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High Mountain Lake Research Natural Areas in Idaho

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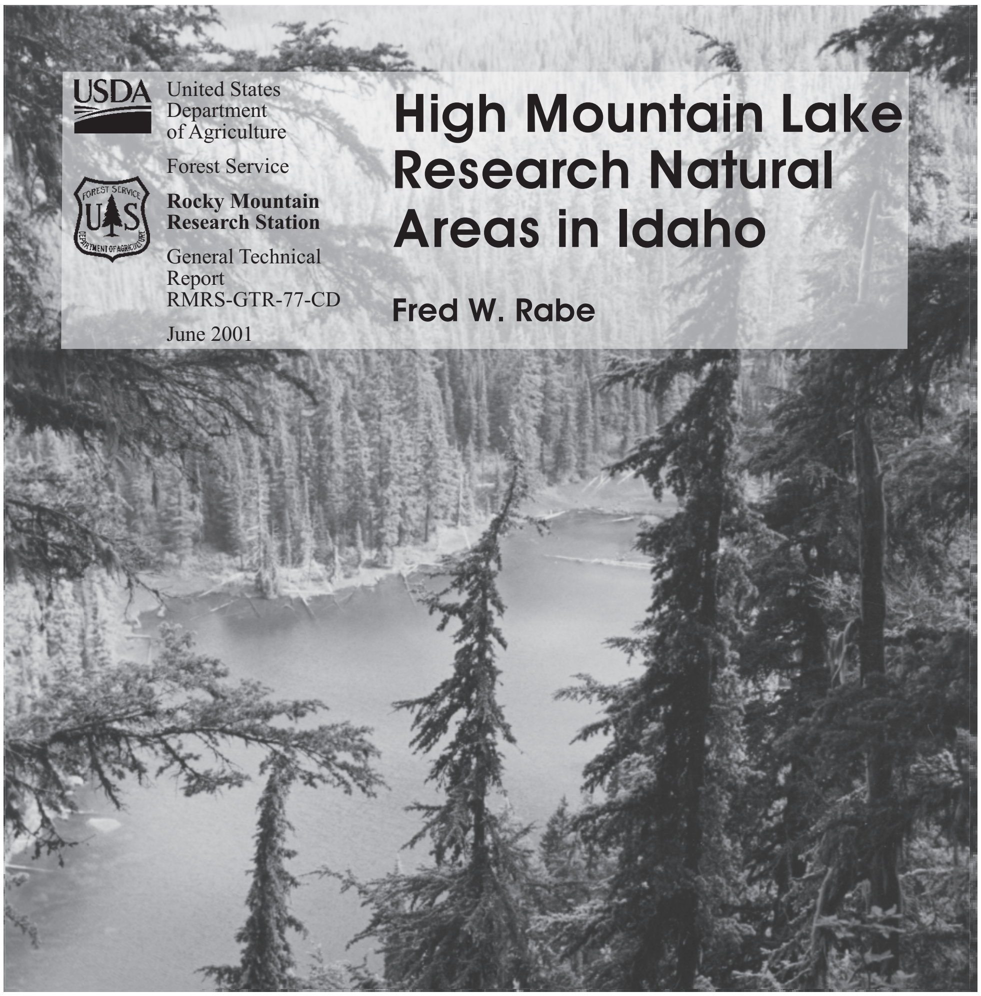

High Mountain Lake Research Natural Areas in Idaho

Fred W. Rabe

The Author

Fred W. Rabe is an aquatic ecologist and retired professor from the Biological Sciences Department at the University of Idaho in Moscow, ID.

Abstract

High mountain lakes in Idaho total about 1800 and represent one of the most pristime type ecosystems in the country. Limnological characteristics are described for 27 lakes and 20 ponds in 32 established and proposed Research Natural Areas (RNA) representing seven subregions in the state. Field collections were made from the 1960s through 1999 by different researchers. Even though data about some of these lakes is not currently available, the databases can be updated as research continues. A classification is developed to include elevation, size, depth, production potential and lake origin. Additional information that describes the sites is pH, rock type and hydrology. Aquatic plants, zooplankton, immature aquatic insects and cold water vertebrates inhabiting the water bodies are described. The classification can be applied to gap analysis to identify missing or under-represented natural area types. Future research efforts can focus on covering the gaps and bringing more high mountain lakes into the RNA system.

Keywords: high mountain lakes, lake classification, reference area, macroinvertebrates, zooplankton

Cover photo: View of Theriault Pond located in a cirque basin on the side of Marble Mountain within Theriault Lake Research Natural Area in north-central Idaho. Photo by the author, July 12, 1998.

HIGH MOUNTAIN LAKE RESEARCH NATURAL AREAS IN IDAHO

Fred W. Rabe

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Mabel Jones of the Idaho Conservation Data Center (CDC) in Boise prepared site basic record sheets of the high mountain lake RNAs which enabled me to better organize visits to the sites throughout the state. Steve Rust of the CDC reviewed the manuscript and offered some valuable suggestions.

Over a 30 year period various individuals accompanied me to the lakes and assisted in collecting data. They were Nancy Abbott, Andrea and Erin Brooks, Robert Bursik, Dana Catts, Roy Harness, Mabel Jones, Michael Mancuso, Bill Minnerly, Craig Rabe, Nancy Savage and Charles Wellner.

Individuals contributing information from their lake studies were Peter Bahls, Steve Crumb, Al Espinosa and Norm Howse. Bob Wissmar and Steve Crumb used some of the RNA high lakes as study sites for their Master's degrees at the University of Idaho.

Ben Studer of the Idaho Geological Survey provided a descriptive geology of different lake sites. In addition I used information about the geology of different RNAs compiled by the Conservation Data Center.

Sedges, grasses and shrubs were identified at some RNAs by Mabel Jones and Michael Mancuso both associated with the Idaho Conservation Data Center. Assistance in identification of macroinvertebrates came from Wade Hoiland and Russell Biggam; information about amphibians was supplied by Dick Wallace.

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Sarah Koerber, a writing and technical consultant, provided substantial editing and Dana Catts, an entomologist, and Sarah Koerber reviewed the final manuscript and provided many useful comments. Edward J. Sala made suggestions for the layout and design of the publication.


Idaho Subregions
NORTH IDAHO
1. Snowy Top RNA
2. Three Ponds RNA
3. Scotchman No. 2 RNA
4. Pond Peak RNA
IDAHO BATHOLITH
5. Theriault Lake RNA
6. Five Lakes Butte RNA
7. Steep Lakes RNA
8. Grave Peak RNA
9. Fenn Mountain pRNA
10. Salmon Mountain RNA
11. Allan Mountain RNA
12. Fish Lake RNA
13. Square Mountain Creek RNA
14. Dome Lake RNA
15. Belvidere Creek RNA
16. Mystery Lake RNA
17. Chilcoot Peak RNA
18. Cache Creek Lakes RNA
19. Soldier Lakes RNA
WESTERN FRINGE
20. Little Granite Creek pRNA
21. Patrick Butte pRNA
22. Lava Butte RNA
23. Pony Meadows RNA
24. Needles RNA*
25. Redfish Lake Moraine RNA*
26. Trinity Mountain RNA
SAWTOOTHS
27. Surprise Valley RNA
28. Smiley Mountain RNA
BROAD VALLEYS
29. Kenney Creek RNA
30. Mill Lake RNA
31. Merriam Lake Basin RNA
32. Targhee Creek RNA*
GREAT BASIN
33. Mount Harrison RNA
SOUTHEAST IDAHO
34. Bloomington Lake Cirque (proposed Special Interest Area)
* Not Surveyed
Sandpoint
Coeur d'Alene
North Idaho
Moscow
Idaho Batholith
Palouse
Lowell
Elk City
Salmon
McCall
Challis
Weiser
Western Fringe
Sawtooths
Broad Valleys
Boise
Pocatello
Snake River Plane
Southeast Idaho
Twin Falls
Owyhees
Great Basin

INTRODUCTION

High lakes in Idaho total about 1800 in number and represent one of the most pristine type of ecosystems in the country (Bahls 1992). Unlike lower elevation lakes they are seldom affected by pollution, habitat alteration or unnatural water level fluctuations. These water bodies are products of rigorous extremes over time and the biota living there often tolerate stressful physical and chemical conditions. Since they are such unique systems and occur predominantly in an unspoiled state, many of these high lakes have been established or proposed as Research Natural Areas.

Research Natural Areas are small tracts of land and water set aside by the Forest Service to provide a range of terrestrial and aquatic diversity. In addition these areas serve as baseline sites to compare to altered systems; they recognize and protect unique and representative biota; and they are used in educational and research activities.

The RNA program has existed for more than 60 years and establishes sites representative of different ecosystems, communities and processes existing on National Forest lands. In 1935, Tepee Creek RNA on the Idaho Panhandle National Forest was established as the first RNA in Idaho Since then over 207 established and 19 proposed sites have been added in the Northern Region, north Idaho and western Montana and Intermountain Region, south Idaho and Utah (Evenden et al. In press). Gaps still exist in the network but with new found knowledge, agency people and volunteers are attempting to fill them (Chadde et al. 1996, Rust 2000).

Charles Wellner retired from the Forest Service is mainly responsible for setting aside some 114 Research Natural Areas in Idaho.

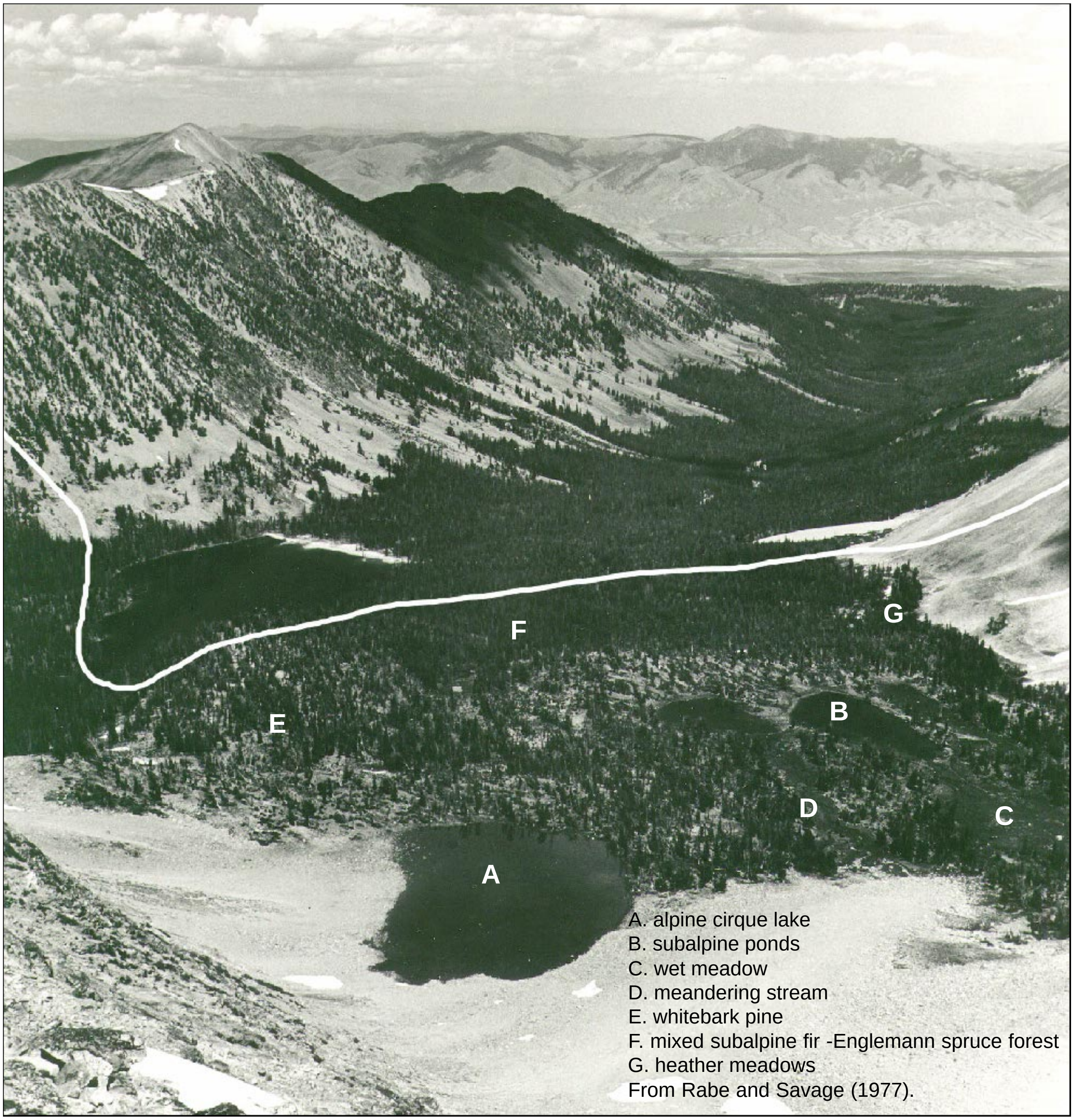
Classifying and cataloging natural diversity and identifying sites suitable for designation as natural areas has occurred at a fairly rapid rate since 1974, primarily through the activities of Charles Wellner, a retired Forest Service employee. Both agency people and university personnel have worked with the U.S. Forest Service, Bureau of Land Management, The Nature Conservancy and other organizations to continue to establish a network of these reserves in Idaho. This network is designed to include representative examples of ecosystems, habitats, and species found in terrestrial, wetland and aquatic sites.

In addition to Research Natural Areas established by the Forest Service, other types of natural areas in the network include Areas of Critical Environmental Concern (ACECs), managed by the Bureau of Land Management and Nature Conservancy preserves.

To effectively compare and evaluate potential natural areas and ensure that an adequate number of examples of every type is included in the reserve system, a classification of ecosystems that includes high lakes is necessary.

Classification of aquatic features has lagged behind that of terrestrial sites because community characteristics are not readily apparent to the observer. Furthermore, classification of aquatic resources in western states is often based on a single use such as fishery value, aesthetic uniqueness, recreation importance or wild and scenic river status.

Since about 1800 high lakes exist in Idaho, a logical selection process is needed to choose the most favorable sites for RNAs. The selection process described in this report takes into account lake productivity and geomorphic lake type. Breckenridge, with the Idaho Geological Survey, and Rabe developed this system for ranking lakes based on their research on high mountain lakes (Rabe and Breckenridge 1985).



Research Natural Areas consist of a number of cells or basic ecological units. Mill Lake RNA in the Salmon -Challis National Forest comprises an aggregation of cells. Natural area needs assessment identifies cells that are under-represented in the system (Chadde et al. 1996 and Rust 2000).

Purposes of Natural Areas

RNAs have an intrinsic value due to their natural beauty and unique habitats and ecosystems. In addition to these values, RNAs also have many practical purposes. As pristine relatively undisturbed natural systems, they are ideal to use as research and reference areas, educational laboratories and biotic preserves.

Freshwater sites have been studied very little compared to terrestrial and marine systems, even though these ecosystems harbor a diverse and unique variety of habitats and endangered species.

Steve Crumb collecting benthos from Lower Steep Lake.

Research

Natural areas may be used as research sites. Glacial lakes are usually located off the beaten path. Due to their remoteness, they are undisturbed except for occasional research activities and visits from hikers. Summaries of some of the research on high lakes are described below.

Several studies have been performed in the Five Lakes Butte area of the Bitterroot Mountains. Astudent earned his master's degree studying the density and horizontal dispersion of zooplankton in four high lakes (Wissmar and Rabe 1970). Another individual described a cutthroat trout population in a shallow sub-alpine lake (Parr and Rabe 1973). Ageneral survey of 10 lakes in the Five Lakes Butte area described selected physical, chemical and biotic conditions (Parr et al. 1968). One of these sites (Bacon Lake) is a Research Natural Area.

Bacon Lake RNA in the Five Lakes Butte area was studied by Bob Wissmar and Bill Parr.

Steve Crumb studied Upper and Lower Steep Lakes comparing the composition and density of invertebrates there (Crumb 1977). Steep Lakes RNA is on the Clearwater National Forest.The lower lake had been stocked with golden trout (*Salmo aguabonito*) and the upper lake was barren of fish. Crumb found most zooplankton species were smaller in the stocked lake presumably due to size selective predation. Some larger invertebrates such as *Gammarus lacustris*, a freshwater shrimp, were absent altogether in the stocked lake presumably reduced by fish predation.

Moseley (1996) developed methods to assess community composition and structure of plants in 10 high lakes in the Sawtooth Mountains using gradient analysis of eight physical variables including elevation and cirque aspect.

A number of limnological high lake surveys in Idaho have been made by the Forest Service and Idaho Fish and Game Department. These include the Gospel Hump Wilderness (Espinosa et al. 1977), the Seven Devils Scenic Area (Howse 1967), the Sandpoint Ranger District (Thorson 1979), and the Nez Perce National Forest (Bahls 1990, 1987). Some of the lakes surveyed in these areas are in designated Research Natural Areas.

Idaho Water Resources Research Institute at the University of Idaho supported research and publication of *Aquatic Natural Areas in Idaho* (Rabe and Savage 1977). This report describes a three year investigation of proposed natural areas in Idaho including some high mountain lakes. The publication explains development of a general classification scheme and a methodology for surveying proposed sites.

Aselection process of high lake natural areas which involved potential productivity and lake types was developed (Rabe and Breckenridge1985). It is important to choose sites that are highly productive as well as those that are less productive thus providing a range of ecosystem and habitat diversity.

Peter Bahls published an excellent discussion of the status of fish populations and management of high mountain lakes in the Western United States based largely on his extensive limnological and fisheries work in northern Idaho (Bahls 1992).

Over a period of years in the high Uinta Mountains of Utah Rabe completed age and growth studies of brook trout, *Salvelinus fontinalis* (Rabe 1968), a transplantation study of brook trout (Rabe 1967b) and an age and growth study of rainbow trout,*Oncorhynchus gairdneri* (1967a). In addition an artificial fertilization experiment was performed in several of the waters (Rabe 1969). These lakes in the Swift Creek drainage of the Uintas are protected as wilderness.

Reference Areas

Natural areas may provide baseline or reference areas. These sites enable us to better understand our impact on the world and it upon us by studying natural systems and then comparing them to systems that have been affected by human activities.

Natural areas provide reference points that we can use to measure the structure and function of ecosystems. They help define ranges of natural variability and present a clearer understanding of natural processes at work in the larger landscape. In addition, they provide an early warning system for environmental problems. The same natural laws that govern fish or plankton in a lake govern us.

The Sawtooth National Forest has been targeting high lakes in the Sawtooth Wilderness as monitoring sites (Moseley 1996). Fish, amphibians and plants are sampled in five year cycles to determine long-term trends of the baseline data measured. A floristic checklist combined with a measure of relative abundance of each species in the lakes and associated wetlands is the goal of this project.

A trip to Lower Steep Lake (Clearwater National Forest) was made to measure any impact Mount St. Helen ash fall (gray in color) might have had on plankton. Most of the lake was frozen, with ash covering the surface.

Steve Crumb compared invertebrate communities of Upper and Lower Steep Lakes in the Bitterroot Range (Crumb 1977). Mount St. Helens erupted soon after he completed his study. Since chemical and biological data for the lakes existed before the eruption, the Forest Service asked Rabe to determine what effect, if any, the ash fall might have had on the water chemistry and biota in one of the lakes.

The baseline data from Upper Steep Lake provided an important control enabling the investigators to see that a slight increase in nitrates and a decrease in zooplankton occurred after the eruption. These effects were only temporary. (Rabe 1982).

In the 1970s, some high lakes in Idaho and Montana were used as baseline sites to monitor the effects of acid rain. Since a majority of these pristine waters are nutrient poor, have relatively low pH values and a poor buffering capacity, any effects of acid rain would be easily detected compared to lower lakes and streams with harder waters and more impacted conditions.

Classrooms

Natural areas may serve as teaching sites or outdoor laboratories where we can learn more about the natural world. They are as important to field scientists as a physiology lab might be to a medical student; hence these valuable resources should be protected. We might think of natural areas as a library with each individual natural area a book, so both students and scientists can read the lives of streams, lakes, wetlands, trees, flowers, soils and landforms.

Belvidere Lakes RNA on the Payette National Forest was the classroom setting for one group of students participating in a University of Idaho ecology class in 1978. Students hiked several miles up a steep grade carrying a microscope, folding table, glassware, rubber rafts and sundry other sampling equipment. The objective was to acquaint students with the methods of sampling high mountain lakes and analyzing the data.

The class studied seven lakes. Students learned how to collect water, plankton and macroinvertebrate samples, mapped each lake and used a gill net to sample fish. Some of the samples were returned to the university for further identification and analysis. A final report was assembled by members of the class and submitted to the Forest Service. One of the students later undertook a high lake survey in the Sandpoint area for the Forest Service (Thorson 1979).

Biotic Preserves

Natural areas may act as preserves for biotic diversity and processes. The sites contain both representative and rare species of plants and animals. It is difficult to imagine studying nature without these pristine habitats in which to work. As with libraries, our understanding of ecological systems in natural areas is enhanced when we have a catalog of native flora and fauna and a description of the habitat.

The following examples demonstrate how studies in RNAs have revealed unique or unusual characteristics of high lakes. While studying plant composition in glacial lakes in the Sawtooths, Moseley (1996) observed a sedge and a rush that while common in low elevation peatlands are rarely observed at higher elevations.

Golden trout (*Salmo aquabonita*)

Lower Steep Lake (North Fork of the Clearwater drainage) is the only lake north of the Salmon River that contains a breeding population of golden trout (*Salmo aquabonita*).

The only known case of a freshwater shrimp (*Gammarus lacustris*) in high lakes north of the Salmon River was collected in Upper Steep Lake which contains no fish. Fishless lakes and ponds are important because they provide a habitat for certain invertebrates, amphibians and salamanders that might not be there if fish were present.

The Forest Service in collaboration with other agencies has established a national network of natural areas that represents terrestial, wetland, stream and lake ecosystems across the country. These sites provide outdoor laboratories for research and education and serve as sites for long term monitoring. It is now possible for scientists to cross-reference information in RNAs, Wilderness Areas, National Parks, private nature preserves, botanical areas and State heritage areas. This library of knowledge will grow as we acquire new sites and study them more thoroughly.

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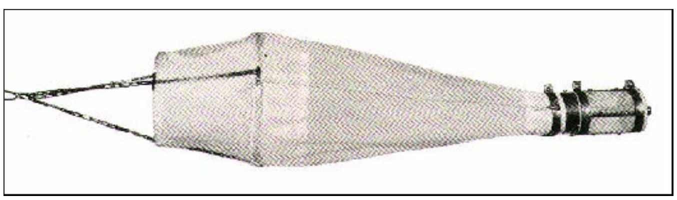
FIELD METHODS

High mountain lake RNAs are typically located in remote areas. Access to these sites is almost always via rugged hiking trails making field work especially challenging. In addition to packing in supplies and camping equipment, the researchers carried sampling gear. The sampling equipment was lightweight, durable and compact weighing less than 15 pounds. Distance and time constraints sometimes limited the number of sampling activities. Field collections were made from the late 1960s through 1999.

Shoreline sampling procedure

Some field methods were modified from Bahls (1989). Sections of shoreline too steep to hike safely were observed from high points above the lake and from the inflatable boat. The **percent coverage of terrestrial vegetation** types (trees, shrubs, herbs) in a 10 m wide strip around the lake were noted together with the percentage of **open ground coverage** (talus and rock).

Macrophytes, mostly emergent sedges, were collected with a small trowel or knife, placed in a ziplock bag, and returned to the lab for identification.



Wisconsin Plankton Net

Three *horizontal* hauls below the water surface were taken with a Wisconsin Plankton Net to collect **zooplankton**. Sampling sites around the lake were at least 10 m apart.

Aquatic macroinvertebrates were collected as the investigator walked around the perimeter of a lake. A trowel was used to scrape up sediment which was placed into a sorting screen where **benthic forms** were removed. In addition the undersides of rocks were searched for benthos. **Free swimming macroinvertebrates** such as freshwater shrimp and beetles were collected with a long handle D-net (below). The net was also used to sweep through aquatic vegetation in the littoral zone for **phytomacrofauna.** Amphibian species observed along the shore were recorded.

From a high point on shore an attempt was made to observe **dominant bottom substrate** in the littoral zone, that area in the lake less than 3 m in depth. Substrates were recorded as silt, sand, gravel, rubble, boulders, bedrock or a combination of the above.

Lake sampling procedure

Collecting samples from the lake posed a challenge. Investigators needed a boat or flotation device that was stable and sturdy enough to allow them to safely navigate the lakes; at the same time, the craft had to be light enough to carry to the research site. The Curtis Designs ultralight inflatable boat weighed only 20 ounces (see below). It is made of urethane-coated nylon taffeta with heat sealed seams. A Therm-a-Rest air mattress served as a seat and two ultralight paddles similar to ping-pong paddles were used to move the raft.

Temperature was measured directly below the water surface. A plastic bottle was filled with lake water for surface chemistry (**ph, alkalinity, conductivity**) and analysis made on shore. Water chemistry values helped determine the potential productivity of the site.

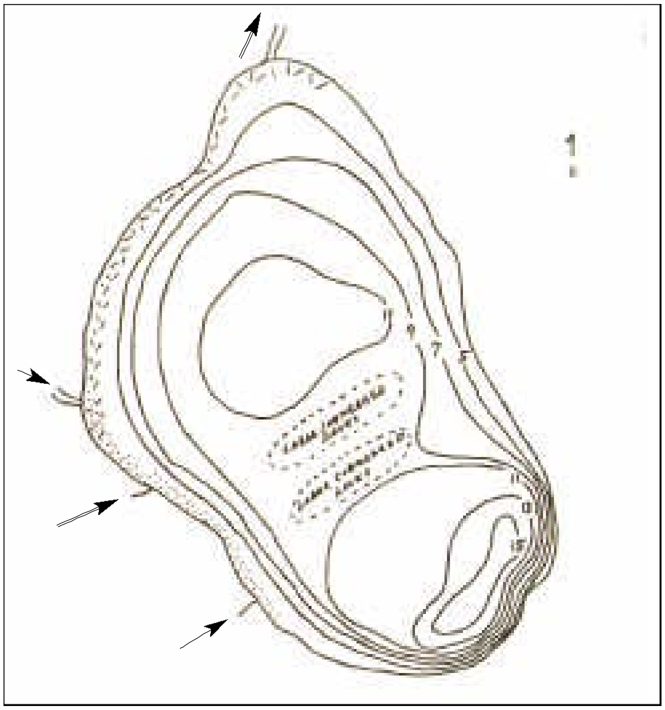
A weighted Wisconsin Plankton net was lowered 5 m or less

Littoral zone in lake with boulder and cobble substrate being dominant.

(depending upon the depth of the lake) into the water and retrieved rapidly to sample a *vertical* haul of **zooplankton.**

An estimate of the **dominant bottom substrate** and **percent littoral zone** was attempted from the boat. In addition the researcher estimated percent bottom coverage of any **submergent macrophytes.**

A **bathymetric survey** of the lake was attempted in lakes less than 4 hectares (10 acres). The study lake is photo-copied from a 7.5 minute USGS topographic map onto a transparency. An overhead projector was used to enlarge the image of the lake for tracing onto water resistant paper (Bahls 1989).

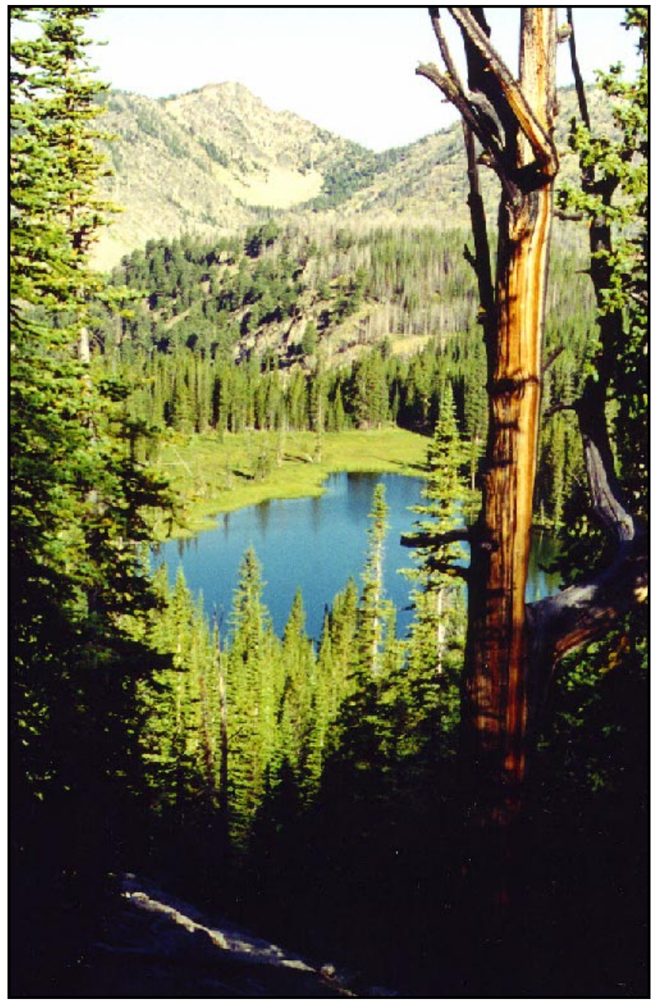


Bathymetric map of Lower Steep Lake. Contour levels in feet. Scale: 1 inch = 64 feet (From Crumb 1977).

A marked weighted line was used to measure depth along at least six transects across the lake. Location of depths sounded along transect lines were recorded on the field map. If time was limited, soundings were taken in locales where the **maximum depth** was believed to occur. Locations of seeps and streams entering or leaving the water body were noted.

Fish were collected from the raft by rod and reel.

Fish were collected from the raft by rod and reel.
The data used in this report were collected by different researchers over several years. Ideally, the data record would contain information on morphometry, water chemistry, geology, macrophytes, zooplankton, macroinvertebrates and vertebrates for every lake. Not all of this information is recorded for every lake but the databases can be updated as continued research adds to our body of knowledge. RNAs targeted as natural "classrooms" can have the dual benefit of providing hands-on research experience for students and providing valuable data for the high mountain lakes RNA library.



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CLASSIFICATION

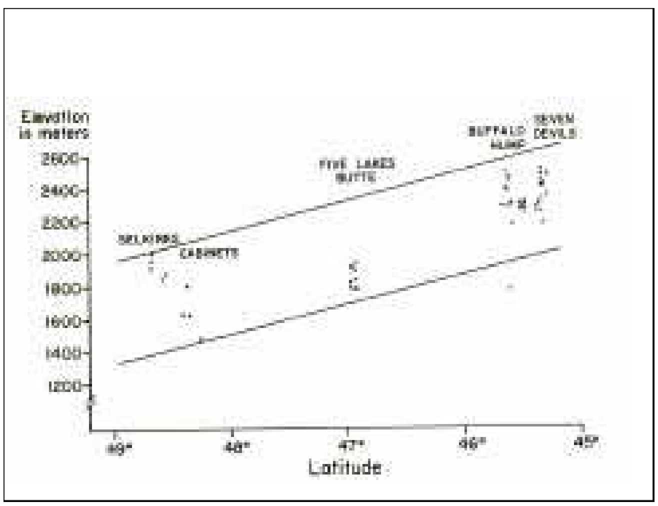
It is important to choose sites that provide a wide range of ecosystem diversity as RNAs. The classification scheme developed for high mountain lake RNAs is based on previous research by the author and others as discussed in the introduction. The system takes into account factors such as lake form, chemistry, and biotic characteristics ensuring that RNAs represent a diverse range of ecosystems.

According to Wuerthner (1986), there are 81 mountain ranges in the state; only the Snake River Plain and some large prairies and valleys lack hills and mountains. The high lake RNAs cover seven mountainous subregions determined by similarities of geology, terrain, climate and plant cover (Wuerthner 1986).

This report presents a classification that encompasses five diverse elements (Table 1). These elements are elevation, size, depth, production potential and geomorphic form.

Elevation

Elevation of lake basins can be used to reconstruct Pleistocene snow lines (Richmond 1965, Pierce 1979).



Elevation and latitude of subalpine lakes in northern Idaho (Rabe and Breckenridge 1985)

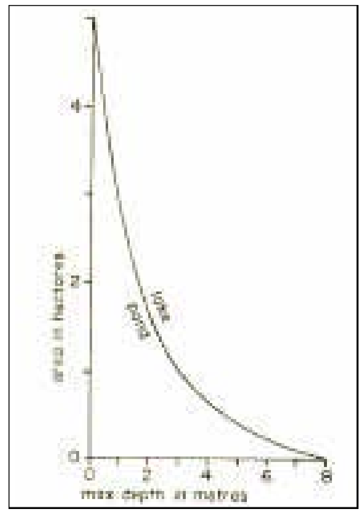
Alpine ice advances at north latitudes in Idaho reached several hundred meters lower than ice advances in the south. The average elevation of the ranges increases from south to north. The net result is that the effects and features of glaciation in northern Idaho ranges are comparable to those in southern Idaho ranges. Paleoclimatic variations and other local factors account for diversity between ranges.

Three lake categories have been associated with elevation: alpine, subalpine and montane (Table 1). **Alpine lakes** are those located above tree line. **Subalpine lakes** are usually set in a rocky basin but are not above tree line. **Montane lakes** are found lower at mid-mountain elevations.

Size-depth

Classifying water bodies according to size can be difficult. In this report they are identified as **lakes** or **ponds**. Since the terms "pond" and "lake" defy description (Reid 1961), the sites were categorized according to the above graph which takes into consideration depth and area (Anderson 1971).

The term "lake" has some additional sub-categories. **Small lakes** are defined as those less than 4 hectares (10 surface acres). **Large lakes** exceed 4 hectares in size (Bahls 1989). **Deep lakes** are over 4 meters (15 ft) in depth, and **shallow lakes** are less than 4 meters.



Curve used for designation of waters as lakes or ponds. Anderson (1971)

Production Potential

Production or productivity is defined here as the rate at which radiant energy is converted to organic substances by photosynthetic activity. Direct measurement of production in lakes involves estimates of phytoplankton productivity measured by such methods as carbon -14 and chlorophyll. The production potential of high mountain lakes can be predicted by examining certain lake characteristics that affect the productivity of these waters.

Ranking high mountain lakes on the basis of production provides a way to select certain lakes as RNAs (Table 2). The parameters chosen were modified from those of Johnston (1973) who developed an association of rank-ordered chemical, physical and biological parameters that were used to predict growth rate of fish in Cascade Mountain high lakes.

Table 1. Classification elements of high mountain lakes			
Elevation	alpine	subalpine	montane
Size	large (> 4 ha)		small (< 4 ha)
Depth	deep (> 4.5 m)		shallow (< 4.5 m)
Production potential	high medium-high	medium	medium-low low
Lake origin	cirque	moraine	upland
	cirque-scour	paternoster	other

Table 2. Association between physical, chemical, and biotic factors with production potential in high lakes			
Factor	Low production	Medium production	High production
Aspect	N	NW, NE, E	SW, S, SE
Elevation	Alpine	Subalpine	Montane
Littoral zone Percentage of lake < 3 m in depth	30	31-84	>85
Dominant bottom substrate in littoral zone	bedrock, boulders	soft sediments	cobble, rubble, gravel
Shoreline development	< 1.07	1.08-1.22	> 1.23
Alkalinity (mg/l)	< 12	13-30	> 30
Sedge beds	Few, scattered	Moderate < 50 %	Extensive > 50 %

Johnston found that where these parameters were relatively low, fish required a longer time to reach a certain length than when these values were higher. Since high lake conditions are believed to be somewhat similar in Idaho and Washington, Johnston's study was applied to selected morphometric, chemical and biotic conditions in Idaho lakes (Rabe and Breckenridge 1985).

It was assumed that the factors used to predict fish production could also be related to ranking high lakes as to potential primary production. In this study the factors used to predict production include elevation (already discussed), aspect, percentage littoral zone, dominant bottom substrate, shoreline development and alkalinity. The areal extent of shoreline emergent vegetation (sedge beds) was added as another significant factor. These factors and their relation to production potential are presented in Table 2.

The individual factors listed in Table 2 were ranked for each lake. The ranking system was derived by comparing characteristics of a large number of high mountain lakes in Idaho (Rabe and Breckenridge 1985). The factor was assigned a zero (0) if it was associated with low production, a one (1) if associated with medium production and a two (2) if associated with high production. For example a lake with a northern aspect would receive a rank of "0" for that single factor.

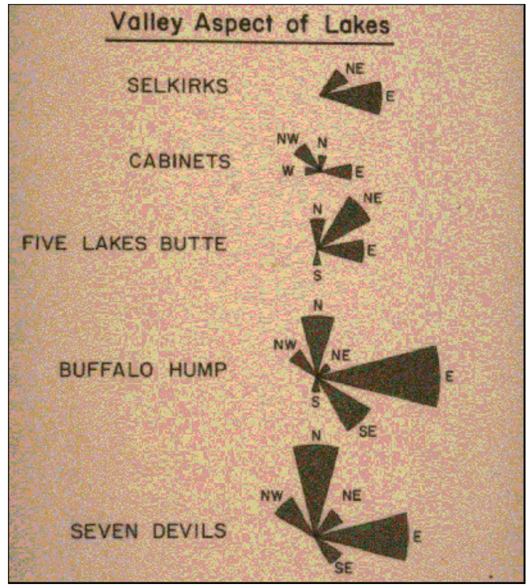
The non-weighted values for all of the factors were then added together to get an overall score, and the lake was assigned a high, medium-high, medium, medium-low or low production potential based on that score. The numeric ranges were 11-14 for high production potential, 9-10 medium-high, 7-8 medium, 6 medium-poor and 1-5 for poor production potential.

Aspect

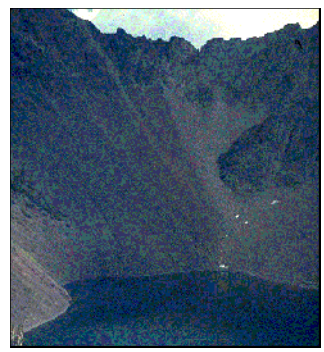
Temperate alpine glaciers tend to develop on the shaded north and northeast facing slopes, where melting rates are relatively slow. Consequently high mountain lakes that are formed by the action of alpine glaciers most commonly develop in the north or northeast quadrants. The direction of storms from the west also helps perpetuate the glaciers on the lee side by the process of snow drifting. A lake having a northern or eastern exposure will have a lower productivity score than one facing south (Table 2). Valley aspects of high lakes in northern Idaho are presented below.

Littoral zone

The littoral zone or shallow area of the lake is where sunlight penetrates to the bottom. In many cases the entire lake basin might be littoral since turbidity from plankton and suspended particles is not common in high altitude waters. Scoring of this factor is based on the percentage of the lake less than 3 m (10 ft) in depth termed the **shallow littoral zone** (Bahls 1989).The percentage littoral zone in the cirque lake below is relatively low due to the steep-sided shoreline.



Valley aspect of subalpine lakes in selected lakes in northern Idaho (Rabe and Breckenridge 1985).

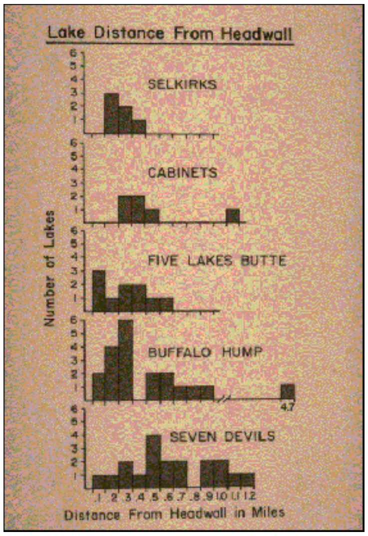


The percentage littoral zone in this steep-sided lake is small.

Bottom substrate

Bottom substrate refers to the type material on the lake bottom in the littoral zone. Substrates can vary from fine silts to rocky boulders and bedrock depending on the geology and geomorphology of the basin and the distance of the lake from the basin headwall. Bottom substrates that are comprised predominantly of small rock sizes (cobble, rubble, gravel) will have a higher production potential than lakes with either soft sediment or boulder/bedrock substrate (Table 2).

Rabe and Breckenridge (1985) studied subalpine lakes in northern Idaho and reported that those with mostly organic substrates consisting of soft sediments were furthest from the valley headwall compared to the lakes with mostly small rock, boulders and bedrock. This agrees with the geologic interpretation that the further the lake basin is from the headwall, the more mature it is and the more likely to accumulate finer-grained sediments from low energy (low gradient) streams.

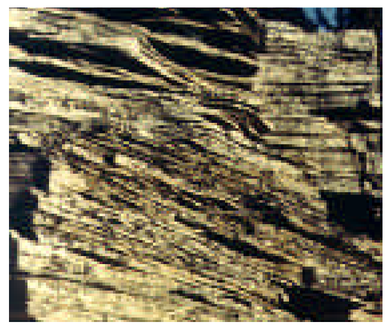


Headwall distance of high lakes in northern Idaho (Rabe and Breckenridge 1985).

Alkalinity

Alkalinity refers to the ability of the lake water to neutralize acid and is expressed in terms of $CaCO_3$ as mg/l. High mountain lakes in Idaho with less than 12 mg/l alkalinity are classed as **soft**; those 13-30 are **medium**; and greater than 30 mg/l **hard** (Reid 1961)-Table 2. Medium and hard water lakes are considered more productive than soft water lakes.

Geologic setting affects the alkalinity of high mountain lakes. In northern Idaho, Rabe and Breckenridge (1985) found that 35 of the 61 lakes sampled occurred in granite and quartzite rock types. Lakes developed in those rock types had the lowest total alkalinities (3-11 mg/l). The Belt rocks in the Cabinet drainage were thought to be less metamorphosed than those in the Buffalo Hump and as expected lakes in the Cabinet drainage had somewhat higher alkalinities. The Seven Devils Mountains consist of volcanics; lakes in that area had relatively high alkalinities compared to lakes in the granitic and quartzite areas.



Precambrian Belt Series metasediments comprise geologic formation. Photo credit: Wellner and Moseley (1986).

Shoreline development

Shoreline development refers to the amount of shoreline relative to the size of the lake: the more convoluted or irregular the shoreline, the more “edge” or shoreline development of the lake. Lakes with more edge or contact with shore have higher production potential than those more round (Table 2). A lake that has an island or a number of bays (irregular shoreline) or is elongate scores higher than one circular in outline. For a lake that is a perfect circle shoreline development is one. Shoreline development is equal to the length of the shoreline divided by two times the square root of the surface area of the lake times pi.

This circular lake has a low shoreline development. Cirque lakes more often have a lower shoreline development than moraine lakes.

Sedge beds

Sedge beds include both aquatic and semiaquatic sedges, rushes and grasses in the water or surrounding the lake shore. The presence of sedge mats provides nutrients and attachment sites for diatoms and invertebrates.

This parameter is scored by choosing between 1) low density - a scattered sedge fringe around the lake shore, 2) moderate density - no emergent sedge areas larger than five meters square and less than 50 percent of lake perimeter with sedge shoreline and 3) high density - more than 50 percent of lake perimeter with sedge shoreline or a continuous area of emergent sedges of more than five meters square (Bahls 1989).

Modifiers

Additional lake characteristics used for a more detailed classification of the site were termed *modifiers* (Rabe and Chadde 1994). They provide supplementary information

.

Table 3. Modifiers used in classification of high mountain lakes

Rock type	pH	Hydrology
Granite	acid (pH 5.5-7.4)	Stream inlet
Quartzite	circumneutral (pH 5.5-7.4)	Seepage inlet
Belt	alkaline (pH 7.5-8.4)	Stream outlet[1]
Volcanics	highly alkaline (pH > 8.4)	No surface outlet

[1]Stream outlet is sometimes described as riffle-pool, meandering glide or cascade pool type.

The island (arrow) in this lake increases shoreline development or "edge" of the waterbody because more contact occurs with shore.

within the five classification categories. The modifiers are pH, rock type and hydrology (Table 3). Lake water pH is measured in the field. Rock types for some RNAs were described by the Conservation Data Center Site Basic Records and personnel from Idaho Geological Survey.

Hydrology is based on number of seep or stream inlets and outlets to the lake. In some cases lake outlets were described more specifically as meandering glides, riffle-pools or cascade-pool types (Savage and Rabe 1979).

Extensive sedge beds exist in this lake.

Lake Origin

The diverse characteristics of high lakes are attributed to differences in geomorphic glacial processes and rates of succession acting on the system (Espinosa et al. 1977). Most of Idaho's glacial record is temporally correlated to the Wisconsin glaciation period which is represented in Idaho by both alpine glaciers and continental ice from Canada. All lakes in this study occur near the crest of mountain ranges and are considered products of alpine glaciation. Repeated glaciation took place during the Pleistocene. A useful discussion of geomorphic lake classification is found in Fairbridge (1968).

Geomorphic lake types in this study are patterned after Rabe and Breckenridge (1985).This classification describes the lake basins using very general terminology and compares them using common parameters. Six types of lakes are recognized (Table 1).

Cirque

A cirque is a deep, steep-walled recess or basin typically situated at the headwall of a glacial valley. Cirques are formed by glacial plucking and scouring with a "down at the heel and up at the toe" motion. Cirque lakes form as melt water and water from seeps and springs fill the cirque. The cirque lake is usually positioned in a cup under the crest of a peak and is flanked on three sides by steep walls.

Cirque lake

Cirque-scour

Cirque-scour lakes form when alpine glaciers scour out a basin down-valley from the headwall. These lakes usually occupy basins carved in less resistant bedrock caused by a variation in geologic structure or rock composition. The basins are often the result of multiple glaciations and represent different ice advances.

Cirque-scour lake

Paternoster

Paternoster lakes are a variety of cirque-scour lakes that form a linear chain or string of "bead lakes" connected by a stream in a glacial valley. These lakes are usually separated by steep drops or by moraines from different ice advances.

Paternoster lakes

Moraine

Moraine lakes are formed in extended valleys when the lake basin is dammed by a terminal or recessional moraine. They are montane in elevation.

Moraine lake

Upland

Upland lakes form in depressions scoured by ice caps on gently rolling or upland valleys. This type might represent early Wisconsin ice cap glaciation or an even older pre-Wisconsin period.

Upland lake

Beaver modified

Some glaciated bodies of water may be modified by beaver activities that control the water level of the lake.

Beaver modified lake

Such lowland lakes are often classed as semidrainage (Pennak 1969). *Semidrainage lakes* lack a permanent outlet. They are small in size, shallow, have a high organic content and are usually located in a meadow (meadow lake). Semidrainage lakes in this study were montane or subalpine in elevation and were mostly cirque-scour in origin.

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The Forest Service conducted a limnological survey of subalpine lakes in the Buffalo Hump area of Idaho (Espinosa et al. 1977).

Vertebrates: When observed, fish, amphibians and salamanders are described.

Literature Cited: Usually a site record or establishment record for a particular RNA is cited. These reports sometimes describe location and a brief resume of the geology and geographic setting of the RNA lakes and ponds.

Bailey, R. G. 1995. Description of the ecoregions of the United States. 2nd ed. Misc. Publ. No. 1391 (rev.) Washington DC.: U. S. Department of Agriculture, Forest Service. 108 p. plus map insert.

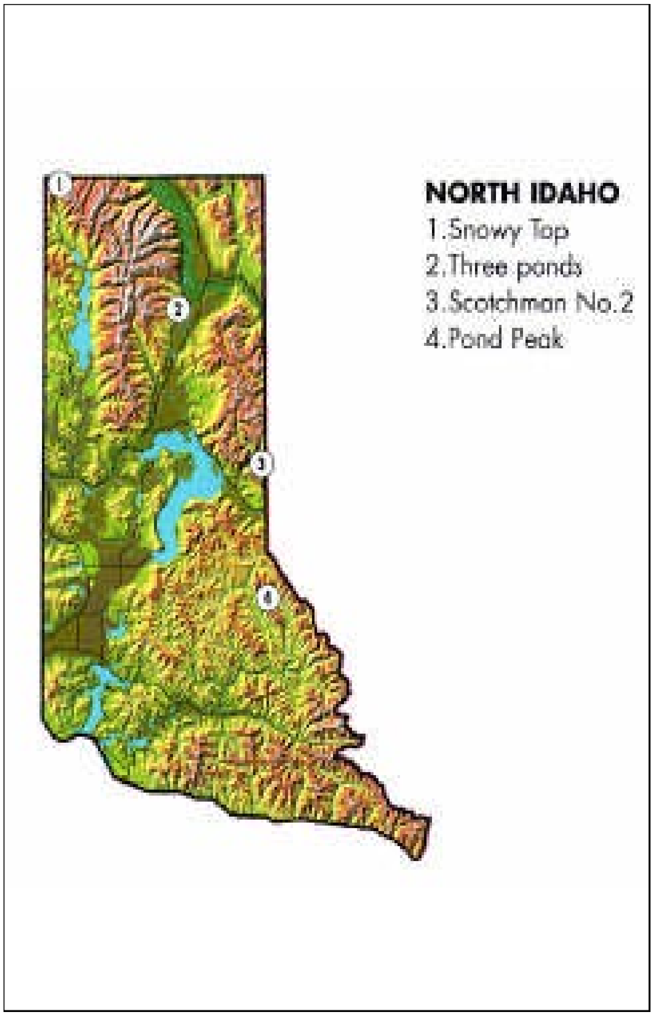
Menakis, J. and Long, D. 1986. Subsections-Landscape characterization further delineating Bailey's sections. J. Nesser and G. Ford, project coordinators. Unpublished map prepared for Interior Columbia Basin Ecosystem Management Project, U. S. Department of Agriculture and U. S. Department of Interior, Bureau of Land Management. Portland, OR.

McNab, W. H.; Avers, P. E., comps. 1994. Ecological subregions of the United States: section descriptions. Administrative Publication WO-WSA-5. Washington DC: U. S. Department of Agriculture, Forest Service, 267 p.

Rust, S. K. 2000. Representativeness assessment of research natural areas on National Forest System lands in Idaho. Gen. Tech. Rep. GTR-45. Fort Collins, CO: U.S. Department of Agriucluture, Forest Service, Rocky Mountain Research Station. 129 p.

Description of high mountain lake Research Natural Areas in Idaho

The ten subregions in the state are determined by similarities of geology, terrain, climate and plant cover. RNA high lakes described in this book are located in seven of these regions. A map of each of the subregions (see example below) preceeds the description of RNAs.



Thirty two established or proposed RNAs in the state have high lakes within their boundaries. Redfish Moraine RNA in the Western Fringe Subregion and Targhee Creek RNA in the Broad Valleys Subregion were not surveyed. Lakes in Scotchman No. 2, Needles, Patrick Butte and Kenny Creek RNAs were only photographed from the air.

Field collections were made from the 1960s through 1999. Distance and time constraints sometimes limited the number of sampling activities. In addition the data used in this report were collected by different researchers over the years. Even though information about some of these lakes is not currently available, the databases can be updated as continued research adds to our body of knowlege.

The individual descriptions of RNA lakes and ponds are arranged in the following format.

Introduction: The introduction contains information about the number of water bodies in each RNA, which ones were sampled and by whom. The sampling date is also included.

Location: This section contains the description of the geographic area, the ecoregion section, county, and the name of the USGS quad map. Although we have chosen to use the National Hierarchical Framework of Ecological Units (McNab and Avers 1994; Bailey 1995) in the publication, it is important to note that refinements in this classification have been made and are being applied within certain geographic areas. For example, the State of Idaho is utilizing a revised version of the national hierarchy that was developed for the Interior Columbia Basin Ecosystem Management Project (Menakis and Long 1996; Rust 2000).

There is also a brief description of how to reach the trailhead and in some cases the distance to the lake from the trailhead. Most lakes were accessed by hiking. A few were briefly observed by aerial fly-overs. Lakes and ponds in each RNA are identified on a USGS map.

Geology: The geology section describes rock type observed or reported from other sources. In addition the physical setting is noted.

Classification: The method for classifying the lakes and ponds is described in the previous section. Classification of the water bodies in the RNA is summarized in a table. The bullet items listed in the table refer to the elements and modifiers assessed in classifying the lakes. Elevation, size, depth and geomorphic form are grouped in the first line; production potential in the second; and applicable modifiers are grouped in the third and fourth lines.

Aquatic physical-chemical factors: For each lake the following is described: surface area, perimeter, depth, elevation, aspect, percent littoral zone, dominant bottom substrate, shoreline development, percentage of rock and type vegetation surrounding lake edge, alkalinity, conductivity, pH, and number and type of inlets and outlets. Data may be missing for some of these factors.

Vegetation: Terrestrial vegetation surrounding the water body is sometimes described. Aquatic and semiaquatic forms identified include mostly sedges.

Zooplankton: Identification of copepods and cladocera are listed.

Macroinvertebrates: Macroinvertebrates, predominantly aquatic insects, are identified from each water body. Crustaceans, snails, clams, aquatic earthworms and leeches are also listed. Macroinvertebrates are described from a lake inlet or outlet.

Vertebrates: When observed, fish, amphibians and salamanders are described.

Literature Cited: Usually a site record or establishment record for a particular RNA is cited. These reports sometimes describe location and a brief resume of the geology and geographic setting of the RNA lakes and ponds.

Bailey, R. G. 1995. Description of the ecoregions of the United States. 2nd ed. Misc. Publ. No. 1391 (rev.) Washington DC.: U. S. Department of Agriculture, Forest Service. 108 p. plus map insert.

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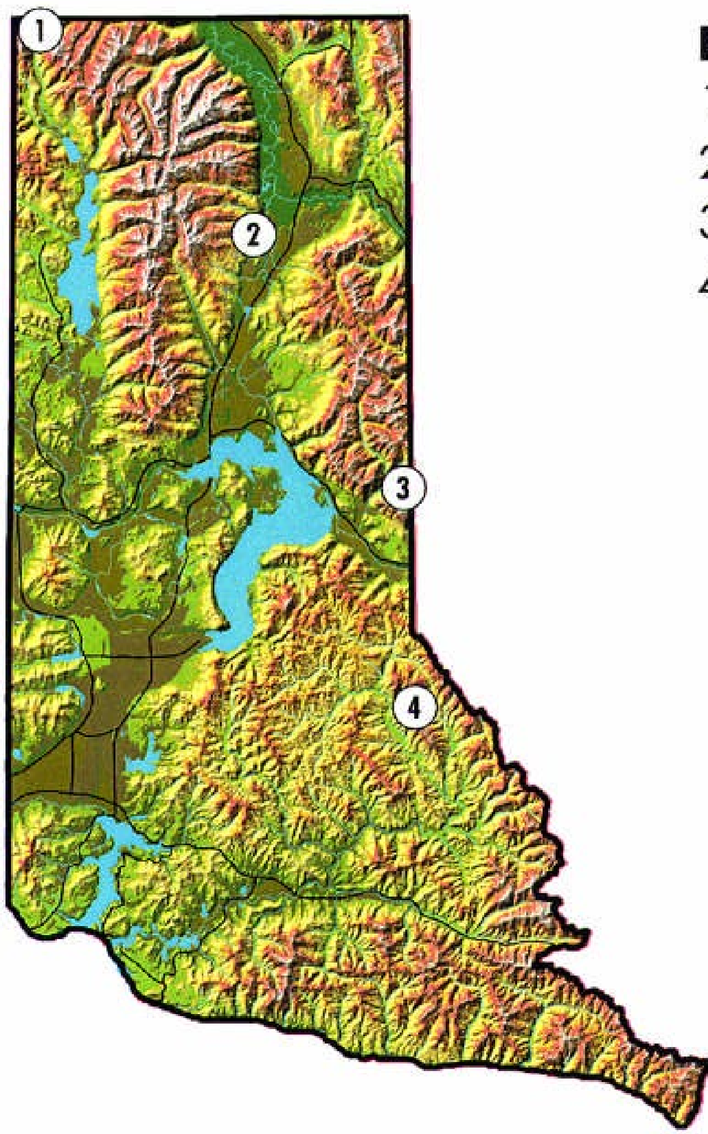


NORTH IDAHO

1.Snowy Top
2.Three ponds
3.Scotchman No.2
4.Pond Peak

SNOWY TOP LAKE

Snowy Top Research Natural Area

Idaho Panhandle National Forest

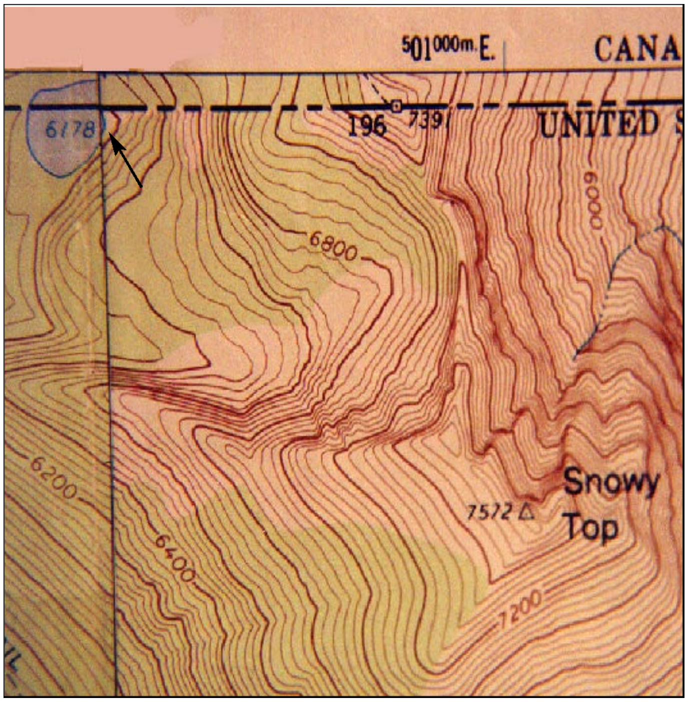
One lake is located in this RNA. It was sampled by Fred Rabe and Nancy Abbott on September 26, 1998.

Location

Snowy Top RNA is located in the northwest corner of Idaho on the Canadian border.

Ecoregion Section: OKANOGAN HIGHLANDS (M333A), Boundary County; USGS Quads: CONTINENTAL MOUNTAIN and SALMO MOUNTAIN.

The easiest route is from the Canadian side. From Creston, British Columbia drive west about 25 miles on Highway 374 to the summit of Kootenay Pass. From here, a four wheel drive vehicle with high clearance is strongly advised. Take Maryland Stagleap Service Road south (begins near snow course). Pass the road to Ripple cabin (1.7 miles) on right. Continue downhill for 3 miles to a junction. Turn right. Continue for 1.5-2.0 miles bearing left until the road ends. Proceed by foot southeast traversing the hillside until reaching a trail to the lake for about 1 1/2 miles. Ablaze through the forest marks the boundary between Canada and United States.



USGS Quads: CONTINENTAL MOUNTAIN and SALMO MOUNTAIN.

Geology

The geologic formation of the RNA is comprised of the Windermere Group of Precambrian Belt Series (Wellner and Bernatus 1990). A volcanic conglomerate with phyllite, quartzite and greenstone underlies most of the area. Volcanics of greenstone with green schist occur at the extreme western edge of the RNA (Aadland and Bennett 1979).

View of summit of Snowy Top Mountain from south. Slope of green fescue (*Festuca viridula*). Photo credit: Charles Wellner.

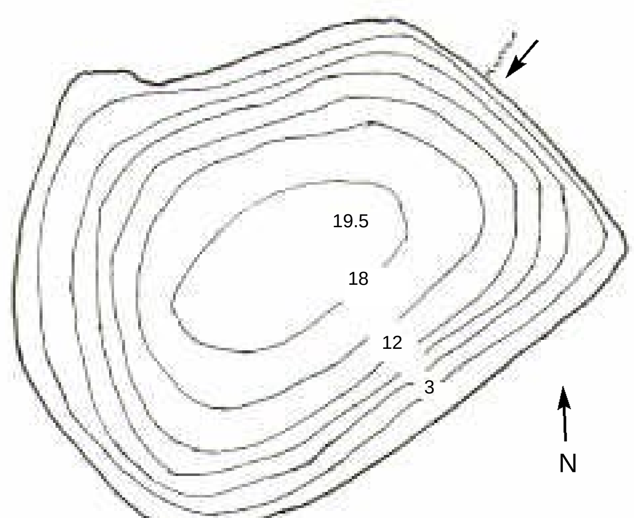
Krummholz near summit of Snowy Top Mountain. Subalpine fir (*Abies lasiocarpa*) and whitebark pine (*Pinus albicaulis*). Photo credit: Charles Wellner.

Classification

- Subalpine, small, deep cirque lake
- Low production potential
- Circumneutral water in Belt Series
- Inlet: seep; Outlet: meandering glide stream

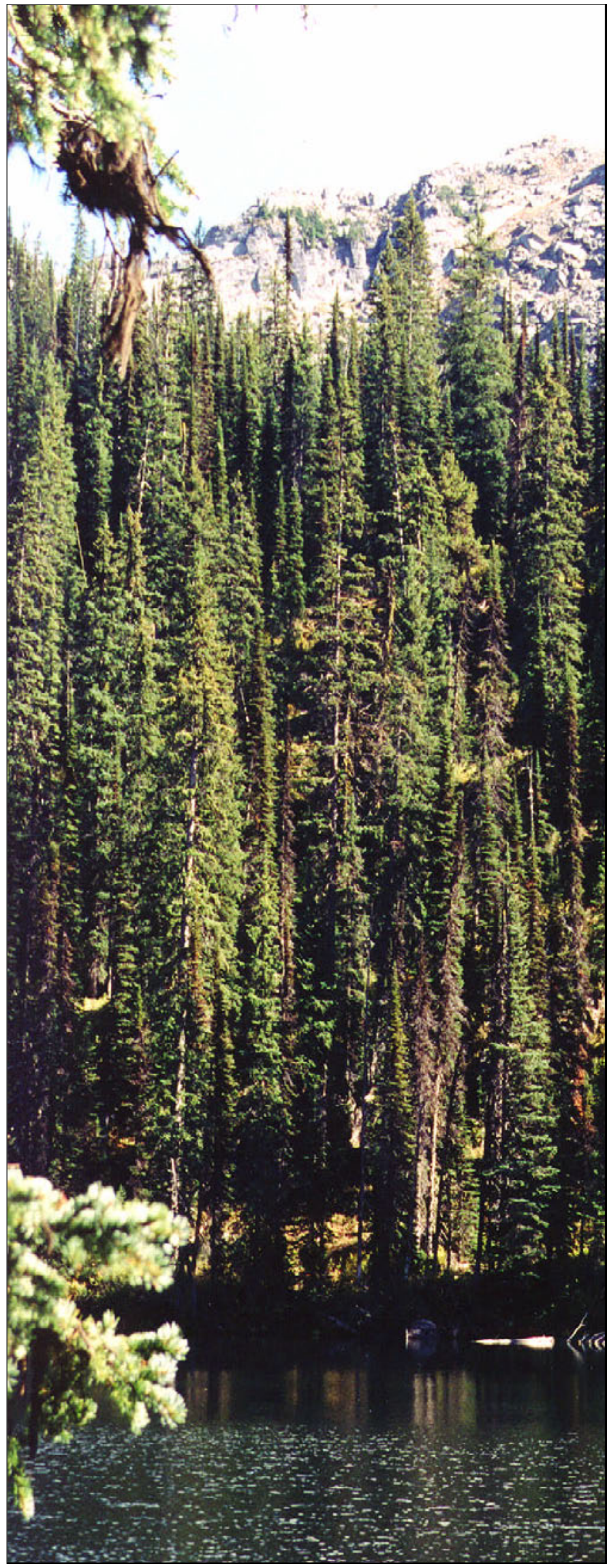
Aquatic physical-chemical factors

Lake surface area (hectares): 2.4 (5.9 acres)
Total perimeter (m): 592 (1942 ft)
Maximum depth (m): 5.9 (19.5 ft)
Elevation (m): 1884 (6179 ft)
Aspect: NW
Percent shallow littoral zone: 15
Dominant bottom substrate: soft sediment
Shoreline development: 1.06
Lake edge %: conifers-50, shrubs-50
Alkalinity (mg/l): 30
Conductivity (micromhos/cm): 65
pH: 7.4
Inlet: seep
Outlet: meandering glide stream



Bathymetric map of Snowy Top Lake
Scale: 1 inch = 84 feet
Contour levels every 3 feet

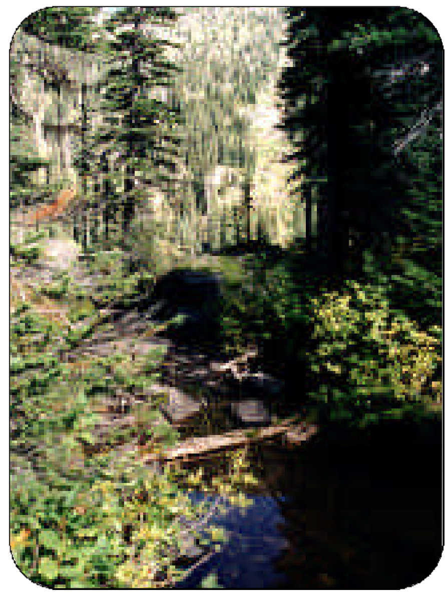
The lake depth drops off abruptly from shore thus the littoral zone is limited. The soft bottom is covered with a layer of felt-like algae. Logs have accumulated near the outlet end of the lake. The outlet stream late in September was partially dried out making it difficult for fish to gain access from the lake. The stream substrate consists of various sized rock coated with algae.



Snowy Top Lake and view of Snowy Top Mountain summit. The shoreline of the lake is ringed with conifers and alder trees.

Snowy Top Lake. The photograph was taken standing in the blaze separating Canada from the United States. The portion of the lake to the left of the blaze is in Canada and that to the right is in the U.S. The blaze continues up the slope on the other side of the lake.

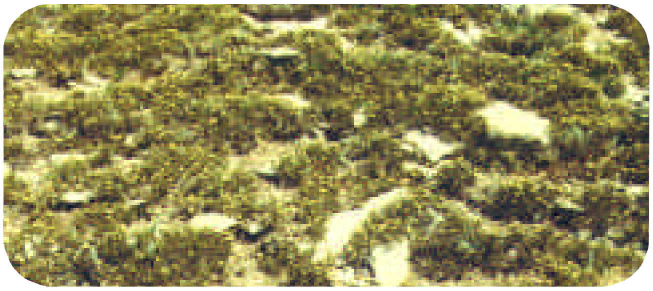
Logs piled up at outlet side of Snowy Top Lake.



Outlet of Snowy Top Lake exhibited low flow late in September.

Vegetation

Plants growing in the Snowy Top RNA lie between subalpine and alpine zones (Wellner and Bernatas 1990). Two of the most interesting habitats are subalpine fir / white rhododendron (*Abies lasiocarpa-Rhododendron albiflorum*) habitat type and the green fescue (*Festuca viridula*) grassland. Krummholz is common because climatic conditions are so severe. Dominant conifers at these high elevations are Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) and whitebark pine (*Pinus albicaulis*). Wellner and Bernatas (1990) state that Snowy Top is the only known Idaho location for alpine arnica (*Arnica alpina*) and mistmaiden (*Romanzoffia sitchensis*).



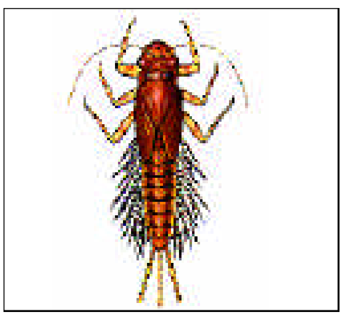
White mountain heather (*Phyllodoce glanduliflora*) near summit of Snowy Top Mountain. Photo credit: Charles Wellner.

Zooplankton

Zooplankton samples collected in the lake consisted entirely of Cyclopoida, a small copepod. In addition, a large number of what appeared to be rotifer eggs were present in the sample.

Macroinvertebrates

Macroinvertebrates were limited in number and kind possibly because of the dense population of brook trout in the lake.. *Polycentropus* was found in the lake and outlet stream.



Paraleptophlebia debilis
Sketch credit: McCafferty 1983

<u>Snowy Top Lake</u>
Ephemeroptera
- *Callibaetis* sp.

Trichoptera
- *Polycentropus* sp.

Chironomidae
Megaloptera
- *Sialis* sp.

<u>Outlet stream</u>
Ephemeroptera
- *Epeorus deceptivus*
- *Paraleptophlebia debilis*

Trichoptera
- *Polycentropus* sp.

Chironomidae

Vertebrates

A large population of brook trout (*Salvelinus fontinalis*) was present. Adults averaged seven inches in length. Young of the year fish were also present.

Mountain caribou (*Rangifer caribou*), a listed Endangered Species, migrate through the RNA on their way in and out of Canada. Snowy Top RNA is within the Selkirk Grizzly Recovery Habitat.

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Three Ponds

Three Ponds Research Natural Area
Idaho Panhandle National Forest

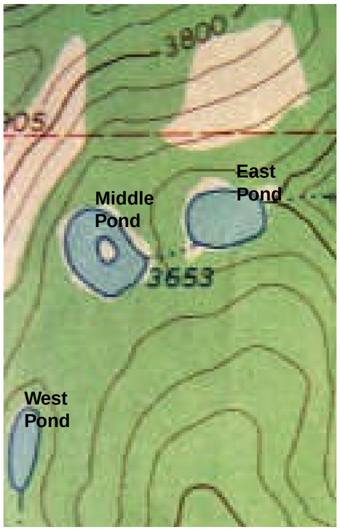
Three ponds are located in the RNA. Charles Wellner and Fred Rabe hiked to the site on June 26, 1982. Aquatic sampling occurred at the West Pond.

Location

The RNA is located on the western edge of the Purcell Trench, 4.5 air miles southwest of Bonners Ferry, Idaho.

Ecoregion section: OKANOGAN HIGHLANDS (M333A), Boundary County; USGS Quad: MORAVIA

From U.S. Highway 95 at the southern end of Bonners Ferry turn west at the golf course onto County Road 2, 1.3 miles south of the Bonner's Ferry Ranger Station. Follow Highway 2 west and south for 2.6 miles; then turn west onto Forest Road 417 and continue 0.5 miles crossing Deep Creek. Take a sharp turn to the north onto 417 and go 1.1 miles. Shortly after crossing Caribou Creek, turn west on a dirt road up Caribou Creek and follow it for 0.3 miles. Park here. Hike south across Caribou Creek and climb the steep ridge to the southwest for 1.1 miles to the boundary of Three Ponds RNA. Go south down the slope for 0.3 miles to Middle Pond. The climb from the parking area to the pond takes about 2.5 hours. Game trails are all that exist (Moseley and Wellner 1987).



USGS Quad: MORAVIA

Geology

The RNA is underlain by intrusive igneous rocks of the Kaniksu Batholith (Bond 1978). The RNA is located on the western edge of the Purcell Trench which was scoured out by continental ice sheets. Moseley and Wellner (1987) report the ponds were formed from glacial scouring that exposed the bare granitic ridges. This is especially evident north of the ponds. A deep valley marks a strike-slip fault on the west side of the RNA..

West Pond is probably the deepest of the three water bodies. A macrophyte (*Potomogeton natans*) can be seen on the water surface (arrow).

Classification

West Pond
- Montane, small, shallow, upland pond
- Medium-high production potential
- Circumneutral water in a granite basin
- Inlet: ephemeral; Outlet: ephemeral

Aquatic physical-chemical factors
West pond

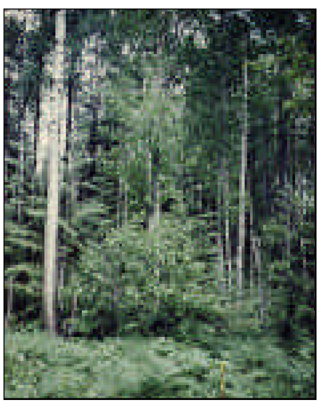
Lake surface areas (hectares): 1.1 (2.7 acres)
Length of shoreline (m): 383 (1257 ft)
Maximum depth (m): 2 (6 ft)
Elevation (m): 1114 (3653 ft)
Aspect: S
Percent shallow littoral zone: 100
Dominant bottom substrate: soft sediment
Shoreline development: 1.04
Alkalinity (mg/l): 14
Inlets: ephemeral from middle pond
Outlet: ephemeral

The semidrainage ponds are in depressions believed to have been formed scoured by ice caps on gently rolling or upland valleys (upland type origin). Beaver activity controls water level of the ponds. No major inlets are present because the ponds are on a ridgeline (Moseley and Wellner 1987). The water bodies are connected by a small intermittent stream. A deep valley near the western boundary of the RNA contains a small stream.

Vegetation

According to Moseley and Wellner (1987), about one third of the trees are mature forest that originated around 1850, and about two-thirds is a mixture of older trees and young stands that grew after a 1929 fire. The following habitat types are intermixed: Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*). On the north side of East Pond there is an excellent stand of western paper birch (*Betula papyrifera*).

Riparian vegetation common along a small stream near the western border of the RNA consists of alder (*Alnus sinuata*) and lady-fern (*Athyrium felix-femina*).A large mat consisting mostly of *Carex lasiocarpa* and sphagnum moss is located in the Middle Pond. Macrophytes on the pond surface are*Potomogeton natans*, *Myriophyllum* sp., and *Vallisneria* sp.



Western paper birch (*Betula papyrifera*)

Middle Pond. Note the large sedge/sphagnum mat and beaver lodge.

East Pond

Zooplankton and macroinvertebrates

Limited sampling of West Pond yielded Cyclopoida zooplankton and a number of macroinvertebrates, identified mostly to the family level.

West Pond	
Aeshnidae	Libelluidae
Porifera	Sphaeridae
Physidae	Caenidae
Phryganeidae	Limnephilidae
Glossiphonidae	Phyryganeidae
Dytiscidae	Gerridae
Chaoboridae	Coenagrionidae
Chironomidae	Planorbidae

An unidentified frog species was observed. No fish were noted. A more thorough collection of macroinvertebrates and amphibians from the ponds is recommended.

Literature Cited

Bond, J. 1978. Geologic map of Idaho. ID: University of Idaho, Idaho Bureau Mines and Geology. 24 p.

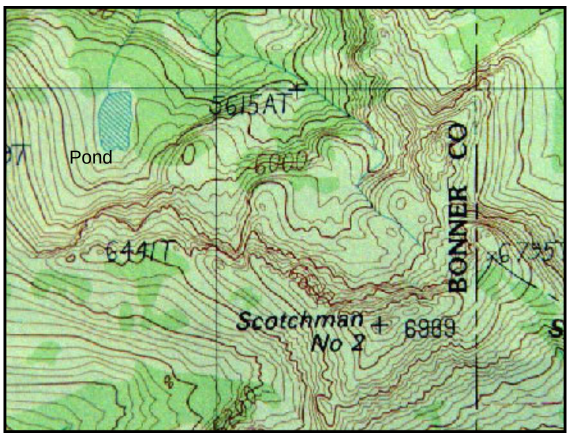
Moseley, R. K.; Wellner, C. A. 1987. Research Natural Area Establishment Record of Three ponds RNA, Boundary County, ID. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Northern Region, Ogden, UT. 21p.

Scotchman No. 2 Pond

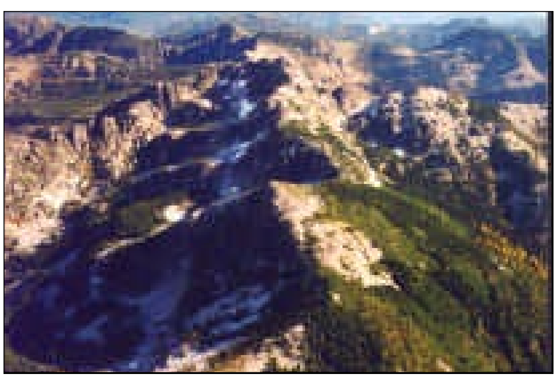
Scotchman No. 2 Research Natural Area
Idaho Panhandle National Forest

The area was photographed from the air by Dave Parker in September 1999. The site was visited by Charles Wellner and Bob Moseley to sample vegetation and establish RNA boundaries (Wellner and Moseley 1987). The RNA is located in the Cabinet Mountains about 12 miles northeast of Clark Fork in the Idaho Panhandle near the Idaho-Montana border.

Ecoregion Section: BITTERROOT MOUNTAIN (M333D), Bonner County; USGS Quad:SCOTCHMAN PEAK



USGS Quad: SCOTCHMAN PEAK.



The RNA is located in the Cabinet Mountains among fractured, tilted, folded, and glaciated sedimentary rocks that have undergone low-grade metamorphism. Photo credit: Dave Parker.

The small pond is located in the North Basin of Scotchman No. 2. Savage Mountain is in far distance. Photo credit: Charles Wellner.

The outlet to the pond (see arrow) flows a short distance and then drops off a steep escarpment to the valley below. Photo credit: Dave Parker.

Literature Cited

Wellner, C. A.; Moseley, R. K. 1987. Establishment record for Scotchman No. 2 Research Natural Areas within Panhandle National Forest. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Northern Region, Missoula, MT. 20 p.

POND PEAK POND

Pond Peak Research Natural Area

Idaho Panhandle National Forest

One pond is located in the RNA. Fred Rabe and Nancy Abbott surveyed it on June 27, 1998.

Location

The RNA is located in the Shoshone Range in the Idaho Panhandle northeast of Interstate 90 near Kingston, Idaho. The pond drains into Shoshone Creek and from there into the North Fork of the Coeur d'Alene River.

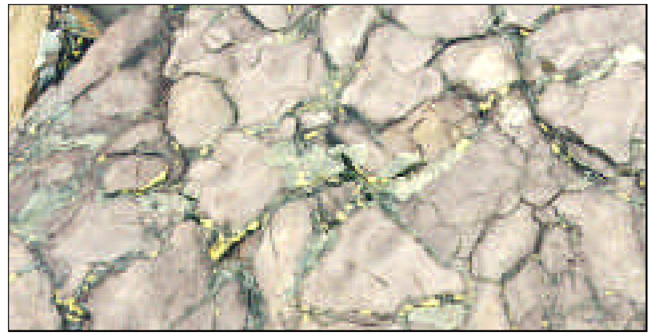
Ecoregion Section: BITTERROOT MOUNTAINS (M333D), Shoshone County; USGS Quad: POND PEAK

From Interstate 90 at Kingston, take FS Road 9 up the Coeur d'Alene River for 23 miles to Prichard. Follow FS Road 208 up the river for 6 miles almost to Shoshone Camp. Turn onto FS Road 151 then onto FS Road 412 up Shoshone Creek for 18 miles to the divide between Shoshone Creek and Jordan Creek. Take FS Road 992 south along the ridge for 7 miles to Pond Peak. The pond is reached by descending northwest about 500 feet from the top of the mountain (Wellner and Moseley 1988).

USGS Quad: POND PEAK.

Geology

The area is underlain by Precambrian Belt Supergroup metasediments that have intensely folded and faulted (Wellner and Moseley 1988). Sediments were deposited between 500 and 1500 million years ago. The Striped Peak Formation is composed of green to maroon siltite and quartzite with interbeds of argillite and some carbonaceous units. The Wallace Formation is comprised of gray and black argillites and greenish to gray carbonate-bearing siltite.



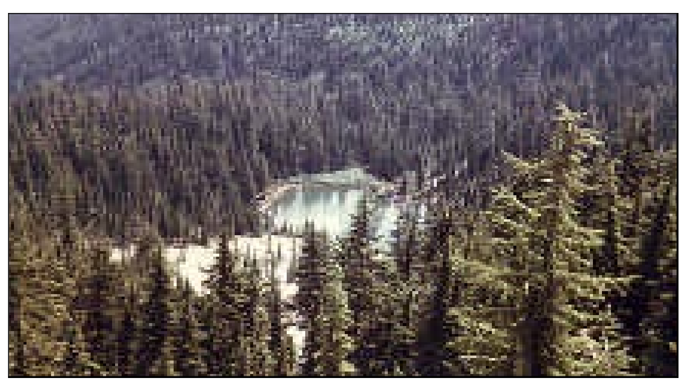
Wallace Formation of the Belt Supergroup. From: Wellner and Moseley (1988).

Ripple marks show on bedding surface. From: Wellner and Moseley (1988).

and quartzite (Savage 1967). An extensive talus slope borders the lake on the west. Ripple marks appear on some of the rock. The RNA has been glaciated and land forms created by localized alpine glaciers are present.

Classification

- Montane, small, shallow, cirque pond
- Medium production potential
- Circumneutral water in belt rock basin
- Inlet: seep; Outlet: none

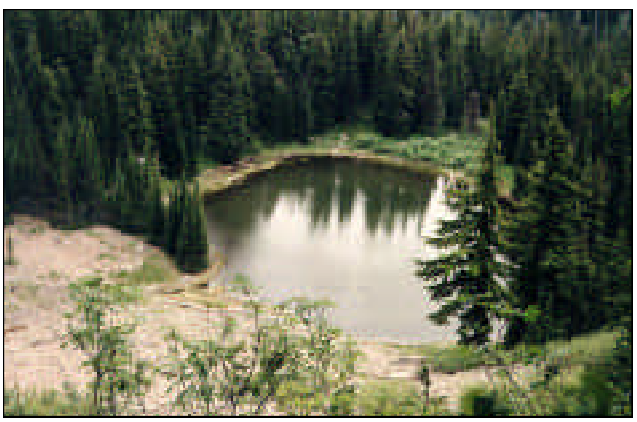


Pond Peak pond. Note Mountain hemlock trees (*Tsuga heterophylla*) in foreground.

Aquatic physical-chemical factors

Lake surface area (hectares): 0.4 (0.9 acres)
Length of shoreline (m): 231 (758 ft)
Maximum depth (m): 1.2 (4 ft)
Elevation (m): 1649 (5410 ft)
Aspect: NE
Percent shallow littoral zone: 100
Dominant bottom substrate: soft sediments
Shoreline development: 1.06
Lake edge %: talus -50, conifers-20, shrubs-15, sedges-15
Alkalinity (mg/l): 4
Conductivity (micromhos/cm): 3
pH: 6.6
Inlet: seep
Outlet: none

Extensive talus slope borders pond on west and south.



Approximately half the pond shoreline is bordered by conifers, Sitka alder (*Alnus sinuata*) and sedges.

The semidrainage pond has no outlet and is fed by springs and melting snowbanks that accumulate during the winter. In June water temperature of the spring was 6 degrees C and the lake 11 degrees C. Talus slopes of very old Precambrian sedimentary rocks line about 50 percent of the shoreline. Lentic waters are scarce in this section of thje Idaho Panhandle National Forest (Wellner and Moseley 1988).

Vegetation

Old growth stands consisting almost exclusively of mountain hemlock (*Tsuga mertensiana*) in the climax stage of succession are one of the main reasons this area was selected as an RNA.

Sitka alder (*Alnus sinuata*), sedges (*Carex* spp.) and conifers occur along 50 percent of the shoreline. The alder and sedges are concentrated on the east shore (Wellner and Moseley 1988).

Carex geyeri (elk sedge)
From: Hurd et al. 1998.

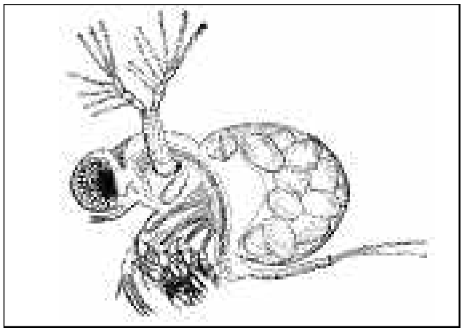
Carex geyeri - Elk sedge
Carex lenticularis - *Lens* sedge
Carex microptera - Small-winged sedge
Carex rossii - Ross sedge
Carex ulticostata - Many-ribbed sedge
Carex vesicaria - Blister sedge

A species of rush, *Juncus filiformis,* was also noted by Wellner and Moseley. In June, no aquatic macrophytes were mature.

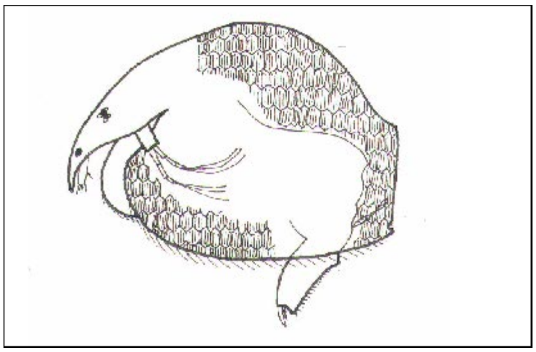
Zooplankton

Polyphemus pediculus
Chydorus sp.
Suborder Harpacticoida

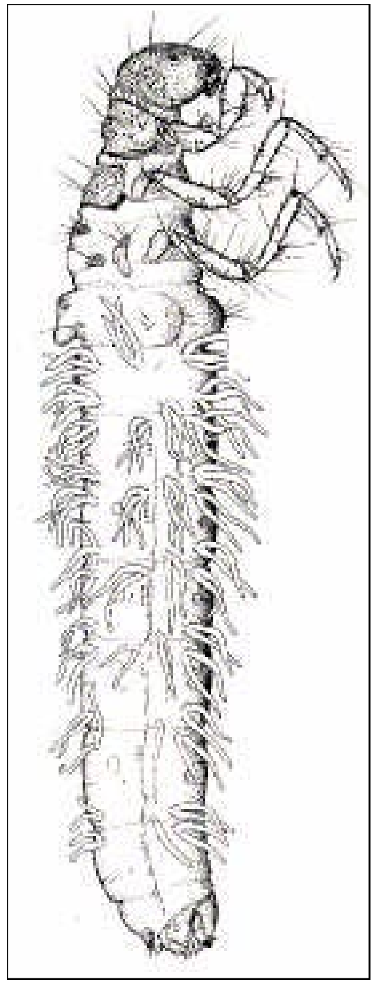
Both Harpacticoida and *Polyphemus* were dominant. They are associated with shallow, littoral areas of lakes and ponds. The head of *Polyphemus* is large, filled in front by a huge movable eye (see illustration).



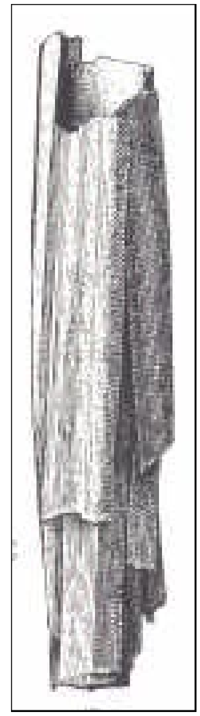
Polyphemus pediculatus is a common zooplankton in shallow weedy water. It is the sole genus in the family Polyphemidae. Sketch from Brooks (1963).



Chydorus sp. is a spherical or oval shaped zooplankton. Sketch credit: Melanie Abel.



A caddisfly (*Grammotaulius* sp.) From Wiggins (1996).



Case of *Grammotaulius*. From Wiggins (1996).

Macroinvertebrates

<u>Pond Peak Pond</u>

Trichoptera
- *Grammotaulius* sp.

Hemiptera
- *Gerris* sp.
- Family Corixidae

Coleoptera
- *Rhantus* sp.
- *Liodessus* sp.
- *Ilibius* sp.

Odonata
- Family Cordulegastridae

<u>Seep</u>

Odonata
- Family Cordulegastridae

Oligochaeta
- Family Lumbriculidae

Seven taxa were collected from the lake and two species from the small seep entering the lake.The dominant taxa was *Grammotaulius,* a caddisfly that builds its case out of sedge parts arranged lengthwise. The larvae have a yellowish-brown head bearing numerous dark spots (Wiggins 1996). They are common in small ponds and slow streams.

Literature Cited

Brooks, J. L. 1963. Cladocera In: Fresh water biology. New York: Wiley Publishers. 599 p.

Hurd, E. G.; Shaw, N. L.; Mastrogiuseppe, J. (and others). 1998. Field guide to intermountain sedges. GTR-10. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 282 p.

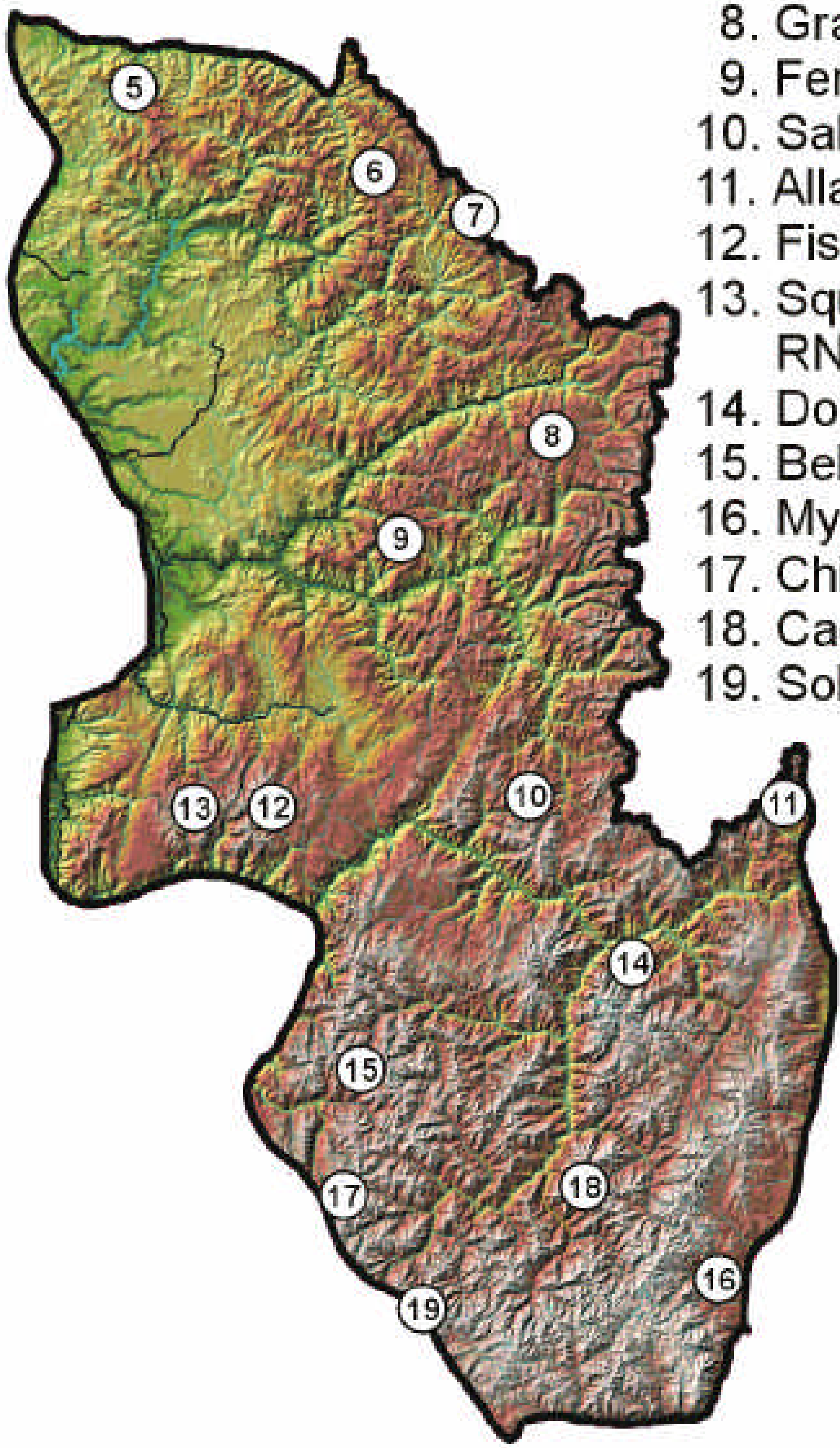
Savage, C. N. 1967. Geology and mineral resources of Bonner County, Idaho. County Report No. 6. Moscow, ID: University of Idaho, Bureau of Mines and Geology. 131 p.

Wellner, C. A. and R. K. Moseley 1988. Establishment record for Pond Peak Research Natural Area, Shoshone County. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Northern Region, Missoula, MT.19 p.

Wiggins, G. B. 1996. Larvae of the North American caddisfly genera 2nd ed. Toronto: University of Toronto Press. 267 p.

IDAHO BATHOLITH

5. Theriault Lake RNA
6. Five Lakes Butte RNA
7. Steep Lakes RNA
8. Grave Peak RNA
9. Fenn Mountain pRNA
10. Salmon Mountain RNA
11. Allan Mountain RNA
12. Fish Lake RNA
13. Square Mountain Creek RNA
14. Dome Lake RNA
15. Belvidere Creek RNA
16. Mystery Lake RNA
17. Chilcoot Peak RNA
18. Cache Creek Lakes RNA
19. Soldier Lakes RNA



Theriault Pond

Theriault Lake Research Natural Area

Idaho Panhandle National Forest

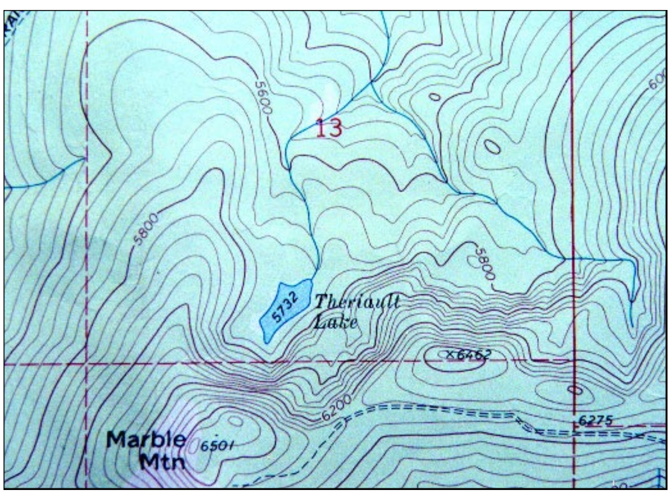
Fred Rabe and Bill Minnerly surveyed Theriault Pond on July 12,1998. According to Anderson (1971), the water body is a pond not a lake (see Classification section).

Location

Theriault Pond is a tributary to Marble Creek, a major tributary to the St. Joe River near Clarkia. The pond is located in a cirque basin on the north side of Marble Mountain.

Ecoregion section: BITTERROOT MOUNTAINS (M333D), Shoshone County; Quad: MARBLE MOUNTAIN.

From Clarkia take FS Road 301 east for one mile. Then travel FS Road 321 north over Hobo Pass down to Marble Creek. Continue on 321 until it joins with FS Road 216, 16 miles from Clarkia. Take FS Road 216 east for about 9 miles bearing left at junctions until reaching FS Road 1936. Proceed northwest on FS 1936 for 4.5 miles until road junctions with FS Road 1938. Continue on FS Road 1938 until you come to the end of the road. Hike up the trail several hundred yards to the top of Marble Mountain. Proceed down steep hillside to Theriault Pond.



USGS Quad: MARBLE MOUNTAIN.

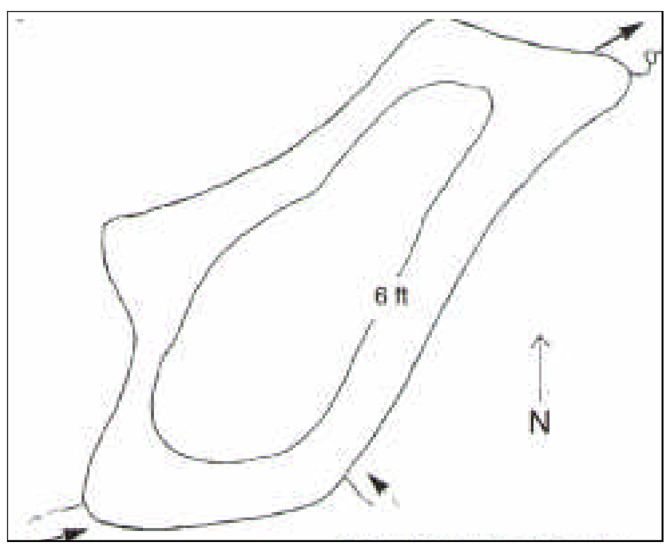
Geology

Precambrian Belt Series metasediments comprise the geologic formations of Theriault Lake RNA. Wellner and Moseley (1986) describe the geology as being metamorphosed rocks of white coarse-grained vitreous quartzite to micaceous quartzite and mica schist.

Precambrian Belt Series metasediments comprise geologic formation. Photo credit: Wellner and Moseley (1986).

Classification

- Subalpine, small, shallow cirque pond
- Medium-high production potential
- Circumneutral water in Precambrian Belt rock
- Inlet: stream; Outlet: Meandering glide stream



Bathymetric map of Theriault Pond (1 inch = 25 m).

Theriault Pond from slope of Marble Mountain with mountain hemlock (*Tsuga mertensiana*) in foreground.

Aquatic physical-chemical factors

Lake surface area (hectares): 1.7 (4.3 acres)
Length of shoreline (m): 231 (758 ft)
Maximum depth (m): 1.9 (6 ft)
Elevation (m): 1747 (5732 ft)
Aspect: NE
Percent shallow littoral zone: 100%
Dominant bottom substrate: soft sediments
Shoreline development: 1.29
Alkalinity (mg/l): 8
Conductivity (micromhos/cm): 20
pH: 7.2
Inlets: 2 seeps
Outlet: Meandering glide stream

A pool originating from an underground spring flowed into an inlet which emptied into the pond. The stream inlet averaged 0.3 m wide and 7 cm deep. Water temperature was 8.3 degrees C.

Ameandering glide outlet stream 25 cm deep and 0.3 m wide flows about 26 m into a large pool, 9 m wide, 25 m long and

View of pool about 26 m below outlet stream with Theriault Pond in the background.

35 cm deep. The stream is surrounded by sedges mostly *Carex utriculata.* Both pool and stream channels have a substrate of soft sediments. The outlet stream below the pool is 1 m wide and about 2 cm deep.

Bottom substrate was mainly composed of soft sediments and coarse particulate organic matter. An aquatic moss (*Fontinalis* sp.) is present in the water. The outlet stream temperature was 21 degrees C compared to 8 degrees for the inlets. Respiratory activities of the massive amount of plant material in the pond apparently contributed to the substantial rise in temperature of the pond.

Mountain hemlock (*Tsuga mertensiana*) with pond in background

Inlet stream flowing into Theriault Lake. The sedge, *Carex aquatilis* dominates the area.

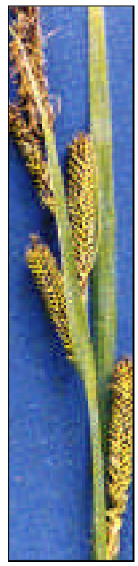
View southwest of outlet stream flowing from Theriault Pond. Here the sedge *Carex utriculata* was dominant. Marble Mountain is in background.

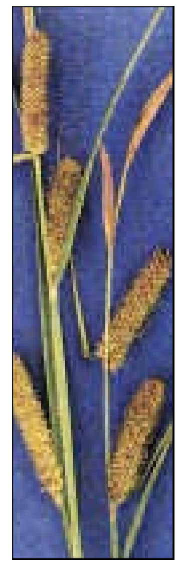
Fontinalis (an aquatic moss) found in the lower outlet stream is an indicator of soft water conditions in the drainage.

Vegetation

The habitat type of mountain hemlock-menziesia (*Tsuga mertensiana*-*Menziesia ferruginea*) is located in the RNA. The old growth mountain hemlock is associated with sub-alpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*).

The wet meadow at the inlet end of the pond is dominated by the water sedge *Carex aquatilus* and the outlet meadow by the beaked sedge *Carex utriculata.* Other sedges and rushes listed by Wellner and Moseley (1986) are Merten's sedge (*C. mertensiana*), smallwing sedge (*C. microptera*), green sedge (*C. oderi*), and the rushes *Juncus drummondii* and *J. ensifolius*.





Carex aquatilus (left) and *Carex utriculata* (right) inflorescences. They are some of the most common sedges of the Intermountain area. *C. aquatilus* has a wide distribution from foothills to near timberline. From: Hurd et al. 1998.

Zooplankton

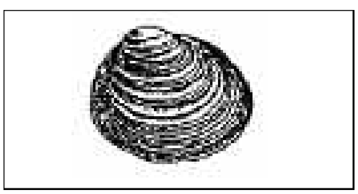
Polyphemus pediculus
Suborder Harpacticoida
Chydorus sp.

Both Harpactocoida and *Polyphemus* were dominant. The same zooplankton were found in Pond Peak Pond which was also shallow and partially surrounded by sedges.

Macroinvertebrates

	Pond edge	Outlet
Trichoptera		
Homophylax sp.		X
Protoptila sp.		X
Ephemeroptera		
Siphlonurus sp.	X	
Odonata		
Libelluidae	X	
Family Cordulegastridae	X	
Ischnura / Enallagma	X	
Coleoptera		
Ilybius / Agabus	X	X
Hemiptera		
Gerris sp.		X
Notonecta kirbiyi		X
Diptera		
Subfamily Tanypodinae	X	X
Family Psychodidae		X
Family Culicidae		X
Pelecypoda		
Pisidium sp.	X	X

Six macroinvertebrate species were collected from Theriault Pond and nine species from the outlet stream. *Pisidium*, a freshwater clam, was found by the hundreds in one square meter of sample from the pond's outlet stream. No clams were observed in the outlet below the pool, which was more shallow and had less sedge cover.



Pisidium sp., a freshwater clam.

Vertebrates

No fish were observed in the pond. However spotted frogs (*Rana pretiosa*) were extremely abundant along the edge of the pond and in the stream. This species is not as common in its western range because of development and the introduction of bass and bullfrogs (Corkran and Thoms 1996).

Spotted frogs breed in flooded meadows like those at Theriault Pond. Tadpoles live in the warmest parts however none were noted in July. The frogs are best identified by the huge black spots on the back and the belly. The underside of the thigh is opaque with a mottling of brick red to orange -red or yellow-orange (Corkran and Thoms 1996).

A Coeur d'Alene salamander (*Plethodon idahoensis*) was observed about 25 m from the lake shore in a wet area. The range of this vertebrate is somewhat restricted; it is one of the less well known amphibians in our region (Corkran and Thoms 1996).

Spotted frog *(Rana pretiosa*) was extremely common in both pond and streams. From Corkran and Thoms (1996)

Coeur d'Alene Salamander (*Plethodon idahoensis*) observed in a wet area 25 m from the pond shore. This specimen coiled up when discovered.

Literature Cited

Anderson, R. S. 1971. Crustacean plankton of 146 alpine and subalpine lakes and ponds in western Canada. Journal Fisheries Research Board Canada 28: 311-321.

Corkran, C. C.; Thoms, C. 1996. Amphibians of Oregon, Washington and British Columbia. Redmond, WA: Lone Pine Press. 175 p.

Hurd, E. G.; Shaw, N. L.; Mastrogiuseppe, J. (and others) 1998. Field guide to Intermountain sedges. GTR-10. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 282 p.

Wellner, C. A.; Moseley, R. K. 1986. Establishment Record for Theriault Lake Research Natural Area. Moscow, ID: U.S. Department of Agriculture, Forest Service. Unpublished report on file at Northern Region, Missoula, MT. 19 p.

Bacon Lakes

Five Lakes Butte Research Natural Area

Idaho Panhandle National Forest

Fred Rabe, Bob Wissmar and Bill Parr studied ten lakes including Lower Bacon Lake in the Five Lakes Butte area in 1968. Upper Bacon Lake was not sampled. Upper and Lower Bacon Lakes were established within Five Lakes Butte RNA in 1986 after a visit to the site by Charles Wellner and Bob Moseley. The following report deals with research on Lower Bacon Lake and several other lakes in the Five Lakes Butte area.

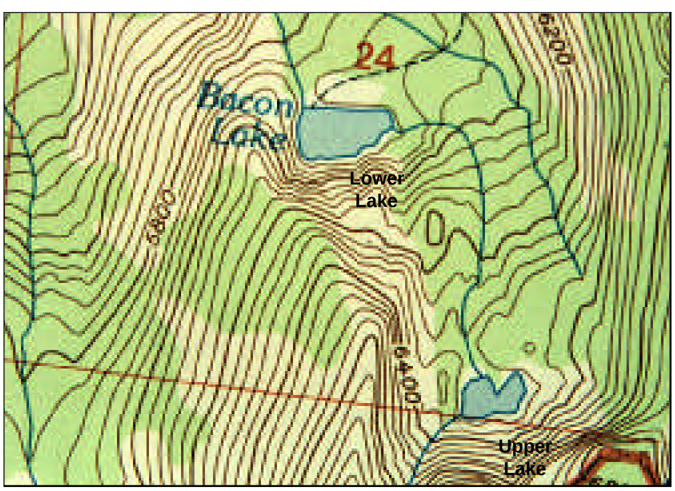
Bacon Lake basin - Lower Bacon Lake to left (see arrow). Photo credit: Charles Wellner.

Location

Upper Bacon Lake occupies a cirque and drains south into a basin entering Lower Bacon Lake about one-half mile downstream. The outlet from the lower lake flows about one-quarter mile south before converging with an unnamed creek that empties into the St. Joe River.

Ecoregion Section: BITTERROOT MOUNTAIN (M333D), Idaho County; USGS Quad: BACON PEAK.

From Superior, Montana on Interstate 90 travel Forest Road 250 south over Hoodoo Pass. Take Forest Road 720 west to Fly Hill. At Fly Hill take Forest Road 715 north to the trail going west to Five Lakes Butte. Park and follow trail approximately two miles between Tin and Gold Lakes. Leave the trail and proceed north across basin to a ridge following it to the head of Bacon Creek. The lakes are within the basin. The trailhead can also be reached from Orofino, Idaho on U.S. Highway 12. From Orofino take State Highway 11 to Pierce, Idaho and then Forest Road 250 to the Cedars (Moseley and Wellner 1988).

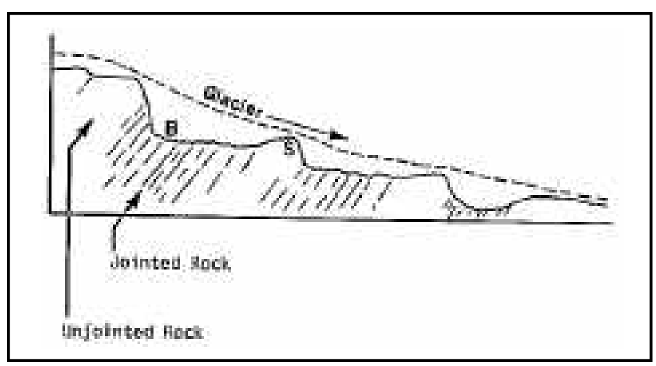


USGS Quad: BACON LAKE.

Geology

The area is underlain by Precambrian Belt Supergroup metasediments which are folded and intensely faulted (Moseley and Wellner 1988). According to Parr et al. (1968), the Wallace Formation is the only carbonate-bearing siltite and quartzite formation of the Belt Supergroup. The glaciated landscape of the area is believed to be less than 40,000 years old (Savage 1967).

Four lakes south of Bacon Lake are described by Parr et al. 1968 as being formed by glacial "quarrying" which occurred in well-jointed bedrock adjacent to the more consolidated resistant rock comprised of black and gray argillites and greenish to gray carbonates.



The dashed line is the original valley floor. The solid line is the valley floor after glaciation. B = basin; S = step. Parr et al. (1968).

Classification

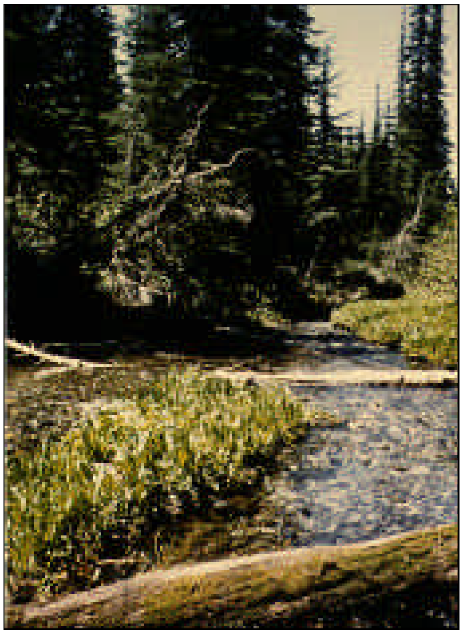
Lower Bacon Lake

- Subalpine, small, deep cirque lake
- Low production potential
- Circumneutral water in Precambrian Belt basin
- Inlet: 1 stream; Outlet: 1 stream

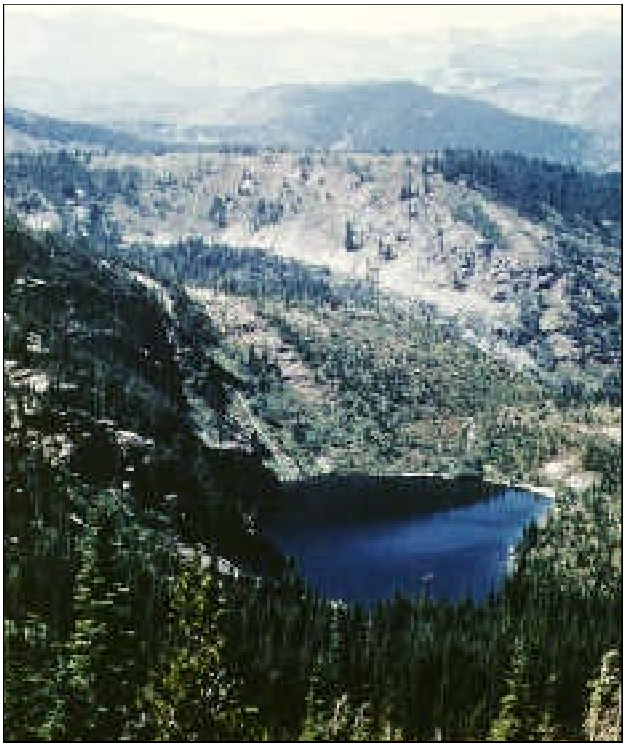
Upper Bacon Lake. Photo credit: Charles Wellner.

Aquatic physical-chemical factors

Lower Bacon Lake
Area (hectares): 2.1 (5.1 acres)
Length of shoreline (m): 597 (1959 ft)
Maximum depth (m): estimate10 m (32 ft)
Elevation (m): 1793 (5880 ft)
Aspect: NNW
Dominant bottom substrate: bedrock, boulders
Shoreline development: 1.181
Alkalinity (mg/l): 4
pH: 6.8
Inlet: 1 stream
Outlet: 1 stream



Bacon Creek. Photo credit: Charles Wellner.



Lower Bacon Lake. Photo credit: Charles Wellner.

Vegetation

Terrestrial vegetation of the RNA is comprised of successional stages of forests in the mountain hemlock series that burned in 1910 (Moseley and Wellner 1988). Relatively dense stands of subalpine fir (*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) occurred on north and east facing slopes whereas west facing slopes had little tree cover. These species also occurred in the valley bottom.

Mountain hemlock-menziesia habitat type. Photo credit: Charles Wellner.

Beargrass (*Xerophyllum tenax*) and mountain heather (*Phyllodoce glanduliflora*) are the dominant understory vegetation and avalanche chute and snowbank communities exist on the cirque headwall.

Carex sp., *Sparganium* sp., *Isoetes* sp., *Fontinalis* sp. and *Drepanocladus* sp. occurr in and around the lower lake. *Isoetes* (quillwort), a rooted submergent, is present in the shallows where the bottom is soft enough for rooting. *Fontinalis,* an aquatic moss, and algae grow profusely around springs in Copper and Tin Ponds a few miles south of Bacon Lake (Parr et al. 1968). A high concentration of carbon dioxide in the vicinity of the spring may account for this growth. *Sparganium* (bur-reed) is an emergent confined to the littoral zone where depth is less than one meter.

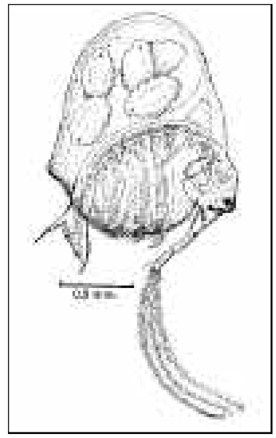
Sparganium sp. (Bur-reed) growing in the littoral zone of Lower Bacon Lake.

Zooplankton

Lakes in Five Lakes Butte area

Diaptomus sp.
Daphnia sp.
Holopedium gibberum
Conochilus sp.

The cladoceran, *Holopedium gibberum*, is considered an indicator of ultra-soft water lake environments (Pennak 1991).



Holopedium gibberum
From: Brooks (1959).

Macroinvertebrates

Ten lakes in the Five Lakes Butte area

Family Ceratopogonidae
Family Limnephlidae
Family Dytiscidae
Family Sialidae
Family Libelluidae
Family Sphaeriidae
Class Oligochaeta

Immature Ceratopogonidae (biting midges). The adults are known as “punkies” or “no-see-ums.” Their mouthparts are modified for piercing. Sketch credit: Melanie Abel.

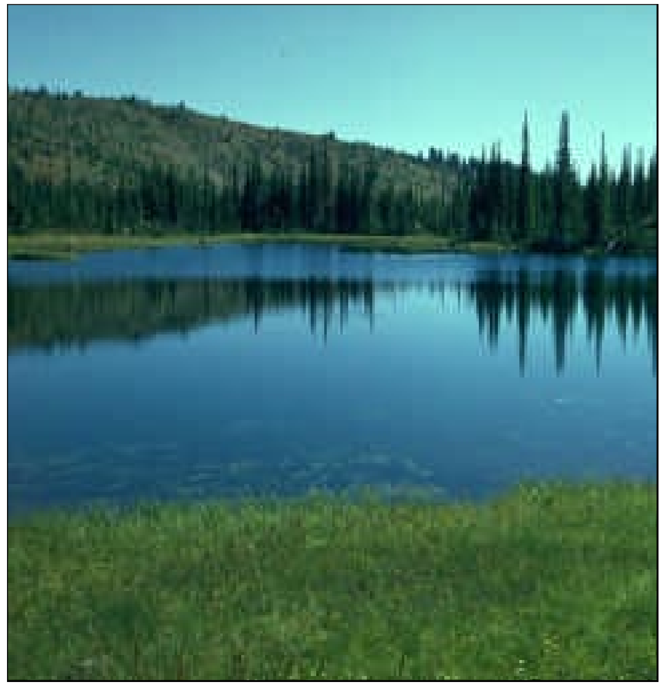
Research

Before Bacon Lake was established as an RNA, research occurred on four lakes adjacent to Bacon Lake. These studies resulted in four publications in refereed journals.

Wissmar and Rabe (1970) studied zooplankton populations and sampling techniques in four mountain lakes in the Five Lakes Butte area. Samples were based on vertical plankton hauls using four different field methods of collection together with various sample sizes. It was concluded that both rocky and semidrainage type lakes had similar species composition and low density of crustaceans.

View of two high lakes in the Five Lake Butte area. Gold Lake is in foreground and Silver Lake in the background. Methods of zooplankton collection in these lakes were studied by Wissmar and Rabe (1970).

Sampling zooplankton from Gold Lake.



Copper Pond is in the Five Lakes Butte area. It is a semi-drainge pond lower in elevation than Gold and Silver Lakes pictured in the opposite column. Instead of a rocky basin it is located in a meadow.

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Steep Lakes

Steep Lakes Research Natural Area
Clearwater National Forest

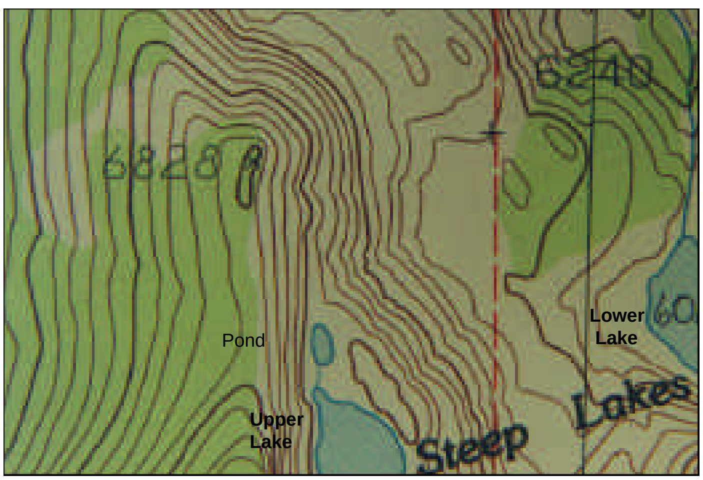
During the summer of 1997, Fred Rabe and Steve Crumb conducted research at the two Steep Lakes and pond.

Location

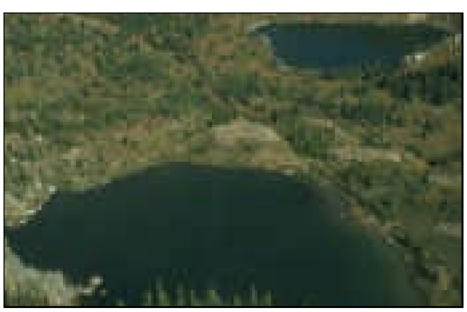
Steep Lakes are located northeast of Lewiston at the head of the Clearwater River drainage straddling the Idaho/ Montana border.

Ecoregion Section: BITTERROOT MOUNTAIN (M333D), Clearwater County; USGS Quad: STRAIGHT PEAK.

From Superior, Montana on I-90, follow FR 250 over Hoodoo Pass and FR 5450 up Goose Creek to its end. Hike Trail 414 which parallels Goose Creek for 1.5 miles to the mouth of Steep Creek. Access to the lower lake is by a steep one mile unimproved trail. An undeveloped campsite is located above the lower lake on the northwest side in the timber. The upper lake and pond are reached by hiking over 500 feet up a steep incline .



USGS Quad: STRAIGHT PEAK.



Upper and Lower Steep Lakes.

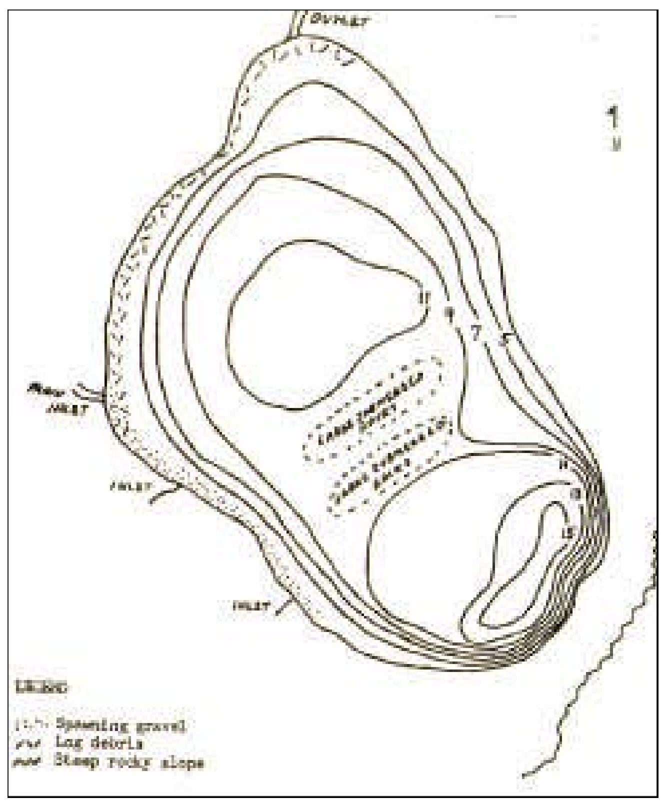
Geology

Upper and Lower Steep Lakes are subalpine cirque lakes si ated on the west side of the Bitterroot Range in the headwate of the North Fork of the Clearwater River. The site is Precambrian Belt quartzites and argillites that have been su jected to alpine glaciation. Carbonaceous argillites are present the basins accounting for the relatively high calcium carbona content of the water (Crumb 1977).

Classification

Upper Steep Lake
- Subalpine, small, deep cirque lake
- Low production potential
- Alkaline water in Precambrian Belt basin
- Inlet: 1 stream, 1 seep; Outlet: 1 stream

Lower Steep Lake
- Subalpine, small, shallow cirque lake
- Low-medium production potential
- Alkaline water in Precambrian Belt basin
- Inlet: 1 stream, 2 seeps; Outlet: 1 stream



Bathymetric map of Lower Steep Lake. Contour levels in feet, Crumb (1977).

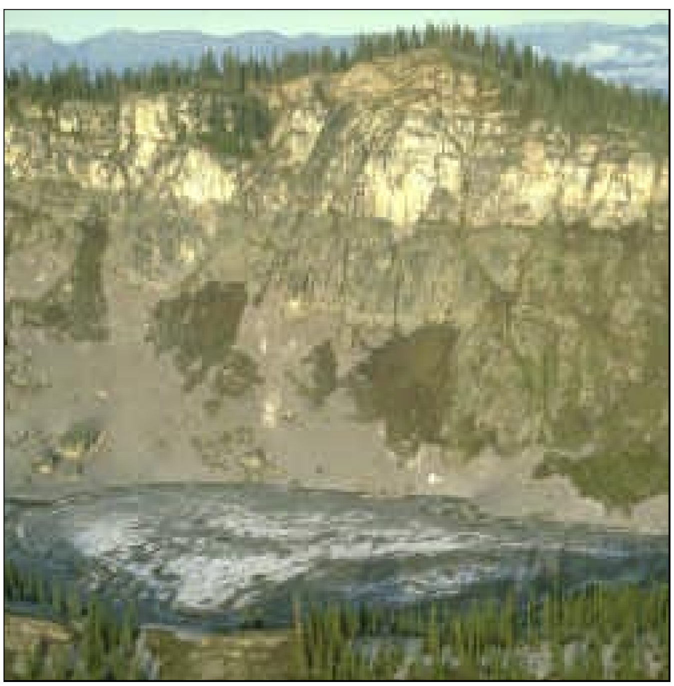
Aquatic physical-chemical factors

Lower Steep Lake

Area (hectares): 2.3 (5.8 acres)
Length of shoreline (m): 610 (2001 ft)
Aspect: NW
Maximum depth (m): 4.7 (15 ft)
Elevation (m): 1800 (5904 ft)
Percent shallow littoral zone: 20
Dominant substrate: primarily silt and large boulders
Shoreline development: 1.142
Alkalinity (mg/l): 50
Inlets: 1 stream, 2 seeps
Outlet: 1 stream

Lower Steep Lake is in a steep-walled cirque basin with a "V" shaped draw at the outlet. The outlet stream from the lake flows for about 150 feet at a low gradient before it cascades into a steep canyon. The upper portion of the outlet stream is partly blocked by log debris forming a barrier preventing loss of fish from the lake. The main inlet stream is on the west side of the lake and provides about 150 feet of 1/4 inch to 1 inch spawning gravel. Two other small seeps enter from the southwest side.

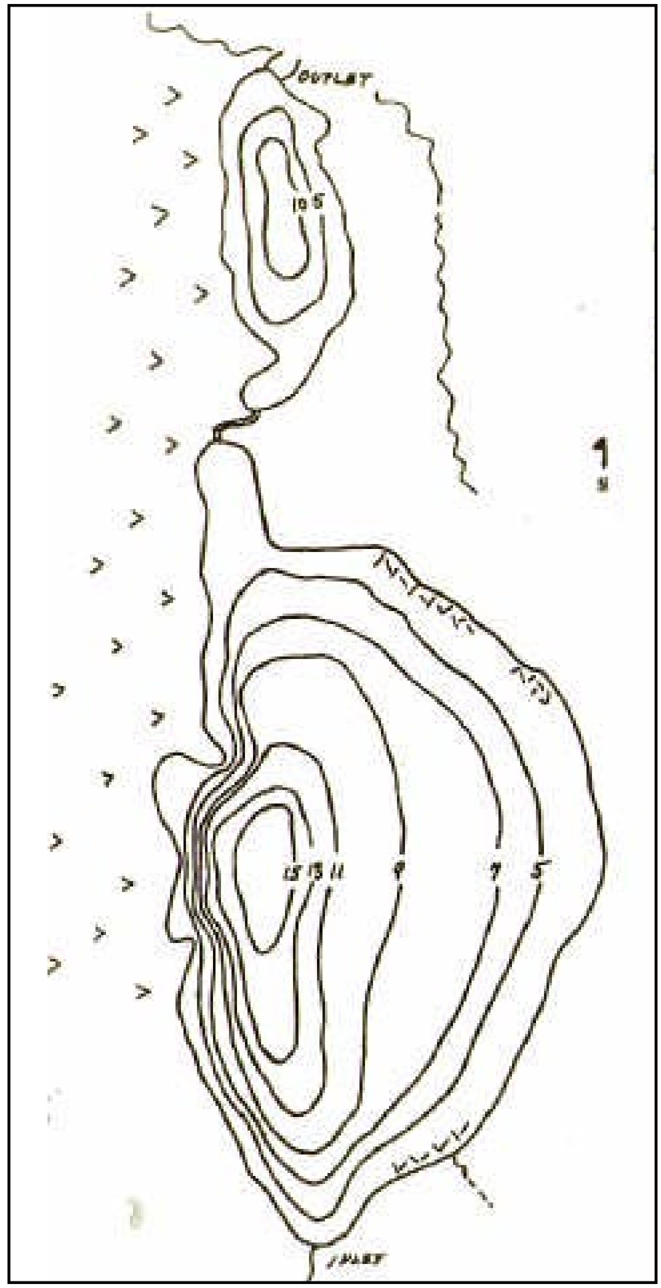
The lake substrate consists of fine silt and large angular boulders. Considerable log debris extends along the northwest side and provides good cover for trout. Underwater springs provide oxygenated water that help the trout survive in the lake during the winter months when oxygen might be limited.



Lower Steep Lake.

Upper Steep Lake

Area (hectares): 2.3 (5.7 acres)
Length of shoreline (m): 625 (2051 ft)
Maximum depth (m): 4.6 (15.1 ft)
Elevation (m): 2012 (6600 ft)
Aspect: N
Percent shallow littoral zone: 20
Dominant substrate: silt and angular boulders
Shoreline development: 1.172
Alkalinity (mg/l): 50

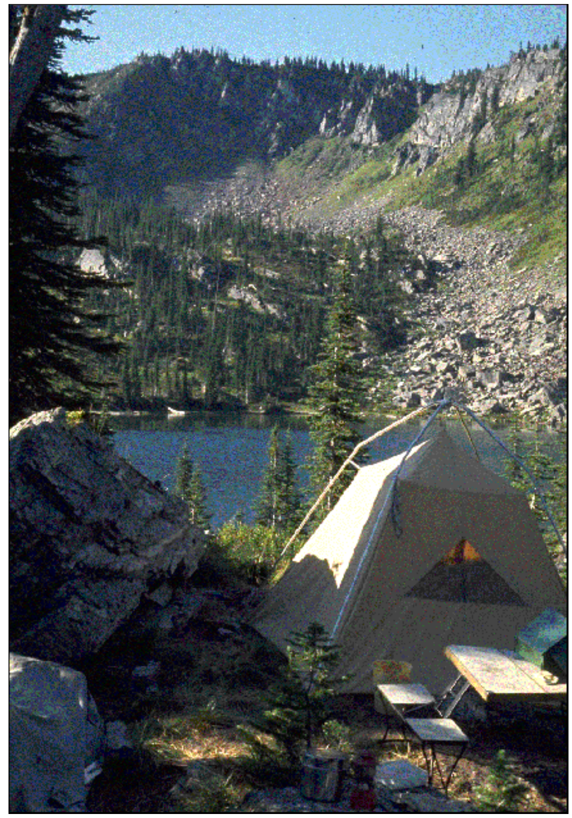


Bathymetric map of Upper Steep Lake and pond. Contour levels are in feet. Crumb (1977).

Upper Steep Lake is southwest of the lower lake and about 213 m (700 ft) higher in elevation. Bottom substrate consists of silt and large boulders. Numerous springs are present. No macrophytes and only scattered log debris occur there. The inlet stream is approximately 3 m (10 ft) wide and lacks the spawning gravel present in the lower lake basin. The outlet, about 3.7m (12 ft) wide, flows into a pond that drains down the mountainside over a steep cascade going undergound before reaching the lower lake.

Upper Steep Lake outlet flows into a pond. The outlet of the pond then cascades down the mountain and goes underground until entering the lower lake.

A helicopter transported us and our supplies back and forth to the study lakes.



Camp and study site on Upper Steep Lake.

Pond draining Upper Steep Lake. Experiments were conducted here on *Diaptomus shoshone,* a zooplankton present in the upper lake and pond. Pond is also visible in upper left photograph.

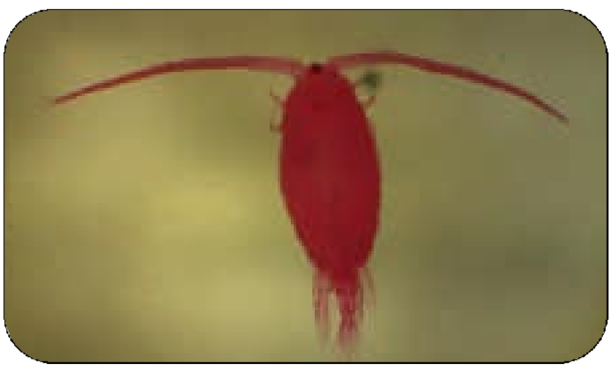
Vegetation

The surrounding forests are dominated by mountain hemlock (*Tsuga mertensiana*) and subalpine fir (*Abies lasiocarpa*). Whitebark pine (*Pinus albicaulis*) and Sitka alder (*Alnus sinuata*) communities are also present (Habeck 1988).

Steep Lakes Basin was burned in 1910 and therefore has sparse tree cover. The South Basin with older stands did not burn in 1910 (Habeck 1988). Little or no macrophytic vegetation was noted in the lakes.

Zooplankton

Diaptomus shoshone, a zooplankton, was present only in the upper lake which lacked fish (Crumb 1977). *Diaptomus arapahoensis* was more abundant in the lower lake stocked with fish. *Daphnia schodleri* was more abundant in the stocked lake except in late summer and fall when fish apparently switched to feeding on it. *Bosmina longirostris* and *Macrocyclops albidus* were zooplankton collected in both lakes.



Diaptomus shoshone was present only in the upper lake. Females like this will attain sizes up to 4 mm in length.

Macroinvertebrates

<u>Upper and Lower Steep Lakes</u>

Amphipoda
- *Gammarus lacustris*

Rhynchobdellida
- *Glossiphonia complanata*

Haplotaxida
- *Ilyodrilus templetoni*

Heterodonta
- *Pisidium subtruncatum*

<u>Upper and Lower Steep Lakes continued</u>

Plecoptera
- *Acroneuria* sp. - stream
- *Alloperla* sp. - stream

Ephemeroptera
- *Ameletus* sp.
- *Siphlonurus* sp. - stream
- *Cinygmula* sp.

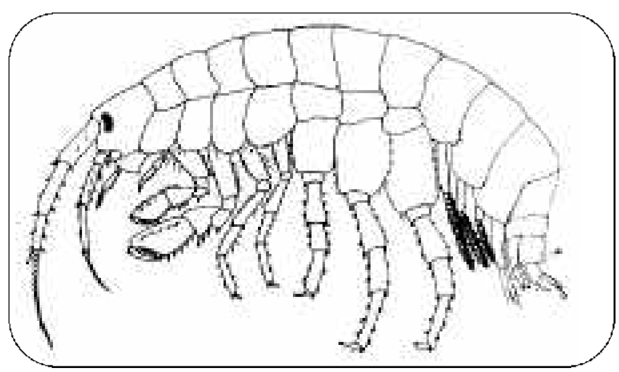
Trichoptera
- *Rhyacophila* sp.
- *Hesperophylax* sp.
- *Onocosmoecus* sp. - stream
- *Psychoglypha* sp.

Megaloptera
- *Sialis* sp.

Coleoptera
- *Gyrinus* sp.
- *Hydrovatus* sp.

Diptera
- *Chironomus* sp.
- *Microspectra* sp.
- *Procladius* sp

The freshwater shrimp (*Gammarus lacustris*) is present in both upper and lower lakes and is represented by unusually large specimens. It is abundant in Upper Steep Lake but limited in number in Lower Steep Lake apparently, due to selective predation by the trout population. The presence and size of these invertebrates may relate to the relatively high alkalinity in the waters compared to other northern Idaho lakes where this species has not been reported.



Freshwater shrimp (*Gammarus lacustris*). From Huggens et al. (1985).

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Research

The invertebrate communities of the two sub-alpine lakes were compared to ascertain the effect of stocking golden trout (*Salmo aquabonito*) in 1962 in the lower lake by the Idaho Fish & Game Department (Crumb 1977). Attempts to stock the upper lake have failed. Both bodies of water were somewhat similar in size, morphometry and physical-chemical characteristics.

Both lakes had similar invertebrates except *Diaptomus shoshone*, a large zooplankton that was absent in the lower lake. This was apparently due to selective fish predation. *Diaptomus arapahoensis,* another zooplankton, was less abundant and of smaller size in the lake containing trout. *Gammarus lacustris*, a freshwater shrimp, was also found in both lakes but nearly absent in the lower lake probably due to selective predation by fish.

Since 1962, growth and reproduction of golden trout have been successful with trout reaching record weights for the state up to four pounds. Since 1977 no stocking has occurred since the original plantings. Lower Steep Lake was the only lake north of the Salmon River that contained a consistently good breeding population of golden trout.

Collecting water and plankton samples from Upper Steep Lake following eruption of Mt. St. Helens in 1978. Ash had settled on the surface of the ice which was beginning to melt.

California Golden Trout (*Salmo aquabonito*).

Upper and Lower Steep Lakes provide an excellent opportunity for aquatic research.

Mt. St. Helens erupted soon after Steve Crumb completed his study of the Steep Lakes. Since chemical and biological data on the lakes existed before the eruption, the Forest Service was interested in determining what effect if any the ash fall might have on the water chemistry and biota in the upper lake. A slight increase in nitrates and decrease in zooplankton was noted, but these effects were only temporary. Baseline data from the lake provided the opportunity to compare the undisturbed site with the disturbed site one year later (Rabe 1982).

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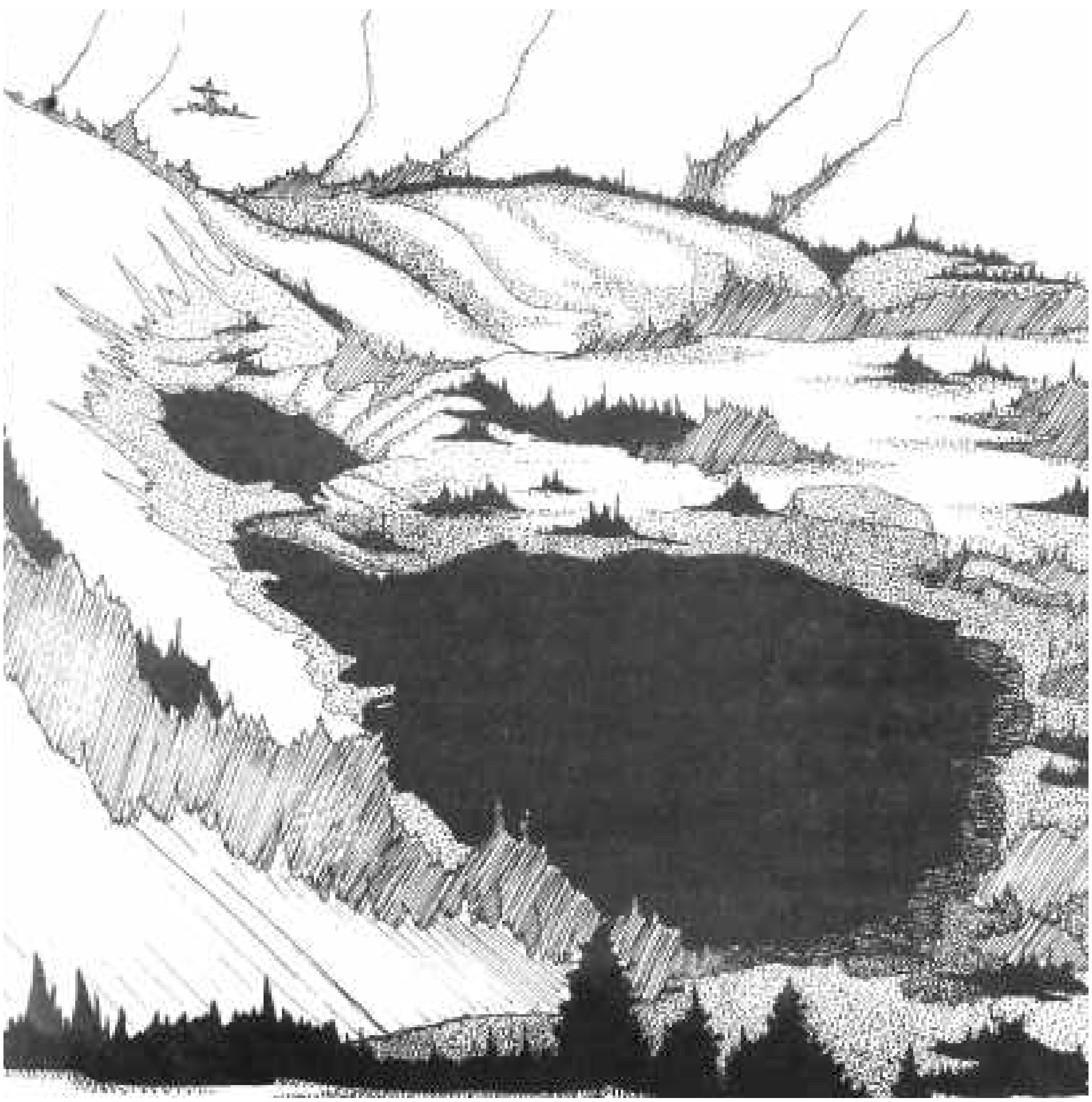


Grave Peak Lake and Ponds

Grave Peak Research Natural Area

Clearwater National Forest

Fred Rabe, Andrea Brooks and Erin Brooks studied a lake, Pond 1, Pond 2 and associated inlet and outlet streams in the RNA on July 31-August 1, 1998. Ponds 3 and 4 in the RNA were not sampled.

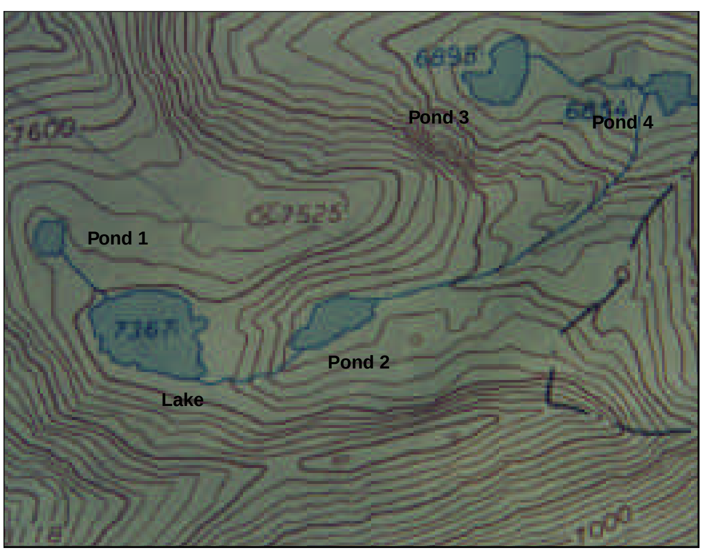
Location

The RNA is situated on the northern boundary of the Selway-Bitterroot Wilderness in the Clearwater Mountains. It is about 8.5 air miles south of Powell Ranger Station (Wellner and Bernatas 1991).

Ecoregion Section: IDAHO BATHOLITH (M332A), Idaho County; Quad: GRAVE PEAK

Turn south onto the Elk Summit Road (FS road 360) from about two miles east of Route 12 near the Powell Ranger Station. Follow FS road 360 about 17 miles to the junction with FS road 358. Turn right on FS 358 and continue for two miles to where the road has been blocked. The road becomes FS trail 45 to Kooskooskia Meadows (Wellner and Bernatas (1991). Continue on the trail past Swamp Lake to Friday Pass about 3.5 miles from the trailhead. About 100 meters before reaching the top of Friday Pass, take a faint trail which branches to the right. It eventually takes you along a ridgeline separating Windy Lakes on one side and Grave Peak Lakes on the other. Two of the Grave Peak water bodies can be viewed off to the right. Use extreme caution working your way down the slope to Pond 1.

Grave Peak Pond 1 and lake viewed from the ridgeline.



USGS Quad: GRAVE PEAK.

Geology

Grave Peak RNA is located within the Idaho batholith of granitic and related rocks which were uplifted and exposed in the late Tertiary. The area experienced multiple glacial events during the Quaternary, described in more detail in the RNA Establishment Report (Wellner and Bernatas 1991).

Classification

Grave Peak Pond 1
- Subalpine, small, shallow, cirque pond
- Medium-high production potential
- Circumneutral water in granitic basin
- Inlet: stream; Outlet: riffle-pool stream

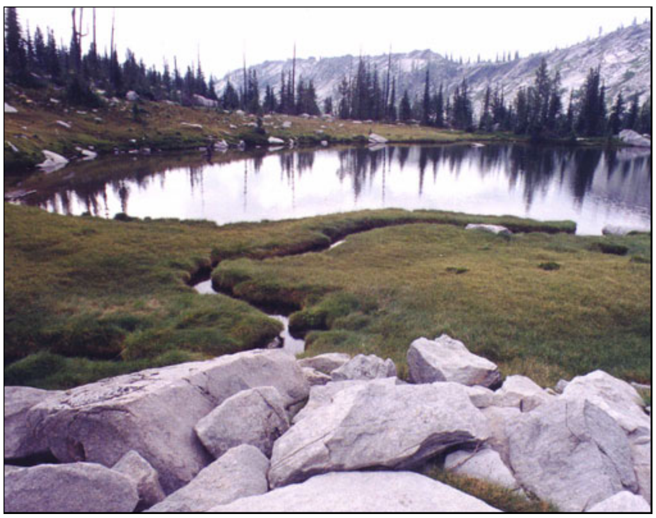
Grave Peak Lake
- Subalpine, small, deep, cirque lake
- Medium-low production potential
- Circumneutral water in granitic basin
- Inlet: stream; Outlet: riffle-pool stream

Grave Peak Pond 2
- Subalpine, small, shallow, cirque pond
- Medium-low production potential
- Circumneutral water in granitic basin
- Inlet: cascade; Outlet: stream

Aquatic physical - chemical factors

Grave Peak Pond 1
Area (hectares): 0.3 (0.8 acres)
Length of shoreline (m): 210 (689 ft)
Maximum depth (m): 1 (3.2 ft)
Aspect: SE
Elevation (m): 2268 (7440 ft)
Percent shallow littoral zone: 100
Dominant substrate: silt
Shoreline development: 1.089
Lake edge %: herbaceous-90, shrubs-10
Inlet: 1 stream
Outlet: 1 stream

The inlet to Pond 1 flows from the talus rock for about 30 meters and then takes on a meandering glide pattern for about the same distance to the pond. Sedges provide riparian cover. The lower section of the inlet substrate was organic sediment. The temperature of the inlet stream is 7 degrees C.



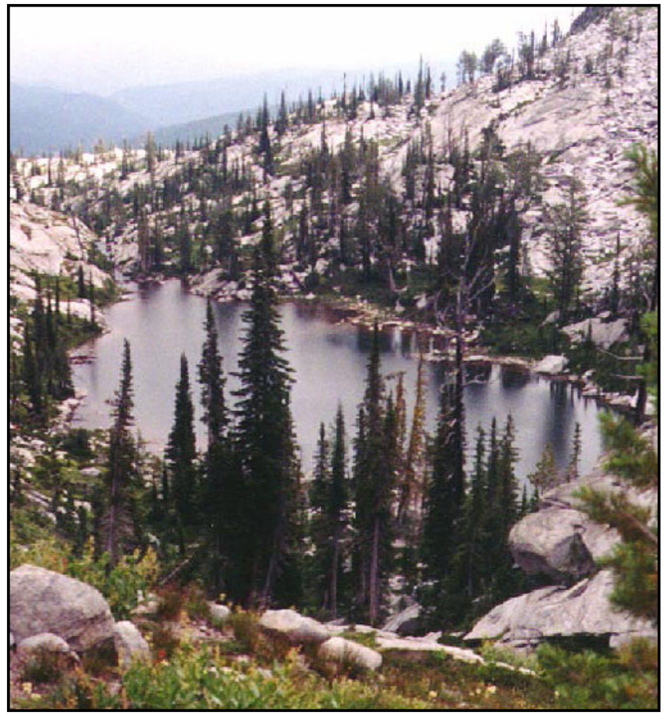
Meandering glide inlet stream flowed from talus rock to Pond 1. Riparian vegetation along the stream is mostly sedges.

Riffle-pool type stream connecting Pond 1 and lake.

Grave Peak Lake
Area (hectares): 2.6 (6.5 acres)
Length of shoreline: 677 (2221 ft)
Maximum depth (m): estimate >5 m (> 16 ft)
Elevation (m): 2246 (7367 ft)
Aspect: SE
Percent shallow littoral zone: 20
Dominant substrate: boulders and cobble
Shoreline development: 1.190
Lake edge %: rock-70, conifers-20, herbaceous-10
Inlets: riffle-pool type stream
Outlets: 1 stream

View SE across Grave Peak Lake.

View southeast at Grave Peak Lake. Note the inlet stream. The lake is a much larger, deeper water body than either of the two ponds studied.



Northeast view of Grave Peak Pond 2.

<u>Grave Peak Pond 2</u>
Area (hectares): 0.8 (2.1 acres)
Length of shoreline (m): 419 (1375 ft)
Maximum depth (m): Estimate 2 (7 ft)
Elevation (m): 2197(7207 ft)
Aspect: E
Percent shallow littoral zone: 100
Dominant substrate: bedrock, silt
Shoreline development: 1.306
Lake edge %: rock-55, shrubs-35, herbaceous-10
Alkalinity (mg/l): 2
Conductivity (micromhos/cm): <5
pH: 7
Inlet: cascades
Outlet: 1 stream

Water cascades down bedrock slope emptying into Pond 2.

After inlet stream cascades down a steep slope it levels out for a short distance and enters Pond 2.

Raynold's sedge (*Carex raynoldsii*) Hurd et al. 1998.

Vegetation

Subalpine coniferous vegetation in the Graves Peak area consists of subalpine fir (*Abies lasiocarpa*), whitebark pine (*Pinus albicaulis*), subalpine larch (*Larix lyallii*), and Engelmann spruce (*Picea engelmannii*).

Sedge meadows occur adjacent to the water bodies. Wellner and Bernatas (1991) reported yellow bog sedge (*Carex dioica*), Raynold's sedge (*Carex raynoldsii*), Ross sedge (*Carex rossii*), and Drummond's rush (*Juncus drummondii*).

Macroinvertebrates

<u>Grave Peak Pond 1</u>
Trichoptera
    Psychoglypha sp.
Coleoptera
    Uvarus sp.
Diptera
    Subfamily Orthocladiinae

<u>Grave Peak Pond 1 inlet</u>

Trichoptera
    Psychoglypha sp.
    Allomyia sp.
Diptera
    Polypedilum sp.
    Rheotanytarsus sp.

<u>Grave Peak lake</u>
Trichoptera
    Clistorina sp.
    Desmona sp.
    Hesperophylax sp.
    Psychoglypha sp.
Megaloptera
    Sialis sp.
Diptera
    Polypedilum sp.
    Prosimulium sp.
    Rheotanytarsus sp.
Platyhelminthes
    Polycelis coronata
Pelecypoda
    Pisidium sp.

Grave Peak lake inlet

Trichoptera
- *Desmona* sp.
- *Psychoglypha* sp.

Diptera
- *Hydrobaenus* sp.
- *Prosimulium* sp

Grave Peak Pond 2 inlet

Trichoptera
- *Neothremma* sp.

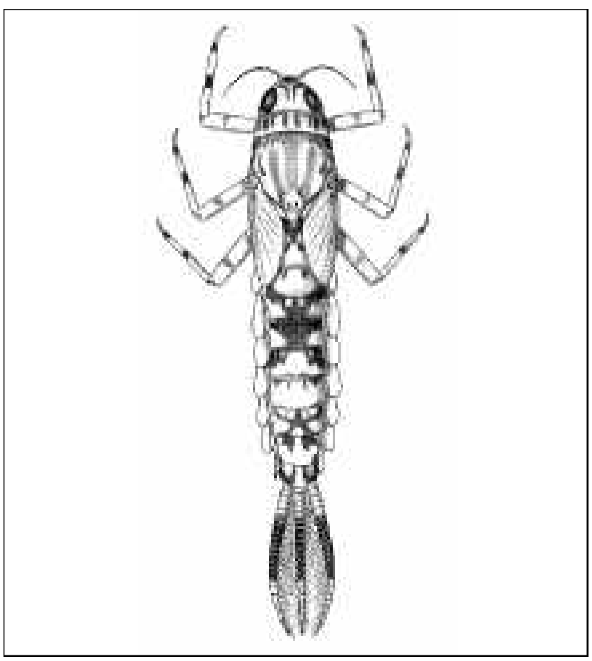
Plecoptera
- *Setvena bradleyi*
- *Sweltza* sp.

Ephemeroptera
- *Nixe* sp.
- *Ameletus* sp.
- *Baetis bicaudatus*

Diptera
- *Cryptolabis* sp.
- Subfamily Orthocladiinae
- *Simulium* sp.

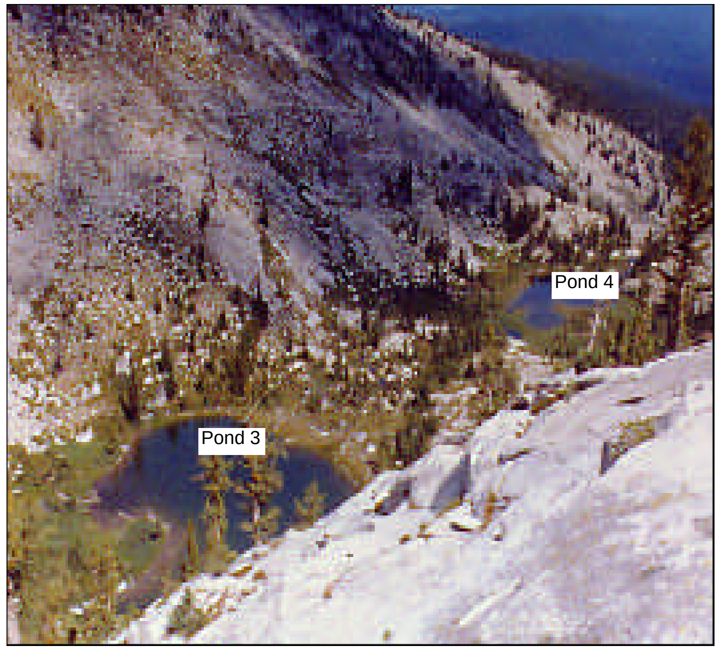
Coleoptera
- *Uvarus* sp.

Platyhelminthes
- *Polycelis coronata*



Ameletus, a mayfly from inlet of Grave Peak Pond 2. Sketch from McCafferty (1983).

Macroinvertebrates (continued)



Ponds 3 and 4 further downstream were not studied. Photo credit: Charles Wellner.

View from ridge looking at Pond 1 and lake.

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McCafferty, W. F. 1983. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Hurd, E. G.; Shaw, N. L.; Mastrogiuseppe, J (and others). 1998. Field guide to intermountain sedges. GTR-10 Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 282 p.

Wellner, C. A.; Bernatus, S. 1991. RNA Establishment Record for Grave Peak RNA, Idaho County. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT. 22 p.

Fenn Mountain Lakes

Fenn Mountain Proposed Research Natural Area

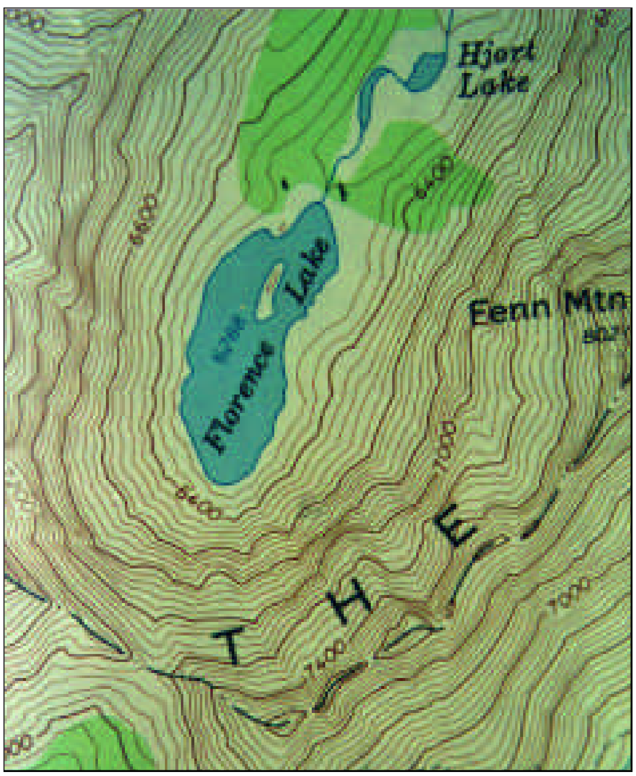
Clearwater National Forest

Florence Lake was surveyed by Peter Bahls on July 23-24, 1991. Hjort Lake, also in the RNA, was not sampled.

Location

Florence Lake and Hjort Lake part of the Selway Bitterroot Wilderness are located in the Craig Mountain Range about 13 air miles from the Fenn Ranger Station on the Selway River. Florence Lake is 9.5 miles from the nearest road (Bahls 1992). Access to the lake is very difficult. It is inaccesible by horseback.

Ecoregion Section: IDAHO BATHOLITH (M332A), Idaho County; USGS Quad: FENN MOUNTAIN.



USGS Quad: FENN MOUNTAIN.

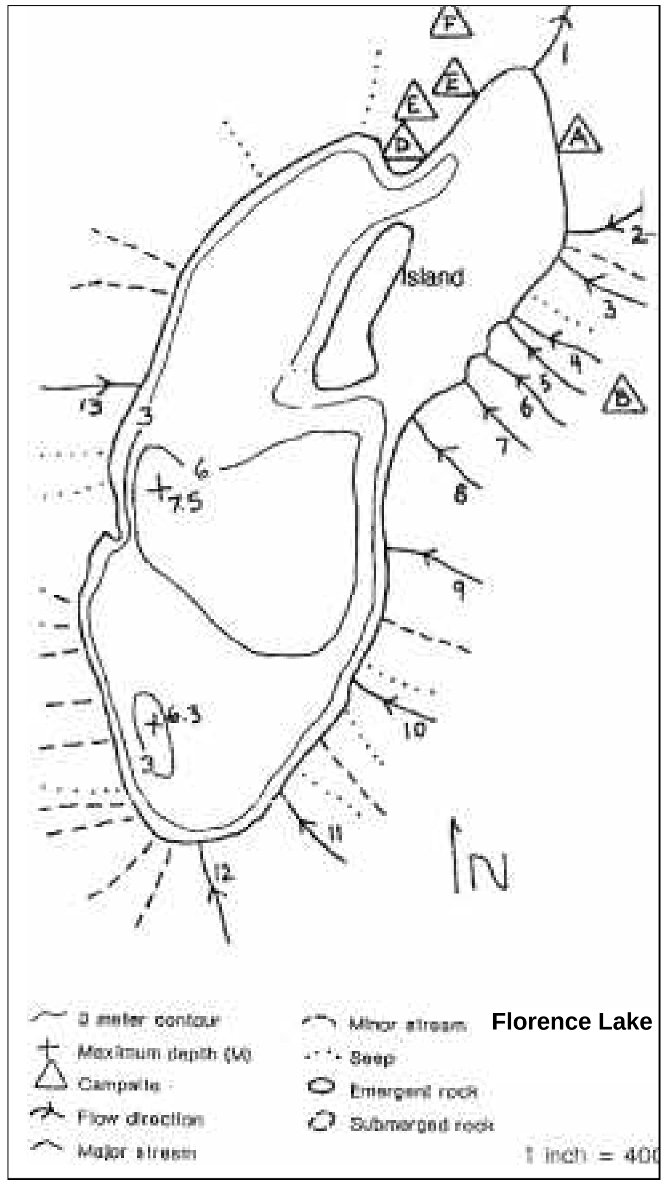
Geology

Foliated quartz monzonite is a granitic rock found in the area that has foliated texture from the parallel alignment of its mica mineral (biotite) as well as the other crystals in this rock (Greenwood and Morrison 1973).

The rock is Cretaceous in age and was emplaced as part of the Idaho batholith. It is uniform in this region and the main varying feature is the structure of the rock which can be uniform or foliated as here, depending on the stage of metamorphism (Greenwood and Morrison 1973).

Classification

- Subalpine, large, deep, cirque lake
- Medium production potential
- Circumneutral water
- Inlet: 13 major, 14 minor streams, 9 seeps
- Outlet: 1 stream



Bathymetric map of Florence Lake (Bahls 1992). Three meter contour level. 1 inch = 400 feet.

Aquatic physical-chemical factors

Area (hectares 12 (29.9 acres)
Length of shoreline (m): 1993 (6539 ft)
Maximum depth (m): 7.5 (25 feet)
Aspect: NE
Elevation (m): 1917 (6288 feet)
Percent shallow littoral zone: < 3
Dominant substrate: silt and rubble
Conductivity (micromhos/cm): 5
pH: 6.6
Inlet: 13 major and 14 minor streams, 9 seeps
Outlet: 1 stream

View north of the The Crags encircling Florence Lake. Notice the island in the water. A small portion of Hjort Lake is visible downstream (arrow). Photo credit: Sheryl Walker.

The littoral zone is limited especially on the west side of the lake (Bahls 1992). Ten percent of the bottom substrate is bedrock. The dominant sedge around the perimeter is *Carex rostrata*. Cutthroat trout (*Salmo clarki*) and rainbow trout (*Salmo gairdneri*) are reported to be large in size. Sheryl Walker, wilderness ranger, initiated campsite restoration measures at Florence Lake in 1992 (Wellner 1991).

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Bahls, P. F.1992. Report of the High Lake Fisheries Project Cooperative Project of Idaho Department of Fish and Game, Region 2, Clearwater National Forest, Orofino, Idaho. 67-72.

Greenwood, W. R.; Morrison, D. A. 1973. Reconnaissance geology of the Selway-Bitterroot Wilderness Area. Moscow , ID: University of Idaho, Bureau of Mines and Geology. l54 p.

Wellner, C. A. 1991. Letter to R. K. Moseley dated 9 September regarding elements occurring in Grave Peak proposed RNA, Fenn Mountain proposed RNA and Elk Creek proposed RNA. 2 p.

View towards west side of Florence Lake. The Crags in background. Photo credit: Sheryl Walker.

Salmon Mountain Lake and Ponds

Salmon Mountain Research Natural Area

Bitterroot National Forest

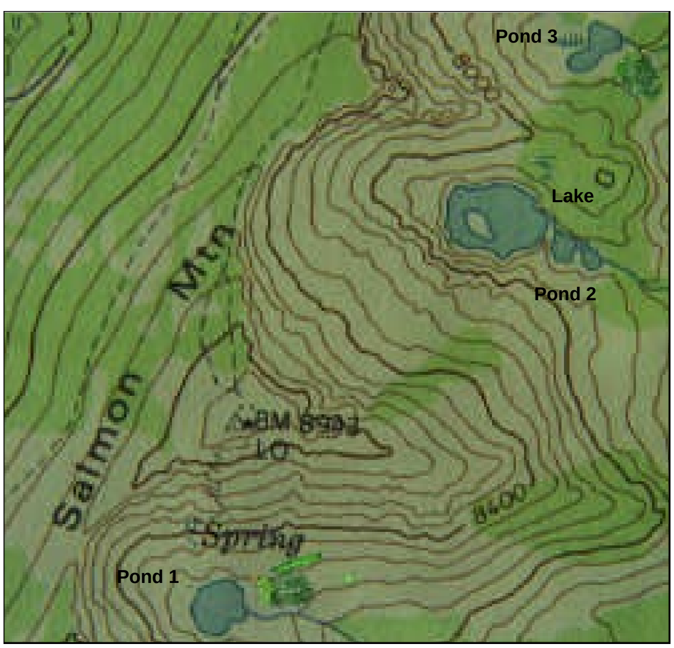
Three ponds and a lake are located in the RNA. Pond 1 and the lake were sampled by Fred Rabe on September 12-13, 1998.

Location

The RNAis located on the divide between the upper Selway River drainage and the Salmon River drainage in east-central Idaho within the Frank Church River of No Return Wilderness (Habeck 1992).

Ecoregion Section: IDAHO BATHOLITH (M332-A), Idaho County; USGS Quad: STRIPE MOUNTAIN.

From Grangeville, Idaho drive east on State Highway 14 to Elk City. Travel southeast 13 miles to FS Road 468 (Magruder Corridor). Drive about 44 miles to Salmon Mt. Base Camp. The trailhead is about one mile further. Hike approximately 1 1/2 miles to the manned lookout atop Salmon Mountain. The lake and Pond 2 are visible as you get close to the top. Pond 1 is reached by descending a trail from the lookout. The trail stops a short distance down the mountain and the remaining way to the pond is quite steep. The lake can be reached by cautiously descending the steep ridge overlooking the water body.



USGS Quad: STRIPE MOUNTAIN.

FS Road 468 (Magruder Corridor).

Lookout atop Salmon Mountain at 2727 m (8943 ft).

Geology

Pleistocene glaciation scoured cirques and steep cliffs in this part of the Bitterroot Mountains (Habeck 1992). The rock type is believed to be coarse grained hornblende-biotite granodiorite, part of the Idaho Batholith (Weis et al. 1972). The area is crudely mapped due to its remoteness and difficulty in interpreting the changes in rock types.

Classification

Salmon Mountain Pond 1

- Subalpine, small, shallow, cirque pond
- Low production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: ephemeral

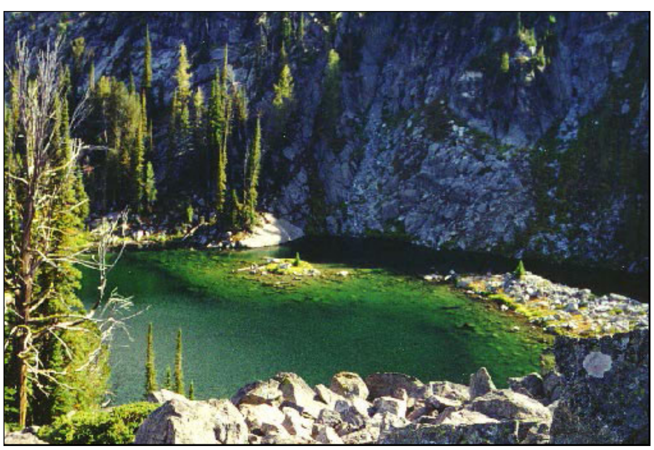
Salmon Mountain Lake

- Subalpine, small, deep, cirque lake
- Low - medium production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: 1 stream

Aquatic physical - chemical factors

Salmon Mountain Pond 1
Area (hectares): 0.5 (1.2 acres)
Length of shoreline (m): 327 (1073 ft)
Maximum depth (m): estimate 3 (10 ft)
Elvevation (m): 2536 (8320 ft)
Aspect: E
Percent shallow littoral zone: 65
Dominant substrate: silt and boulders
Shoreline development: 1.327
Lake edge %: talus-80, cliff-15, trees-herbaceous-5
Alkalinity (mg/l): 6
Conductivity (micromhos/cm): 10
pH: 7
Inlets: none
Outlets: 1 ephemeral stream

View of slope from lookout to Salmon Mountain Pond 1.



View of west end of Salmon Mountain Pond 1. Note littoral zone.

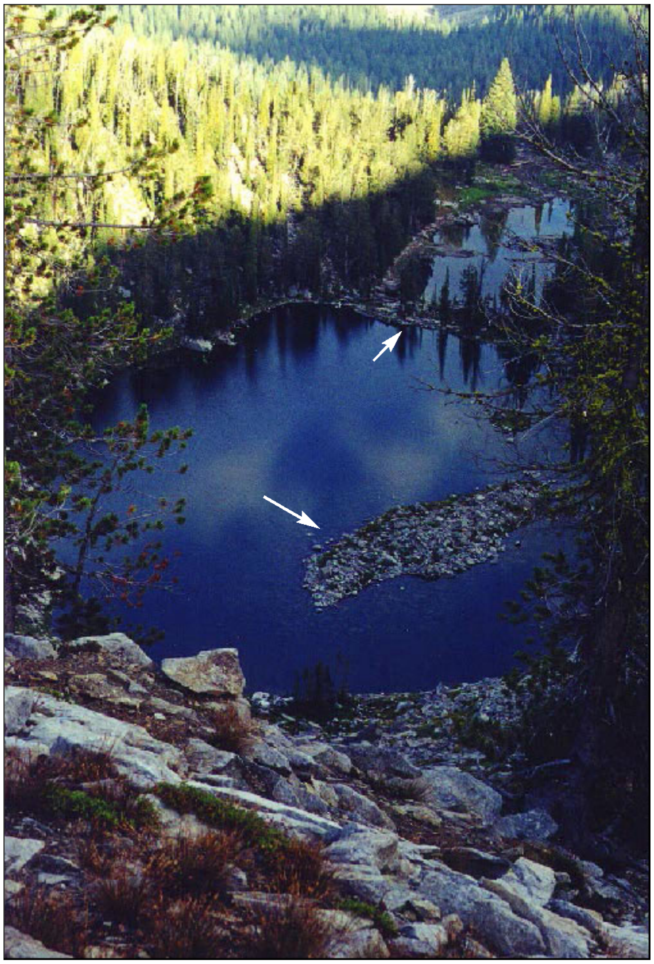
Steep cliff and talus slope surrounding most of shoreline of Salmon Mountain Pond 1.

Salmon Mountain Lake

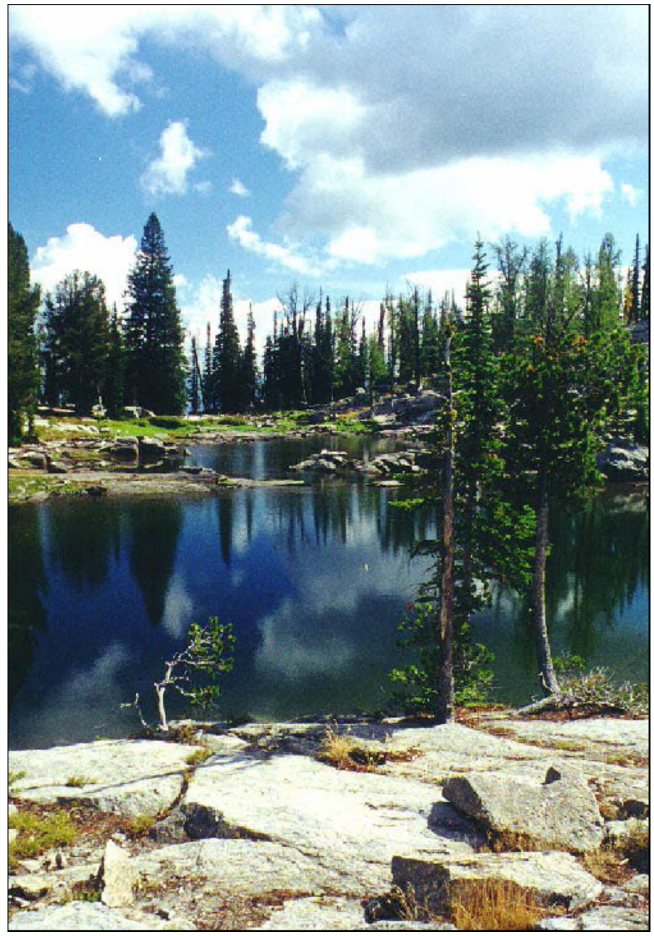
Area (hectares): 1.9 (4.9 acres)
Length of shoreline (m): 802 (2631 ft)
Maximum depth (m): 9 (30 ft)
Elevation (m): 2415 (7920 ft)
Aspect: SE
Percent shallow zone: 10
Dominant substrate: sediment, boulders
Shoreline development: 2.067
Lake edge %: cliff-55, herbaceous-15, trees-15, talus-15
Alkalinity (mg/l): 3
Conductivity (micromhos/cm): 15
pH: 7
Inlets: none
Outlets: 1 stream

An island is located in the lake. Only a small amount of littoral zone exists. The surface water temperature was 16 degrees C.

The outlet from the lake is about 5 centimeters deep. It flows approximately 5 meters to a rock face where it trickles over the surface into a pond that appears as two ponds on the map. Bedrock and soft sediments comprise the substrate of the pond.



View east of Salmon Mountain Lake from the ridge trail. Note island in the lake (lower arrow) and adjoining Pond 2 (upper arrow).



View of pond 2 which appears as two separate ponds.

View west of Salmon Mountain Lake and ridgeline.

View east of Salmon Mountain Pond 3, a shallow water body in the RNA that was not sampled.

Outlet from Salmon Mountain Lake flows into Pond 2.

Water sedge (*Carex aquatilis*) From Hurd et al. 1998.

Cliff sedge (*Carex scopulorum*) From Hurd et al. 1998.

Lower end of Pond 2, view west towards Salmon Mountain ridge.

Vegetation

<u>Salmon Mountain Pond 1</u>
Juncus mertensianus
Juncus nevadensis
Carex scopulorum

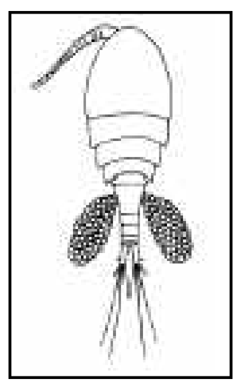
<u>Salmon Mountain Lake</u>
Juncus mertensianus
Carex aquatilis
Carex sp.

Quillwort (*Isoetes* sp.) was observed in the shallow portion of Pond 2.

Zooplankton

<u>Salmon Mountain Lake</u>
Cladocera
- *Pleuroxis* sp.
- *Daphnia* sp.
- *Chydorus* sp.

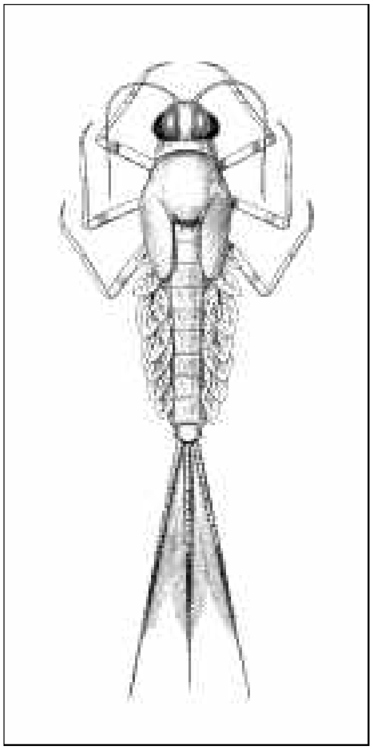
Copepoda
- Family Cyclopidae



Cyclopoid copepods From Brooks (1963).

Macroinvertebrates

<u>Salmon Mountain Pond 1</u>
Trichoptera
    Unidentified
Diptera
    Subfamily Chironominae
Ephemeroptera
    Callibaetis sp.
Pelecypoda
    Pisidium sp.
Coleoptera
    Hydroporus sp.

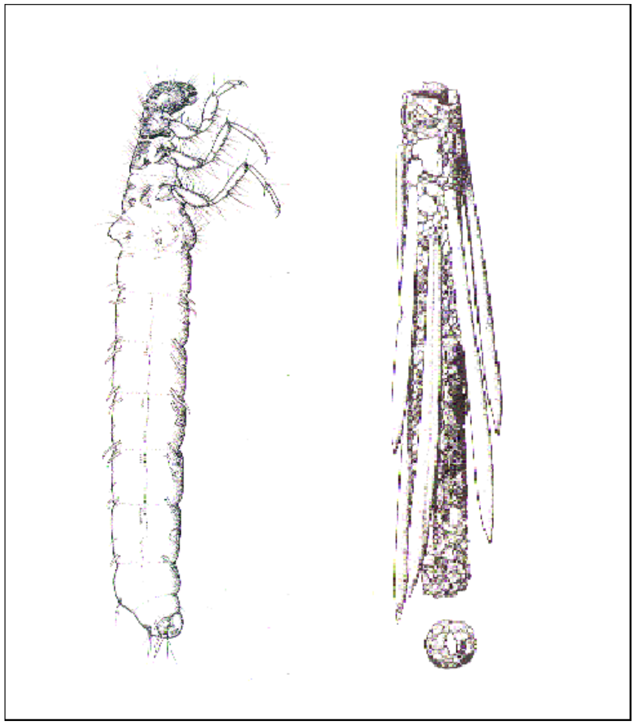


Callibaetis sp., a mayfly dominant in the lake. They are collector-gatherers. Drawing: McCafferty (1981).

<u>Salmon Mountain Lake</u>
Ephemeroptera
    Callibaetis sp.
Diptera
    Subfamily Chironominae
Coleoptera
    Hydroporus sp.
Pelecypoda
    Pisidium sp.

<u>Salmon Mountain Lake outlet</u>

Trichoptera
    Ecclisomyia sp.
    Unidentified
Diptera
    Subfamily Tanypodinae
Pelecypoda
    Pisidium sp.



Ecclisomyia sp., a caddisfly that commonly feeds on diatoms. It often fixes plant material on to a rock case as seen here. Drawing: Wiggins (1996).

Literature Cited

Brooks, J. L. 1963. Cladocera. In: Freshwater biology. New York: Wiley Publishers. 599 p.

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Hurd, E. G.; Shaw, N. L.; Mastrogiuseppe, J. (and others). 1998. Field guide to intermountain sedges. GTR-10. U.S. Department of Agriculture, Forest Service, Intermountain Region, Ogden, UT. 282 p.

McCafferty, W. P. 1981. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Weis, C. P. 1972. Mineral resources of the Salmon River Breaks Primitive Area. Moscow, ID: University of Idaho, Bureau of Mines and Geology. 52 p.

Wiggins, G. B. 1996. Larvae of the North American caddisfly genera. 2nd ed. Toronto: University of Toronto Press. 267 p.

Allan Mountain Ponds

Allan Mountain Research Natural Area
Salmon-Challis National Forest

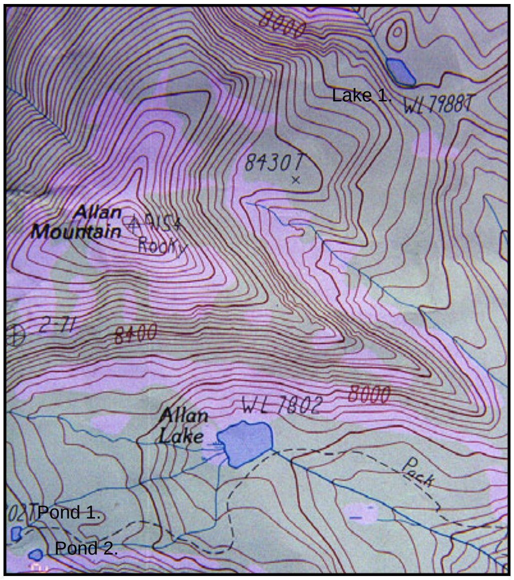
Two ponds and a lake are located in the RNA. Fred Rabe surveyed Pond 1 on September 24, 1999. Some data were collected from Pond 2.

Location

Allan Mountain RNA is located in the Bitterroot Mountains close to the Idaho / Montana border about 16 miles north of North Fork, Idaho.

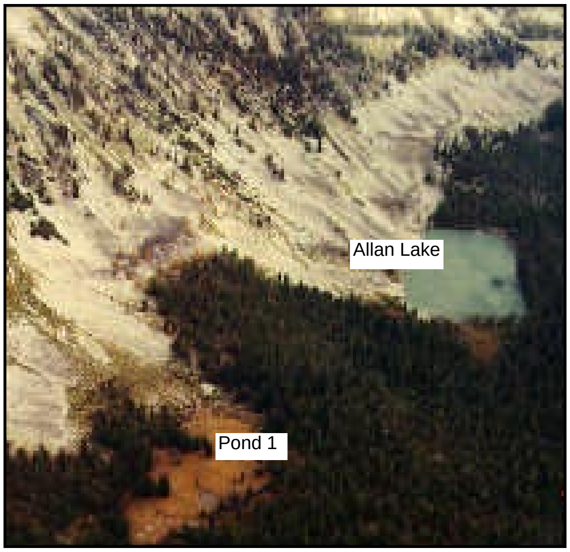
Ecoregion section: IDAHO BATHOLITH (M332A), Lemhi County; USGS Quad: ALLAN MOUNTAIN

From the town of North Fork, follow U.S. Route 93 north up the North Fork of the Salmon River about 5.5 miles to the junction with FS Road 091. Turn left on 091 and follow this road about 2 miles to the junction with FS Road 089. Turn right on 089 and follow it up Ditch Creek about 4.6 miles until it junctions with FS Road 202. Take FS 202 about 1.5 miles to the bridge over Ditch Creek. Take FS Trail 112 for approximately three miles to Allan Lake. The ponds are about one mile west of Allan Lake.



USGS Quad: ALLAN MOUNTAIN.

Allan Lake is not included in the RNA because of heavy recreational use. Lake 1 north of Allan Mountain drains into Twin Creek. It was not sampled. The two ponds are located in a meadow above Allan Lake. A wetland comprised of small interconnected pools is located between the ponds.



Aerial view of Allan Lake and Pond 1 along the flank of Allan Mountain.

Classification

Pond 1

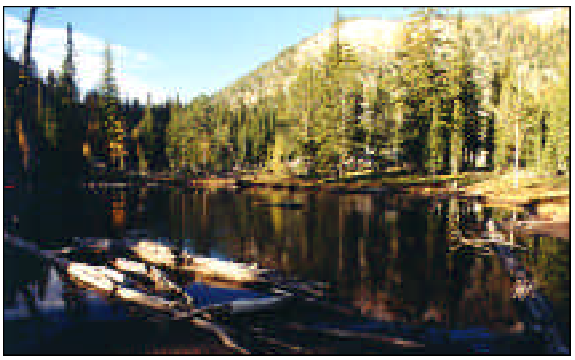
- Subalpine, small, shallow cirque-scour pond
- Medium production potential
- Circumneutral water in Belt supergroup
- Inlet: seeps; Outlets: ephemeral stream

Geology

Near alpine conditions occur on Allan Mountain, 9154 feet (2791 m). Lateral and terminal moraines are illustrative of mountain glaciation (Wellner 1988). The rock type is Precambrian undifferentiated quartzite and argillite possibly of the Belt supergroup. Rocks of the area range from a light to dark-gray flat laminated argillite to a white to light gray quartzite with sedimentary structures. The argillite is relatively darker colored and softer than the green to dark gray impure quartzite (Ross 1963).

Aquatic physical-chemical factors

Pond 1
Surface area (hectares): 0.01 (0.03 acres)
Length of shoreline: (m): 40 (131 ft)
Maximum depth (m): 1.2
Elevation (m): 2500 (8200 ft)
Aspect: NE
Percent shallow littoral zone: 100
Dominant bottom substrate: soft sediment
Lake edge %: herbaceous-90, conifers-10
Alkalinity (mg/l): 8
Conductivity (micromhos): 11
pH: 6.9
Inlet: seeps
Outlet: ephemeral stream



Pond 1 above. Pond 2 below occupies a cirque. Note subalpine larch (*Larix lyallii*) in foreground.

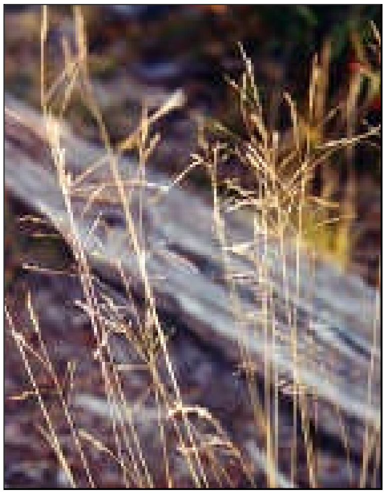
A series of shallow pools and channels comprise a wetland in a high meadow adjacent to Allan Mountain. This wetland separates the two ponds.

Wetland adjacent to the two ponds. Note subalpine larch (*Larix lyallii*). Allan Mountain at an elevation of 9154 ft is in background.

Vegetation

The following plants surrounding Pond 1 were identified by Michael Mancuso working for the Idaho Conservation Data Center: Subalpine fir (*Abies lasiocarpa*), whitebark pine (*Pinus albicaulis*), huckleberry (*Vaccinium* spp.), laurel (*Kalmia microphylla*), wintergreen (*Gaultheria humifusa*), hairgrass (*Deschampsia cespitosa*), rock sedge (*Carex scopulorum*), and rush (*Juncus torreyi*). The mosses *Polytrichum juniperinum, Aulcomnium androgynum* and *Sphagnum* sp. were also identified.

Subalpine larch (*Larix lyallii*) is relatively rare in the inland United States. At Allan Mountain the species is at the southeastern limit of its range (Wellner 1988).



Tufted hairgrass (*Deschampsia cespitosa*).

A rush (*Juncus torreyi*)

Zooplankton

<u>Pond 1</u>
Diaptomus sp.
Daphnia sp.
Simocephalus sp.

Macroinvertebrates

<u>Ponds 1 and 2</u>	
Ephemeroptera	Hemiptera
Caenis sp.	*Limnogonus* sp.)
Coleoptera	*Gerris* sp.
Coptotomus sp.	Diptera
Pelecypoda	Family Chironomidae
Pisidium sp.	Class Oligochaeta

Vertebrates

Long-toed salamanders (*Ambystoma macrodactylum*) were quite numberous in Pond 2 and the wetland area. They had just metamorphosed and averaged about 9 cm in length.

Long-toed salamander (*Ambystoma macrodactylum*).Photocredit: Corkran and Thoms (1996).

Spotted frogs (*Rana pretiosa*) were common at the edge of Pond 2 and wetland. The one year age group averaged about 20 mm in length. The larger frogs, approximately 70 mm long were believed to be 2-3 years old

Spotted frog (*Rana pretiosa*) Photo credit: Corkran and Thoms (1996).

Literature Cited

Corkran, C. C.; Thoms, C. 1996. Amphibians of Oregon, Washington and British Columbia. Vancouver: Lone Pine Publishing. 175 p.

Ross, C. P. 1963. Geology along U.S. Hiway 93 in Idaho. Moscow, ID: University of Idaho, Bureau of Mines and Geology. 130 p.

Wellner, C. A. 1988. Establishment Record for Allan Mountain RNA within Salmon National. Forest. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT. 19 pp.

Fish Lake

Fish Lake Research Natural Area
Nezperce National Forest

Al Espinosa, a former fisheries biologist with the Forest Service, conducted a limnological survey of Fish Lake and other lakes in the Buffalo Hump area in August 1977.

Location

Fish Lake is located in the Buffalo Hump area of the Gospel Hump Wilderness Area about 20 miles southwest of Elk City, Idaho. Buffalo Hump is the most prominent landmark in the area at an elevation of 2713 m (8,900 feet).

Ecoregion Section: PALOUSE PRAIRIE (331A), Idaho County; USGS Quads: SILVER SPUR RIDGE

USGS Quad: SILVER SPUR RIDGE

From Grangeville travel southeast on State Highway 14 along the South Fork of the Clearwater River to FS Road 233 up the Crooked River to Orogrande Summit. From there take a FS trail about two miles to Fish Lake.

Geology

According to Espinosa et al. (1977), the oldest rocks of the region apparently belong to the Belt series which include gneisses, schists, quartzites and limestones. Quartz monzonite and granodiorite of the Idaho Batholith intruded these Belt rocks. Faulting and warping of a partly dissected peneplain formed basin- like depressions in which clay, gravel and sand were deposited. According to Espinosa et al. (1977), only the higher region around Buffalo Hump has been extensively glaciated. There is no evidence of more than one glaciation.

Buffalo Hump, elevation 2713 m (8900 ft) in the Gospel Hump Wilderness. Photo credit: Espinosa et al. 1977.

Fish Lake RNA is an example of a large valley that radiates from high areas containing deposits of morainal material left by valley glaciers.

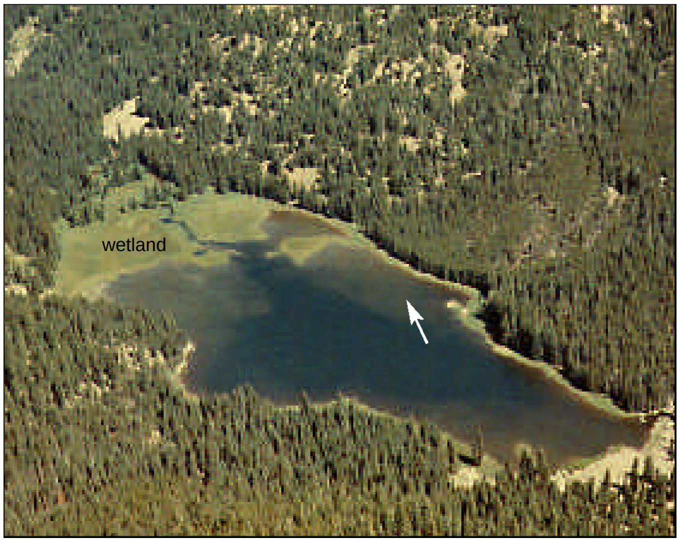
Classification

- Montane, large, deep, moraine lake
- High production potential
- Circumneutral water in Belt rock
- Inlet: 4 streams; Outlet: 1 stream

Aquatic physical - chemical factors

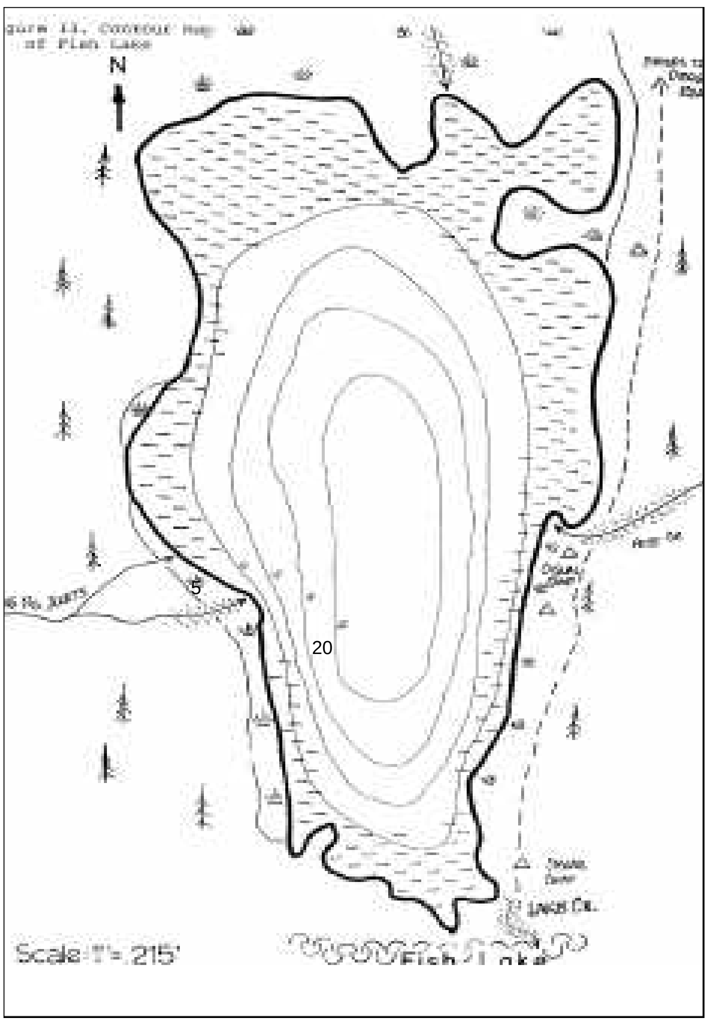
Area (hectares): 11.5 (28.8 acres)
Length of shoreline (m) 1934 (6345 ft)
Maximum depth (m): 6.1 (20 ft)
Elevation (m): 1733 (5684 ft)
Aspect: S
Percent shallow littoral zone: 89
Dominant bottom substrate: soft sediments
Shoreline development: 1.615
Lake edge %: estimate, primarily herbaceous
Alkalinity (mg/l): 17
Conductivity (micromhos): 23
Inlets: 4 streams
Outlet: 1 stream

This moraine type lake is relatively large in size with a mean depth of 2.4 m (8.8 ft). It has a long shoreline length and a high shoreline development. Fish Lake has four inlets and one outlet. The mouth of Lake Creek inlet averages 6.1 m (20 ft) in width and 1.2 m (3.8 ft) in depth. According to Espinosa et al. (1977), the inlet at this location contains 5,000 square feet of high quality spawning gravel. The outlet (Lake Creek) is 4.6 m (15 ft) wide and averages 0.2 m (0.8 ft) deep.



Fish Lake, formed by a glacial moraine, is relatively low in elevation. Note the extensive sedge growth along the lake edge and large littoral zone extending out in the lake (arrow). Also observe the extensive wetland transected by Lake Creek, a large meandering glide inlet. Photo credit: Espinosa et al. 1977.

View west across Fish Lake toward the Englemann spruce stand at the outlet of Whistling Pig Creek. Photo credit: Charles Wellner.



Morphometric map of Fish Lake. Contour depths in feet. 1 inch = 215 feet. Map credit: Espinosa et al. 1977.

View south at Lake Creek inlet near its entrance to Fish Lake. Photo credit: Charles Wellner.

Lake Creek outlet (cascade-pool) type stream). Photo credit: Charles Wellner.

Vegetation

Alluvial deposits adjacent to relatively large flat lake shores have accumulated around Fish Lake where the topography is gentle. The soils tend to be deep and relatively stable and support dense amounts of sedges, rushes, grasses and forbs. The major phytoplankton taxa in Fish Lake are *Staurastrum* sp., a desmid and *Melosira* sp., a diatom.

Some of the macrophytes found in the water were yellow water lily (*Nuphar polysepalum*), water lily (*Nuphar varigatum*), water buttercup (*Ranunculus aquatilis*) and quillwort (*Isoetes* sp.).

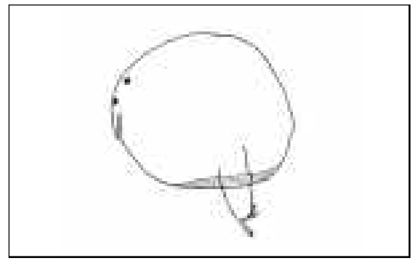
Quillwort is eaten by moose. As the animals forage on the plant off the bottom, large quantities of the plant are torn loose and the uprooted vegetation floats to the surface where moose continue to eat the plant.

Sizeable “rafts” of quillwort float to the leeward side of Fish Lake after moose forage on the lake bottom. Photo credit: Al Espinosa 1971.

Zooplankton

Copepoda
- *Diaptomus lintoni*
- *Orthocyclops modestus*
- *Cyclops venustoides*

Cladocera
- *Daphnia rosae*
- *Chydorus sphaericus*

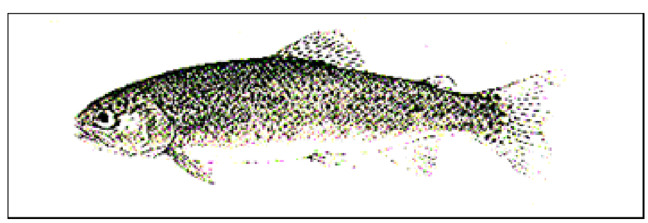


A zooplankton, *Chydorus sphaericus*
Sketch credit: Melanie Abel.

Vertebrates

At the time of gillnet sampling, species composition consisted of 70 percent rainbow trout (*Salmo gairdneri*), 26.7 percent brook trout (Salvelinus fontinalis) and 3.3 percent rainbow - cutthroat hybrid. Many brook trout and rainbows were observed by the investigators in the shoal areas of the lake.

Fish Lake has had a reputation for good fishing since 1899 (Elsensohn 1971) when large catches of trout were reported. Since the lake has such high quality spawning and rearing habitat, the lake, according to the authors, will likely sustain a moderately heavy to heavy level of fishing intensity without supplemental stocking (Espinosa et al. 1977).



Rainbow trout (*Salmo gairdneri*) was the dominant trout in Fish Lake. Sketch from Simpson and Wallace 1978.

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Elsensohn, A. 1971. Pioneer days in Idaho County. The Idaho Corporation of Benedictine Sisters, Cottonwood, Idaho. 2: 618 p.

Espinosa, F. A.; Orme, J. J.; Dolan, J. J. 1977. A limnological survey of subalpine lakes in the Buffalo Hump Area. U.S. Department of Agriculture, Forest Service, Red River Ranger District, Nezperce National Forest, Idaho Unpublished report. 211 p.

Simpson, J. C.; Wallace, R. L. 1978. Fishes of Idaho. Northwest Naturalist Book. University Press of Idaho, Moscow, Idaho. 237 p.

Square Mountain Lake

Square Mountain Creek Research Natural Area

Nez Perce National Forest

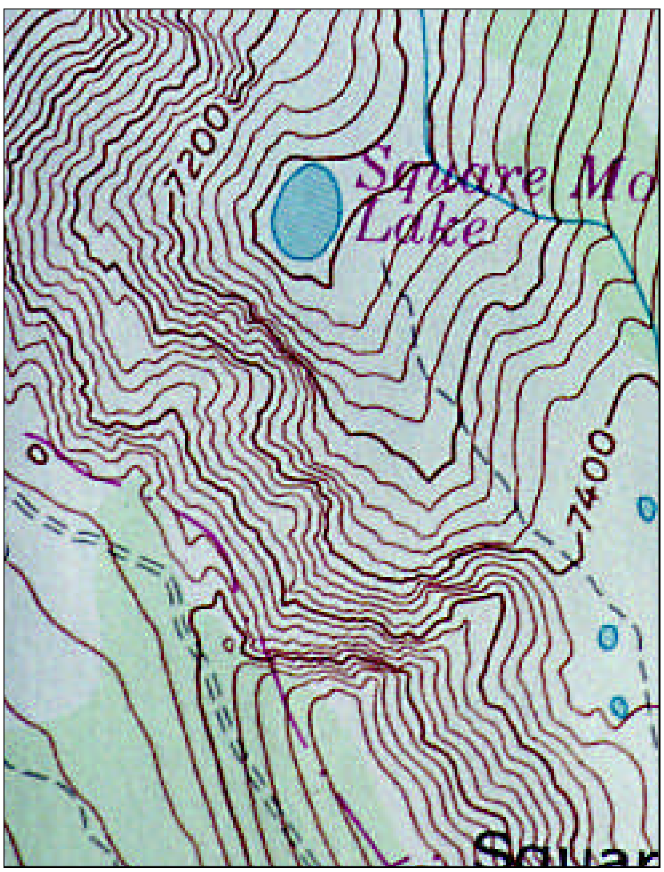
On July 15, 1998 Fred Rabe and Nancy Abbott sampled the lake and inlet and outlet streams.

Location

The RNA is located in the center of the Gospel-Hump Wilderness in the South Fork Clearwater River drainage of north-central Idaho. It is 51 miles south-southeast of Grangeville, Idaho (Wellner and Bernatas 1980).

Ecoregion Section: IDAHO BATHOLITH (M332A), Idaho County; USGS Quad: MARBLE BUTTE

From the eastern edge of Grangeville, take FS road 221 south for about 35 miles to its junction with FS road 444. Turn east on FS road 444 and follow it east and southeast for 16 miles to its end on Square Mountain. The distance to the lake from the trailhead is about 1 1/2 miles.



USGS Quad: MARBLE BUTTE.

Geology

The area has a complex geology. It occurs on the contact line between sedimentary Belt quartzite rocks and the igneous, granitic rocks of the Idaho Batholith. Much of the RNA is exposed rock in the form of cliffs and talus slopes on bedrock (Wellner and Bernatas 1980).

View north of Square Mountain Lake.

Classification

- Subalpine, small, deep, cirque lake
- Low production potential
- Circumneutral water in Belt - granitic basin
- Inlets: 1 stream, 2 seeps; Outlet: 1 stream

Aquatic physical-chemical factors

Maximum depth (m): 5.3 (17 ft)
Elevation (m): 2122 (6960 ft)
Aspect: NE
Percent shallow littoral zone: 30
Dominant substrate: soft sediments
Lake edge %: shrubs/herbs-85, conifers-5, rock-10
Alkalinity (mg/l): 4
Conductivity (micromhos/cm): 15
pH: 7.0
Inlets: 1 stream, 2 seeps
Outlets: 1 stream

View of wet meadow east of the lake.

Inlet stream to Square Mountain Lake. Note pea-gravel substrate and herbaceous riparian growth.

The RNA is a glaciated cirque basin containing a lake, stream that drains the lake and wet meadows (Wellner and Bernatas 1980). The lake is bounded by talus slopes on the west and a meadow on the east. Logs line the periphery of the lake.

The inlet stream is about 0.3 meters wide and 0.5 m meters deep. Small pea-gravel comprises the substrate. Water temperature of the inlet was 11 degrees C.

Inlet stream (arrow) into Square Mountain Creek Lake.

Outlet stream. Note coarse particulate organic material comprising most of substrate.

The outlet stream averages about 3 meters wide and 14 cm deep. The channel has a slight meander. Coarse particulate organic matter comprises most of the substrate in contrast to the mineral substrate of the inlet. The water temperature of the outlet is 18 degrees C, 7 degrees warmer than the inlet. Pools downstream are up to 55 cm deep. Water flow is subsurface in places.

Vegetation

The entire area burned in 1919 and partially burned again in 1933. Tree cover is minimal over much of the RNA due to fire and lack of adequate soil development (Wellner and Bernatas 1980). Whitebark pine-subalpine fir (*Pinus albicaulis-Abies lasiocarpa*) habitat types are found in the RNA together with six subalpine fir types. *Douglasia idahoensis*, a category two candidate and Forest Service Sensitive species is found along the southwest boundary.

An aquatic moss (*Fontinalis* sp.) is commonly observed in the outlet stream. Wetland vegetation in the RNA includes *Carex nigricans*, *Carex scopulorum*, and *Juncus parryi*.

Carex nigricans
Hurd et al. 1998.

Carex scopulorum
Hurd et al. 1998.

Macroinvertebrates

Outlet stream
Megaloptera
- *Sialis* sp.

Ephemeroptera
- *Paraleptophlebia debilis*
- *Ameletus* sp.
- *Baetis tricaudatus*

Diptera
- *Prosimulium* sp.
- Subfamily Tanypodinae
- Subfamily Chironominae

Coleoptera
- *Agabus* sp.
- *Hygrotus* sp.

Hemiptera
- Corixidae

Trichoptera
- *Clistorina* sp.
- *Limnephilus* sp.

Inlet stream
Platyhelminthes
- *Polycelius coronata*

Trichoptera
- *Clistorina* sp.
- *Psychoglypha* sp.
- *Doliphiloides* sp.
- *Gramataulius* sp. ?

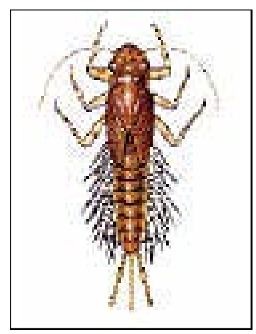
Plecoptera
- Family Chloroperlidae
- *Cultus* sp.

Ephemeroptera
- *Nixe* sp.
- *Ameletus* sp.

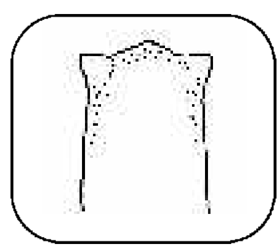
Pelecypoda
- *Pisidium* sp.

Diptera
- Subfamily Tanypodinae

The most obvious diifference in community structure of the two streams was that six Plecoptera-Trichoptera species occurred in the inlet compared to only two Trichoptera in the outlet stream. Dominant forms were *Paraleptophlebia debilis,* a mayfly in the outlet stream and *Polycelius coronata*, a planarian flatworm in the inlet.



Paraleptophlebia, a mayfly from outlet stream. Sketch credit: McCafferty (1983).



Anterior of *Polycelius coronata* a planarian flatworm dominant in the inlet stream. Note numerous simple eye spots. Sketch credit: Kolasa (1991).

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Dome Lake

Dome Lake Research Natural Area
Salmon-Challis National Forest

Charles Wellner, Roy Harness and Fred Rabe briefly surveyed the lake on August 22, 1974.

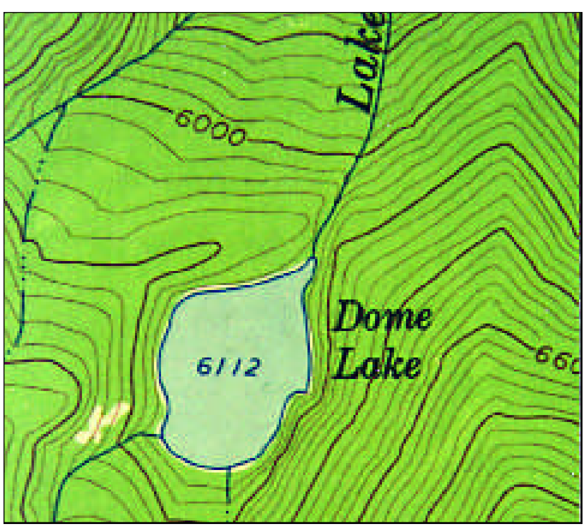
Location

The RNA lies at the northern end of the Bighorn Crags in the Salmon River Mountains. This is about 3 miles south of the Salmon River at a point 17 miles southwest of Shoup, Idaho (Mancuso 1992).

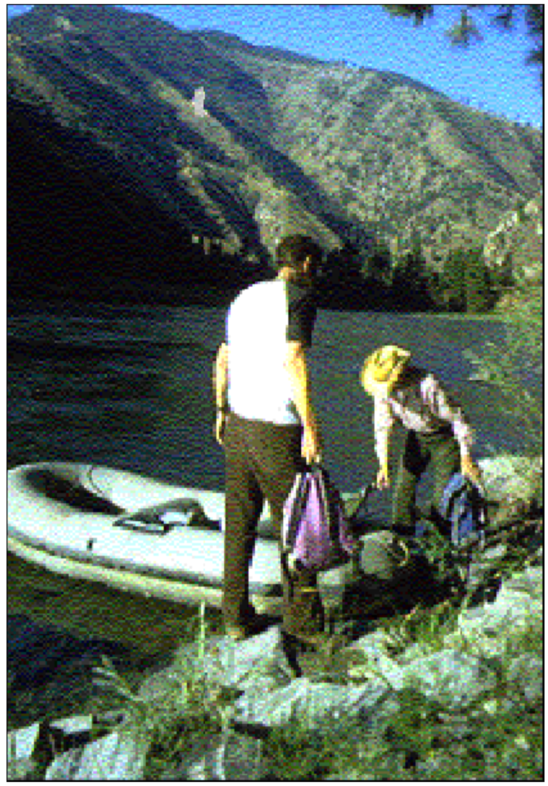
Ecoregion Section: IDAHO BATHOLITH (M332A), Lemhi County; USGS Quad: LONG TOM MTN., MT. MCGUIRE

Access is difficult. From the town of North Fork head west on the Salmon River Road 033 for about 36 miles. The western trailhead for FS Trail 172 is on the south side of the Salmon River between river miles 201 and 202. This is opposite Colson Creek RNA just west of the junction with FS Road 123 (Colson Creek Road). FS Trail 172 heads south from the trailhead, switchbacking up the ridge west of Shell Creek and gaining about 5000 feet in elevation as it ascends to an area immediately below the Horse Heaven Lookout. Just southeast of the lookout, FS Trail 172 joins the ridgeline that defines the western boundary of the RNA. Other routes include FS Trail 021 from Crags Campground which is about a ten mile hike and the eastern trailhead of FS 172 which leaves from near the junction of the Salmon River Road 033 and Panther Creek Road 055 (Mancuso 1992).

A more direct way to the lake is to cross the Salmon River by raft near Ebenezer Campground. From there it is a steep climb with no FS trails. There are game paths to the lake.



USGS Quad: LONG TOM MOUNTAIN, MOUNT MCGUIRE.



A direct but very difficult route to Dome Lake is to cross Salmon River near Ebenezer Campground and ascend the steep terrain to the left in the photograph. Once on top, follow game trails and bushwhack to the lake. Charles Wellner and Roy Harness in photograph.

Geology

The geology of the lake area is of foliated gneiss and schist and of gneissic sedimentary rocks. They may be a part of the Belt supergroup or of a pre-Belt origin. These Belt rocks are about 1,500 million years old and still have preserved sedimentary structures in northern Idaho and western Montana (Bennett1977).

Classification

- Montane, large, deep moraine lake
- Medium production potential
- Circumneutral water in Belt rock
- Inlets: 1 seep, 1 stream; Outlet: 1 stream

Dome Lake RNA in the Frank Church River of No Return Wilderness contains the entire upper portion of the Lake Creek watershed including moraine-dammed Dome Lake. About 1407 m (4616 feet) of vertical relief occurs in the area which represents an excellent cross section of upper elevation aquatic and terrestrial ecosystems of the Salmon River Canyon (Mancuso 1992).

Dome Lake is one of the few moraine lakes in Idaho's RNA system. This subalpine water body is uncommon relative to its latitude in central Idaho.

Dome Lake is a moraine-dammed water body at a relatively low elevation in central Idaho.

Inlet end of Dome Lake. Photo credit: Charles Wellner.

View of moraine that dams Dome Lake. Photo credit: Charles Wellner.

Aquatic physical - chemical factors

Area (hectares): 7.8 (19.4 acres)
Length of shoreline (m): 1158 (3799 ft)
Maximum depth (m): Estimate 8 (26 ft)
Elevation (m): 1863 (6112 ft)
Aspect: NE
Percent shallow littoral zone: estimate, 50
Dominant bottom substrate: rubble and soft sediment
Shoreline development: 1.188
Lake edge %: estimate - rocks-70, shrubs and herbs- 30
Alkalinity (mg/l): 9
Conductivity (micromhos/cm): 34
pH: 6.8
Inlets: 1 seep, 1 stream
Outlets: 1 stream

Vegetation

Most of the terrestrial vegetation surrounding the lake is coniferous forest habitat types, largely Douglas-fir *(Pseudotsuga menziesii*) and subalpine fir (*Abies lasiocarpa*). Forests at the middle elevation in the RNA burned in the 1986 Dome 2 Fire. A population of the rare plant Borsch's stonecrop (*Sedum borschii*) occurs near the summit of Dome Mountain (Mancuso 1992).

Vertebrates

Apopulation of stunted Eastern brook trout (*Salvelinus fontinalis*) occurrs in the lake. Successful spawning takes place because different age classes of fish were observed.

Stunted brook trout (*Salvelinus fontinalis*) in lake.

Literature cited

Bennett, E. 1977. Reconnaissance geology and geochemistry of the Blackbird Mountain, Lemhi Co., Idaho, Moscow, ID: University of Idaho, Bureau of Mines and Geology. 167 p.

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Belvidere Lakes and Ponds

Belvidere Creek Research Natural Area

Payette National Forest

Twelve lakes and ponds exist in the RNA. From July 18-27, 1978 eight of these sites together with associated inlet and outlet streams were studied by Fred Rabe and his Aquatic Biology class from the University of Idaho.

Location

Belvidere Creek, located in the Salmon River Mountains, lies between Goat Mountain and Coin Mountain and covers almost the entire Belvidere Creek drainage which is a tributary to Big Creek (Lichthard and Rust 1994).

Ecoregion Section: CHALLIS VOLCANICS (M332F), Valley County; USGS Quad: EDWARSBURG and PROFILE GAP

From McCall, Idaho travel FR 48 east about 40 miles to Yellow Pine. Continue east on FR 412 along the South Fork of the Salmon River for five miles to Profile Creek. Next take FR 340 north for 10-12 miles. Belvidere Creek enters Big Creek from the south about 4.5 miles before reaching Big Creek Ranger Station. After crossing Big Creek, access to the RNA is overland. An unmaintained trail follows Belvidere Creek up into the basin. The easiest access to the lakes is by hiking one of the spur ridges to the main ridge system on the west side of the RNA and following it to the top (Lichthardt and Rust 1994).

East end of Belvidere Creek drainage showing six of the headwater lakes and ponds studied. USGS Quads: Edwardsburg, Profile Gap. T20N, R9E.

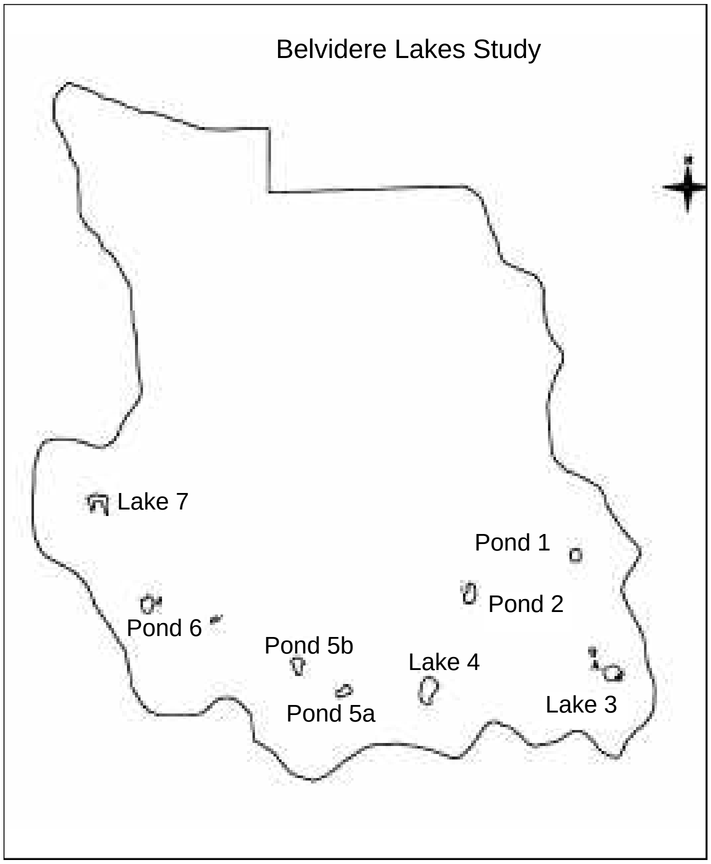
Geology

The bedrock varies from moderately hard, well fractured granite of the Pinnacles adjacent to Lake 3 to weathered volcanic rocks near Lake 7. The lands are characterized as being geologically young and erosion is quite active (Rabe et al. 1979). Much of the area has rock debris from talus, loose rubble from avalanche slopes or exposed bedrock on the surface.

The RNA encompasses an entire watershed that was glacially sculpted during the Pleistocene. Outlet streams from nine cirque and paternoster lakes comprise the headwaters of Belvidere Creek. After the tributaries merge they enter a straight U-shaped lower valley and flow into Big Creek which eventually enters the Middle Fork of the Salmon River.

View of Belvidere Lake basin.

Lower Belvidere Creek in “U” shaped valley.



Location of three lakes and five ponds studied among the twelve water bodies in the Belvidere Creek Research Natural Area.

Classification

Pond 1

- Subalpine, small, shallow, cirque pond
- Low-medium production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: 1 stream

Pond 2

- Subalpine, small, shallow, cirque pond
- Medium-high production potential
- Circumneutral water in granitic basin
- Inlet: 1 stream; Outlet: 1 stream.

Lake 3

- Alpine, small, shallow, paternoster lake
- Low-medium production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: 1 stream.

Classification

Lake 4

- Subalpine, small, deep, cirque lake
- Low production potential
- Circumneutral water in granitic basin
- Inlet: 1 seep; Outlet: 2 streams

Pond 5a

- Subalpine, small, shallow, cirque-scour pond
- Medium-high production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: 1 stream

Pond 5b

- Subalpine, small, shallow, cirque pond
- Low-medium production potential
- Circumneutral water in granitic basin
- Inlet: 2 streams; Outlet: 1 stream

Pond 6

- Subalpine, small, shallow, cirque pond
- Medium production potential
- Circumneutral water in granitic basin
- Inlet: 1 stream; Outlet: 1 stream

Lake 7

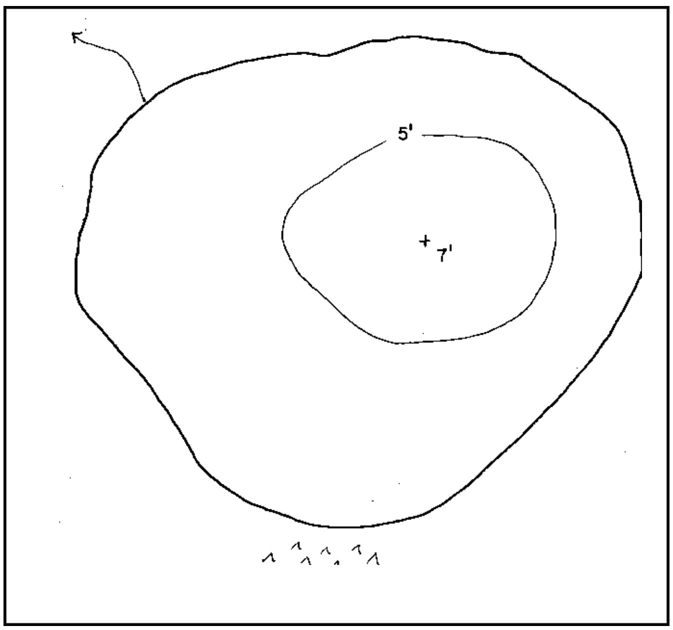
- Subalpine, small, deep, cirque lake
- Medium-high production potential
- Circumneutral water in granitic basin
- Inlet: 2 seeps; Outlet: 1 stream

Unidentified lake in the Belvidere Creek RNA.

Aquatic physical - chemical factors

Pond 1

Area (hectares): 0.4 (1.1 acres)
Length of shoreline (m): 241 (791 ft)
Maximum depth (m): 2.1 (7 ft)
Elevation (m): 2598 (8520 ft)
Aspect: E
Percent shallow littoral zone:100
Dominant substrate: rubble
Shoreline development: 1.087
Alkalinity (mg/l): 10
pH: 7.0
Inlets: none
Outlets: 1 stream

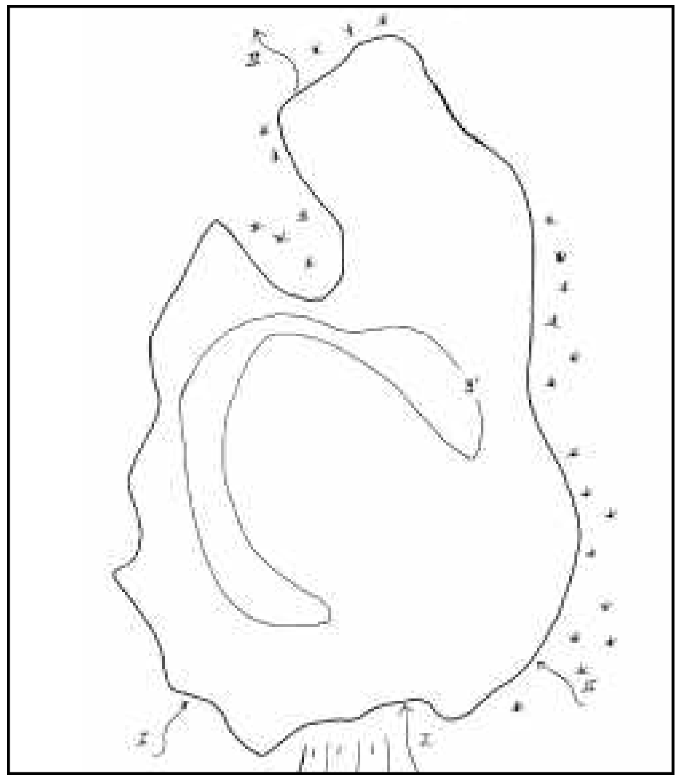


Map of Pond 1 in the Belvidere Creek RNA.

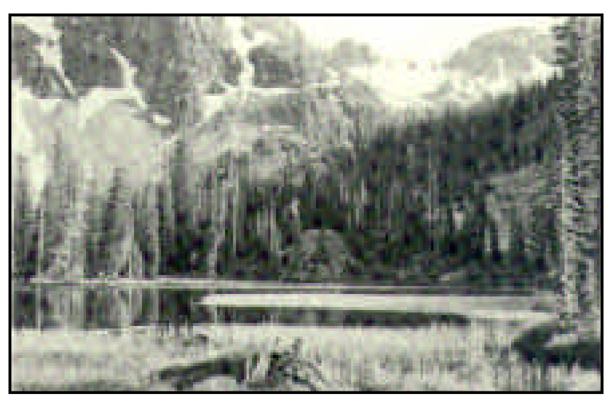
Belvidere Pond 1. Note banding of the lake sediments.

Pond 2

Area (hectares): 0.6 (1.5 acres)
Length of shoreline (m): 341
Maximum depth (m): 1.2 (4 ft)
Elevation (m): 2348 (7700 ft)
Aspect: N
Percent shallow littoral zone: 100
Dominant substrate: rubble and gravel
Shoreline development: 1.204
Alkalinity (mg/l): 19
pH: 6.8
Inlets: 3 streams
Outlets: 1 stream

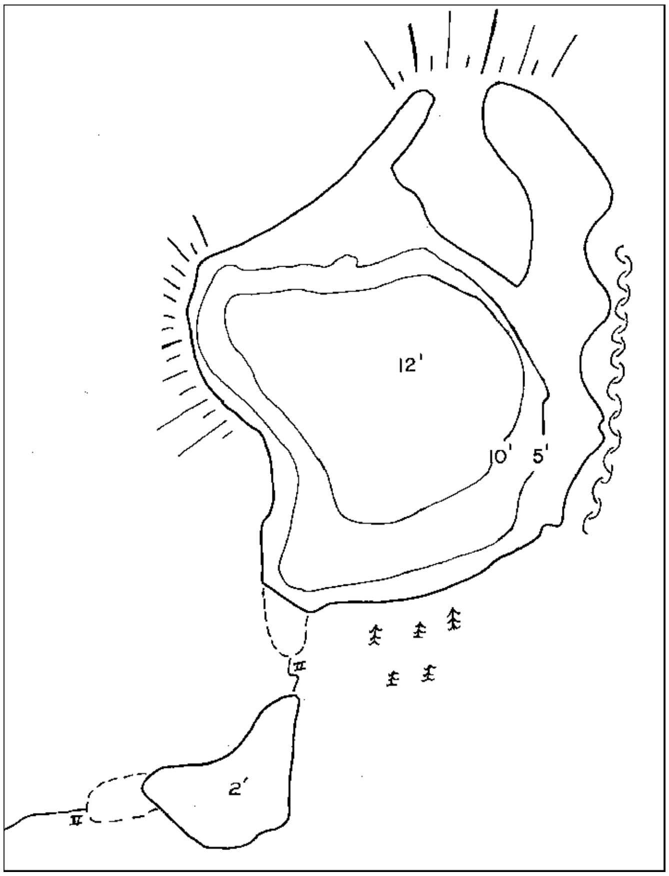


Map of Pond 2 in the Belvidere Creek RNA.



Belvidere Pond 2. The Pinnacles at an elevation of 2827 m (9273 ft) in background.

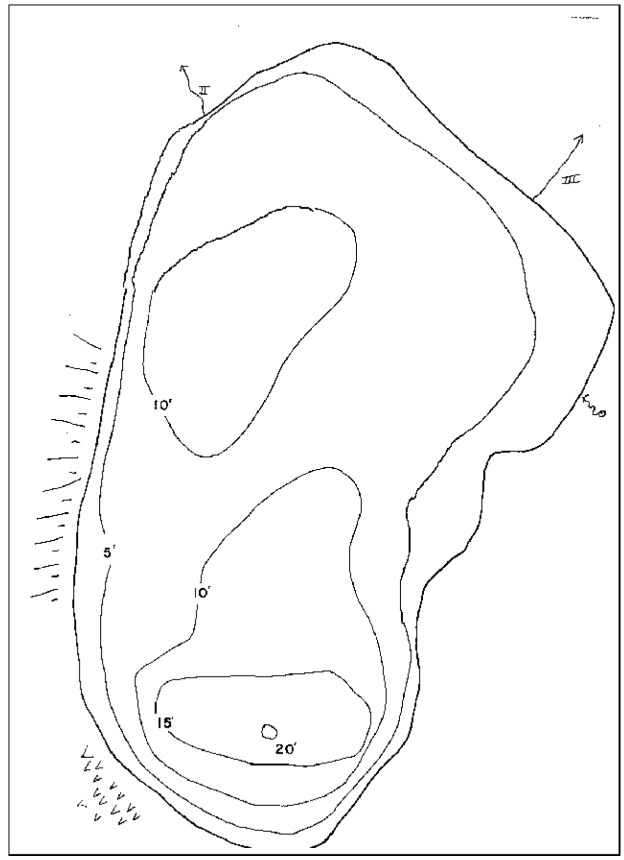
Lake 3
Area (hectares): 0.8 (2.1 acres)
Length of shoreline (m): 458 (1503 ft)
Maximum depth (m): 3.7 (12 ft)
Elevation (m): 2512 (8240 ft)
Aspect: NE
Percent shallow littoral zone: 40
Dominant substrate: cobble
Shoreline development: 1.411
Alkalinity (mg/l): 20
pH: 7.1
Inlets: none
Outlets: 1 stream



Map of Lake 3 in Belvidere Creek RNA.

Belvidere Lake 3 is the upper lake in a chain of three lakes (paternoster lakes).

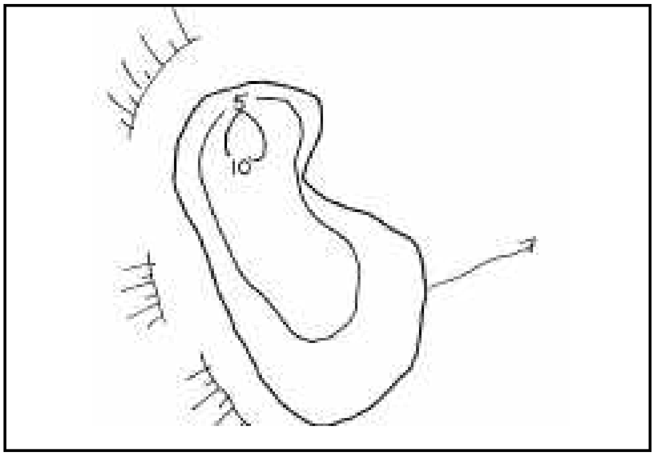
Lake 4
Area (hectares): 1.3 (3.2 acres)
Length of shoreline (m) 457
Maximum depth (m): 6.1 (20 ft)
Elevation (m): 2463 (8080 ft)
Aspect: N
Percent shallow littoral zone: 60
Dominant substrate: cobble
Shoreline development: 1.103
Alkalinity (mg/l): 12
pH: 7.0
Inlets: 1 seep
Outlets: 2 streams



Map of Lake 4 in Belvidere Creek RNA.

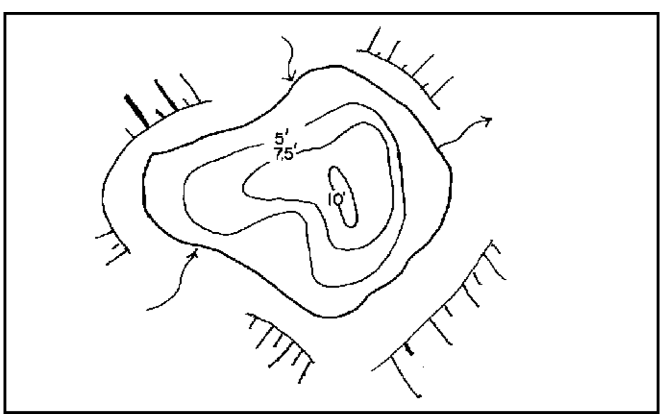
Belvidere Lake 4.

Pond 5a
Area (hectares): 0.4 (1 acre)
Length of shoreline (m): 269 (883 ft)
Maximum depth (m): 3 (10 ft)
Elevation (m): 2402 (7880 ft)
Aspect: N
Percent shallow littoral zone: 90
Dominant substrate: cobble
Shoreline development: 1.208
Alkalinity (mg/l): 16
pH: 6.8
Inlets: none
Outlets: 1 stream



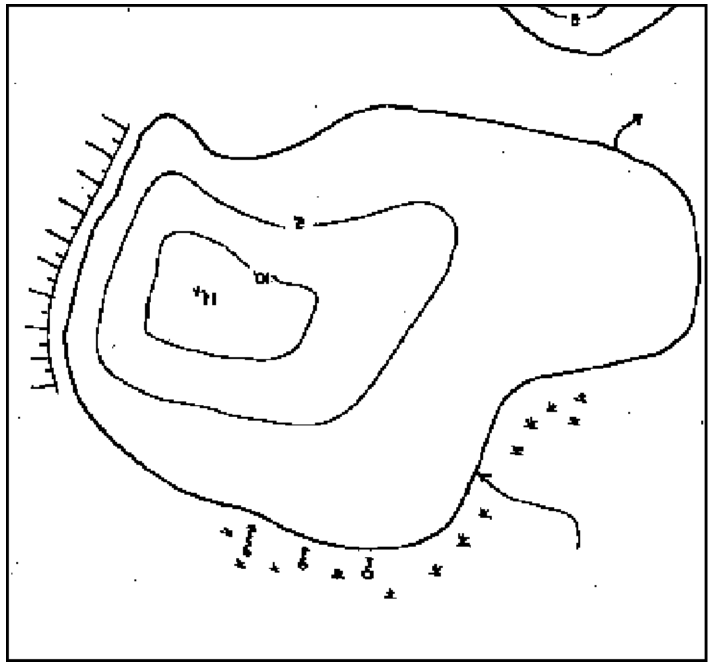
Map of Pond 5b in Belvidere Creek RNA.

Pond 5b
Area (hectares): 0.5 (1.3 acres)
Maximum depth (m): 3 (10 ft)
Elevation (m): 2402 (7880 ft)
Aspect: N
Percent shallow littoral zone: 50
Dominant substrate: cobble
Shoreline development: 1.1
Alkalinity (mg/l): 16
pH: 6.8
Inlets: 2 streams
Outlet: 1 stream



Map of Pond 6 in the Belvidere Creek RNA.

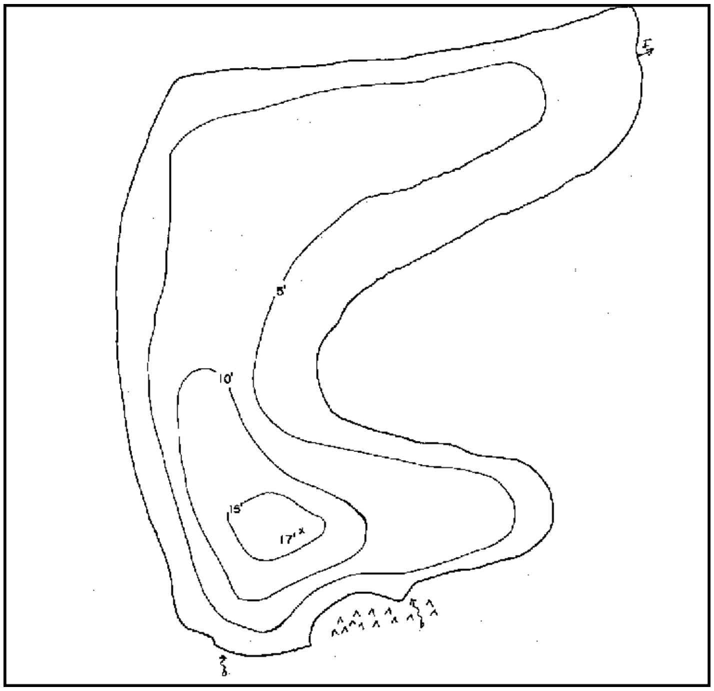
Pond 6
Area (hectares): 0.6 (1.5 acres)
Length of shoreline (m): 323 (1060 ft)
Maximum depth (m): 3.3 (11 ft)
Elevation (m): 2439 (8000 ft)
Aspect: ESE
Percent shallow littoral zone:70
Dominant substrate: cobble
Shoreline development: 1.184
Alkalinity (mg/l): 18
pH: 6.8
Inlets: 1 stream
Outlet: 1 stream



Map of Pond 6 in the Belvidere Creek RNA.

Cutthroat trout (*Salmo clarki*) collected from one of the Belvidere Lakes.

Lake 7
Area (hectares): 0.8 (2 acres)
Length of shoreline (m): 567 (1860 ft)
Maximum depth (m): 5.1 (17 feet)
Elevation (m): 2439 (8000 ft)
Aspect: S
Percent shallow littoral zone: 60
Dominant substrate: cobble
Shoreline development: 1.800
Alkalinity (mg/l): 12
pH: 6.8
Inlets: 2 seeps
Outlet: 1 stream



Map of Belvidere Lake 7. It was found to have one of the highest prodution potentials compared to the other water bodies due in part to its southern aspect and high shoreline development.

Belvidere Lake 7.

Vegetation

The majority of terrestrial vegetation consisted of subalpine fir *(Abies lasiocarpa*) habitat types. Most of the understory near the lakes was grouse whortleberry (*Ledum glandulosum*).

Zooplankton

Zooplankton density and richness was quite low in most lakes and ponds. Only one taxa was present in Ponds 1, 5a, and 5b and Lakes 2 and 4, two taxa in Pond 6, and four taxa in Lake 7. In Pond 1 and Lake 3, where fish were absent, large red calanoid copepods (*Diaptomus* sp.) were present. Depth of the ponds may have had some effect on numbers and kinds of zooplankton observed.

Belvidere Creek lakes and ponds

Copepoda
- *Diaptomus* sp.
- Cyclopoidea

Cladocera
- *Daphnia* sp.
- *Chydorus sphaericus*
- *Holopedium gibberum*

Chydorus sphaericus , a zooplanton was only found in Pond 6.

Macroinvertebrates

Outlet streams

Taxa	1	2	3	4	5a	5b
Trichoptera						
Limnephilus sp.		X				X
Asynarchus sp.	X					X
Imania sp.						
Rhyacophila acropodes					X	X
Rhyacophila vaccua			X			
Ephemeroptera						
Cinygma sp.		X		X		
Ephemerella infrequens		X			X	X
Siphlonurus columbianus		X				
Paraleptophlebia memorialis			X	X		
Centroptilum sp.					X	X
Plecoptera						
Nemoura sp.						X
Yoraperlis brevis						X
Acroneuria californicus			X			X
Isoperla sp.						X
Family Chloroperlidae				X		
Diptera						
Simulium sp.	X					
Family Chironomidae		X	X			
Pelecypoda						
Family Sphaeriidae			X			
Platyhelminthes						
Order Tricladida		X				

The stonefly (*Yoraperla brevis*) was collected only from the outlet stream of Pond 5b.

Lakes and ponds

Taxa	1	2	3	5a	5b	7
Trichoptera						
Chyranda centralia		X				
Asynarchus sp.		X		X		X
Limnephilus sp.						X
Hesperophylax sp.			X			
Ephemeroptera						
Centroptilum sp.			X			X
Siphlonurus sp.		X				
Odonata						
Aeshna sp.						X
Coleoptera						
Agabus sp.	X		X			
Bidessus sp.	X					
Neuroptera						
Sialis sp.			X			
Hemiptera						
Graptocorixa sp.			X			
Gerris sp.		X				
Diptera						
Family Chironomidae		X	X			X
Pelecypoda						
Family Sphaeriidae						X
Hirudinea						
Family Erpodellidae				X		X
Platyhelminthes						
Order Tricladida		X				

Chloroperlidae, a stonefly family, was collected from the outlet stream of Lake 4.

In Lakes 4 and 7, which supported relatively large trout populations, macroinvertebrate numbers were substantially less than in water bodies without fish.

The first record of the caddisfly *Chyranda centralis* in Idaho came from specimens collected from Pond 2 in the Belvidere Creek RNA (Russell Biggam-personal communication).

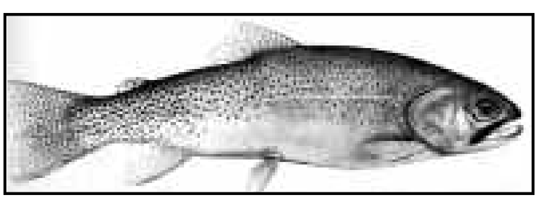
In Belvidere Pond 2, *Chyranda centralis* was identified for the first time in Idaho. The case consists of pieces of thin bark arranged to form a straight tube with a prominent flange, like a seam along each side (Wiggins 1996).

Vertebrates

Cutthroat trout (*Salmo clarki*) were sampled from Lakes 4 and 7 and Ponds 2 and 5b. In Lake 7, fish collected by angling and gill nets had an average length of 278 mm (11 1/8 inches) and an average weight of 229 gm (1/2 lb). Fish samples from the same length class in Lake 4 averaged considerably less in length and weight. Many of the fish from Lake 4 were well developed sexually compared to trout from Lake 7 that were immature.

A limited number of fish were observed in Ponds 2 and 5b. They were considerably smaller than in Lakes 4 and 7. Trout from Pond 2 had ready access to spawning from inlet and outlet streams. However, no young of the year fish were noted in any of the lakes, suggesting that spawning was not successful.

It is reasonable to believe that a high degree of fish winterkill exists in the water bodies since they are so shallow and some of them retain ice and snow cover quite late into the summer. Lack of fish in Ponds 1, 5a, 6 and Lake 3 even though they were all planted at the same time in the early 1970s supported this theory.



Westslope cutthroat (*Salmo clarki*). Drawing: Simpson and Wallace 1978.

Camp was set up adjacent to one of the study sites. All equipment which included a microscope and a folding table was packed in by the students enrolled in Aquatic Biology (Zoology 503) at the University of Idaho.

Aquatic Biology Class Field Trip

The field trip from July 18-27, 1978 to the Belvidere Lake drainage was a requirement in Zoology 503 (Aquatic Biology) which at the time was offered at the University of Idaho. Support for the course was supplied by the Office of Continuing Education at the university. The objective of the class was to acquaint students with methods of sampling aquatic high lakes and analyzing the resulting data. An additional objective was to provide data to justify selection of this site as a Research Natural Area.

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Mystery Lake

Mystery Lake Research Natural Area
Salmon-Challis National Forest

Fred Rabe and Craig Rabe surveyed Mystery Lake and its outlet on August 21,1998. A lower lake and two ponds in the RNA were not surveyed.

Location

The RNA is located in the Salmon River Mountains at the head of the Loon Creek drainage about 28 air miles west of Challis, Idaho (Rust and Evenden 1996).

Ecoregion Section: IDAHO BATHOLITH (M332A), Lemhi County; USGS Quad: MOUNT JORDAN

From Stanley, Idaho, travel west on State Route 75 along the Salmon River to Sunbeam, Idaho. Take FS Road 013 north along the Yankee Fork for about 9.5 miles to the junction with FS Road 172 just past the Bonanza Guard Station. Go north approximately 15 miles on FS Road 172 up Jordan Creek over Loon Creek Summit and down the West Fork Mayfield Creek to the mouth of Mystery Creek. A trail follows Mystery Creek up the mountain. In places the trail is marked by rock cairns some of which are difficult to locate. No regular trail exists from the lower lake to the upper lake.

Rock glaciers are moving out into the water below the headwall of *The General* , a massif ridge partly encircling the lake.

Geology

The glaciated basin includes four water bodies of varying size. The highest point in the area is *The General*, a massif partly encircling Mystery Lake at an elevation of 3149 m (10,329 ft). Rock glaciers are moving out from below the headwall into Mystery Lake. The area is underlain by Idaho Batholith granitics with a close contact to the Custer Graben. The granitic bedrock has been cut by a number of volcanic dikes of tertiary age (Rust and Evenden 1996).

USGS Quad: MOUNT JORDAN.

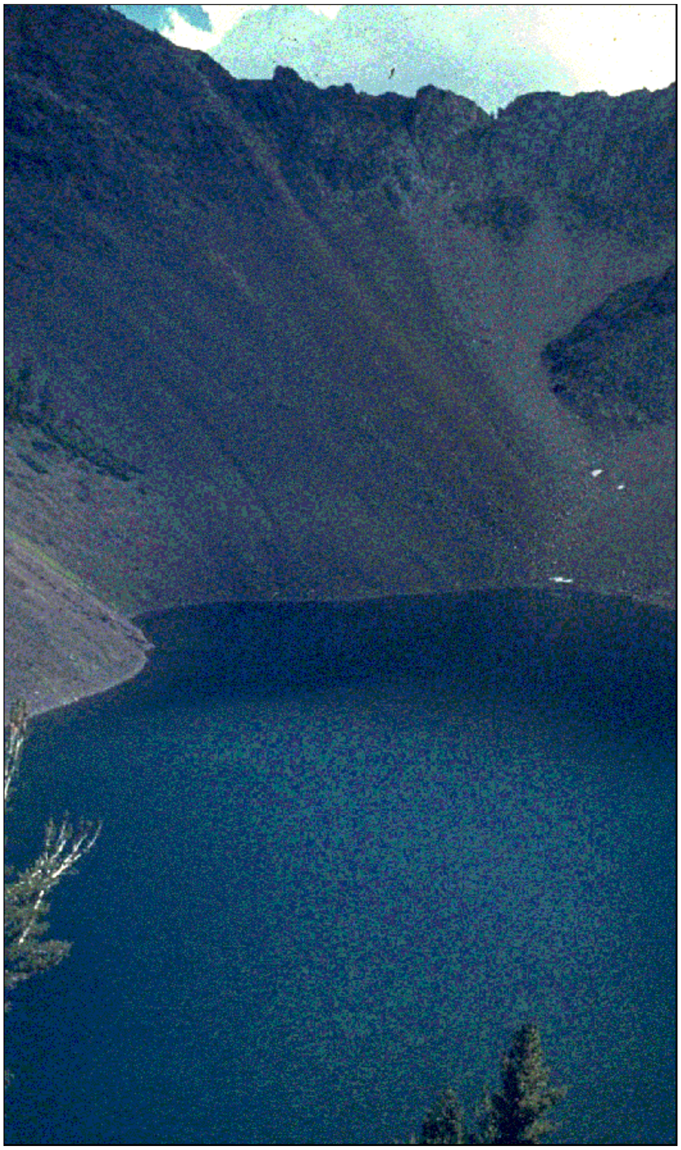
Classification

Upper Mystery Lake

- Alpine, large, deep, cirque lake
- Low production potential
- Circumneutral water in a granitic basin
- Inlet: 1 stream; Outlet: 1 stream

Aquatic physical - chemical factors

Maximum depth (m): 20 (64 ft)
Elevation (m): 2765 (9070 ft)
Aspect: NE
Percent shallow littoral zone: 10
Dominant substrate: boulders, soft sediments
Lake edge %: scree-80, cliff-20
Alkalinity (mg/l): 4
Conductivity (micromhos/cm): 15
pH: 7.0
Inlet: 1 stream
Outlet: 1 stream



View of south end of Mystery Lake. Note steepness of shoreline and lack of littoral zone. Another view of shoreline is seen below.

A view of rock glaciers moving into the lake. Massif in background is *The General.* Whitebark pine (*Pinus albicaulis*) in the foreground.

The depth recorded in the middle of the lake is 20 m (66 feet). About 4 m from shore, depth is 5.5 m (18 ft). The lake water temperature was 16 degrees C at the surface. Most of the lake has a limited littoral zone with the shoreline consisting of cliffs and scree slopes.

The outlet stream has a channel bottom comprised of bedrock. A massive amount of green algae occurs in the water. Water temperature was 16 degrees C. No sedges were noted along the edge of the stream.

Parts of the north and east sides of the lake have a shallow littoral zone.

View of substrate in littoral zone along east side of Mystery Lake.

Lower Mystery Lake.

Pond 1 is 2720 m (8920 ft) in elevation. Pond 2 at an elevation of 9200 feet drains into Pond 1.

Vegetation

Due to the relatively arid climate in the central portion of the Salmon River Mountains, whitebark pine *(Pinus albicaulis*) and subalpine fir *(Abies lasiocarpa*) communities dominate (Rust and Evenden 1996). Krummholz exists at upper timberline on *The General* above the whitebark pine and subalpine fir. Masses of filamentous green algae were noted in the outlet stream of Mystery Lake. Dense algae concentrations were also observed in the stream outlet of Upper Surprise Lake towards the end of summer. Both lakes are alpine.

Lower Mystery Lake at 2622 m (8600 ft). Pond 1 drains into the lake.

Whitebark Pine (*Pinus albicaulis*) on slope surrounding Mystery Lake.

Outlet of Upper Mystery Lake has a bedrock channel. Flow is rapid. Large amounts of filamentous green algae observed in the water.

Zooplankton

Cladocera
Simocephalus sp.
Copepods
Diaptomus sp.
Cyclopoida

Zooplankton were collected in the littoral zone. Density of organisms was very sparse.

Macroinvertebrates

<u>Upper Mystery Lake outlet</u>
Trichoptera
Glossosoma sp.
Family Odontoceridae
Diptera
Simulium sp.
Pseudodiamesa sp.

Extremely low numbers of macroinvertebrates were collected from the outlet stream. Large amounts of filamentous algae in the channel may account for the low density of invertebrates.

Vertebrates

Cutthroat trout (*Salmo clarki*) were sampled from Upper Mystery Lake. Golden trout (*Salmo aguabonita*) were collected at an earlier date from Lower Mystery Lake.

Golden trout (*Salmo aguabonita*)

Literature Cited

Rust, S.; Evenden, A. G. 1996. Establishment record for Mystery Lake Research Natural Area, Lemhi County, ID. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT. l6 p.

Chilcoot Lake

Chilcoot Peak Research Natural Area
Boise National Forest

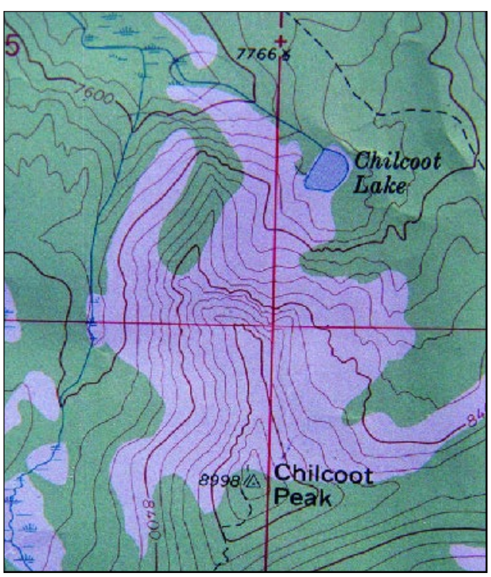
Fred Rabe and Mike Mancuso surveyed the lake and inlet streams on September 25, 1999.

Location

The site is located in the Salmon River Mountains on the divide between the Middle Fork and South Fork of the Salmon River drainages. The area is approximately 54 miles northeast of Cascade, Idaho (Mancuso 1992).

Ecosystem section: CHALLIS VOLCANICS (M332F) Valley County; USGS Quad: CHILCOOT PEAK

Travel south from Cascade, Idaho to the intersection of Warm Lake Road and State Route 55. Drive northeast on the Warm Lake Road for about 35 miles to Landmark. Turn onto FS Road 447 and go southeast then northeast for about 19 miles. Here the road passes near the Chilcoot RNA western boundary about a mile northwest of Chilcoot Pass. Follow a trail east over Chilcoot Pass and down a series of switchbacks. Then proceed north on the trail for about a mile; the lake is at the base of Chilcoot Peak a short distance off the trail.



USGS Quad: CHILCOOT PEAK.

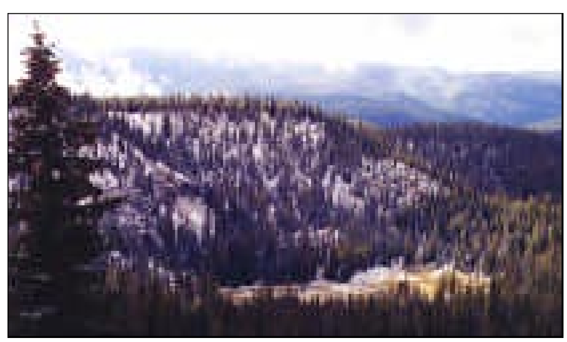
View north of Chilcoot Lake from the flank of Chilcoot Peak.

Geology

This area is along the boundary between undifferentiated Idaho batholith dark granitic rocks and alaskite (a granite rock with only a few dark minerals) with metamorphic fragments (Rember and Bennett 1979). Recent glacial deposits border the north face of the lake.

Classification

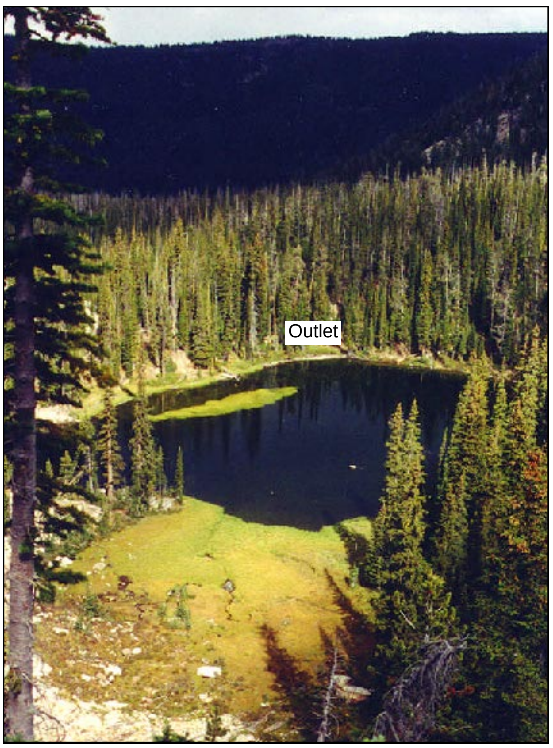
- Subalpine, small, shallow, cirque lake
- Medium production potential
- Circumneutral water
- Inlet: 2 seeps, 1 stream; Outlet: 1 stream



View east from Chilcoot Peak ridge of extensive wetlands in the valley.

Aquatic physical-chemical factors

Area (hectares) 1 (2.5 acres)
Length of shoreline (m): 389 (1276 ft)
Maximum depth (m): 3 (10 ft)
Elevation (m): 2335 (7660 ft)
Aspect: NW
Percent shallow littoral zone: 90
Dominant bottom substrate: soft sediment
Shoreline development: 1.051
Lake edge %: herbs-65, shrubs, trees-15, rocks-15
Alkalinity (mg/l): 15
Conductivity (micromhos/cm): 20
pH: 7.6
Inlet: 3 seeps
Outlet: 1 stream



View north of Chilcoot Lake. Note extensive sedge mat consisting mostly of beaked sedge (*Carex utricularia*) in foreground. Seepage of water from this mat provides the main source of water into the lake.

Vegetation

An almost pure stand of beaked sedge (*Carex utricularia*) occurred along the south shore of the lake with a patch of willow (*Salix commutata*) and reed grass (*Calamagrostis canadensis*) in one place. On the northwest side of the lake, a drier and slightly more raised meadow exists. Sedges occur here but not *Carex utricularia*. Labrador tea (*Ledum glandulosum*) together with small Engelman spruce (*Picea engelmannii*) were observed. Scattered patches of water sedge (*Carex aquatilis*) were noted along the lake shore.

A species of pondweed (*Potomogeton*) was submerged in the water together with the blue green algae (*Nostoc*). A "green island" floating in the lake was bur-reed (*Sparganium angustifolium*).

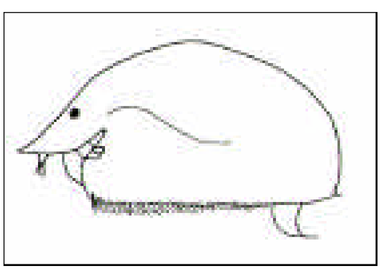
A willow (*Salix drummondiana*) was observed lining the outlet area close to a small patch of alder (*Alnus sinuata*). Collection and identification of plants were made by Michael Mancuso from the Conservation Data Center in Boise, Idaho.

View south across Chilcoot Lake with Chilcoot Peak in background (8998 ft elevation). The willow *Salix drummondiana* is in the foreground. Bur-reed (*Sparganium angustifolium*) appears as a pale green island in the lake.

Beaked sedge (*Carex utricularia*) occurred in an almost pure stand in the wet meadow on the south side of the lake. From Hurd et al. 1998.

Zooplankton

Cladocera
- *Graptoleberis testunaria*
- *Chydorus* sp.
- *Alona* sp.



Graptoleberis testunaria. Sketch credit: Melanie Abell.

Macroinvertebrates

<u>Inlet stream</u>

Trichoptera
- *Ecclisomyia* sp.

Diptera
- *Procladius* sp.

<u>Lake</u>

Ephemeroptera
- *Baetis tricaudatus*
- *Paraleptophlebia* sp.

Trichoptera
- *Lenarchus* sp.
- *Limnephilus* sp.

Diptera
- *Procladius* sp.
- Subfamily Chironominae
- Subfamily Orthocladiinae

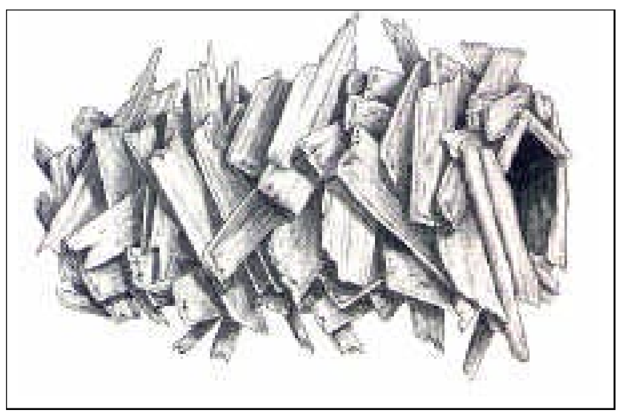
Neuroptera
- *Sialis* sp

Coleoptera
- *Neoscutopterus* sp.

Pelecypoda
- *Pisidium* sp.

Oligochaeta
- Family Lumbriculidae

Aeshnidae
- *Aeshna* sp.



A larval case of *Limnephilus*, a caddisfly. Sketch credit: McCafferty (1983).

Vertebrates

Cutthroat trout (*Salmo clarki*) up to nine inches in length were observed in the lake.

Literature Cited

Hurd, E. G.; Shaw, N. L.; Mastrogiuseppe, J. (and others)1998. Field guide to Intermountain sedges. GTR-10. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 282 p.

Mancuso, M. 1992. Establishment record for Chilcoot Peak Research Natural Area within Boise National Forest. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT. 27 p.

McCafferty, W. P. 1983. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Rember, W. C.; Bennett, E. H. 1979. Challis 1 x 2 degrees geologic map. Moscow, ID: University of Idaho, Bureau of Mines and Geology.

Cache Creek Lakes and Pond

Cache Creek Lakes Research Natural Area
Salmon-Challis National Forest

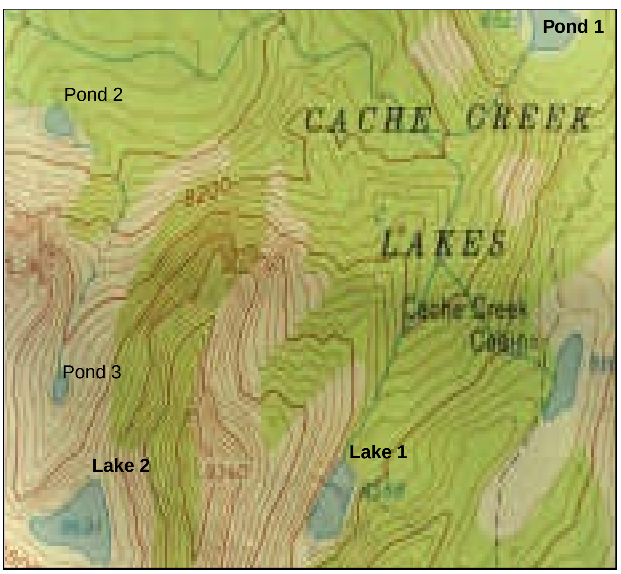
On August 22, 1998 Fred Rabe and Craig Rabe sampled Lake 1 and Pond 1 together with associated inlet and outlet streams in the RNA. Lake 2 and Ponds 2 and 3 were not sampled.

Location

The RNA is located on the north side of Sleeping Deer Mountain in the Salmon River Mountains about 42 miles northwest of Challis, Idaho (Rust and Evenden 1996).

Ecoregion Section: CHALLIS VOLCANICS (M332F) Lemhi County;USGS Quad: SLEEPING DEER MOUNTAIN

From Challis, Idaho drive northwest on Twin Peaks Road which becomes FS Road 086 at the Forest boundary. Continue on this road about 39 miles until it ends. Take FS Trail 103 to the lakes. After about two miles the trail borders the east side of the RNA (Rust and Evenden 1996).



USGS Quad: SLEEPING DEER MOUNTAIN.

Geology

Pond 1 and Pond 2 are in a hornblende rich granite while those waters south of Ponds 1 and 2 are in the Casto Volcanics. The rocks around Sleeping Deer Mountain are more sodium rich than the surrounding rocks of the same type (Ross 1934). The granitic rock is identifiable due to its weathered rusty appearance. The Castro volcanics surrounding Sleeping Deer Mountain are mostly rhyolitic. They have a pallid drab-gray to somewhqat greenish-gray color.

FS Road 086. Sleeping Deer Mountain in background at an elevation of 3012 m (9881 ft).

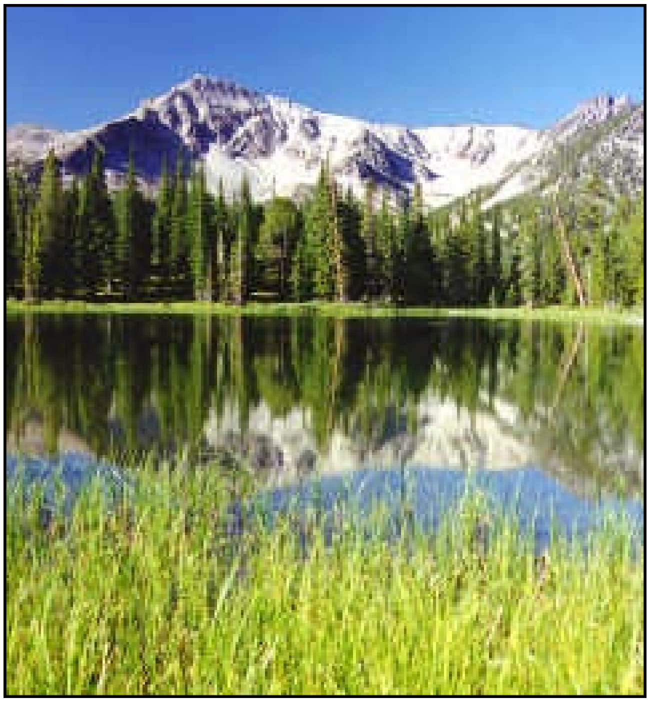
Classification

Cache Creek Pond 1
- Subalpine, small, shallow, cirque-scour pond
- High production potential
- Circumneutral water in granitic basin
- Inlet: 1 stream; Outlet: seep

Cache Creek Lake 1
- Subalpine, small, deep, cirque lake
- Medium production potential
- Circumneutral water in volcanic basin
- Inlet: 1 stream; Outlet: 2 streams

Aquatic physical - chemical factors

<u>Cache Creek Pond 1</u>
Area (hectares): 0.8 (2 acres)
Length of shoreline (m): 418 (1371 ft)
Maximum depth (m): 2 (6 ft)
Elevation (m): 2598 (8525 ft)
Aspect: SW
Percent shallow littoral zone: 100
Dominant substrate: Soft organic material
Shoreline development: 1.322
Lake edge %: herbaceous-100
Inlet: 1 seep
Outlet: 1 stream



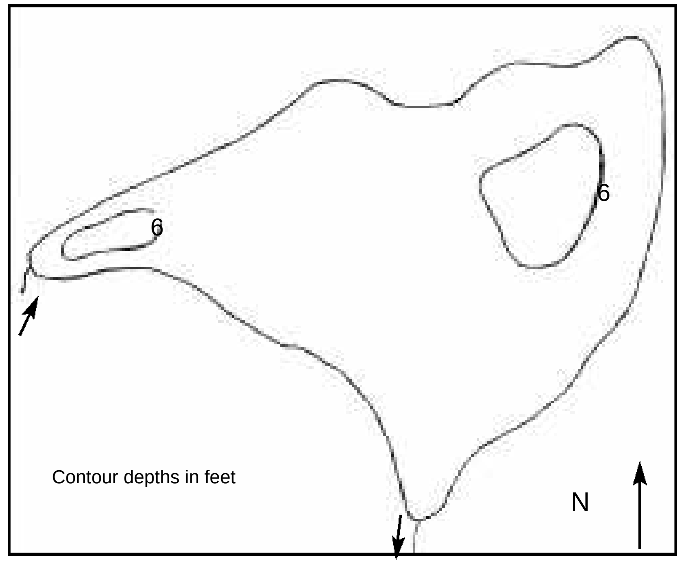
Cache Creek Pond 1 is set in a meadow with an extensive growth of sedges. Sleeping Deer Mountain is in the background.

Cache Creek Pond 1, set in a meadow, is surrounded by tall sedges. Bottom substrate is soft sediment which in places measures 0.75 m deep. A large amount of plant debris is in the lake except at the inlet end where a depression exists. Springs are believed to occur in this depression and probably account for the large concentration of macrophytes observed there. The water temperature in this part of the pond was 16 degrees C.

Cache Creek Pond 1 substrate is mainly soft organic material. The log in the water provides shade for fish.

The inlet stream runs through an extensive sedge meadow. Water temperature was 11 degrees C. The low gradient meandering glide stream averages 0.3 m wide and about 5 cm deep. A fingerling brook trout collected in the benthos sample indicates that the site is a nursery area for small fish.

The outlet to Cache Creek was 19 degrees C, a seven degree temperature difference from the inlet. Mean width was 0.3 m and depth 0.1 m. Substrate is soft organic material; riparian growth is sedges.The outlet stream continues for about 70 m and then drops off a cliff.

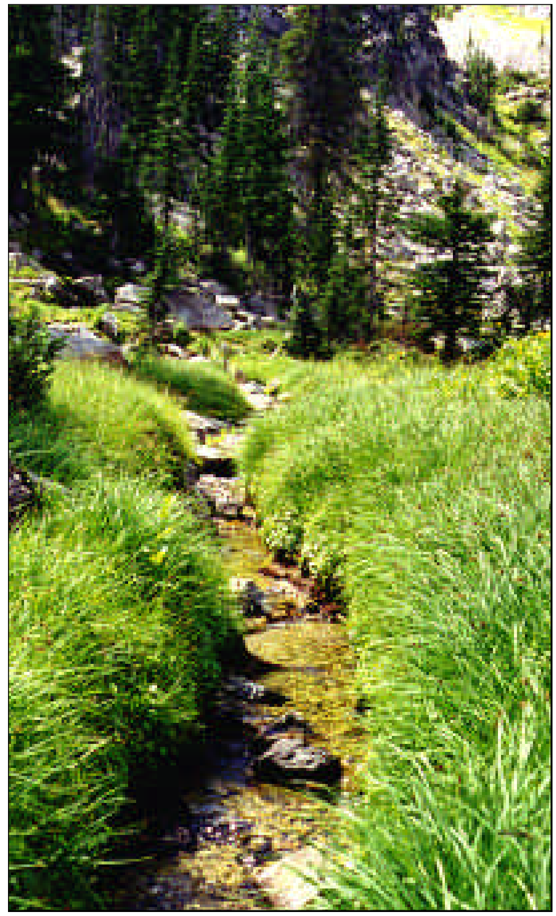


Bathymetric map of Cache Creek Pond 1. 1 inch = 125 feet

<u>Cache Creek Lake 1</u>
Area (hectares): 1 (2.5 acres)
Length of shoreline (m): 418 (1371 ft)
Maximum depth (m): 4.3 (14 ft)
Elevation (m): 2610 (8560 ft)
Aspect: SW
Percent shallow littoral zone: 15
Dominant substrate: boulders
Shoreline development: 1.173
Lake edge %: conifers-70, talus-20, herbaceous-10
Alkalinity (mg/l): 17
Conductivity (micromhos/cm): 25
Inlets: 1 stream
Outlets: 2 streams

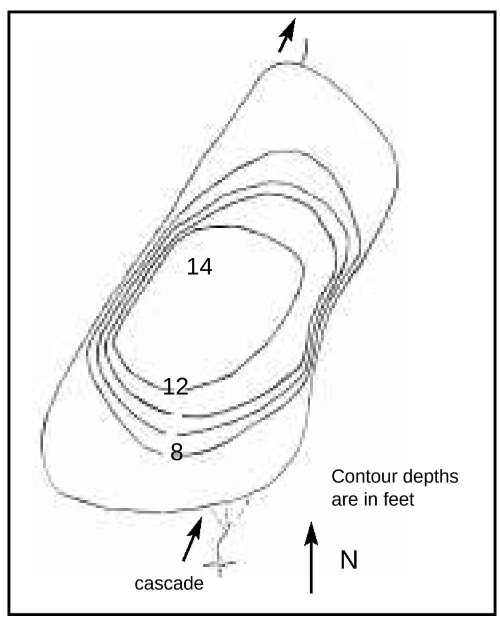
The maximum depth of the lake is 4.3 m (14 feet). More than half the lake area exceeds 2.4 m (8 ft) in depth. Sedges are common at the inlet end where an extended littoral zone is present.

View from east shore of Cache Creek Lake 1.

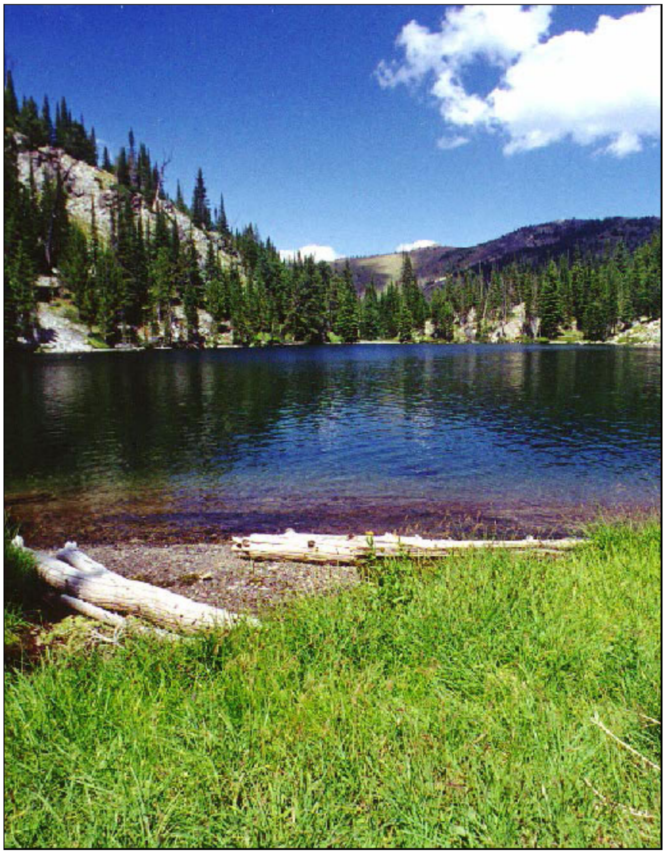


Inlet stream into Cache Creek Lake 1. Note thick sedge riparian growth.

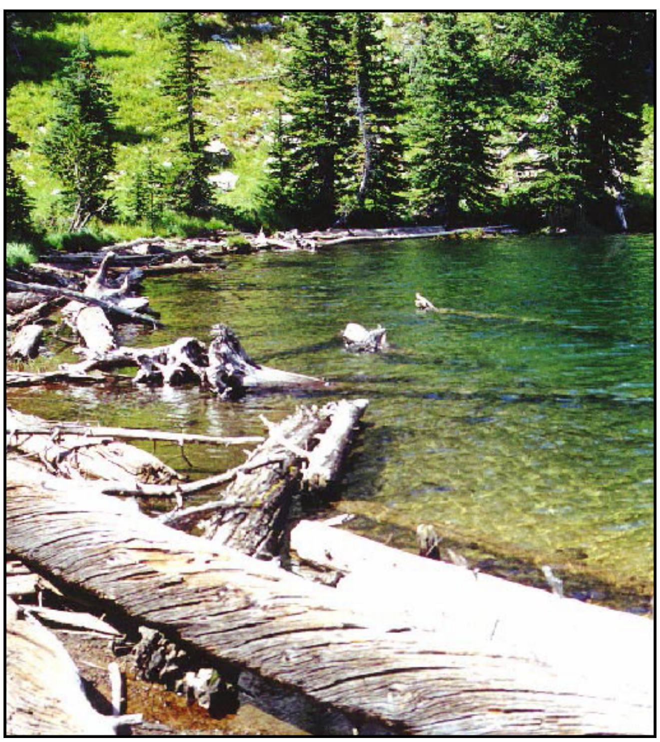
View southwest of Cache Creek Lake 1. No trail to this water body exists.



Bathymetric map of Cache Creek Lake 1. One inch = 197 feet.



View from inlet end of Cache Creek Lake 1.



Littoral area at inlet end of lake.

The inlet stream into the lake was 11 degrees C. The substrate is comprised of small, light colored gravel mixed with some rubble-size stones. Arelatively small amount of coarse particulate matter (CPOM) is present. Riparian vegetation is primarily sedges. The stream which averages about 0.5 m wide and only 3 cm deep with pools up to 10 cm in depth, cascades down a steep slope and then flows about 30 m into the lake.

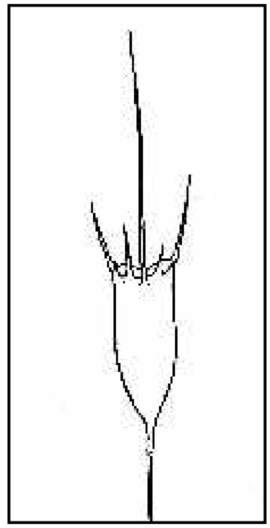
In contrast the outlet stream is laden with CPOM. The inlet is about 3.5 m wide and 0.5 m deep. Further downstream the substrate changes to small boulders, cobble and gravel.

Inlet stream to Cache Creek Lake 1. Note the small size rock substrate and clarity of water.

Vegetation

Cache Creek Pond
Quillwort (*Isoetes* sp.)
Pondweed (*Potomogeton crispus*)
Cliff sedge (*Carex scopulorum*)
Beaked sedge (*Carex utricularia*)
Bogbean (*Meyanthes trifoliata*)

Quillwort - *Isoetes* sp.



Kellicottia sp. a rotifer dominant in Cache Creek Lake 1. Sketch credit: Needham and Needham 1962.

Pondweed (*Potamogeton crispus*)

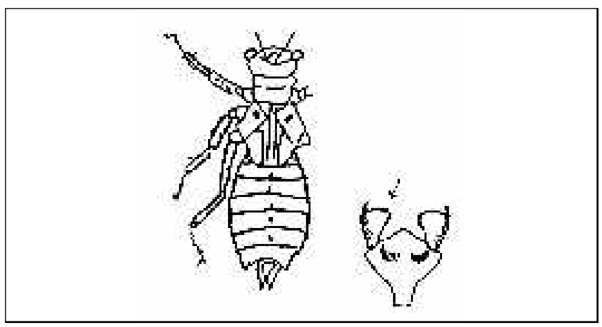
Cache Creek Lake 1
Cliff sedge (*Carex scopulorum*)
Gray sedge (*Carex canescens*)
Small-winged sedge (*Carex microptera*)

Zooplankton

Cache Creek Lake 1
Cladocera
    Pleuroxus sp.
Copepods
    Cyclopoida
    Calanoida

Macroinvertebrates

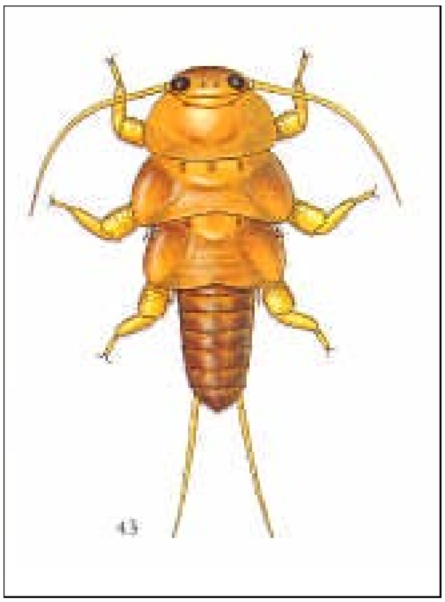
Cache Creek Pond 1
Ephemeroptera
    Callibaetis sp.
Odonata
    Family Libelluidae
    Enallagma sp.
Diptera
    Family Chironominae
Amphipoda
    Hyallela azteca
Pelecypoda
    Pisidium sp.



Libelluidae, a family of dragonflies was dominant in Cache Creek Pond 1. They are sometimes sprawlers along the bottom or climbers among debris and vegetation. Some species are tolerant of low dissolved oxygen levels or highly eutrophic environments (McCafferty 1981).

Cache Creek Lake 1 - inlet
Ephemeroptera
    Cinygmula sp.
Plecoptera
    Yoraperla brevis
    Visoka sp.
    Family Chloroperlidae
Trichoptera
    Clistorina sp.
    Allomyia sp.
    Hesperophylax sp.
Diptera
    Family Chironomidae

Some mayflies, stoneflies, and caddisflies listed above are quite sensitive to perturbations and reflect a pristine habitat.



Yoraperla brevis is a roachlike stonefly found in cold clean water in an erosional habitat. (Merritt and Cummins 1996). Sketch Credit: McCafferty 1981.

Vertebrates

The spotted frog (*Rana pretiosa*) was observed in Cache Creek Pond 1. Brook trout (*Salvelinus fontinalis*) up to 24 cm (9.5 in) in length were collected. The fish apparently reproduce in the lake because there were at least three length classes present. The lake is overpopulated with this species. Cutthroat trout (*Salmo clarki*) were collected in Cache Creek Lake 1.

Literature Cited

McCafferty, W. P. 1981. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Merritt, R. W.; Cummins, K. W. 1996. Aquatic insects of North America. Dubuque: Kendall Hunt Publishers. 862 p.

Needham, J. G.; Needham, P. R. 1962. A guide to the study of freshwater biology. San Francisco: Holden-Day Publishers. 108 p.

Ross, C. P. 1934. Geology and ore deposits of the Casto Quadrangle, Idaho. U.S. Geological Survey. B-854. 132 p.

Rust, S.; Evenden, A. G. 1996. Establishment record for Cache Creek Lakes Research Natural Area within Lemhi County, Idaho. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT. 15 p.

Sleeping Deer Mountain on right. Abandoned lookout tower on summit.

Master Sergeant Lake and Ponds

Soldier Lakes Research Natural Area
Salmon-Challis National Forest

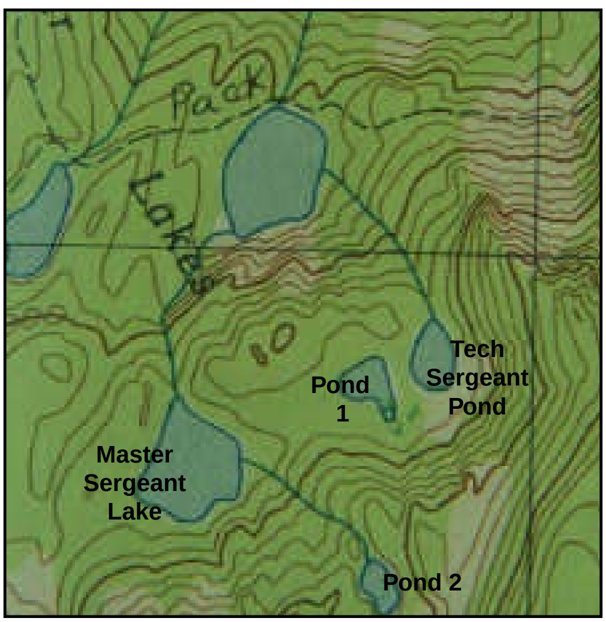
During July 1980, Charles Wellner, Nancy Savage and Fred Rabe sampled Master Sergeant Lake and three ponds comprising the RNA.

Location

The RNA is located 25 air miles northwest of Stanley, Idaho at the head of Soldier Creek which is a tributary to the Middle Fork of the Salmon River.

Ecoregion Section: IDAHO BATHOLITH (M332A), Custer County; USGS Quad: SOLDIER CREEK

From Stanley, Idaho travel 18 miles northweston State Route 21. From there drive north on FS Road 008 for about 20 miles to the end of the road at Josephus Lake Campground. Hike approximately four miles west from the campground on FS Trail 013. The RNA is up the steep slope to the south where the trail approaches the first water body. Tech Sergeant Pond is less than 0.25 miles from there (Wellner 1991).



USGS Quad: SOLDIER CREEK. The upper two water bodies are not in the Sodier Lakes RNA.

Geology

One lake and three ponds are connected by moderate to steep gradient streams in high elevation cirque basins of granitic-quartz monzonite (Wellner 1991). Three-quarters of these basins consist of rocky, treeless headwalls and talus slopes. The basin floors are scoured bedrock.

Classification

Master Sergeant Lake

- Subalpine, small, deep, cirque-scour lake
- Medium-high production potential
- Circumneutral water in granitic-quartz monzonite
- Inlet: 1 stream; Outlet: 1 stream

Tech Sergeant Pond

- Subalpine, small, shallow, cirque pond
- Low-medium production potential
- Circumneutral water in granitic-quartz monzonite
- Inlet: none; Outlet: 1 stream

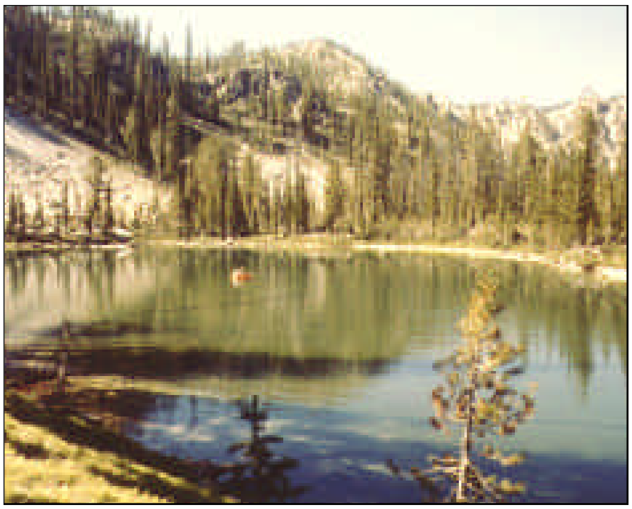
Aquatic physical - chemical factors

Master Sergeant Lake
Area (hectares): 2.2 (5.5 acres)
Length of shoreline (m): 578 (1896 ft)
Maximum depth (m): 5.5 (18 ft).
Elevation (m): 2402 (7880 ft)
Aspect: NW
Percent shallow littoral zone: estimate, 50
Dominant substrate: soft sediments and gravel
Shoreline development: 1.145
Lake edge %: herbaceous-70, conifers-20, talus-10
Alkalinity (mg/l): 30
Conductivity (micromhos/cm): 30
Inlets: 1 stream
Outlets: 1 stream

Master Sergeant Lake. An unidentified macrophyte appears in the littoral zone where the substrate is gravel. Photo credit: Charles Wellner.

Tech Sergeant Pond
Area (hectares) 0.6 (1.5 acres)
Length of shoreline (m): 301 (988 ft)
Maximum depth (m): 2.1 (7 ft)
Elevation (m): 2329 (7640 ft)
Aspect: N
Percent shallow littoral zone: estimate, 80
Dominant substrate: soft sediments
Shoreline development: 1.010
Lake edge %: talus-80, conifers-20
Alkalinity (mg/l): 30
Conductivity (micromhos/cm): 30
Inlets: none
Outlets: 1 stream

Pond 1 on left and Tech Sergeant Pond on right. Photo credit: Charles Wellner.



Tech Sergeant Pond. Note raft used to collect samples. Photo credit: Charles Wellner.

Pond 1 is located in a shallow closed basin near Tech Sergeant Pond. Water loss is by seepage and evaporation and inflow is primarily from snowmelt. The water body warms considerably during the summer and may be vernal in dry years. It contains a high density of invertebrates, frogs and submerged macrophytes.

Pond 1 is about 1 1/4 acres in size and three feet in depth. It warms up considerably during summer months. A temperature of 73 degrees F was recorded in July. Photo by Charles Wellner.

Pond 2 is in an upper cirque near the headwall and drains into Master Sergeant Lake. It is about 0.5 acres in size and contains sparse populations of plankton and macroinvertebrates.

Vegetation

Trees in the area include lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmanni*) and whitebark pine (*Pinus albicaulis*). Common shrubs are grouse whortleberry (*Vaccinium scoparium*) and western ledum (*Ledum glandulosum*).

Quillwort (*Isotes* sp.) was abundant in Pond 1.

Subalpine fir-grouse whortleberry habitat type on slope to right of Tech Sergeant Pond. Photo credit: Charles Wellner.

Invertebrates

High densities of invertebrates were observed in Pond 1 including the red calanoid zooplankton (*Diaptomus shoshone*), the fairy shrimp (*Branchinecta* sp.), aquatic beetles and the caddisfly, *Limnephilus*. The uppermost Pond 2 contained few of the taxa described above.

Subalpine fir-labrador tea habitat type near Pond 2. Photo credit: Charles Wellner.

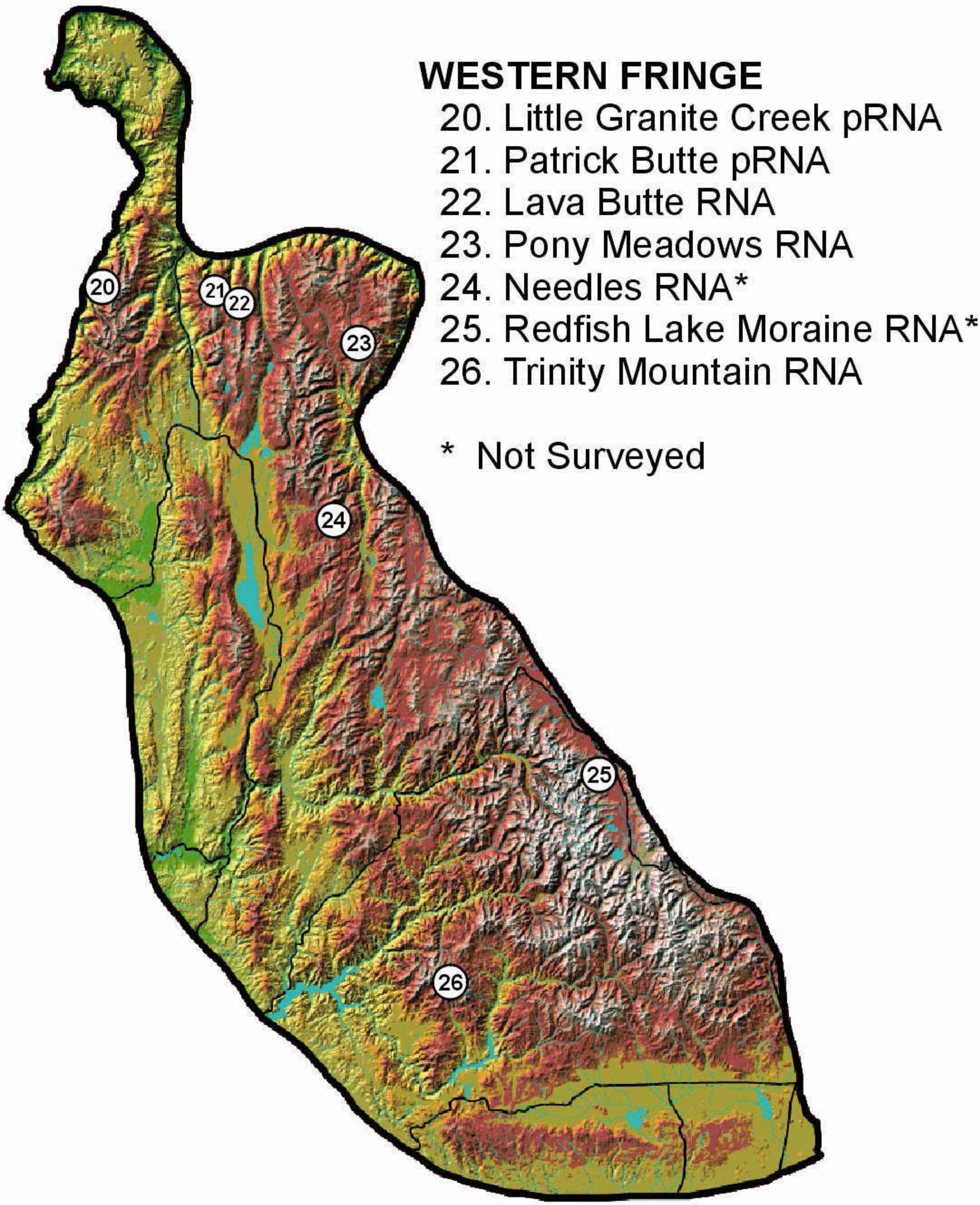
Fairy shrimp (*Branchinecta* sp.) were observed in two of the fishless ponds. These specimens are about 1 cm in length. They are filter feeders.

Vertebrates

Eastern brook trout (*Salvelinus fontinalis*) were present in Master Sergeant Lake. The spotted frog *(Rana pretiosa*) was noted in large numbers at Pond 1.

Literature Cited

Wellner, C. A. 1991. Establishment record for Soldier Lakes RNA within Challis Naional Forest. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT. 23 p.


WESTERN FRINGE
20. Little Granite Creek pRNA
21. Patrick Butte pRNA
22. Lava Butte RNA
23. Pony Meadows RNA
24. Needles RNA*
25. Redfish Lake Moraine RNA*
26. Trinity Mountain RNA
* Not Surveyed
20
21
22
23
24
25
26

Little Granite Creek Lakes

Little Granite Creek Research Natural Area
Nezperce National Forest

There are five lakes and five ponds in the proposed RNA. Norm Howse surveyed Echo Lake, Quad Lake, and He Devil Lake on August 7-11, 1967 (Howse 1967). Fred Rabe and Nancy Savage subsequently made observations of Baldy Lake and Ponds 1-3 on September 27-29, 1974. Triangle Lake was not sampled.

Location

The high lakes in the proposed RNAare located in two basins forming the headwaters of Little Granite Creek in the Hells Canyon National Recreation Area.

Ecoregion Section: BLUE MOUNTAINS (M332G), Idaho County; USGS Quad: HE DEVIL, SQUIRREL PRAIRIE

From Riggins, Idaho, drive south about two miles to the Seven Devils Road (FR 517) and travel to Heaven's Gate and the Seven Devil's Guard Station. By trail, Quad Lake, He Devil Lake and Echo Lake are about 9 miles from the guard Station.

Geology

The area in the Seven Devisl Mountain Range is rich in aquatic features, ranging from cirque lakes and ponds to moderate to steep gradient streams. The higher elevation portions of the area have been shaped by alpine glaciation. The area contains Triassic metabasalt rocks and possibly granitics (Wellner 1979). The natural area spans elevations from abou 427 m (1400 feet)where Little Granite Creek flows into th Snake River to 2863 m (9393 ft) at the summit of one of th peaks. The proposed RNA will contain the entire drainage c Little Granite Creek except for some recreational exclusions.

View west of Seven Devils Mountain Range

Classification

Quad Lake

- Subalpine, small, deep, cirque-scour lake
- Low production potential
- Circumneutral water in a basalt-granite basin
- Inlet: none; Outlet: intermittent

Echo Lake

- Subalpine, small, deep, cirque-scour lake
- Low production potential
- Circumneutral water in a basalt-granite basin
- Inlets: seeps; Outlet: 1 stream

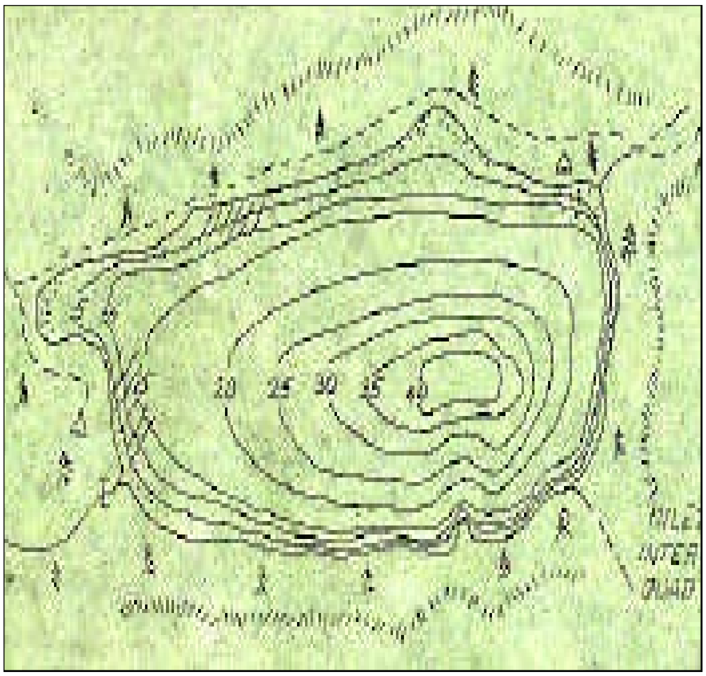
He Devil Lake

- Subalpine, small, deep, cirque-scour lake
- Medium production potential
- Circumneutral water in a basalt-granite basin
- Inlet: none; Outlet: intermittent stream

Aquatic physical - chemical factors

Echo Lake, Quad Lake and He Devil Lake were surveyed by Norm Howse August 7-11,1967.

<u>Echo Lake</u>
Area (hectares): 3.5 (8.6 acres)
Length of shoreline (m): 827 (2713 ft)
Maximum depth (m): 12.2 m (40 ft)
Elevation (m): 2208 (7243 ft)
Aspect: NW
Percent shallow littoral zone: 20
Dominant substrate: silt covered rock bottom
Shoreline development: 1.3
Lake edge %: conifers-80, herbacous-10, rock-10
Alkalinity (mg/l) 17
pH: 6.5
Inlets: 2 seeps
Outlets: 1 stream



Morphometric map of Echo Lake (Howse 1967). Contour levels in feet.

There are two intermittent seepage inlets at the east end of the lake and an outlet at the west end measuring about 0.75 m wide and 10 cm deep. The outlet was blocked with alders, sedges and a fish screen installed several years ago. Marginal spawning gravel was noted near the north and west sides. Transparency was 12 m (40 feet) indicating high light penetration.

Echo Lake (above and below). Note extensive coniferous growth along inlet shore. Photographs by W. Burleson, August 1982.

Quad Lake
Area (hectares1.3 (3.2 acres)
Length of shoreline (m): 549 (1801 ft)
Maximum depth (m): estimate, >7.6 (>25 ft)
Elevation (m): 2195 (7200 ft)
Aspect: NW
Percent shallow littoral zone: 20
Dominant bottom substrate: silt covered boulders
Shoreline development: 1.3
Lake edge %: slide rock-90, conifers-10
Inlets: none
Outlet: intermittent

No aquatic vegetation was observed in Quad Lake. Considerable amounts of spawning gravel were observed around most of the water body. The pond below the lake is about 2 m deep.

He Devil Lake
Area (hectares): 2.1 (5.2 acres)
Length of shoreline (m): 593 (1946 ft)
Maximum depth (m): estimate, 7.6 (25 ft)
Elevation (m): 2268 (7440 ft)
Percent shallow littoral zone: estimate, 35
Dominant bottom substrate: rock and sediment
Shoreline development: 1.2
Lake edge %: conifers-30, herbaceous-20, rock-50
Inlets: none
Outlets: intermittent stream to small pond

He Devil Lake. Note the island in the lake.

Baldy Lakes

These water bodies are reached from Seven Devils Guard Station Campground, a distance of about 12 miles by trail. A brief description follows. Detailed measurements and samples were not taken.

Baldy Lake , square in shape, is surrounded by a young forest growing over the site of a fire in 1945. An extensive littoral zone exists except for the southern shore which has a steep drop off. The substrate is rocky and there is no inlet visible. The outlet is dry except for a small spring.

Baldy Pond 1 has an estimated depth of about 3 m (10 ft). The substrate consists of soft bottom sediments.

Baldy Pond 2 has an estimated maximum depth of 2.4 m (8 feet). The water body has a boulder substrate and the shoreline is predominantly rocky. The lake at its widest point is estimated to be about 37 m (120 ft).

Baldy Pond 3 has an estimated maximum depth of about 1 m (3 ft). Herbaceous plant growth covers the muddy substrate with filamentous algae attached to the plants. No inlet or outlet is noted. The diameter of the pond is estimated to be 15 m (50 ft).

According to the topographic map the main body of Little Granite Creek begins as the outlet stream of Baldy Lake but such is not the case. Little Granite Creek probably originates as a spring draining water out of Baldy Lake through underground channels. This spring is located somewhere north of the side trail to Baldy Lake and south of the small trickle that constitutes the direct overflow out to the water bodies below.

Baldy Pond 1 with Baldy Pond 2 to the right and Baldy Pond 3 to the left.

Vegetation

Quillwort (*Isotes* sp.) was observed in Big Baldy Lake and Bur-reed (*Sparganium* sp.) in Big Baldy and Lower Baldy Lake 1.

Bur-reed (*Sparganium* sp.)

Quillwort (*Isotes* sp.) reproduces by megaspores just large enough to be seen and microspores which appear as fine powder (Fassett 1972).

Zooplankton

Echo Lake
- *Daphnia longispina*
- *Diaptomus* sp.
- Ostracoda
- *Kellicottia* sp.

Macroinvertebrates

Echo Lake
- Order Trichoptera
- Family Aeshnidae
- Family Coenagrionidae

Literature Cited

Howse, N. R. 1967. Fishery survey of alpine lakes in the Seven Devils Scenic Area. Nez Perce National Forest. U.S. Department of Agriculture, Forest Service, Grangeville, ID. 50 p.

Fassett, N. C. 1972. A manual of aquatic plants. Madison: University of Wisconsin Press. 405 p.

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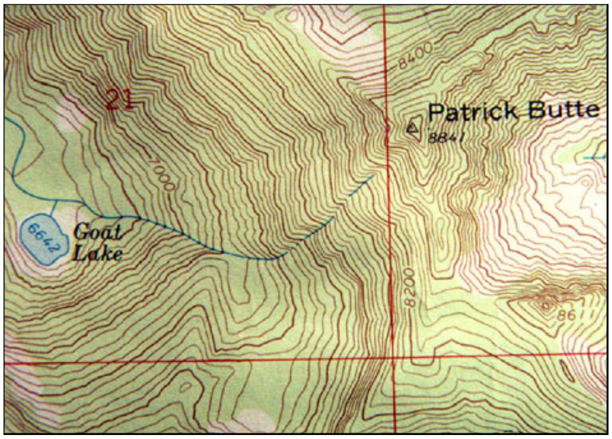
Goat Lake

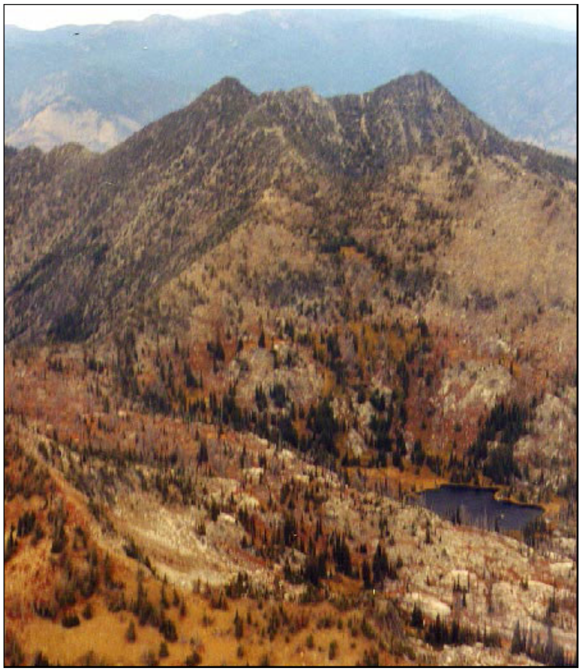
Patrick Butte Proposed Research Natural Area
Payette National Forest

The RNA has one lake. The site was visited in the 1980s by Charles Wellner and Bob Moseley to establish an RNA. Aerial photos were taken of the area in September1999. The RNA is located in the western Salmon River Mountains about 8.5 air miles southeast of Riggins, Idaho (Wellner and Tisdale 1985).

Ecoregion Section: IDAHO BATHOLITH (M332A), Idaho County; USGS Quad: PATRICK BUTTE



USGS Quad: PATRICK BUTTE.



View north. Paradise Lake on the right below Patrick Butte, 2695 m (8841 feet). Goat Lake is over saddle on left. Photo credit: Jim Weaver.

View south. Goat Lake lies in an extremely deep glacial cirque basin (arrow). Photo credit: Jim Weaver.

View southwest. Goat Lake is surrounded on all sides by very steep slopes. Photo credit: Jim Weaver.

Literature Cited

Wellner, C. A.; Tisdale, E. W. 1985. Coverage of natural diversity in northern, central and southern Idaho within established and proposed Research Natural Areas and equivalents. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT.

Lava Butte Lake and Ponds

Lava Butte Research Natural Area

Payette National Forest

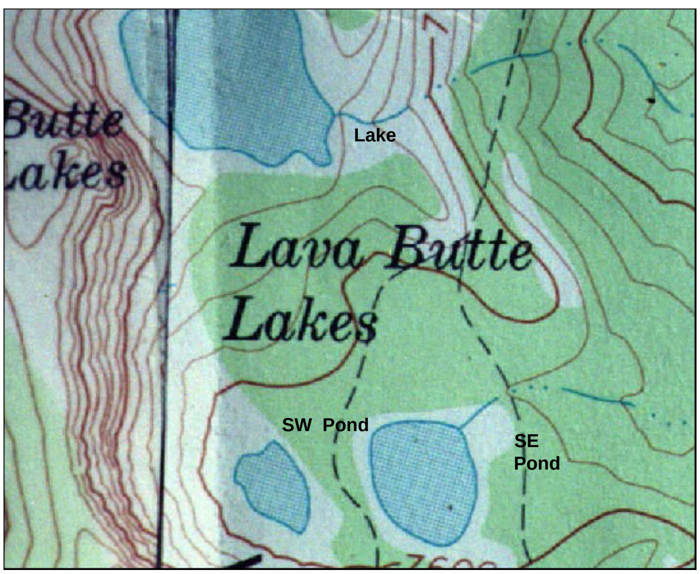
On July 16-17, 1998, Fred Rabe and Nancy Abbott sampled the lake in the RNA. Two ponds outside the RNA but near the lake were also sampled.

Location

The RNAis situated in the western Salmon River Mountains about 25 air miles north of McCall, Idaho.

EcoregionSection: IDAHO BATHOLITH (M332A), Idaho County; USGS Quad: HERSHEY POINT and PATRICK BUTTE

From the bridge crossing on U.S. Route 95 over the North Fork Payette River in McCall, travel 3.5 miles northwest on U.S. 95. Take FS Road 257 north about 26 miles past Hazard Creek to the junction with FS Road 308. Follow Road 308 southeast then north about 11 miles to its junction with FS Road 365. Take FS 365 about 0.4 mile west to the Lava Lakes Trail 347. Proceed west and north about 1.5 miles to the junction with Trail 149. Turn south on 149 for about 1 mile to Lava Butte Lakes. Part of the trail is in serious need of maintenance.



USGS Quad: HERSHEY POINT, PATRICK BUTTE.

Geology

The Lava Butte RNA includes a subalpine glacial basin and ridgeline system. The granite and basalt formations that occur on Lava Butte offer an opportunity to study the influence of parent material on plant distribution.

Classification

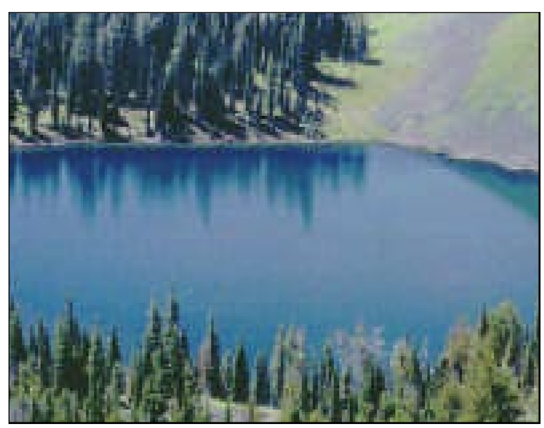
Lava Butte Lake
- Subalpine, large, deep, cirque lake
- Low production potential
- Circumneutral water in granite-basalt basin
- Inlet: none; Outlet: riffle-pool type stream

Lava Butte Pond SW
- Subalpine, small, shallow, cirque pond
- Low-medium production potential
- Circumneutral water in granite-basalt basin
- Inlet: none; Outlet: none

Lava Butte Pond SE
- Subalpine, small, shallow, cirque-scour lake
- Medium production potential
- Circumneutral water in granite-basalt basin
- Inlet: seeps; Outlet: meandering glide stream

Aquatic physical - chemical factors

<u>Lava Butte Lake</u>
Area (hectares): 4.8 (11.8 acres)
Length of shoreline (m): 864 (2835 ft)
Maximum depth (m): 10.5 (34 ft)
Elevation (m): 2280 (7480 ft)
Aspect: SE
Percent shallow littoral zone: 15
Dominant substrate: boulders, soft sediments
Shoreline development: 1.099
Lake edge %: shrub-70, conifers-15, talus-15
Alkalinity (mg/l): 10
Conductivity (micromhos/cm): 21
pH: 7.4
Inlets: None
Outlets: 1 stream



Lava Butte Lake before widespread fire which occurred in 1995.

Lava Butte Pond SW
Area (hectares): 0.6 (1.6 acres)
Length of shoreline (m): 320 (1050 ft)
Maximum depth (m): 1.8 (5.9 ft)
Elevation (m): 2317 (7600 ft)
Aspect: E
Percent shallow littoral zone: 100
Dominant substrate: boulders and soft sediments
Shoreline development: 1.097
Lake edge %: talus-65, herbaceous-35
Alkalinity (mg/l): 11
Conductivity (micromhos/cm): 30
pH: 7.3
Inlets: None
Outlets: None

Lava Butte Lake. Water depth exceeds 4 m in most of lake. Downed logs in the water are prevalent towards outlet end.

Lava Butte Pond SE
Area (hectares): 1.6 (4 acres)
Length of shoreline (m): 470 (1542)
Maximum depth (m): 4 (13.1 ft)
Elevation (m): 2317 (7600 ft)
Aspect: NE
Percent shallow littoral zone: 35
Dominant substrate: soft sediments
Shoreline development: 1.022
Lake edge %: dead conifers -50, herbaceous-50
Alkalinity (mg/l): 13
Conductivity (micromhos/cm): 20
pH: 7.4
Inlets: Seeps
Outlet: 1 stream

Lava Butte Pond SE. Color of lake indicates suspended fine particles in water or "rock flour."

Lava Butte Pond SW. Boulders near the distant shore are-heavily mineralized. Large fairy shrimp (*Branchianecta coloradensis*) are dominant invertebrates in the water.

Vegetation

Whitebark pine (*Pinus albicaulis*) and subalpine fir (*Abies lasiocarpa*) habitat types and dry grass meadow vegetation occur in upslope areas (Wellner and Rust 1996). There is an opportunity in this locale to study the influence of parent material, especially granite and basalt, on plant distribution.

Extensive sedge beds primarily water sedge (*Carex aquatilis*) surround Lava Butte Pond SE.

Carex aquatilis
(water sedge)
Hurd et al. 1998.

Zooplankton

Lava Butte Lake
- *Daphnia* sp.
- Chydorus *sp.*
- *Family* Cyclopidae

Lava Butte Pond SW
- *Diaptomus shoshone*

Lava Butte Pond SE
- *Scapholeberis sp.*

Diaptomus shoshone is a large size calanoid copepod which is found predominantly in water bodies without fish populations as was the case in the southwest pond.

Macroinvertebrates

Lava Butte Lake
- Ephemeroptera
  - *Callibaetis* sp.
- Diptera
  - Family Orthocladiinae
- Hirudinea
  - *Helobdella stagnalis*

Lava Butte Lake outlet stream
- Platyhelminthes
  - *Polycelius coronata*
- Plecoptera
  - *Isoperla* sp.
  - *Cultus* sp.
  - *Amphinemura* sp.
- Ephemeroptera
  - *Ephemerella* sp.
  - *Nixe* sp.
  - *Cingyma* sp.
- Diptera
  - *Simulium* sp.
  - Subfamily Tanypodinae
- Trichoptera
  - Rhyacophila albertae
  - Rhyacophila grandis

Stoneflies, mayflies and caddisflies were well represented in the first order stream outlet from the lake.

Dead timber adjacent to Lava Butte Pond SW from 1995 fire.

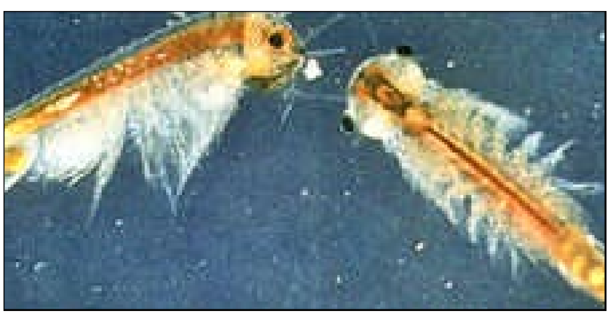
Lava Butte Pond SW

Eubranchiopoda
- *Branchianecta coloradensis*

Amphipoda
- *Hyallela azteca*

Diptera
- Family Culicidae

Trichoptera
- *Limnephilus* sp.



These fairy shrimp (*Brachianecta coloradensis*) were collected as dominant macroinvertebrates in Lava Butte Pond SW.They are commonly observed in ponds less than one hectare in area. Fish populations are usually absent.

Lava Butte Pond SE

Ephemeroptera
- *Ephemerella* sp.

Diptera
- *Ablabesmyia* sp.
- Family Ceratopogonidae
- Family Culicidae
- Family Orthocladiinae

Odonata
- *Ischnura* sp.

Oligochaeta
- Family Lumbriculidae

Pelecypoda
- *Pisidium* sp.

Hirudinea
- *Helobdella stagnalis*

Lava Butte Pond SE outlet stream

Ephemeroptera
- *Ephemerella* sp.

Diptera
- *Simulium* sp.
- Family Culicidae

Family Ceratopogonidae
- Family Tanypodinae
- Family Orthocladiinae

Pelecypoda
- *Pisidium* sp.

Oligochaeta
- Family Lumbriculidae

Literature Cited

Hurd, E., G.; Shaw, N. L.; Mastrogiuseppe, J. (and others) 1998. Field guide to intermountain sedges. GTR-10. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 282 p.

Wellner, C. A.; Rust, S. 1996. Establishment record for Lava Butte RNA within Payette National Forest, Idaho County, Idaho. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT. Unpaginated.

Steamboat Lake

Pony Meadows Research Natural Area
Payette National Forest

Robert Bursik and Fred Rabe sampled the lake on June 28, 1987. Other aquatic resources in the RNAare a small pond, stream and spruce bog at the headwaters of Pony Creek .

Location

The RNAis located in the Salmon River Mountains about 61 miles northeast of McCall and 11 miles south of Warren, Idaho (Savage and Wellner 1979).

Ecoregion Section: IDAHO BATHOLITH (M332A), Idaho County; USGS Quad: PONY MEADOWS

From McCall follow the Warren Wagon Road (FS 21) north along the west side of Payette Lake and the North Fork Payette River to the town of Warren a distance of about 50 miles. Continue southeast on FS Road 340 about 1.5 miles past Warren.Turn right (southwest) onto FS Road 359 and follow it for nine miles.Turn right again onto FS Road 361 which ends within the RNA (Savage and Wellner 1979).

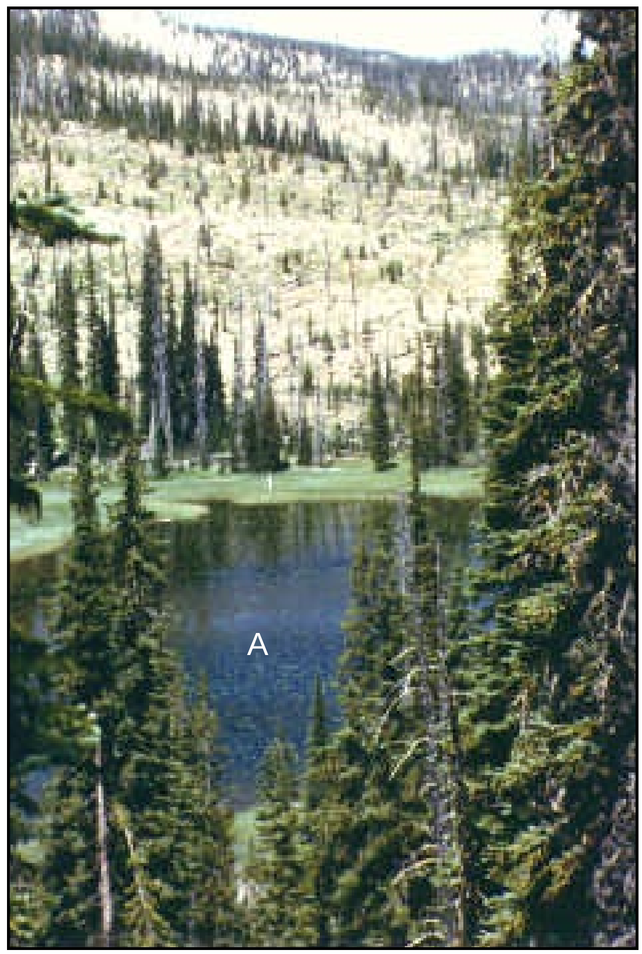
USGS Quad: PONY MEADOWS.

Geology

The lake basin was developed by ice scour in granitic rock. This water body is probably one of the youngest (Little Ice Age) wetland lakes studied by Rabe et al. (1990). Boulder fields are rock meadows surround the area.

Classification

Steamboat Lake
- Subalpine, small, shallow, cirque lake
- Medium-high production potential
- Circumneutral water in granitic basin
- Inlet: none; Outlet: 1 stream



Steamboat Lake in Pony Meadows RNA. Extensive sedge beds surround the lake (1). Open water supports yellow water lilly - *Nuphar polysepalum* (A).

Aquatic physical - chemical factors

Area (hectares): 2.7 (6.7 acres)
Length of shoreline (m): 890 (2920 ft)
Maximum depth (m): 1.5 (5 ft)
Elevation (m): 2278 (7472 ft)
Aspect: NE
Percent shallow littoral zone: 100
Dominant bottom substrate: soft sediment
Lake edge %: herbaceous-100 %
Alkalinity (mg/l): 30
pH: 7.1
Conductivity (micromhos/cm): 10
Inlets: none
Outlets: 1 stream

The yellow water lily (*Nuphar polysepalum*) is the dominant aquatic macrophyte and is distributed somewhat uniformly in Steamboat Lake.

Vegetation

Steamboat Lake, located in a shallow drainage basin, is surrounded by a forest of mostly Engelman spruce (*Picea engelmanii*), lodgepole pine (*Pinus contorta*) and subalpine fir (*Abies lasiocarpa*). The lake is encircled by an open fen dominated by water sedge (*Carex aquatilis*) and firethread sedge (*Carex prionophylla*). The yellow water lily (*Nuphar polysepalum*) is the only aquatic macrophyte present and is distributed somewhat uniformly throughout the lake.

Other emergents surrounding the lake are small headed sedge (*Carex illota*), early sedge (*C. praeceptorum*), spike rush (*Eleocharis pauciflora*), and rush (*Juncus mertenisanus*).

The firethread sedge (*Carex prionophylla*) is one of the dominant herbaceous plants surrounding the lake. Sketch from Hurd et al. 1998.

Literature cited

Hurd, E., G.; Shaw, N. L.; Mastrogiuseppe, J. (and others) 1998. Field guide to intermountain sedges. GTR-10. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 282 p.

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Needles Lake and Pond

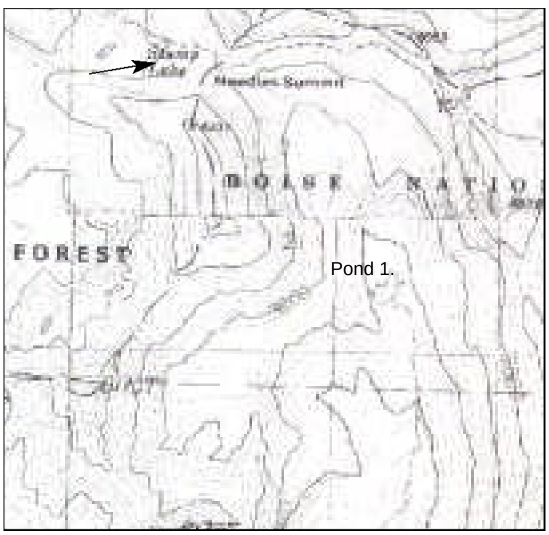
Needles Research Natural Area
Boise National Forest

One lake and a pond are located in Needles RNA..

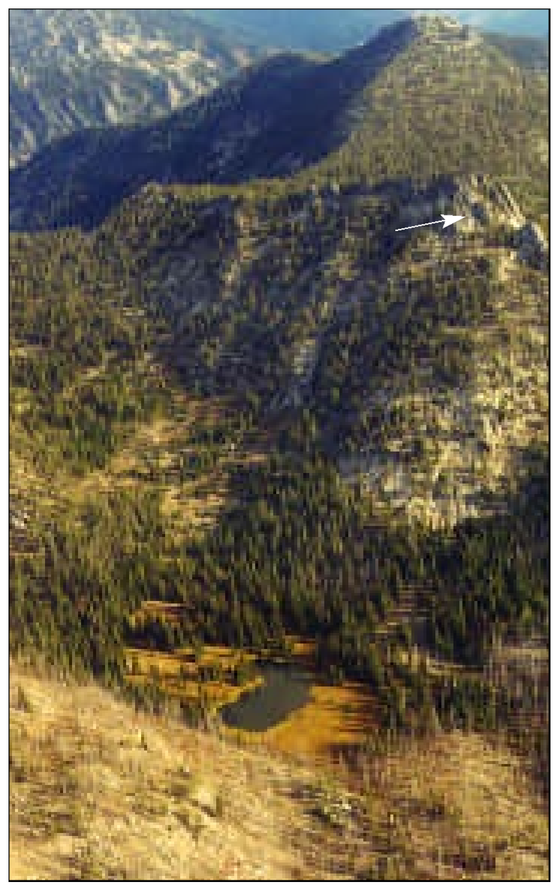
The site was visited several times to help establish an RNA. Aerial photographs were taken by Jim Weaver in September 1999. The RNA is located in the North Fork Payette River drainage at the headwaters of an unnamed tributary to the North Fork of the Gold Fork River approximately 34 miles northeast of Cascade, Idaho.

Ecoregion Section: IDAHO BATHOLITH (M332A), Valley County; USGS Quad: GOLD FORK ROCK and BLACKMARE.

Stump Lake. Plants in foreground are Shooting Star (*Dodecatheon jefferyi*) (Lichthardt 1993). Photo credit: Michael Mancuso



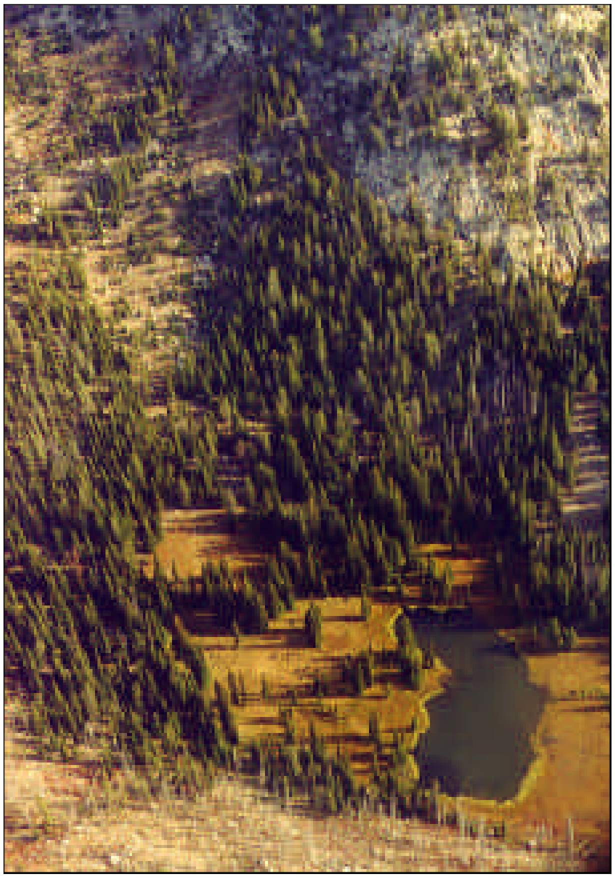
Aerial view of Stump Lake looking southeast Photo credit: Jim Weaver.



Aerial view looking northeast at Pond 1. Squaretop Peak at 8681 feet elevation at upper right of photo. Some of the Needles formations can be seen (arrow). Photo Credit: Jim Weaver

Literature Cited

Lichthardt, J. 1993. Establishment record for Needles Research Natural Area within Boise National Forest, Valley County, Idaho. USDA Forest Service. 24 p. Draft.



Closer view of Pond 1.

Fiddle Lake

Trinity Mountain Research Natural Area

Boise National Forest

On August 12, 1998 Fred Rabe sampled the lake and inlet and outlet streams to the lake.

Location

Trinity Mountain RNA is located in the Trinity Mountains about 38 air miles east of Boise, Idaho.

Ecoregion Section: IDAHO BATHOLITH (M332A), Elmore County; USGS Quad: TRINITY MOUNTAIN

From Mountain Home, Idaho, take U.S. Route 20 north for about 25 miles to paved FS Road 134. Turn left and take FS Road 134 north about 5 miles and cross Anderson Ranch Dam. Follow FS Road 113 north along Anderson Ranch Reservoir to the Fall Creek recreation site. From there take FS Road 123 north; it turns into FS Road 129 past Ice Springs Campground. Continue north for a total of 16 miles to Big Trinity Lake Campground. The trailhead for Rainbow Basin (Trail 174) leaves the campground from the north side of Big Trinity Lake. After about 1.5 miles, the trail switchbacks steeply into a saddle. The ridge running southwest from the saddle is the northwest boundary of the RNA. The trail into the basin provides easy access to Fiddle Lake (Lichthardt 1993).

USGS Quad: TRINITY MOUNTAIN.

Geology

Trinity Mountain RNA includes a complex series of cirques on the north side of Trinity Mountain which is one of the highest peaks in the Boise Mountains at 2881 m or 9451 ft (Lichthardt 1993). The rock type is diorite believed to have intruded into the older Atlanta lobe approximately 30-50 millions years after it formed. The rocks are medium grained and salt and peppery in appearance (Bennett 1980).

Classification

- Subalpine, small, shallow, cirque lake
- Medium production potential
- Circumneutral water in granitic basin
- Inlet: 1 stream; Outlet: 1 cascade-pool type

The trail to Fiddle Lake with view of Trinity Mountain which is 2881 m in elevation (9451 ft).

Aquatic physical-chemical factors

Area (hectares): 1 (2.5 acres)
Length of shoreline (m): 625 (2050)
Maximum depth (m): 3 (10 ft)
Elevation (m): 2524 (8280 ft)
Aspect: NE
Percent shallow littoral zone: 40
Dominant bottom substrate: soft sediment, silt
Shoreline development: 1.728
Lake edge %: shrubs-80, herbaceous-10, conifers-10
Alkalinity (mg/l): 9
Conductivity (micromhos/cm): 25
pH: 7.0
Inlets: 1 stream, 3 seeps
Outlet: 1 stream

View of Fiddle Lake southwest towards Trinity Mountain. Inlet at opposite end of lake (arrow). Outlet of lake is below to the right.

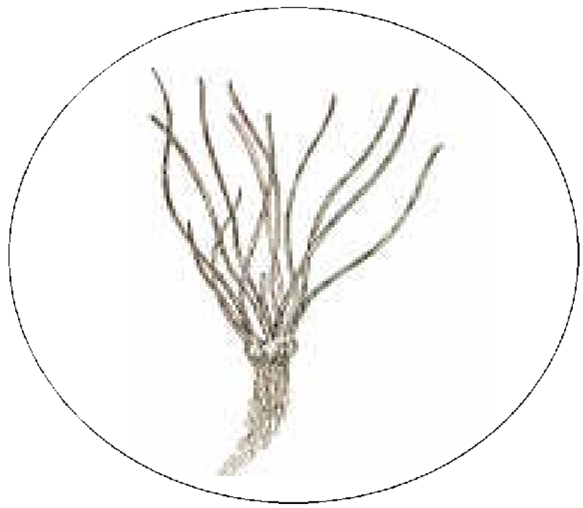
The narrow portion of the lake (neck of the fiddle) was dry during August, leaving only pools of water.

The inlet averages 38 cm wide and 3 cm deep. The substrate is small pea-gravel. The gradient is 1 percent. No pools are present. The water temperature is 14 degrees C. Shrubs and sedges comprise the riparian vegetation.

The outlet stream below the thin neck of Fiddle Lake averages 1.5 m wide and 10 cm deep. It is a cascade-pool type stream characterized by a boulder substrate and 5-6 percent gradient. The water temperature is 17 degrees C. The dominant riparian growth is herbaceous vegetation.

Vegetation

The vegetation is typically open, high elevation forest including *Pinus albicaulis* (whitebark pine) and *Abies lasiocarpa* (subalpine fir) habitat types (Lichthardt 1993). *Isoetes* sp. (quillwort) covers about one third of the bottom substrate of Fiddle Lake. Large amounts of an aquatic moss (*Fontinalis* sp.) were observed in the outlet stream.



Isoetes sp. (quillwort) was the dominant macrophyte on lake bottom. Sketch from Steward et al. (1963).

An aquatic moss (*Fontinalis* sp.) common in outlet of lake. Sketch from Prescott (1969).

The inlet stream into Fiddle Lake. Note the small size pea-gravel comprising the substrate. Sedges and shrubs are the dominant riparian vegetation.

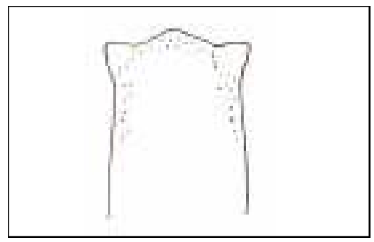
Macroinvertebrates

Inlet stream to Fiddle Lake

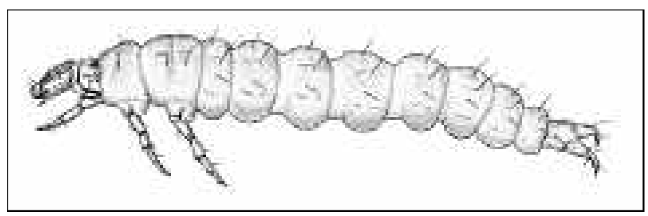
Trichoptera
Rhyacophyla brunea
Plecoptera
Visoka sp.
Ephemeroptera
Ameletus sp.
Diptera
Diamesa sp.
Platyhelminthes
Polcelius coronata

Outlet stream from Fiddle Lake

Trichoptera
Rhyacophyla - Albertae group
Eocosmoecus sp.
Platyhelminthes
Polycelius coronata
Diptera
Corynorena sp.
Tventenia sp.
Prosimulium sp.
Nanocladius sp.
Pentaneura sp.
Plecoptera
Cultus sp.
Isoperla sp.
Pelecypoda
Pisidium sp.



Head portion of *Polycelius coronata*, a flatworm common in clean water environments. Sketch credit: Kolasa (1991).



Rhyacophyla sp., a caddisfly, collected from inlet and outlet streams of Fiddle Lake. Sketch from McCafferty (1983).

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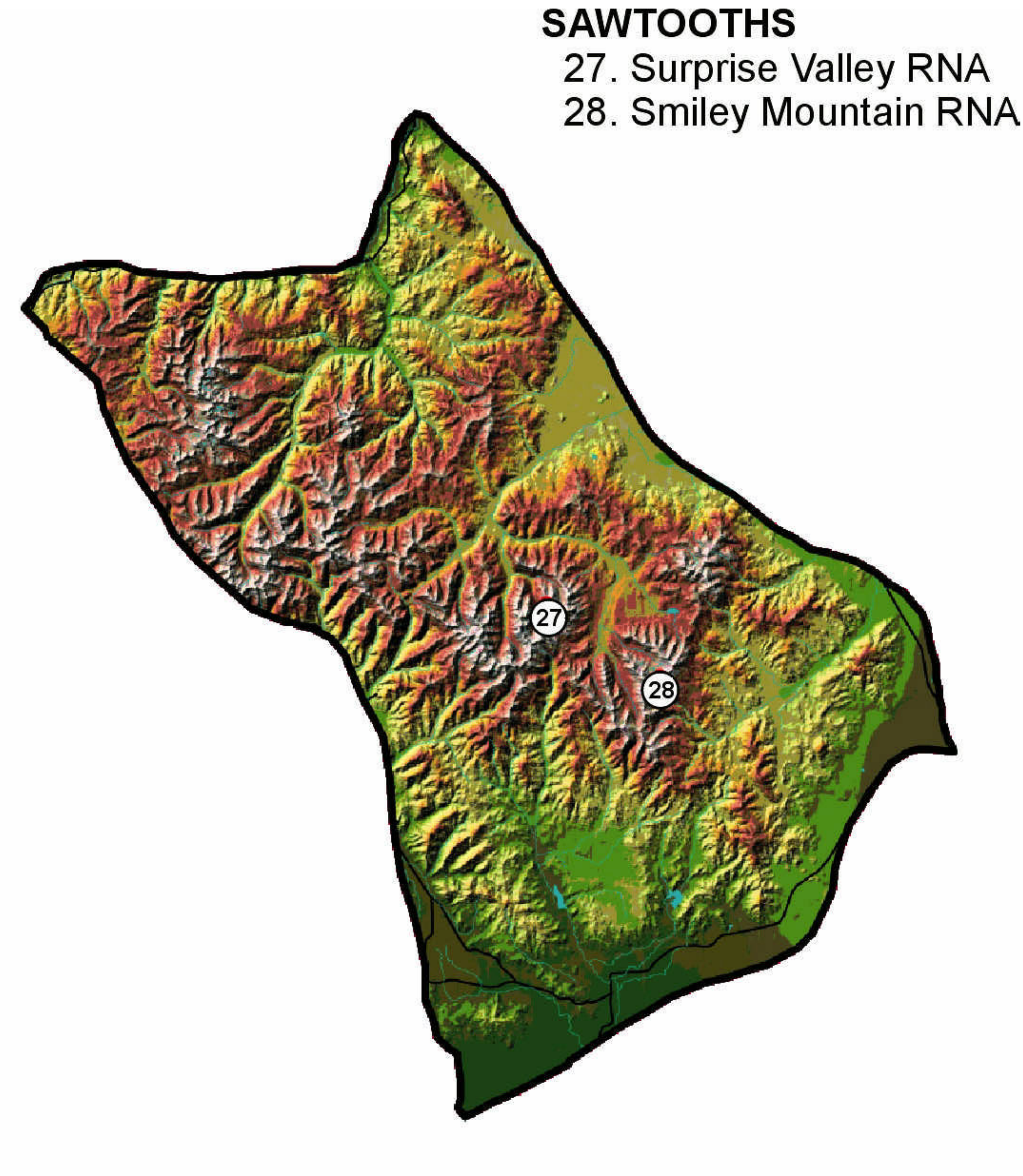

SAWTOOTHS
27. Surprise Valley RNA
28. Smiley Mountain RNA
27
28

Surprise Valley Lake and Pond

Surprise Valley Research Natural Area
Salmon-Challis National Forest

Fred Rabe and Mabel Jones sampled a pond and a lake in the RNA on August 20, 1998.

Location

The RNA is located north of Standhope Peak in the Pioneer Mountains about 19 air miles northeast of Ketchum, Idaho.

Ecoregion Section: CHALLIS VOLCANICS (M332F), Custer County; USGS Quad: STANDHOPE PEAK

From Mackay, Idaho travel northwest on U.S. Route 93 for 16 miles to the junction with the Trail Creek Road. Turn left onto this road and travel 19 miles to the junction with FS Road 135. Turn left on 135, go 2 miles; then turn right on FS Road 136, driving up Wildhorse Creek for about 3 miles to the mouth of Fall Creek. Take FS Trail 059 up Fall Creek for about 2 miles to the junction with FS Trail 045. Take this trail up Fall Creek for another mile to its junction with the Moose Lake Trail 068. Shortly beyond this junction the trail forks again. One fork continues to Angel Lake and the east fork goes to Surprise Valley. Continue on the east fork of FS Trail 045 for another mile to the entrance to Surprise Valley and the lower lake. The upper lake is about 2 1/2 miles above the lower lake (Wellner 1991).

USGS Quad: STANHOPE PEAK.


Trail along Fall Creek. View south of Pioneer Mountains.

Geology

Surprise Valley RNA is a glacially-formed, high elevation hanging valley perched some 1,000 feet above Fall Creek and bordered by rugged ridges especially on the eastern side. The granitic rocks are composed of calcium rich minerals formed in the late Cretaceous to Tertiary periods (60-80 million years ago). These granitoids commonly have xenoliths or inclusions of a separate rock type averaging one foot in length (Dover 1966, Dover and Hall 1976). A stream leaves the lake, cascades down the slope as a waterfall over part of a moraine and flows down valley.


Standhope Peak 3621 m (11,878 ft).

Classification

Upper Surprise Valley Lake
- Alpine, small, deep, cirque lake
- Medium production potential
- Circumneutral water in granitoid basin
- Inlets: 4 seeps; Outlet: 1stream

Lower Surprise Valley Pond
- Subalpine, small, shallow, cirque-scour pond
- Medium-high production potential
- Circumneutral water in granitoid basin
- Inlets: none; Outlet: none

Aquatic physical - chemical factors

Lower Surprise Valley Pond
Area (hectares): 0.6 (1.42 acres)
Length of shoreline (m): 288 (945 ft)
Maximum depth (m): estimate 1 (3 ft)
Elevation (m): 3000 (9840 ft)
Aspect: SE
Percent shallow littoral zone: 100
Dominant substrate: soft sediment
Shoreline development: 1.058
Lake edge %: herbaceous-90, conifer-5, shrub- 5
Inlets: none
Outlets: none

The organic sediment in the lower pond measures 35 cm deep. Water temperature was 18 degrees C. The pond is probably spring fed; no inlets or outlets were observed. It is classed as a semi-drainage pond.

View north of Lower Surprise Valley Pond. Standhope Peak is in background.

View south of Lower Surprise Valley Pond.

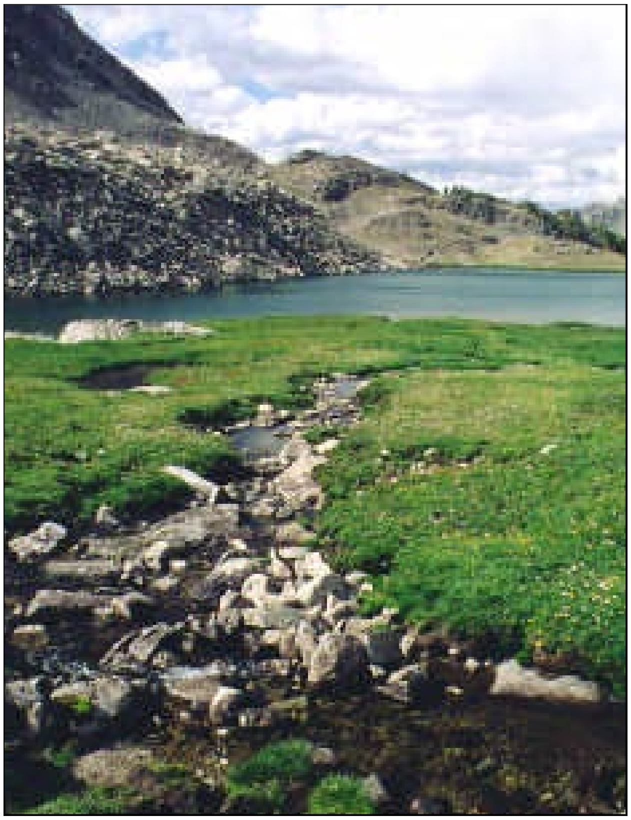
Upper Surprise Valley Lake

Area (hectares): 2.3 (5.7 acres)
Length of shoreline (m): 685 (2247 ft)
Maximum depth (m): estimate 5 (16 ft)
Elevation (m): 3098 (10,160 ft)
Aspect: SE
Percent shallow littoral zone: estimate 40
Dominant substrate: boulders
Shoreline development: 1.255
Lake edge %: talus rock-60, herbaceous-40
Alkalinity (mg/l): 25
Conductivity (micromhos/cm): 40
pH: 7.6
Inlets: 1 stream, 4 seeps
Outlets: 1 stream

The lake surface water temperature was 14 degrees C, 4 degrees cooler than the lower lake. Extensive wet meadows surrounding the lake are intersected by seeps. The relatively high alkalinity, pH and conductivity readings in the upper lake might relate to the calcium rich granitoid rock basin.

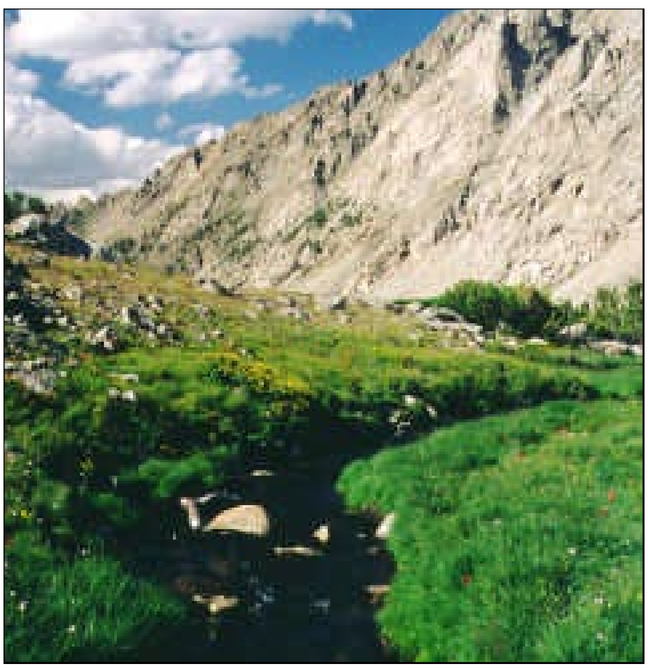
Upper Surprise Valley Lake at an elevation of 3098 m (10,160 ft) view north. Standhope Peak is in background.

View south. Herbaceous plants including forbs, sedges and grasses grow extensively around the lake shore.



Inlet stream into Upper Surprise Valley Lake. Temperature was 9 degrees C.

First order tributary (riffle-pool stream type) of Fall Creek from upper lake. Standhope Peak in the background.



Swift flowing outlet stream from Upper Surprise Valley Lake. Temperature was 13 degrees C. The substrate was dominated by large boulders. Dense amounts of algae in stream channel may be due to nutrients from decomposition of large amounts of herbaceous growth surrounding the lake.

Vegetation

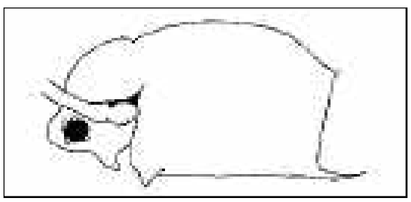
Salix planifolia var. *monica* (plane-leaf willow) and *Carex aquatilis* (water sedge) were the dominant shrub and herbaceous plants surrounding the lower lake. *Carex limosa* (mud sedge) and *Eleocharis pauciflora* (few-flowered spikerush) were also present in the area. *Sparganium emersum* (Bur-reed) was noted in the lake. No aquatic plants were observed in the upper lake and sedges and other wetland forms were not collected there.

Edge of Lower Surprise Valley Pond. *Carex aquatilis* (water sedge) is dominant.

Taking a plant transect adjacent to Lower Surprise Valley pond. A list of terrestrial plants and aquatic species can be obtained from the Conservation Data Center in Boise, Idaho.

Zooplankton

The only taxa observed in Lower Surprise Valley Pond was *Scapholeberis kingi* . This form is common in weedy waters such as occurs in the lower pond. *S. kingi* swims on its back near or at the surface (Brooks 1959). No plankton sample was collected from the upper lake.



Scapholeberis kingi was the only zooplankton observed in the lower pond sample. Sketch credit: Melanie Abell.

Macroinvertebrates

Lower Surprise Valley Pond
Diptera
  Family Orthocladiinae
  Bezzia sp.
Ephemeroptera
  Callibaetis sp.
Amphipoda
  Hyallela azteca
  Gammarus lacustris
Hemiptera
  Notonecta undulata
  Family Gerridae
Pelecypoda
  Pisidium sp.

Inlet to Upper Surprise Valley Lake
Diptera
  Diamesa sp.
  Prosimulium sp.

Trichoptera
  Lenarchus sp.

Outlet to Upper Surprise Valley Lake
Diptera
  Diamesa sp.
  Family Chironomidae
Ephemeroptera
  Baetis bicaudatus

Diamesa sp. was the dominant chironomid larvae from the inlet and outlet of Upper Surprise Valley Lake.

Literature Cited

Brooks, J. L. 1959. Cladocera. In: Fresh water biology. New York: Wiley Press. 1248 p.

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Dover, J. H.; Hall, W. E. 1976. Geologic map of the Pioneer Mountains region. Blaine and Custer Counties, Idaho. U.S. Department of Agriculture, Forest Service. Open file report: 75-76

Wellner, C. A. 1991. Establishment record for Surprise Valley Research Natural Area within Challis National Forest, Custer County, ID. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT. 25 p.

Smiley Mountain Lake and Ponds

Smiley Mountain Research Natural Area
Salmon-Challis National Forest

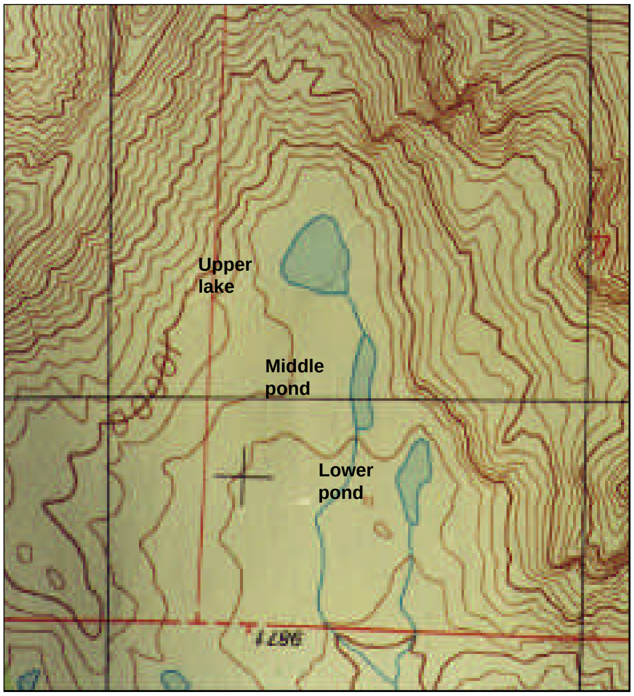
One lake and two large ponds occur in the RNA together with smaller ponds and wetlands at a lower elevation. Fred Rabe and Mabel Jones sampled the large ponds and lake along with a number of interconnecting streams on August 19 - 20,1998.

Location

The RNA is located at the southeastern end of the Pioneer Mountains approximately 27 air miles east of Ketchum Idaho.

Ecoregion Section: CHALLIS VOLCANICS (M332F), Custer County; USGS Quad: SMILEY MOUNTAIN

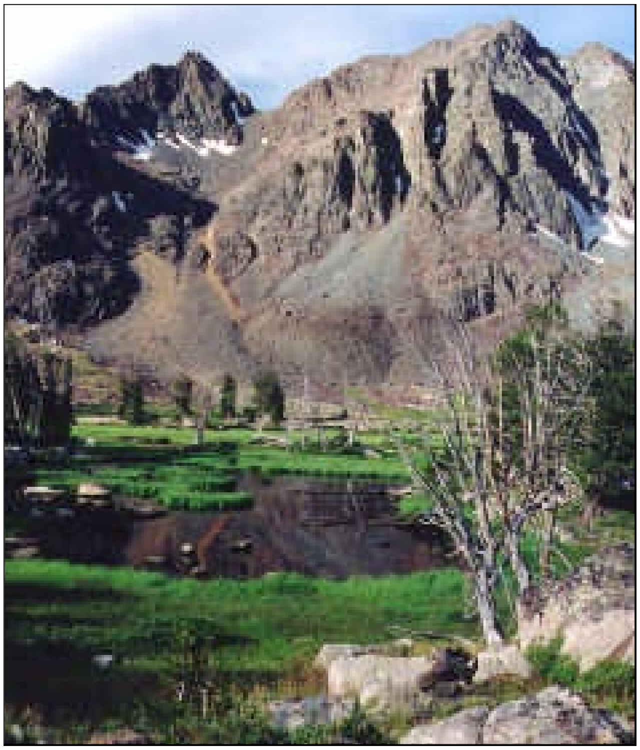
From Mackay, Idaho go southeast on U.S. Route 93 for 16 miles. Turn right on Antelope Road and travel southwest for 18 miles to Antelope Guard Station. Turn right onto FS Road 135 and go 17 miles crossing Antelope Pass to the junction with FS Road 138 near the Copper Basin Guard Station. Turn left onto FS Road 138 and go 4.5 miles to Lake Creek. Park at the Lake Creek trailhead and take FS Trail 064 up Lake Creek for 5 miles to the point near Round Lake where the trail divides. One branch goes to the south end of Long Lake and the other goes past the north end of Long Lake and on to Rough Lake and Big Lake. The western boundary of the RNA is about 0.2 miles southeast of the point where the trail divides (Wellner 1991).



USGS Quad: SMILEY MOUNTAIN.

Geology

The RNA is located in the extreme southeastern of the Pioneer Mountains. The main rock formations in the area are Challis volcanics and granitics (Dover 1981). Mountain glaciation has resulted in sharp and broad ridges, cliffs, ledges, talus slopes, rock glaciers and cirque basins.



Small ponds and wetlands in the RNA are downstream of study site. These ponds were not sampled.

Classification

Upper Smiley Lake
- Alpine, small, shallow, cirque lake
- Medium production potential
- Circumneutral water in volcanic-granitic basin
- Inlet: seep; Outlet: stream

Middle Smiley Pond
- Alpine, small, shallow, cirque-scour pond
- Medium production potential
- Circumneutral water in volcanic-granitic basin
- Inlet: stream; Outlet: stream

Lower Smiley Pond
- Alpine, small, shallow, cirque pond
- Medium production potential
- Circumneutral water in volcanic-granitic basin
- Inlet: stream; Outlet: stream

View north of Upper Smiley Mountain Lake in the Pioneer Mountains. The elevation is 3024 m (9920 ft).

View south of Upper Smiley Mountain Lake with seep entering lake.

Aquatic physical - chemical factors

Upper Smiley Mountain Lake
Area (hectares): 1.6 (4.0 acres)
Length of shoreline (m): 483 (1585 ft)
Maximum depth (m): 3 (10 ft)
Elevation (m):3024 (9920 ft)
Aspect: SE
Percent shallow littoral zone: 100
Dominant bottom substrate: soft sediments, silt
Shoreline development: 1.059
Lake edge %: herbaceous / willow-80, talus, cliffs-20
Alkalinity (mg/l): 7
pH: 7.0
Conductivity (micromhos/cm): 15
Inlets: 1 seep
Outlets: 1 stream

Rock in the littoral zone is covered with a fine layer of silt. Temperature of the lake is 12 degrees C. The outlet from the upper lake flows about 200 m to the middle pond. The first section of stream has no perceptible flow and was about 2 m wide and 20 cm deep. Downstream the current increased; stream averages 10 cm deep and 70 cm wide. Substrate in the stream consists of boulders and cobble. No coarse particulate organic matter are observed. Temperature was 14 degrees C.

Middle Smiley Mountain Pond
Area (hectares): 0.6 (1.4 acres)
Length of shoreline (m): 288 (945)
Maximum depth (m): estimate 3 (10)
Elevation (m): 3012 (9880 ft)
Aspect: S
Percent shallow littoral zone: 100
Dominant bottom substrate: boulders and cobble
Shoreline development: 1.054
Lake edge %: herbaceous-99, rock-1
Inlets: 1 stream
Outlet: 1 stream

Middle Smiley Mountain Pond. Note inlet to the right. *Salix planifolia* var. monica (plane-leaf willow) visible in foreground.

A meandering glide stream flows from the middle pond. Boulders with some rubble constitute the stream substrate. Width and depth averages about 1 m. No coarse particulate organic material exists. Silt covers the rocks in the stream similar to the upper pond and lake. Water temperature was 16 degrees C. The riparian zone consists of herbaceous plants and low growing willows.

Outlet from Middle Smiley Mountain Pond. Note preponderance of boulders in channel.

<u>Lower Smiley Mountain Pond</u>
Area (hectares): 0.7 (1.8 acres)
Length of shoreline (m): 408
Maximum depth (m): 4
Elevation (m): 2982 (9780 ft)
Aspect: S
Percent shallow littoral zone: 80
Dominant substrate: soft sediment and silt.
Lake edge %: Sedge-90, talus and boulders-10
Inlets: 1 stream
Outlets: 1 stream

The inlet stream into Lower Smiley Mountain Pond originated from snow and ice accumulated under loose rock. At its beginning the inlet is about 1 m wide and 8 cm deep. It flows rapidly 100 m downhill into a shallow pool which then empties into the pond. At this point, the stream is about 45 cm deep.

Origin of inlet to Lower Smiley Mountain Pond. Accumulated snow and ice insulated by rock provide runoff into the pond.

View south of Lower Smiley Mountain Pond.

The low gradient outlet from the lower pond with a boulder-rubble substrate averages about 61 cm wide and 13 cm deep.The riparian vegetation is primarily sedges and other herbaceous growth.

Low gradient outlet from Lower Smiley Mountain Pond. Herbaceous growth provides the riparian cover. Note lack of coarse particulate organic matter in stream channel.

A large number of interconnected ponds within an extensive wet meadow occur below the study site.

Vegetation

Mabel Jones from the Conservation Data Center in Boise, Idaho identified the plants in the Smiley Mountain area. Willows are *Salix artica* (arctic willow) which forms mats in snowmelt areas and *Salix planifolia* var. *monica* (plane-leaf willow) dominant along outlet channels. When mature, *S. planifolia* is only about 1 m tall.

Salix artica (arctic willow) observed in vicinity of upper lake.

Sedges common as riparian vegetation surrounding lakes and streams were *Carex scopulorum* (Holm's Rocky Mountain sedge), *Carex aquatilis* (water sedge) and *Carex utriculata* (bladder sedge). Tufted hairgrass (*Deschampsia cespitosa*) was also common in some of these aquatic habitats.

Sedges, forbs, grasses and willows line the edge of Upper Smiley Mountain Lake. Note the scarlet paintbrush (*Castilleja miniata*).

Zooplankton

A calanoid copepod (*Diaptomus* sp.) was the only taxa observed in all three water bodies. This was somewhat unexpected since a minimum of at least three species of zooplankton are usually found in high mountain lakes. No rotifers were present in the samples. The most dense population of zooplankton occurred in the lower pond and least dense was observed in the upper lake. The presence of these large *Diaptomus* may be due to the lack of fish populations.

Macroinvertebrates

Upper Smiley Mountain Lake
Trichoptera
- *Brachycentrus* sp.
- *Lenarchus* sp.

Diptera
- Subfamily ChironomInae

Coleoptera
- *Uvarus* sp.

Ephemeroptera
- *Baetis bicaudatus*

Amphipoda
- *Gammarus lacustrus*
- *Hyallela azteca*

Outlet Upper Smiley Mountain Lake
Ephemeroptera
- *Baetis bicaudatus* - dominant

Plecoptera
- Family Chloroperlidae

Diptera
- Subfamily Tanypodinae
- Subfamily Chironominae
- *Simulium* sp.

Trichoptera
- *Lenarchus* sp.

Platyhelminthes
- *Procotyla* sp.

Middle Smiley Mountain Pond
Trichoptera
- *Lenarchus* sp.

Diptera
- Subfamily Orthocladiinae
- Subfamily Chironominae

Amphipoda
- *Gammarus lacustris*

Outlet Middle Smiley Mountain Pond
Ephemeroptera
- *Baetis bicaudatus*

Plecoptera
- Unidentified

Diptera
- *Simulium* sp. - dominant
- *Pseudodiamesa* sp.

Amphipoda
- *Hyallela azteca*

Lower Smiley Mountain Pond
Ephemeroptera
- *Baetis bicaudatus*

Trichoptera
- *Dicosmoecus* sp.

Diptera
- *Prosimulium sp.*

Coleoptera
- *Rhantus* sp.
- *Hydroporus* sp.

Oligochaeta
- Family Tubificidae

Pelecypoda
- *Pisidium* sp.

Outlet Lower Smiley Pond

Ephemeroptera
- *Baetis bicaudatus*

Trichoptera
- *Dicosmoecus* sp.

Diptera
- *Simulium* sp.
- Subfamily Orthocladiinae

Platyhelminthes
- *Procotyla* sp.

Inlet Lower Smiley Pond

Ephemeroptera
- *Baetis bicaudatus*

Trichoptera
- *Rhycophyla albertae*

Diptera
- Subfamily Orchocladinae

First order tributary of Lake Creek below Lower Smiley Pond.

Ephemeroptera
- *Baetis bicaudatus*
- *Ameletus* sp.

Plecoptera
- *Zapada* sp.

Trichoptera
- *Chyranda* sp.
- *Dicosmoecus* sp.
- *Psychoglypha* sp.

Diptera
- *Pseudodiamesa* sp.
- *Simulium* sp.
- *Triboles* sp.
- *Pagastea* sp.
- *Diamesa* sp.

Platyhelminthes
- *Proctyla* sp.

Two additional stream reaches below Lower Smiley Mountain Pond were sampled. One site has a heavy riparian cover of willow (*Salix planifolia* var. *monica*) and the other site is a steep gradient cascade-pool type below the confluence of two streams.

First order tributary below Lower Smiley Mountain Pond with thick riparian cover of willow. Large rocks embedded in sediment and ample CPOM (coarse particulate organic matter). Channel varies in width. Water temperature was 11 degrees C. Soft water conditions (pH 7, alkalinity 7, conductivity 15). Large concentrations of flatworms and caddisfly larvae were sampled.

Second order tributary of Lake Creek averaged 2 m in width. Gradient about 7 percent. Pools up to 35 cm deep. Rapid flow. Water temperature was 14 degrees C. Many different kinds of mayflies and caddisflies were sampled.

Second order tributary of Lake Creek below confluence of stream draining Lower and Middle Smiley Mountain Ponds

Ephemeroptera

- *Baetis bicaudatus*
- *Cinygmula* sp.
- *Seratella tibialis*
- *Epeorus albertae*

Trichoptera

- *Rhyacophyla albertae*
- *Rhyacophyla bettini*
- *Dicosmoecus* sp.
- *Parapsyche* sp.
- *Arctopsyche* sp.

Diptera

- *Simulium* sp.

Chyranda sp. is a caddisfly whose case consists of pieces of thin bark arranged to form a straight tube with a prominent flange-like seam along each side. This taxa was dominant in the first order stream leaving Smiley Mountain Lower Pond.

Rhyacophyla albertae is a caddisfly common in the second order tributary of Lake Creek with a cascade-pool type flow. A relatively large proportion of aquatic insects from this stream reach were mayflies and caddisflies compared to the low gradient first order stream with a willow dominated riparian zone which had a different macroinvertebrate composition.

A freshwater shrimp (*Gammarus lacustrus*) occurs in Upper Smiley Mountain Lake.and Middle Smiley Pond. This crustacean is usually not found in high lakes where fish occur as was the case with the Smiley lakes. *Gammarus* is omnivorous. It browses on the film of diatoms and organic debris covering leaves such as might occur on the dense sedges along the lake shores. *Hyallela azteca* is another freshwater shrimp sampled from the two lakes. It is considerably smaller in size than *Gammarus*.

Vertebrates

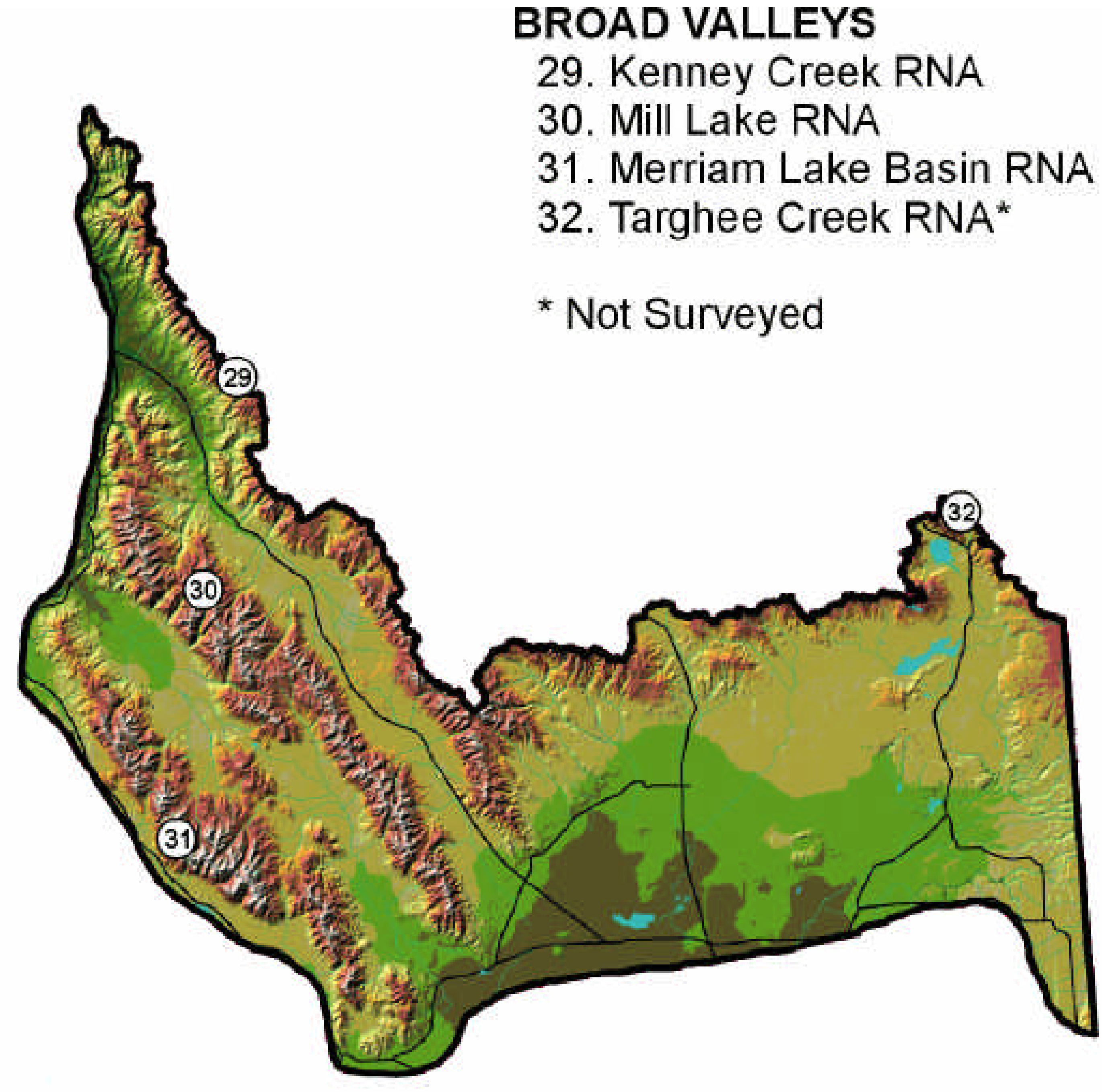
No fish species were observed in the relatively shallow alpine lake and ponds. The spotted frog (*Rana pretiosa*) was commonly seen along the water's edge.

Spotted frog (*Rana pretiosa*) was common along the shore of the lake and ponds.

Literature Cited

Dover, J. H. 1981. Geology of the Boulder - Pioneer wilderness study area. Blaine and Custer Counties, Idaho. U.S. Geological Survey. Bulletin 1497-A: 16-75.

Wellner, C. A. 1991. Establishment record for Smiley Mountain Research Natural Area within Challis National Forest, Custer County, Idaho. U.S. Department of Agriculture, Forest Service,Unpublished report on file at Intermountain Region, Ogden, UT. 26 p.


BROAD VALLEYS
29. Kenney Creek RNA
30. Mill Lake RNA
31. Merriam Lake Basin RNA
32. Targhee Creek RNA*
* Not Surveyed
29
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31
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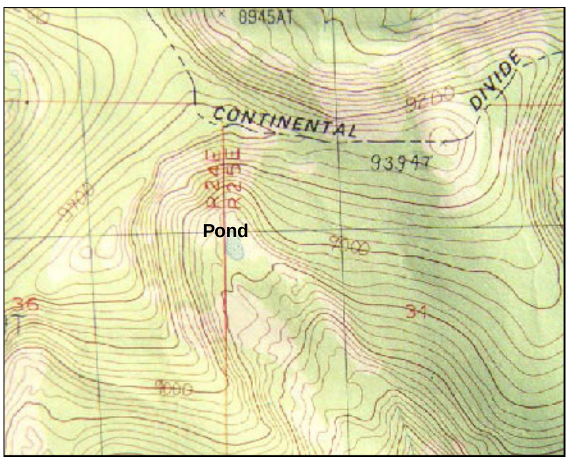
Kenney Creek Pond

Kenney Creek Research Natural Area
Salmon-Challis National Forest

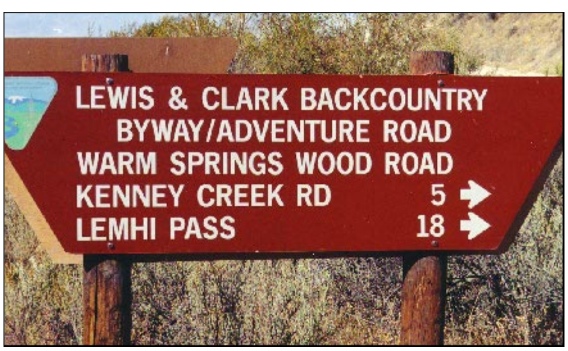
One pond in the RNA was photographed from the air on September 25, 1999.

The RNA is at the head of the Kenney Creek drainage in the Beaverhead Mountains on the west side of the Continental Divide (Idaho-Montana border). The site is approximately 19 air miles east-southeast of Salmon, Idaho (Bernatus and Wellner (1989).

Ecoregion Section: BEAVERHEAD MOUNTAINS (M332E), Lemhi County; USGS Quad: GOLDSTONE MOUNTAIN



USGS Quad: GOLDSTONE MOUNTAIN.



After crossing the Lemhi River, about 15 miles south of Salmon, drive the backcountry byway approximately 17 miles to a point where you can hike into Kenney Creek. The pond is about 1 mile north of here. No trail is observed from the road.

View into Kenney Creek drainage (arrow) and the Continental Divide separating Idaho from Montana.

Glacial pond (arrow) north of Kenney Creek in the Beaverhead Mountains. Pond is partially dry.

Literature cited

Bernatus, S.; Wellner, C. A. 1989. Establishment Record for Kenney Creek Research Natural Area within Salmon National Forest, Lemhi County, ID. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT.

Upper Mill Lake

Mill Lake Research Natural Area

Salmon-Challis National Forest

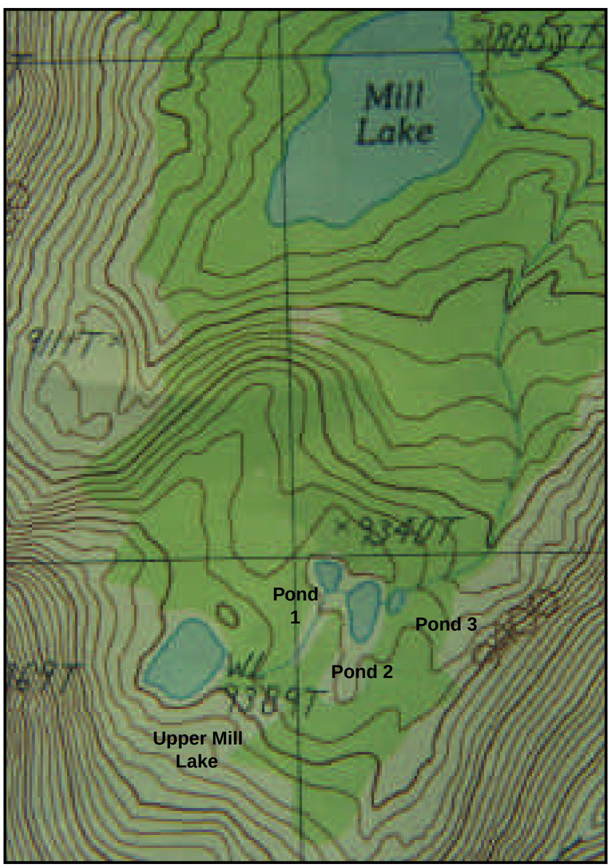
Charles Wellner, Nancy Savage and Fred Rabe visited the RNA on November 3, 1975 and sampled the lake, three ponds and outlet streams. A fourth pond was dry at the time of the survey.

Location

Mill Lake is located on the east slope of the Lemhi Range about 15 miles west-southwest of Leadore, Idaho.

Ecoregion Section: BEAVERHEAD MOUNTAINS (M332E), Lemhi County; USGS Quad: MOGG MOUNTAIN

From Leadore, Idaho, proceed north on State Route 28 about 7.5 miles. Turn left onto Cottom Lane and proceed abou three miles to junction with FS Road 189. Turn right heading west about three miles to Mill Creek and turn left onto FS Road 006 which runs along the north-northwest side of Mill Creek. Drive about five miles to the trailhead of FS Trail 181 and follow the trail about 3.5 miles to the RNA boundary adjacent to Upper Mill Lake (Wellner 1993).



USGS Quad: MOGG MOUNTAIN

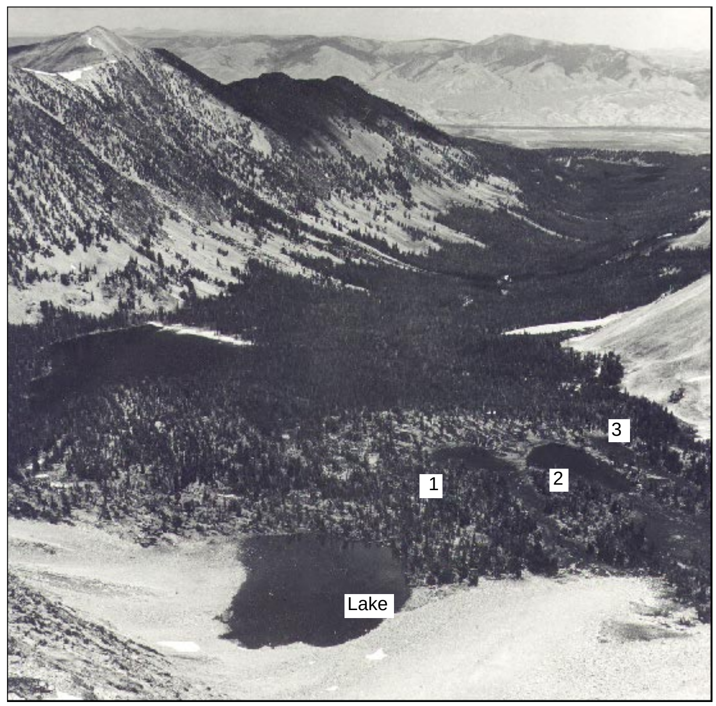
Geology

The larger Mill Lake is a recreational site and not part of the RNA. Subalpine and alpine habitats above Mill Lake comprise the RNA. Upper Mill Lake is situated in a cirque at timberline. Several shallow ponds exist in the basin just below Upper Mill Lake. The lake basin consists primarily of a quartzite formation. Steep cliffs below the crest and numerous moraines down-valley are evidence of alpine glaciation (Wellner 1993).

Classification

Upper Mill Lake

- Alpine/subalpine, small, deep, cirque lake
- Circumneutral water in quartzite basin
- Low production potential
- Inlet: seeps; Outlet: meandering glide stream



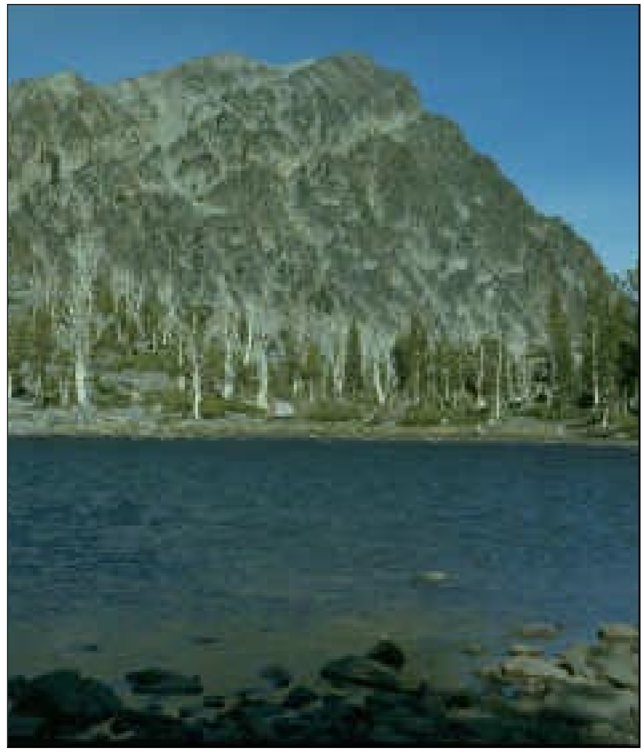
View east of Upper Mill Lake at 2863 m (9390 ft) elevation. Part of the lake is above timberline. Three lower ponds lie east of the lake. The water bodies are in a "U" shaped glaciated valley.

The outlet of Upper Mill Lake flows through talus rubble and reappears as a slow moving low gradient stream in a sphagnum-sedge meadow. The stream substrate is comprised of rubble, gravel and sediment. The outlet averages about 1 m wide and 8 cm deep and flows about 200 m to Pond 1. The moss *Dermatocarpo fluviatile* covers rocks in the stream.

The outlet from Pond 1 discharges to Pond 2; the Pond 2 outlet discharges to Pond 3. The water bodies all appear to be less than two m deep. Pond 4 was dry in November.

Aquatic physical - chemical factors

Upper Mill Lake
Area (hectares): estimate 0.5 (1.4 acres)
Maximum depth (m): 5 (16.4 ft)
Elevation (m): 2863 (9389 ft)
Aspect: NE
Percent shallow littoral zone: 60
Dominant bottom substrate: boulders
Lake edge %: talus rock: 70, conifers-30
Alkalinity (mg/l): 5
pH: 6.8
Inlets: 2 seeps
Outlet: 1 stream



View northwest across Upper Mill Lake.

Upper Mill Lake looking southwest into talus slope. Note littoral zone in foreground.

Pond 1 receives water from Upper Mill Lake.

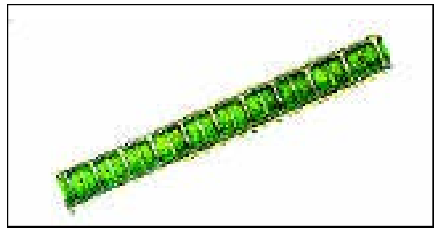
Pond 2 receives water from Pond 1. Water level is low in November. Observe the dead whitebark pine (*Pinus albicaulis*) in background.

Pond 3 outlet leaves pond as series of pools eventually forming a discrete channel (Mill Creek).

Vegetation

The dominant tree in the timberline forest is whitebark pine (*Pinus albicaulis*), with grouse whortleberry (*Vaccinium scoparium*) in the understory (Wellner 1993).

Diatoms and a filamentous green algae (*Zygnema* sp.) were dominant in Pond 2. Four additional algal taxa were observed there.



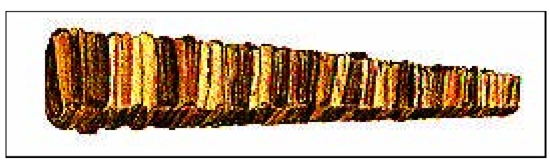
Filamentous green algae (*Zygnema* sp.) Sketch credit: Palmer (1959).

Zooplankton

Upper Mill Lake	Pond 2
Copepoda	Copepoda
Diaptomus shoshone	*Diaptomus shoshone*
Diaptomus sp.	*Diaptomus* sp.
	Cladocera
	Chydorus sphaericus

Macroinvertebrates

Upper Mill Lake	Outlet to Upper Mill Lake
Ephemeroptera	Ephemeroptera
Centroptilum sp.	*Centroptilum* sp.
Trichoptera	Trichoptera
Family Limnephilidae	*Brachycentrus* sp.
Diptera	Diptera
Dolichopesa sp.	Family Chironomidae
Coleoptera	
Agabus sp.	



Four sided case of *Brachycentrus* constructed of plant material arranged transversely. Drawing: McCafferty (1981).

Literature Cited

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Palmer, C. 1959. Algae in water supplies. U.S. Department of Health, Education and Welfare, Washington D.C. Public Health Service Publication 657. 88 p.

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Upper Merriam Lake

Merriam Lake Basin Research Natural Area

Salmon-Challis National Forest

Charles Wellner and Fred Rabe sampled the lake, outlet stream and pools in the Upper Merriam Lake basin on July 21, 1978. Merriam Lake, lower in elevation, is outside the RNA. and was not studied.

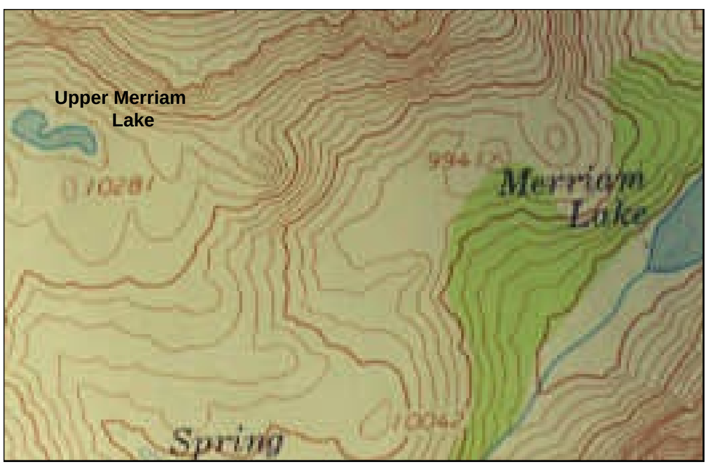
Location

Upper Merriam Lake is located in the Merriam Lake Basin on the eastern slope of the Lost River Range near the head of the West Fork Pahsimeroi River in southcentral Idaho.

Ecoregion Section: BEAVERHEAD MOUNTAINS (M332E), Custer County; USGS Quad: ELKHORN CREEK

From U. S. Route 93, 46 miles north of Arco (32 miles south of Challis), follow FS Road 116 northeast over Doublespring Pass for 10 miles to the turnoff of FS Road 117. Follow 117 over Horseheaven Pass for 6 miles to the junction with FS Road 118. Follow 118 up the West Fork Pahsimeroi River for 4.5 miles to its junction with FS Road 267. Follow 267 for 2.5 miles up the West Fork Pahsimeroi River to the end of the road.The FS Trail to Merriam Lake begins near the end of the road. Climb for about 2.2 miles to Merriam Lake and follow the valley above Merriam Lake into the RNA (Wellner 1991).

View of Upper Merriam Lake basin (arrow) looking west from Merriam Lake. Borah Peak, the highest peak in Idaho at 3858 m (12655 ft), is in the background. Photo credit: Charles Wellner.



USGS Quad: ELKHORN CREEK.

View of Merriam Lake (outside the RNA) from trail to Upper Merriam Lake. Photo credit: Charles Wellner.

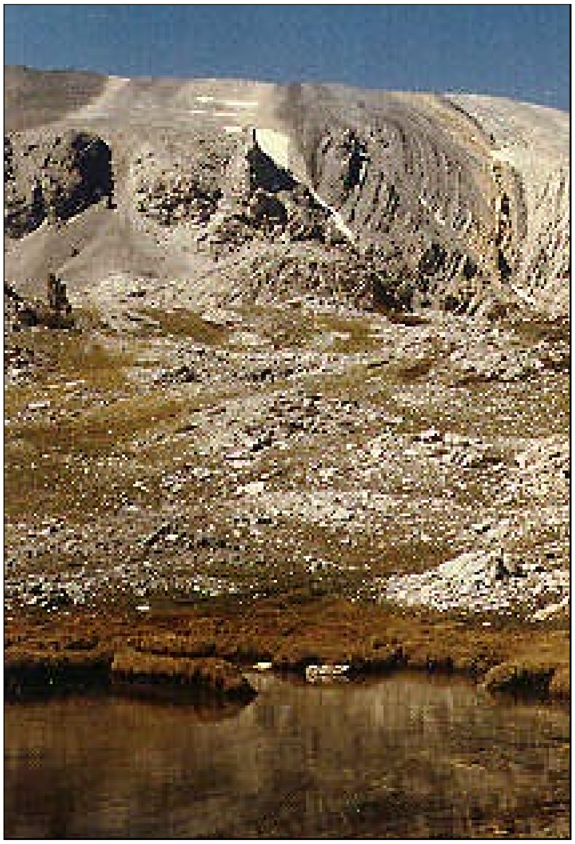
Geology

The RNA is comprised of metamorphic and sedimentary limestone, dolomite, sandstone, and quartzite rocks with the strata exhibiting considerable folding. The Lost River Range experiences convergence of storm systems from over the Pacific Ocean and Gulf of Mexico. As a result this mountain range is relatively dry and the valleys are some of the driest in Idaho (Wellner 1991).

Classification

Upper Merriam Lake

- Alpine, small, deep cirque lake
- Low production potential
- Highly alkaline water
- Limestone, dolomite, quartzite basin
- Inlet: seeps Outlet: riffle-pool stream



View of vertical rock strata northwest of the lake. One of several pools is in foreground.

Upper Merriam alpine lake is located at 3122 m (10,240 ft) elevation. The lake lies against a cirque headwall surrounded by talus rock on three sides. One year it was reported that lake size varied from about 1.6 h (4 acres) during snowmelt to less than 0.24 h (1 acre) after snow melt. The water is clear and the bottom substrate consists of large angular rocks and silt.

Aquatic physical - chemical features

Area (hectares): 0.6 (1.5 acres)
Length of shoreline (m): 459 (1506 ft)
Maximum depth (m): estimate > 5 (16 ft)
Elevation (m): 3122 (10,240 ft)
Aspect: SE
Percent shallow littoral zone: estimate 20
Dominant substrate: boulders and silt
Shoreline development: 1.471
Lake edge %: talus rock-100
Alkalinity (mg/l): 41-105 recorded in lake and pools
Inlet: small seeps
Outlet: riffle-pool stream

The lake outlet and other steep first order streams enter a wet meadow downstream where the gradient diminishes and the stream becomes sinuous with fine organic and inorganic substrate materials. The stream eventually flows into lower Merriam Lake. A portion of the meadow is of interest because of its hummocky character probably caused by freezing and thawing action. Seasonal pools are brown in color (dystrophic).

Riffle-pool type stream draining Upper Merriam Lake basin. Marshmarigold (*Caltha leptosepala* var *sulfurea*) lines the banks. Photo credit: Charles Wellner.

Marshmarigold (*Caltha leptosepala*) surrounds the wet meadow and pools. Whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) are both in the photograph. Photo credit: Douglas Henderson.

Merriam Lake Basin RNA has pools and wet meadows. Photo credit: Charles Wellner.

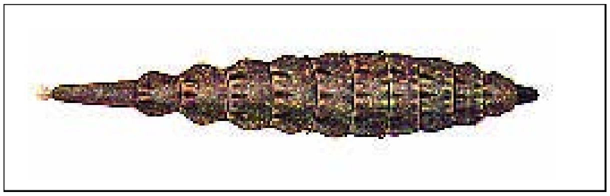
Hummocks in the wet meadow are likely caused by freezing and thawing action. Photo credit: Charles Wellner.

Vegetation

Extremely varied alpine vegetation exists in the upper basin growing on different rock formations. Several rare plants are located here. East of Upper Merriam Lake an extensive population of purple saxifrage (*Saxifraga oppositifolia*) was growing on dolomite with no other plant species present (Wellner 1991). This particular occurrence has not been observed anywhere else in Idaho but apparently is typical of sites in the high arctic tundra north of Hudson Bay, Canada. No plants were observed around the edge of the upper lake.

Macroinvertebrates

Limited observations in the lake waters revealed the large red calanoid copepod, *Diaptomus shoshone,* and fairy shrimp, *Branchinecta* sp. It is unlikely that fish are present in the lake since fairy shrimp are not known to coexist with trout populations (Rabe 1967).



The larval soldier fly (*Stratiomys* sp.) feeds largely on algae and detritus common in the pools. Often these insects must remain in contact with the water surface intermittently to obtain air. Sketch credit: McCafferty 1981

Streams and pools in Merriam Lake Basin

- Ephemeroptera
  - *Ameletus similor*
- Plecoptera
  - *Zapada* sp.
- Trichoptera
  - *Lenarchus* sp.
  - *Philarctus* sp.
  - *Allomyia* sp.
- Coleoptera
  - *Agabus* sp.
- Diptera
  - *Stratiomys* sp.
  - *Aedes* sp.
  - Family Chironomidae
- Coleoptera
  - *Agabus* sp.
- Pelecypoda
  - *Pisidium* sp.
- Eubranchiopoda
  - *Branchinecta* sp.

Allomyia sp. formerly *Imania* is a small caddisfly up to 11 mm (0.4 inches) long. The head is flattened dorsally. It lives at high elevations and frequently occurs on vertical rock faces. *Allomyia* is a grazer and is believed to require more than a year to complete its life cycle (Wiggins 1996).

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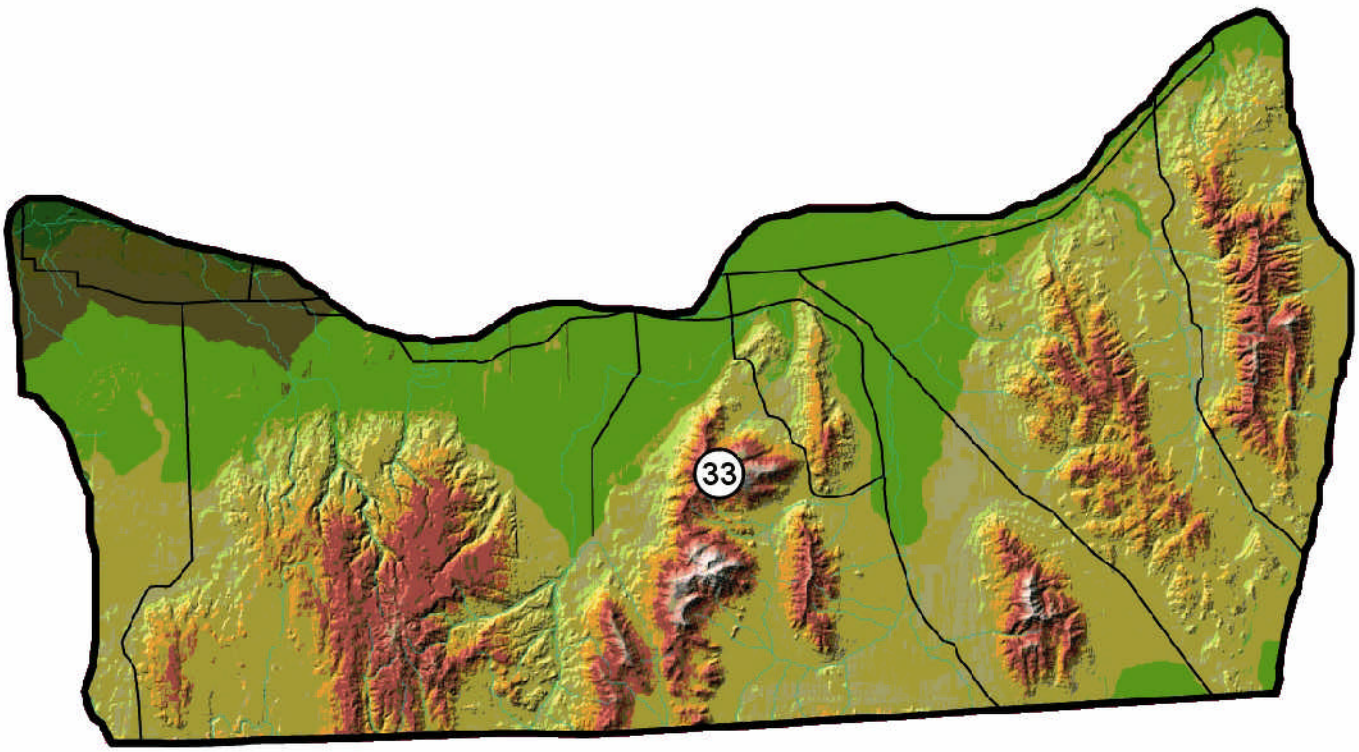
McCafferty, W. P. 1981. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Rabe, F. W. 1967. The transplantation of brook trout in an alpine lake. The Progressive Fish-Culturist 29(1): 53-55.

Wellner, C. A. 1991. Establishment record for Merriam Lake Basin RNA within Salmon-Challis National Forest, Custer County, ID. U.S. Department of Agriculture, Forest Service, Unpublished report on file at Intermountain Region, Ogden, UT. 23 p.

Wiggins, G. B. 1996. Larvae of the North American caddis-fly genera. 2nd edition. Toronto: University of Toronto Press. 267 p.

GREAT BASIN
33. Mount Harrison RNA



Mount Harrison Pond

Mount Harrison Research Natural Area
Sawtooth National Forest

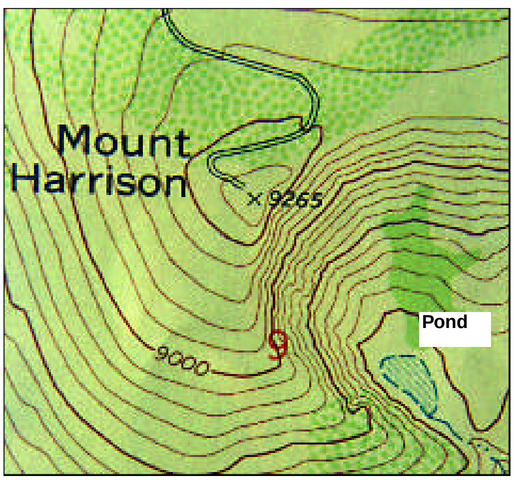
Fred Rabe sampled the single pond in the RNA on August 14, 1998.

Location

Mount Harrison RNA, located in the Albion Mountains, is about 14 miles southwest of Albion, Idaho.

Ecoregion Section: NORTHWESTERN BASIN AND RANGE (342B). Cassia County; USGS Quad: MOUNT HARRISON

From Albion, Idaho travel southeast on State Route 77 for about 4 miles to the intersection with the Howell Canyon Road which becomes FS Road 549. Drive about 9 miles to the summit. From the Forest Service fire lookout, descend approximately 600 feet to the pond below.



USGS Quad: MOUNT HARRISON.

A road goes to the top of Mt Harrison from the Snake River Plain. The summit is 2825 m (9265 ft).

Looking down at pond (arrow) from inside Forest Service fire lookout atop Mount Harrison.

Geology

Mount Harrison is the highest point in the Albion Range of southern Idaho. The steep topography and distribution of geologic formations result in very distinct vegetation patterns (Mancuso and Evenden 1996). Subalpine fir (*Abies lasiocarpa*) occured on quartzite while limber pine (*Pinus albicaulis*) was observed on calcareous substrates. The basin consists of a steep-walled, rocky cirque with a vernal pool at the bottom.

This Precambrian quartzite rock shows streaking or smearing where an allignment of minerals occurs. Mica is present in the rock.

Classification

- Subalpine, small, shallow, cirque pond
- Circumneutral water in quartzite, calcareous basin
- Medium - high production potential
- Inlet: snow melt; Outlet: ephemeral stream

Aquatic physical - chemical factors

Area (hectares): 0.8 (2.1 acres)
Length of shoreline (m): 384 (1260 (ft)
Maximum depth (m): 2 (7)
Elevation (m): 2619 (8590 ft)
Aspect: SE
Percent shallow littoral zone: 100
Dominant bottom substrate: cobble and boulders
Shoreline development: 1.189
Pond edge %: talus rock-90, herbaceous-10
Alkalinity (mg/l): 9
Conductivity (micromhos): 10
pH: 7.3
Inlet: snowmelt
Outlet: ephemeral stream

Spike rush (*Eleocharis* sp.) lines about a third of the pond edge.

View looking northwest at Mt. Harrison Pond. The pond is ephemeral drying up in some years. Surface water had receeded about 6 m (20 ft) by the middle of August. Snow drifts in the basin likely provide an inflow to the pond.

Flagged trees (whitebark pine) reflect windy conditions on the rim of the cirque wall.

An army plane crashed into the basin in 1942 killing a few people. A large tire and other scattered debris still remain from the crash close to the pond.

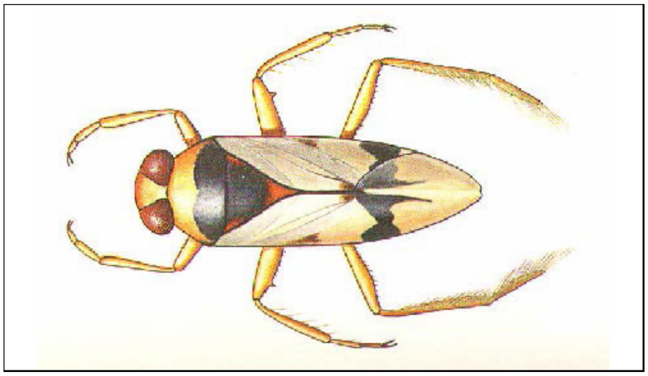
Vegetation

Castilleja christii (Indian paintbrush) is endemic to Mount Harrison and is a candidate for listing. (Mancuso and Evenden 1996). *Cymopterus davisii* is endemic to the Albion Range and is known from only two other sites. *Machaeranthera laetevirens* (aster) is a USFS Sensitive species and known from three other sites in Idaho and Nevada. Mount Harrison RNA is the only documented occurrence for this species in Idaho.

Zooplankton

The only taxa observed in the sample was a species of *Diaptomus* seen below.

Diaptomus sp. is a calanoid copepod.



The backswimmer *Notonecta* is a swimmer and climber. It may utilize the macrophyte, *Eleocharis*, as a substrate. *Notonecta* is a predator which pierces the body of prey sucking out the contents. It is also cannibalistic (Merritt and Cummins 1996). Drawing: McCafferty 1983.

Macroinvertebrates

Trichoptera
- *Clistorina* sp.

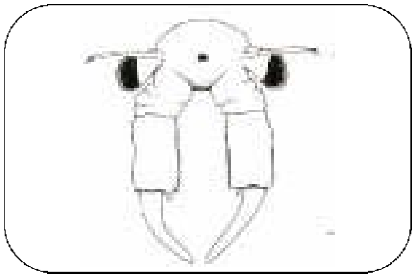
Diptera
- Subfamily Chironominae

Hemiptera
- *Notonecta undulata* -dominant
- *Notonecta kirbiyi*
- *Family* Corixidae

Coleoptera
- *Agabus* sp.

Eubranchiopoda
- *Branchianecta paludosa*

According to Pennak (1989)the fairy shrimp (B*ranchianecta paludosa*) found in the pond is not known in Idaho. This might be its first documented occurrence.



Head area of the fairy shrimp (*Branchianecta paludosa*) Sketch credit: Pennak (1989).

Fairy shrimp and a zooplankton (*Diaptomus* sp.) are often found together in small ephemeral water bodies where no fish exist as was the case in Mt. Harrison pond.

Backswimmers *(Notonecta undulata* and *N. kirbiyi*) were found throughout the pond but were in more dense concentrations in the vicinity of *Eleocharis*, a species of sedge growing in the north end of the pond.

View of stunted coniferous vegetation and steep-walled, rocky cirque with Mount Harrison pond at bottom.

Literature Cited

Mancuso, M.; Evenden, A. G. 1996. Establishment record for Mount Harrison Research Natural Area within Sawtooth National Forest. Cassia County, ID. U.S. Department of Agriculture, Forest Service. Unpublished report on file at Intermountain Region, Ogden, UT. 20 p.

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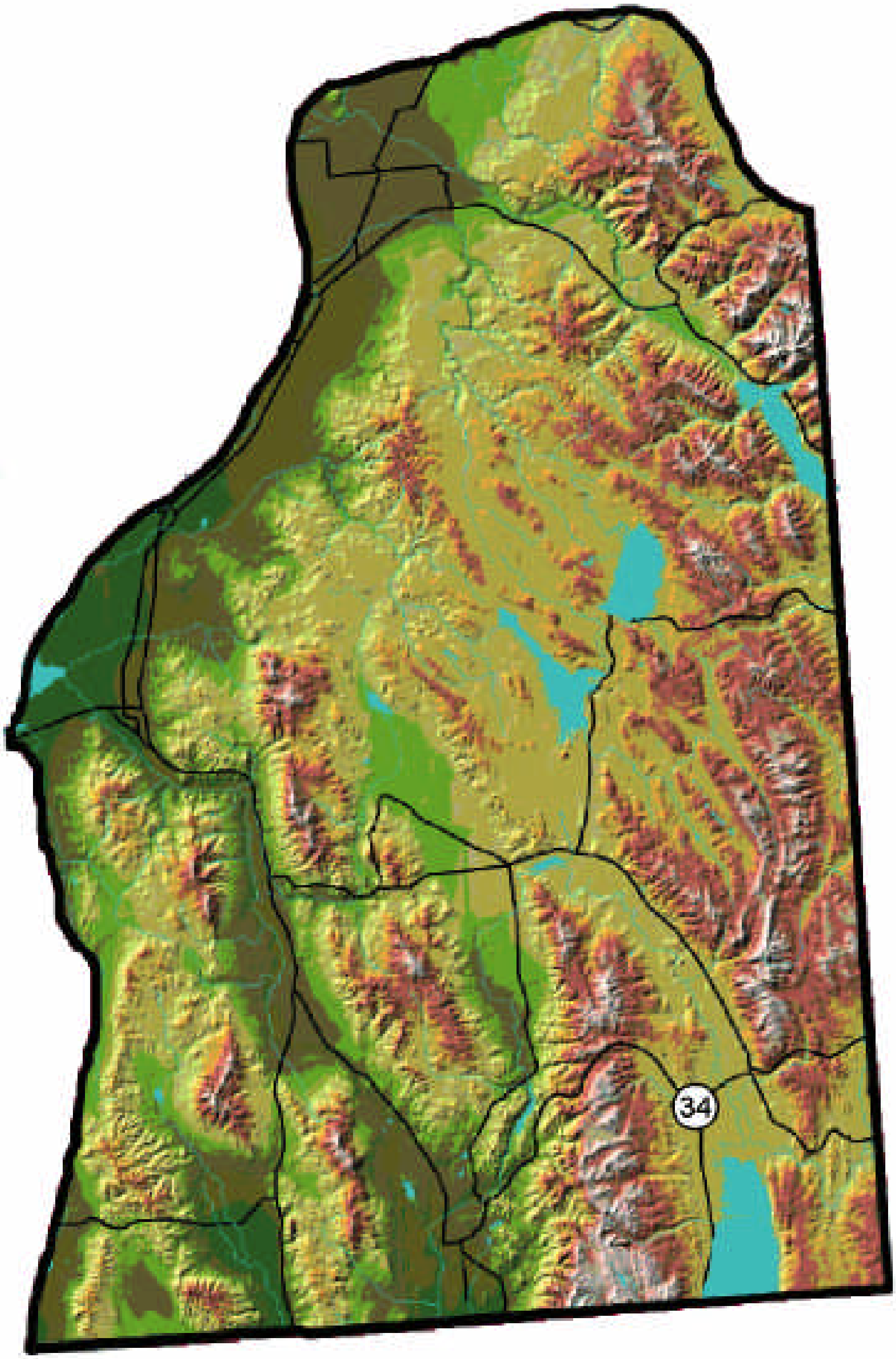
Merritt, R. W.; Cummins, K. W. 1996. Aquatic insects of North America. Dubuque: Kendall Hunt Publishing Company. 861 p.

Pennak, R. W. 1991. Freshwater invertebrates of the United States. Third Edition. New York: Wiley Interscience. 618 p.

SOUTHEAST IDAHO

34. Bloomington Lake Cirque
(proposed Special Interest Area)



Bloomington Lake

Proposed Bloomington Lake Special Interest Area

Caribou National Forest

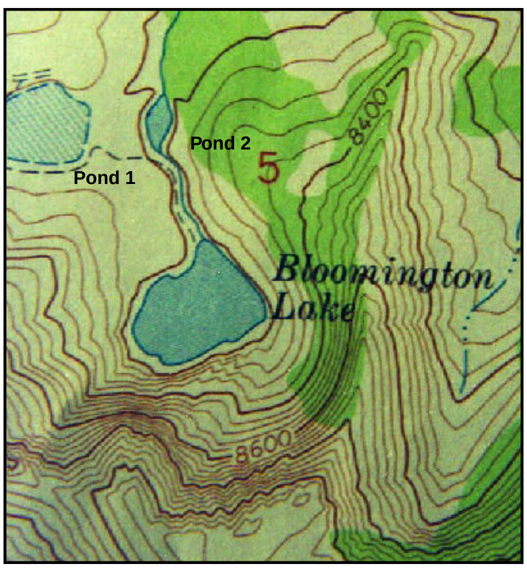
Fred Rabe sampled the lake in the RNA on August 15, 1998. Limited sampling occurred in Pond 2. Pond 1 was not sampled.

Location

The lake lies at the head of Bloomington Creek in the Bear River Range east of the town of Bloomington,Idaho (Moseley 1992).

Ecoregion Section: OVERTHRUST MOUNTAIN (M331D), Bear Lake County; USGS Quad: PARIS PEAK.

From Bloomington travel west about 12 miles (no road name or number) to a well marked trailhead. The road can be very dusty and the last few miles are extremely rough. The trail to the lake is about 0.5 miles long.



USGS Quad: PARIS PEAK

Note the upper dolomite formation over the lower quartzite layer in Bloomington Lake. Observe the littoral zone comprised of soft sediment and some boulder-size rocks.

Classification

- Subalpine, large, deep, cirque lake
- Low - medium production potential
- Highly alkaline, quartzite-dolomite basin
- Inlet: snow seepage; Outlet: stream

Geology

The headwall above the lake is the steepest in the Idaho portion of the Bear River Range. According to Moseley (1992) two quite different geologic formations occur on the headwall. White Swan Peak Quartzite comprises the lower cliff next to the lake; the upper face is gray Laketown Dolomite. Moseley reports that the two substrates have quite different physical and chemical properties. Lake water chemistries reveal highly alkaline conditions compared to other high lakes studied in the state.

Aquatic physical - chemical factors

Maximum depth (m): 15 (49 ft)
Elevation (m): 2500 (8200 ft)
Aspect: NW
Percent shallow littoral zone:10
Dominant bottom substrate: soft sediment
Lake edge %: cliff-25, herbaceous-5, boulders-5, willows-65
Alkalinity (mg/l):104
Conductivity (micromhos/cm): 195
pH: 8.5
Inlet: snow seepage
Outlet: 1 stream

The headwall retains snow in the chutes and along cliff bases longer than in any other area of the Bear River Range (Moseley 1992). The lake is deep (15 m). About 3 m off shore the depth is 9 m. Even though alkaline conditions exists in the water, the lake was classed as low to medium production potential mainly because of a limited littoral zone and limited sedge growth around the lake perimeter. A few logs and boulders were observed on the light colored soft sediment substrate in the littoral zone.

Vegetation

Rydberg's musineon (*Musineon lineare*) and green spleenwort (*Asplenium viride*) are two rare plant species that occur in the area (Moseley 1992). Moseley also noticed two rare species that occur at Bloomington Lake, but not in other portions of Idaho's Bear River Range; these species are usually observed at elevations 2000 feet higher than the elevation of Bloomington Lake. Sedges were noted mostly along the west shore of the lake.

Pond 1 is a short distance northwest of Bloomington Lake.

Zooplankton

Bloomington Lake

Cladocera
- *Polyphemus pediculus*
- *Simocephalus* sp.

Copepoda
- *Diaptomus* sp.

Ostracoda

Macroinvertebrates

Bloomington Lake

Ephemeroptera
- *Callibaetis* sp.

Trichoptera
- *Limnephilis* sp.

Diptera
- Subfamily Tanypodinae

Odonata
- *Aeshna californica / multicolor*
- *Coenagrion / Enallagma* sp.

Coleoptera
- *Gyrinus* sp.

Amphipoda
- *Hyallela azteca*

The low gradient outlet of Bloomington Lake has a boulder - rubble substrate. It flows about 10 m into a wet meadow and then into Pond 2 which is surrounded by a profusion of sedges and other herbaceous plants.

Bloomington Pond 2

Diptera
- Subfamily Orthocladiinae

Hemiptera
- *Gerris* sp.

Odonata
- Family Aeshnidae

Pelecypoda
- *Pisidium* sp.

Gastropoda
- *Physella* sp.

Oligochaeta
- Family Lumbriculidae

The whirligig beetle (*Gyrinus*) is somewhat unique in having a ventral pair of eyes that serve for vision in water and a dorsal pair used for aerial vision, an adaptation for optimal sight at the water surface. The beetles swim erratically or dive while emitting defensive secretions when disturbed. McCafferty (1983).

Sampling the lake was difficult because of the limited littoral zone. Density of macroinvertebrates was high possibly due to alkaline water conditions in the basin. The lake and Pond 2 shared very few common species.

Limnephilus sp. was present along the lake margin. It is the most common caddisfly in the western United States. *Limnephilus* constructs a variety of different type cases. The above case is comprised of wood and bark arranged transversely (Wiggins 1996).

A small specimen of dragonfly (Aeshnidae). It appears that different species occur in the pond and lake. They are voracious predators, some reaching a maximum size of 5 cm.

View of Bloomington Lake. Observe the White Swan Peak Quartzite which comprises the base of the steep headwall in the background.

Literature Cited

Moseley, R. K. 1992. The biological and physical features of Bloomington Lake Cirque, Caribou National Forest. Unpublished report on file at Idaho Department of Fish and Game, Conservation Data Center, Boise Idaho.11 p.

McCafferty, W. P. 1981. Aquatic entomology. Boston: Jones and Bartlett Publishers. 448 p.

Wiggins, G. B. 1996. Larvae of the North American caddisfly genera. Toronto: University of Toronto Press. 457 p.

Summary and Discussion

This section describes characteristics of 27 lakes and 20 ponds sampled in 32 established or proposed Research Natural Areas in Idaho. Five classification elements - elevation, size, depth, production potential and lake origin are addressed followed by a discussion of semi-drainage waters and data describing modifiers (pH, rock type and hydrology). Dominant flora and fauna in the RNAs are identified. The report closes with some projects proposed to carry forward the identification and characterization of new RNAs and thoughts on the future of high lake RNAs.

Classification elements

Four classification elements of the water bodies are summarized in Table 4. Two lakes and two ponds are montane; 20 lakes and 16 ponds are subalpine; and five lakes and two ponds are alpine. Alpine water bodies are located in the Broad Valleys, Sawtooths and Idaho Batholith subregions. Montane sites are in the North Idaho, Idaho Batholith and Western Fringe subregions. Subalpine waters are located in all subregions.

Twenty-one of the lakes are small in size or less than 4 hectares (10 acres) and six are large or more than 4 hectares in size (Table 4). Twenty-one of the lakes are classed as deep or more than 4.5 m (15 ft) and six lakes are shallow or less than 4.5 m in depth. All of the ponds are small and shallow.

Ten lakes and three ponds are classed as having low production potential; 16 lakes and 16 ponds have low-medium, medium and medium-high production potential and; one lake and one pond have a high production potential (Table 4).

Production potential is mostly low in alpine lakes. Factors that contribute to low production are high elevation, small littoral zone, boulder-bedrock substrate and few or scattered sedge mats. Exceptions occur in Upper Smiley Lake and Surprise Lake in the Pioneer Mountains where extensive sedge beds occur together with relatively large littoral zones of cobble and rubble.

Alpine lakes usually have a low production potential compared to subalpine waters.

Table 4. Classification elements associated with high lakes and ponds.

LAKE NAME	TYPE		ELEVATION			SIZE		DEPTH		PRODUCTION POTENTIAL				
	Lake	Pond	Montane	Subalpine	Alpine	Small	Large	Shallow	Deep	Low	Med-Low	Med	Med-High	High
Dome Lake	X		X				X		X			X		
Fish Lake	X		X				X		X					X
Lower Steep Lake	X			X		X		X	X		X			
Chilcoot Lake	X			X		X		X				X		
Fiddle Lake	X			X		X		X				X		
Steamboat Lake	X			X		X		X					X	
Snowy Top Lake	X			X		X			X	X				
Lower Bacon Lake	X			X		X			X	X				
Upper Steep Lake	X			X		X			X	X				
Square Mountain Creek Lake	X			X		X			X	X				
Belvidere Lake 4	X			X		X			X	X				
Quad Lake	X			X		X			X	X				
Echo Lake	X			X		X			X	X				
Graves Peak Lake	X			X		X			X		X			
Salmon Mountain Lake	X			X		X			X		X			
Cache Creek Lake 1	X			X		X			X			X		
He Devil Lake	X			X		X			X			X		
Belvidere Lake 7	X			X		X			X				X	
Master Sergeant Lake	X			X		X			X				X	
Lava Butte Lake	X			X			X		X	X				
Bloomington Lake	X			X			X		X		X			
Florence Lake	X			X			X		X			X		
Belvidere Lake 3	X				X	X		X			X			
Upper Smiley Lake	X				X	X		X				X		
Upper Merriam Lake	X				X	X			X	X				
Upper Surprise Valley Lake	X				X	X			X			X		
Mystery Lake	X				X		X		X	X				
Pond Peak Pond		X	X			X		X				X		
Three Ponds-West		X	X			X		X					X	
Salmon Mountain Pond 1		X		X		X		X		X				
Belvidere Pond 1		X		X		X		X		X				
Tech Sergeant Pond		X		X		X		X		X				
Grave Peak Pond 2		X		X		X		X			X			
Belvidere Pond 5b		X		X		X		X			X			
Lava Butte Pond SW		X		X		X		X			X			
Allan Mountain Pond 1		X		X		X		X				X		
Belvidere Pond 6		X		X		X		X				X		
Lava Butte Pond SE		X		X		X		X				X		
Theriault Pond		X		X		X		X					X	
Grave Peak Pond 1		X		X		X		X					X	
Belvidere Pond 2		X		X		X		X					X	
Belvidere Pond 5a		X		X		X		X					X	
Lower Surprise Valley Pond		X		X		X		X					X	
Mount Harrison Pond		X		X		X		X					X	
Cache Creek Pond		X		X		X		X						X
Middle Smiley Pond		X			X	X		X				X		
Lower Smiley Pond		X			X	X		X				X		

Montane lakes have medium-high to high production potential. Fish Lake (high production) has a low elevation, large littoral zone with a mix of small rock and sediments comprising the bottom substrate, high shoreline development, extensive sedge mats and a relatively high alkalinity. Subalpine lakes varied from low to medium-high production and subalpine ponds from low to high production potential (Table 4).

In comparing subalpine lakes with forest lakes located near the base of Mount Rainier, Larson et al. (1994), observed that lower elevation forest lakes had larger watersheds, larger surface areas, deeper waters and more nutrients than subalpine lakes. This was true for the two montane lakes in this study compared to most subalpine waters.

Lake origin

Thirty-four water bodies were characterized as having a cirque origin formed near a mountain headwall. Fourteen lakes/ponds were classed as cirque-scour occupying basins carved in less resistant rock formed down valley from the headwall. It was often difficult to differentiate between cirque and cirque-scour types due to variation in the extent and flow patterns of glaciers.

Paternoster lakes and ponds form a chain of at least three water bodies connected by a stream in a glaciated valley. Two sets of paternoster lakes were observed in this study. For example, in the Graves Peak watershed, a small pond is linked to a large lake by a steep gradient stream merging into a cascade-pool type stream. The outlet to the lake becomes a steep cascade that flows into a lower pond. A pond further down stream is connected by a steep gradient stream.

The two montane lakes in the study are formed by an end moraine in extended valleys. Upland lakes and ponds form in depressions scoured by ice caps on gently rolling or upland valleys. This type might represent early Wisconsin ice cap glaciation or an even older pre-Wisconsin period (Rabe and Breckenridge 1985). Three Ponds RNA is a montane site modified by the presence of beaver activities that control water levels in the ponds.

Semidrainage systems

Semidrainage waterbodies are not connected with definite drainage systems or the drainage is poorly defined (Pennak 1989). Pennak studied semidrainage ponds in Colorado and described most as being located in grassy meadows with highly organic, peaty soils and no surface outlets or having poorly defined outlets. Maximum depths range from 1 to 4 m, and water levels remain somewhat constant. Most semidrainage waterbodies in the Idaho study conform to the above meadow description; however Lava Butte SW is a semidrainage pond set in a rocky basin with limited organic growth.

Pennak describes most semidrainage waters at midmountain (montane) elevations. However subalpine semidrainage waterbodies include Allan Mountain ponds, Steamboat Lake, Mt. Harrison Pond, Lava Butte Ponds, Quad Lake, Baldy Pond 3, Surprise Pond and Soldier Lake Pond 1. Most semidrainage waters in this study are cirque-scour in origin but some semidrainage ponds such as Pond Peak RNA and Lava Butte RNA are cirque in origin.

Since semidrainage waters are for the most part closed systems, their basins fill with fine organic sediment that supports rooted plants such as burr reed (*Sparganium angustifolium*) one of the most common aquatic macrophytes observed in this study. Also amphibians, leeches, aquatic earthworms, dragonflies, and snails are apt to occur in these meadow waters more than in rocky drainage basins.

Theriault Pond is a small, shallow, montane waterbody having a substrate comprised of soft organic sediments and encircled by an extensive sedge meadow. In addition a large population of spotted frogs (*Rana pretiosa*) occupies this site. It is not a closed system since a relatively deep outlet stream exits the pond. However further downstream the outlet diminishes in size so that later in the year it might be described as ephemeral. Cache Creek pond has some of the same characteristics described above but also has a well defined outlet stream. Topographic maps are not often accurate in showing or not showing outlets.

Cache Creek Pond, a shallow, subalpine waterbody having an organic substrate, is surrounded by an extensive sedge meadow.

Modifiers

All of the waterbodies in this study are circumneutral (pH 5.5-7.4) except Steep Lakes which are alkaline (pH 7.5-8.4) and Upper Merriam Lake and Bloomington Lake which is highly alkaline (pH > 8.4).

Medium soft water (13-30 mg/l) most commonly occurs in Precambrian Belt and volcanic rock basins compared to soft water lakes (0-12 mg/l) mostly in granitic basins. Bloomington Lake in a quartzite-dolomite basin is a hardwater lake with an alkalinity of 104 mg/l. Merriam Lake basin pools and lake are hardwater with alkalinities of 41-105 mg/l. They occur in limestone, dolomite, sandstone, quartzite basins. Steep Lakes in Precambrian Belt rock are also classed as hardwater with alkalinities of 50 mg/l.

Surface and subsurface seepage commonly form inlets into alpine lakes such as Mystery Lake which is close to the headwall. Such small flows are often difficult to distinguish and usually do not appear on maps. Examples of multiple inlets into subalpine large deep lakes were observed at Fenn Lake with four inlet streams and Fish Lake with 27 stream inlets and nine seep inlets. A cascade of water was observed to flow into Graves Peak Pond 2 from the lake above, part of the paternoster pattern. Outlet streams are either riffle-pool, meandering glide or cascade-pool type streams. Riffle-pool and meandering glide streams are the most common types observed.

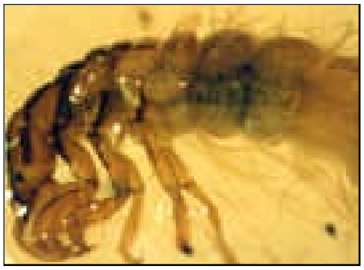
Inlets and outlets often differ in size, substrate, temperature and biological composition. Inlet streams are usually small in width and depth and have small size substrate, commonly small gravel. Inlets are usually several degrees cooler than outlet streams. Outlet streams have more coarse particulate organic matter and dense filamentous algae often covers the rocks late in the season. When this occurred, fewer macroinvertebrates were present in the stream channel.

Biota

The most common aquatic plants associated with standing water are quillwort (*Isoetes* sp.) and bur-reed (*Sparganium*) *Fontinalis* is a moss prevalent in streams. Twenty-three different sedges and rushes were identified. *Juncus mertenisana* is the rush most frequently collected and *Carex aquatilus* and *C. scopulorum* are the most common sedges.

Fourteen zooplankton taxa were identified. The composition of microcrustacean communities varies from one lake to the next, similar to what Larson et al. (1994) report. The copepods *Diaptomus* and Cyclopoidea and the cladocerans *Chydorus*, *Polyphemus pediculus* and *Simocephalus* are dominant. *Diaptomus* is thought to be absent in many lakes due to selective fish predation.

There are 16 different mayflies (Ephemeroptera) collected. Dominant forms are listed in Table 5. Other common mayflies sampled are *Ameletus* and *Nixe*. Twelve different Plecoptera (stoneflies) are recorded but only from streams since they do not ordinarily occur in lakes. Thirty-three caddisfly (Trichoptera) taxa are identified. Dominant mayflies, stoneflies and caddisflies are listed in Table 5.



Trichoptera (caddisflies) are the most diverse group of macroinvertebrates collected.

Table 5. Dominant Ephemeroptera, Plecoptera and Trichoptera from lakes, ponds and streams

Ephemeroptera	Plecoptera	Trichoptera
Baetis bicaudatus	*Sweltsa* sp.	*Asynarchus* sp.
Callibaetis sp.	*Yoraperla brevis*	*Psychoglypha* sp.
Siphlonurus sp.	*Isoperla* sp.	*Limnephilis* sp.
Paraleptophlebia sp.	*Zapada* sp.	*Dicosmoecus* sp.

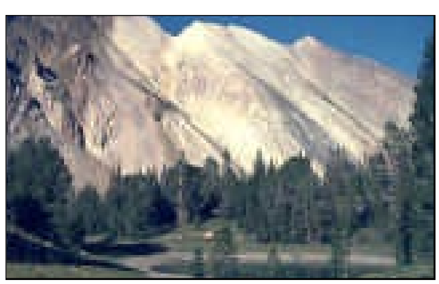
Insect representatives from the Orders Coleoptera, Hemiptera, Diptera, Megaloptera and Odonata are also present. Macroinvertebrates other than insects common in the water bodies are freshwater clams (*Pisidium*), freshwater shrimp (*Gammarus lacustris, Hyallela azteca*), flatworms (*Polycelius*), and fairy shrimp (Anostraca).

The spotted frog (*Rana pretiosa*), long-toed salamander (*Ambystoma macrodactylum*) and Coeur d'Alene salamander (*Plethodon idahoenus*) are the amphibians observed. Cutthroat trout (*Salmo clarki*), brook trout (*Salvelinus fontinalis*) and golden trout (*Salmo aguabonita*) are identified from the lakes.

Recommendations

The classification system presents elements and modifiers (Tables 1 and 3) that can be observed, measured and analyzed. This approach has two primary benefits. First, it sets up uniform methods and target parameters for future research. Second, the system can be applied to gap analysis to identify missing or under-represented natural area types. These gaps may not exist on the landscape or may simply not be reported in the inventory. Future research efforts can focus on covering the gaps and bringing more natural areas into the RNA system.

Of the 52 lakes and ponds assessed in this study, only five were classed as alpine, and lakes in only three RNAs were identified as highly alkaline. Our surveys have identified a series of alpine lakes and ponds located in sedimentary rock basins adjacent to waters in granitic basins in the White Cloud Mountains of central Idaho. Highly alkaline alpine lakes in argillaceous quartzite, dolomite and conglomerates at elevations above 9000 feet are common here (Wissmar and Rabe 1967). Such lakes would provide an excellent opportunity for research comparing the composition and density of macroinvertebrate and plant communities in soft and hard water lakes.



Pond in the White Cloud Mountains.

There is also a need to establish more upland and moraine lakes as RNAs. Both of these geomorphic types occur at slightly lower elevations and are not recognized as high lakes. However since they demonstrate such significant differences in limnological characteristics, a greater effort should be made to identify and inventory these systems.

High lake ecosystems provide an important early warning system for environmental problems expected to grow in number, such as the threat of acid rain and eutrophication. Natural perturbations can also be monitored, as when ash from Mount St. Helens fell on the Steep Lakes, where we had previously gathered baseline data (Crumb 1977).

It is important to increase public awareness of the opportunities that RNAs offer for studying natural systems. Educators and research groups can use these RNA lakes and ponds to give students valuable experience in making scientific observations and collecting samples. Such learning opportunities are exciting for those who enjoy and appreciate nature and can open up a new perspective for those who have never been introduced to these prized natural systems. At the same time, the research produces more information about high lake ecosystems and heightens our awareness and appreciation of Idaho's natural treasures.

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Glossary

Terms that are in bold italics and other words describing high mountain lakes are included in the glossary. The glossary was adapted in part from Horn and Goldman (1994), Hutchinson (1967, Merritt and Cummins (1996, and Reid (1964).

Alkalinity— Ability of lake water to neutralize acid expressed in terms of calcium carbonate as mg/l.

Alpine lake — Lake located above tree line.

Aspect — Direction the outlet of a lake is facing.

Bathymetric — Related to depth measurement of lakes.

Belt Rock — Formations of sedimentary rocks laid down in Idaho, eastern Washington and western Montana during the latter part of Precambrian time, 850-1450 million years ago.

Benthos— Invertebrates living on the bottom of lakes and streams.

Cascade-pool type—Steep gradient stream with a series of cascades and pools.

Circumneutral — Water having a pH of between 5.5 and 7.4.

Cirque — A glacially formed depression containing a lake at the upper end of a mountain valley.

Cirque-scour — Basin scoured out down-valley by alpine glaciers, usually in less resistant rock.

Conductivity— Measure of water to carry an electrical current, varies both with the number and type of ions the solution contains. It is expressed as micromhos/cm.

CPOM — Coarse particulate organic matter comprised of wood litter, leaves and needles in water bodies.

Dystrophic — Brownish in color with much dissolved humic matter.

Ecoregion — Ecosystems of regional extent or ecosystems described at the macroscopic scale (McNab and Avers 1994; Bailey 1993).

Geomorphic form — Lake origin related to glacial processes.

Granite — Common intrusive igneous rock compound predominantly of quartz and felsic minerals with crystals large enough to distinguish with the unaided eye.

Hard water — Waters that contain bound carbon dioxide in excess of 30-35 mg/l. Common in regions where the substrate contains easily dissolved minerals.

Krummholz —Stunted trees characteristic of timberline.

Lake — Large inland body of water. This study used a curve plotting maximum depth in meters against area in hectares used to designate waters as lakes or ponds.

Lentic — Standing bodies of water such as lakes and ponds.

Littoral —Shallow zone. In this study lake waters less than 3 meters (9.8 feet) in depth.

Macrophyte — Macroscopic plant in an aquatic environment.

Macroinvertebrate — Invertebrates visible with the unaided eye. Aquatic insects, flatworms, freshwater clams, freshwater shrimp, fairy shrimp and snails are examples of macroinvertebrates collected in lakes and streams.

Massif — Large mountain mass or compact group of connected mountains forming an independent portion of a range.

Meandering glide —Low gradient stream having a sinous channel.

Modifiers— Lake characteristics (pH, rock type ,hydrology) that provide supplementary information to classifying high mountain lakes.

Montane — a mountain zone lower than alpine and subalpine zones. Upland and moraine type lakes are commonly found in this zone.

Moraine — A deposit of glacial till. One of the geomorphic lake types in this study characterized as being formed by morainal dams.

Paternoster — Variety of cirque-scour lakes that form a linear chain of at least three lakes connected by a stream in a glacial valley.

Phytomacrofauna — Macroinvertebrates associated with aquatic plants.

Pond — Small shallow body of water in a depression. A curve plotting maximum depth in meters against area in hectares is used for designating waters as lakes or ponds.

Production potential — Production of lake based on seven physical, chemical and biotic parameters. Lakes are classified as poor, medium-poor, medium, medium-high and high production.

Quartzite — Metamorphic rock formed by recrystallization of quartz sandstone.

Reference area —Pristine or unaltered site used as a contro to compare with locales changed by human disturbance or natural events.

Riffle-pool — Stream type with series of alternating stretches of fast and slow water in the channel located on a terrain of moderate gradient.

RNA — Research Natural Area. Tracts of land and water set aside by the U.S. Forest Service for the purpose of research, biotic diversity, education and reference areas.

Rock glacier —Mass of poorly sorted angular boulders and other material cemented by interstitial ice, as observed in Mystery Lake.

Scree — An accumulation of rocky debris lying on a slope or at the base of a hill or cliff; talus

Sedge — Any of various plants of the family Cyperaceae resembling grasses but having solid stems.

Sedimentary rock — A deposit of sediment hardened into rock. Most sedimentary rocks are layered or stratified.

Seep — Slow movement of water, sometimes derived from melting snow through porous material.

Semidrainage lake — Small, shallow, soft bottomed lakes lacking a permanent outlet and not being connected with a definite drainage system, most commonly located in a meadow. Macroinvertebrate community is usually different compared to that in a seepage lake.

Shoreline development — Amount of shoreline relative to size of lake. The more convoluted or irregular the shoreline, the more "edge" or shoreline development of the lake. Lakes with more edge or contact with shore have higher production potential than those more round.

Soft water lake — Having a low pH. Concentratrion of bound carbon dioxide as carbonate is low usually less than 10 mg/l.

Subalpine lake — Located on a high upland slope but not above tree line.

Subregion — An area clssified as similar geology, terrain, climate and plant cover. There are ten subregions in the state of Idaho, seven of which contain high mountain lake Research Natural Areas.

Talus — A sloping mass of rock accumulated at base of a cliff or hill.

Upland lake — Form in depressions scoured by ice caps on gently rolling or upland valleys.

Volcanic rock — Finely crystalline or glassy igneous rock resulting from volcanic action at or near the earth's surface, either ejected explosively or extruded as lava, e.g. basalt.

Zooplankton — Microscopic crustaceans and rotifers occupying the water column of a lake.

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Appendix A: Vascular and Nonvascular Plant Species of High Mountain Lake RNAs in Idaho

The emphasis here is on aquatic and semi-aquatic plants, however some terrestrial species in describing an RNA are also listed. Vascular plant nomenclature follows Hitchcock and Cromquist (1973). Common names are developed by the Northern Region, U.S. Department of Agriculture, Forest Service (U. S. Department of Agriculture, Forest Service 1992). Moss nomenclature follows Anderson and others (1990).

Pteridophytes

Isoetaceae	
Isoetes lacustris L.	Lake quillwort
Dry Opteridacea	
Althyrium filix-femina (L.) Roth ex Mertens	Ladyfern

Gymnosperms

Cupressaceae	
Thuja plicata Donn.	Western redcedar
Pinaeceae	
Abies grandis (Dougl.) Forbs	Grand fir
Abies lasiocarpa (Hook) Nutt.	Subalpine fir
Larix lyalli Parl.	Subalpine larch
Picea contorta Dougl.	Lodgepole pine
Picea engelmannii Parry	Engelmann spruce
Pinus albicaulis Engelm.	Whitebark pine
Pinus flexilis James	Limber pine
Tsuga heterophylla (Raf.) Sarg.	Western hemlock
Tsuga mertensiana (Bong.) Carr.	Mountain hemlock

Angiosperms

Betulaceae	
Alnus sinuata (Regel) Rydb.	Sitka alder
Betula papyrifera Marsh.	Paper birch
Boraginaceae	
Romanzoffia sitchensis Bong	Mistmaiden
Cyperacea	
Carex aquatalis Wahl.	Water sedge
Carex canescens L.	Gray sedge
Carex dioica L.	Yellow-bog sedge

Carex geyeri Boott	Elk sedge
Carex illota Bailey	Small-headed sedge
Carex lasiocarpa Ehrh.	Slender sedge
Carex lenticularis Michx.	Lens sedge
Carex limosa L.	Mud sedge
Carex mertensii Prescott	Merten sedge
Carex microptera Mack.	Small-winged sedge
Carex multicostata Mack.	Many-ribbed sedge
Carex nigricans C. A. Meyer	Black alpine sedge
Carex oderi Retz.	Green sedge
Carex parryana Dewey	Parry sedge
Carex prionophylla Holm	Firethread sedge
Carex raynoldsii Dewey	Raynold sedge
Carex rossii Boott	Ross sedge
Carex scopulorum Holm	Holm Rocky Mountain sedge
Carex utriculata Boott	Beaked sedge
Carex vesicaria L.	Inflated sedge
Eleocharis pauciflora (Lightf.) Link	Few-flowered spike rush
Compositae	
Arnica alpina (L.) Olin	Alpine arnica
Machaeranthera laetevirens Ness	Aster
Crassulaceae	
Sedum borschii	Stonecrop
Ericaceae	
Gaultheria humifusa (Grah.) Rydb.	Wintergreen
Kalmia microphylla (Hook.) Heller	Laurel
Ledum glandulosum Nutt.	Labrador- tea
Menziesis ferrusginea Smith	Fool's huckleberry
Rhododendron albiflorum Hook	White rhododendron
Vaccinium scoparium Leiberg	Grouse whortleberry
Vaccinium spp.	Huckleberry
Gramineae	
Deschampsia cespitosa (L.) Beauv.	Hairgrass
Hippuridaceae	
Myriophyllum sp. L.	Water-milfoil
Hydrocharitaceae	
Vallisneria americana Michx.	Tapegrass
Juncaceae	
Juncus drummondii E. Meyer	Drummond's rush
Juncus ensifolius Wikst.	Dagger-leaf rush
Juncus filiformis L.	Thread rush

Juncus mertensianus Bong	Rush
Juncus nevadensis Wats	Nevada rush
Juncus parryi Engelm.	Rush
Juncus torreyi Cov.	Rush
Menyanthaceae	
Meyanthes trifokiata L.	Bogbean
Nymphaeaceae	
Nuphar polysepalum Engelm.	Yellow water- lily
Umbelliferae	
Cymopterus sp. Raf.	Cymopterus
Musineon lineare Raf.	Rydberg's musineon
Poaceae	
Callamagrostis canadensis (Michx) Beauv.	Bluejoint reedgrass
Festuca viridula Vasey	Green fescue
Potamogetonaceae	
Potomegeton crispus L.	Curly pondweed
Potomegeton natans L.	Floating-leaved pondweed
Primulaceae	
Douglasia idahoensis Henderson	
Ranunculaceae	
Calltha leptosepala DC.	Marshmarigold
Saxifragaceae	
Saxifraga oppositifolia L.	Purple saxifrage
Salicaceae	
Salix artica Pall.	Arctic willow
Salix commutata Bebb	Undergreen willow
Saoix drummondiana Barratt	Drummond willow
Salix planifolia Pursh	Planeleaf willow
Scrophulariaceae	
Castilleja christii Rydb.	Indian paintbrush
Sparganiaceae	
Sparganium angustifolium Michx.	Bur-reed

Mosses

Polytrichum juniperinum Hedw
Aulacomnium sp.
Sphagnum spp.

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Appendix B: Zooplankton Species of High Mountain Lake RNAs in Idaho

Microcrustacean zooplankton consisting of cladocerans and copepods are listed below. Common names of these taxa do not occur. Ostracods are found in the samples but not identified beyond the Class Ostracoda. Brooks (1963) is used to identify cladocerans and Wilson and Yeatman (1963) to identify copepods. Harpacticoid copepod specimens are not identified beyond the Order Harpacticoida.

Cladocera

Polyphemidae
Polyphemus pediculus (Linne)

Holopedidae
Holopedium gibberum Zaddach

Chydoridae
Alona sp. Baird
Chydorus sphaericus (O. F. Muller)
Chydorus spp. Stebbing
Graptoleberis sp. Sars
Pleuroxus sp. Baird

Daphnidae
Ceriodaphnia spp. Dana
Daphnia rosea Sars
Daphnia schodleri Sars
Daphnia spp. Straus
Scapholeberis sp. Schodler
Simocephalus sp. Schodler

Bosminidae
Bosmina longirostris (O. F. Miller)
Bosmina spp. Sars

Copepoda

Diaptomidae
Diaptomus arapahoensis Dodds
Diaptomus lintoni S. A. Forbes
Diaptomus shoshone S. A. Forbes
Diaptomus spp.

Cyclopidae
Macrocyclops albidus Claus
Cyclops venustoides Coker
Orthocyclops modestus E. B. Forbes
Cyclopidae spp.

Harpacticoida

Ostracoda

Literature Cited

Brooks, J. L. 1963. Cladocera 1963. In: Fresh water biology. New York: Wiley Press. 1248 p.

Wilson, M. S.; Yeatman, H. C. 1963. Free-living Copepoda. In: Fresh water biology. New York: Wiley Press. 1248 p.

Appendix C: Macroinvertebrate taxa of High Mountain Lake RNAs in Idaho

Immature aquatic insects were identified from Merritt and Cummins (1996), Wiggins (1996) and Stewart and Stark (1993). Pennak (1989) was used to identify macroinvertebrates other than aquatic insects. The invertebrates were collected from both lakes and streams.

ARTHROPODA

INSECTA

Ephemeroptera

Heptageniidae
Cingma sp.
Cinygmula sp.
Epeorus albertae (McDunnough)
Epeorus deceitivus (McDunnough)
Nixe sp.

Ephemerillidae
Ephemerella infrequens Eaton
Seratella tibialis McDunnough

Ameletidae
Ameletus similor Eaton
Ameletus sp.

Caenidae
Caenis sp.

Leptophlebiidae
Paraleptophlebia debilis (McDunnough)
Paraleptophlebia memorialis (McDunnough)

Siphlonuridae
Siphlonurus columbianus
Siphlonurus sp.

Baetidae
Baetis bicaudatus Dodds
Baetis tricaudatus Dodds
Callibaetis sp.

Centroptilum sp.

Plecoptera

Peltoperlidae
Yoraperla brevis (Banks)

Nemouridae
Amphinemura sp.
Nemoura sp.
Visoka sp.
Zapada sp.

Perlidae
Acroneuria sp.

Perlodidae
Cultus sp.
Isoperla sp.
Setvena bradleyi (Smith)

Chloroperlidae
Alloperla sp.
Sweltsa sp.

Trichoptera

Glossosomatidae
Glossosoma sp.
Protoptila sp.

Limnephilidae
Asynarchuis sp.
Chyranda sp.
Clistorina sp.
Desmona sp.
Ecclisocosmoecus sp.
Ecclisomyia sp.
Ecosmoecus sp.
Grammotaulius sp.
Hesperophylax sp.
Homophylax sp.
Lenarchus sp.
Limnephilus sp.

Onocosmoecus sp.

Hydropsychidae
Arctopsyche sp.
Parapsyche sp.

Philopotamidae
*Dolophilode*s sp.

Polycentropoidae
Polycentropus sp.

Apataniidae
Allomyia sp.

Brachycentridae
Brachycentrus sp.

Uenoidae
Neothremma sp.

Odontoceridae

Megaloptera

Sialidae
Sialis sp.

Coleoptera

Dytiscidae
Agabus sp.
Coptoptomus sp.
Hydroporus sp.
Hydrovatus sp.
Hygrotus sp.
Ilybius / Agabus sp.
Neoscutopteris sp.
Rhantus sp.
Uvarus sp.

Gyrinidae
Gyrinus sp.
Limnogonus sp.

Hemiptera

Notonectidae
Notonecta kirbyi Hungerford
Notoecta undulata Say

Corixidae

Diptera

Ceratopogonidae
Bezzia sp.

Stratiomyidae
Stratiomyia sp.

Culicidae

Psychodidae

Simulidae
Prosimulium sp.

Chironomidae
Ablabesmyia sp.
Chironominae
Corynorena sp.
Cryptolabis sp.
Diamesa sp.
Dolichopesa sp.
Hydrobaenus sp.
Microspectra sp.
Nanocladius sp.
Orthocladiinae
Pagastea sp.
Pentaneura sp.
Polypedilum sp.
Procladius sp.
Pseudodiamesa sp.
Tanypodinae
Tventenia sp.

Odonata

Cordulegastridae

Libelluidae

Aeshnidae
Aeshna sp.

Coenagrionidae
Ischnura sp.
Ischnura / Enallagma

CRUSTACEA

Gammaridae
Gammarus lacustris Sars

Talitridae
Hyallela azteca Saussure

Branchinectidae
Branchinecta coloradensis Packard
Branchinecta paludosa (O. F. Muller)

PLATYHELMINTHES

Dendrocoelidae
Polycelis coronata Kenk
Procotyla sp.

ANNELIDA

Oligochaeta

Lumbriculidae

Tubificidae

Hirudinea

Glossiphoniidae
Helobdella stagnalis (Linnaeus)
Glossiphonia complanata (Linnaeus)

MOLLUSCA

Sphaeridae
Pisidium sp.

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