Agency (EPA), the best way to make sure that water is bacteriologically safe is to boil it. (2).

Although previous government publications have recommended boiling times anywhere from 1 to 30 minutes, this study showed that holding water at or near 100°C (vigorously boiling) for 1 full minute was sufficient to kill vegetative cells of most bacteria and viruses as well as cysts of organisms (e.g. Giardia lamblia) that cause amoebic dysentery and giardiasis. (1,2).

Water should be made "aesthetically acceptable" before boiling (i.e. strained through a clean cloth to remove sediment, etc.) and should be timed from when it reaches the point of a high rolling boil rather than when bubbles first appear on the walls of the container.

Although water boils at lower temperatures at higher altitudes, the EPA also suggests that there is a margin of safety in the one minute time period that compensates for this fact. There are some heat resistant organisms which may survive this heat-time exposure, but the occurrence of such organism "would be extremely rare" (2). In order to fully sterilize water, moreover, it would be necessary to hold it at a higher pressure (e.g. in a pressure cooker) and at a higher temperature (121°C) for 15 minutes.

Recommendations

1. We recommend that water from each of the proposed sampling locations be analyzed at least once during the 1980 summer season. This will allow for a baseline inventory upon which future management decisions can be based. Findings may dictate that the proposed study should be continued into the 1981 summer season.

2. The backcountry regulations issued with all backcountry permits should include the following warning on the safety of water sources within the park:

NOTICE TO VISITORS

> Only water obtained from the piped water systems in the park can be assumed to be safe to drink. All water obtained from streams, lakes, springs, and other natural sources should be treated before it is used for drinking, tooth brushing, or cooking.
>
> Any water that is aesthetically acceptable for drinking can be made microbiologically safe by vigorous boiling for one full minute. Prior to boiling, the water should be strained through cloth to remove sediment. The one minute of boiling refers to the total time the water is at the boiling point. This state is not to be confused with the first sight of dissolved oxygen release (the appearance of bubbles on the bottom and sidewalls of the container) which occurs at a temperature far below the boiling point.

3. Other divisions, especially the interpretors, should be informed of the possible hazards of drinking untreated water within the park (including the lake water) and should have knowledge of proper means of disinfection.

There is a difference between the amount of "particulates" and the amount of contaminants found in water. Consequently, clean doesn't necessarily mean pure.

References

1. Associate Regional Director, Pacific Northwest Region. September 26, 1977. Memorandum: Water Disinfection. Seattle, Washington.

2. Kim, V.J. 1978. Emergency Disinfection of Drinking Water--Boiling. Water Supply Guidance #51. Environmental Protection Agency, Washington, D.C.

3. Klamath Basin Water and Soil Testing Laboratory. 1977. Water Sample Collection Instructions. Water Bacteriological Examination. Klamath Falls, Oregon.

4. Milipore Corporation. 1974. Total Coliform Analysis. Application Bulletin #311. Bedford, Massachusetts.

5. Milipore Corporation. 1976. Fecal Coliform Analysis. Application Bulletin #313. Bedford, Massachusetts.

6. Toops, C. 1979. A Hiker's Guide to Crater Lake National Park. Crater Lake Natural History Association, Crater Lake, Oregon.

7. Van Gieson, G. Pers. Comm. Quote from: Safe Drinking Water Acts Requirements (For Public Drinking Water).