WATER QUALITY STATUS REPORT NO. 115

Idaho Lake Water Quality Assessment

1992 Report

Idaho Department of Health and Welfare

Division of Environmental Quality

1995

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Prepared By
Sandra K. Lockhart

North Idaho Regional Office
2110 Ironwood Parkway
Coeur d'Alene, Idaho 83814

Idaho Department of Health and Welfare
Division of Environmental Quality
1410 North Hilton Street
Boise, Idaho 83720-9000

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ABSTRACT

Section 314(a) (2) of the Clean Water Act, as amended by the Water Quality Act of 1987, requires the state to submit a biennial assessment of their lake water quality as part of the 305(b) report. In 1990 and 1991 a Lake Water Quality Assessment Study (LWQA) was conducted on 15 Northern Idaho Lakes (Mossier, 1992). In 1992 an additional 15 lakes were monitored. The LWQA was designed to assess the trophic characteristics and water quality of these lakes.

The objectives of this LWQA were: 1) characterize trophic status for each lakes and 2) determine beneficial use support status for each lake.

The LWQA demonstrated that Secchi depth, chlorophyll *a*, and total phosphorus can be used in combination with late summer dissolved oxygen and temperature profiles to determine water quality and trophic characterization. The number of prevalent species of submergent macrophytes was also useful in determination of trophic status. The maximum water depth of submergent macrophytes was related to Secchi depth and was an indicator of lake trophic status. Both trophic status and beneficial use support status for each lake were determined.

INTRODUCTION

Background

Idaho has over 2800 named freshwater lakes covering a total of more than 7,000,000 surface acres (IDFG). The types and distribution of the lakes range from large, mainstream river reservoirs in Southern Idaho to alpine lakes in the high mountainous areas of Central Idaho to developed recreational lakes in the Panhandle area.

Previous information on the condition of Idaho lakes has come from three major sources. Two sources were lake eutrophication studies, one completed in 1983 (Miliagan, et. al. 1983), the other in 1977 (U.S. EPA 1977). The third source of water quality information was DEQ's Citizen Volunteer Lake Monitoring Program (CVMP).

The Clean Water Act requires states to summit a biennial assessment of lake water quality. In 1990 and 1991 a Lake Water Quality Assessment (LWQA) Study was conducted on 15 northern Idaho lakes (Mossier, 1993). In 1992 an additional 14 Idaho lakes were monitored.

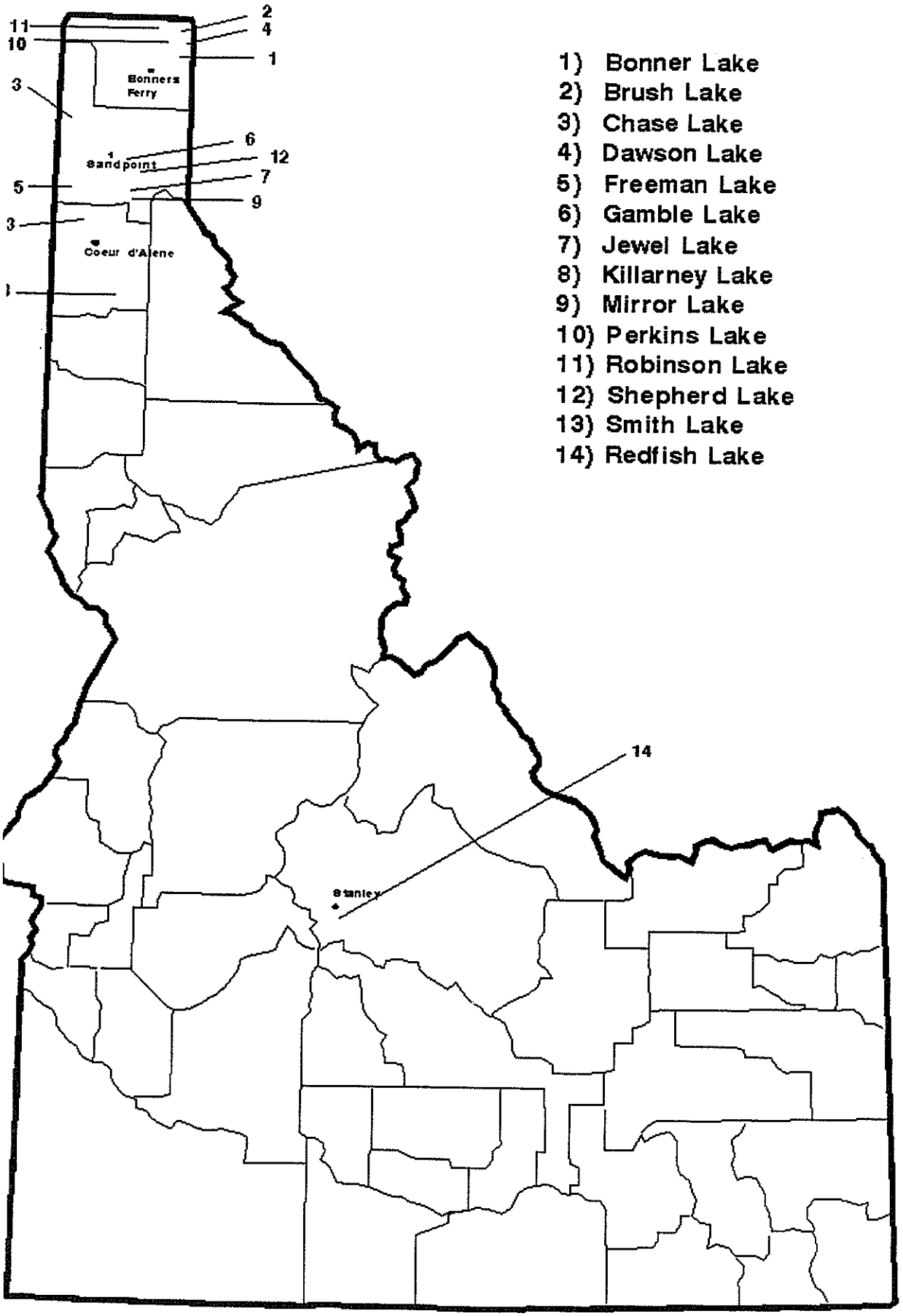
Objectives

The objectives of this LWQA are:
1) To characterize trophic status for each selected lake.
2) To determine beneficial use support status for each selected lake.

MATERIALS AND METHODS

Monitoring Site Locations

LAKE	LONGITUDE	LATITUDE	ELEVATION (ft)	STORET #
Bonner	116°05'40"N	48°43'10"W	2489	2000523
Brush	116°20'00"N	48°52'50"W	2998	2000533
Chase	116°49'10"N	48°27'50"W	2495	2000529
Dawson	116°13'40"N	48°47"30"W	2959	2000525
Freeman	117°07'00"N	48°13'30"W	2400	2000530
Gamble	116°23'00"N	48°13'10"W	2083	2000527
Jewel	116°42'30"N	48°08'00"W	2477	2000531
Killarney	116°33'15"N	47°31'10"W	2140	2000534
Mirror	116°29'20"N	48°10'30"W	2370	2000528
Perkins	116°05'30"N	48°46'10"W	2632	2000524
Robinson	116°09'20"N	48°57'30"W	2642	2000522
Shepherd	116°32'30"N	48°11'20"W	2280	2000532
Smith	116°16'00"N	48°47'20"W	2981	2000526
Redfish	114°55'57"N	44°07'02"W	6547	2090000



1) Bonner Lake
2) Brush Lake
3) Chase Lake
4) Dawson Lake
5) Freeman Lake
6) Gamble Lake
7) Jewel Lake
8) Killarney Lake
9) Mirror Lake
10) Perkins Lake
11) Robinson Lake
12) Shepherd Lake
13) Smith Lake
14) Redfish Lake

LWQA monitoring sites and locations, 1992.

Monitoring Design

Trophic status was determined using a number of water quality and biological parameters. Water quality parameters were Secchi depth, chlorophyll *a*, total phosphorus, ortho phosphate, total ammonia, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total hardness, total alkalinity, pH, specific conductivity, and dissolved oxygen/temperature profiles. The biological parameters measured were phytoplankton percent frequency, submergent macrophyte abundance, and submergent macrophyte species comparison.

Lakes were monitored two to three times throughout 1992 coinciding with spring turnover, summer thermal stratification, peak summer productivity, or fall turnover. Samples were taken at specific open-water locations, usually at the deepest point of the lake. Lakes with multiple distinct basins required additional stations.

Secchi Depth

Secchi depth transparency is influenced by the absorption characteristics of the water and of it's dissolved and particulate matter. Seasonal variations are common and reflect changes in turbidity and algal productivity. Secchi depth was determined by lowering a black and white disk (Secchi disk) into the water until it was no longer visible. The depth at which the disk reappeared after pulling upward toward the lake surface was recorded. Secchi depth was recorded in meters.

Chlorophyll a

Chlorophyll *a* samples were composite samples comprised of 5 water samples taken from equal interval depths using a Kemmer water sampler. These depths were determined by multiplying the Secchi depth by 2.4 to obtain the approximate lower reach of the trophogenic zone then dividing by 5. Water samples from these 5 depth intervals were mixed in a polyeurethane mixer (churn splitter) then filtered using a standard Millipore filter apparatus while in the boat. The filter was placed in a petri dish, wrapped in aluminum foil, labeled with date, station, and sample then placed inside an insulated cooler and kept in the dark while being transported to the laboratory.

Phytoplankton

Phytoplankton samples were taken as a composite of 5 integrated water depths in the trophogenic zone. The taxonomic identification and enumeration of phytoplankton genera and species was preformed by the Idaho Bureau of Laboratories. The percent frequency for major genera or species was determined from counts of blue green algae, diatoms, and flagellates. The percent frequency for each genera/species was grouped and a mean percent frequency was calculated for each group. The percent

frequency of these groups was related to chlorophyll *a* and trophic condition of the lake (Mossier 1993).

Dissolved Oxygen/Temperature Profile

Dissolved oxygen, temperature, pH, and specific conductivity were measured at 1 meter intervals on each of the lakes. A HydroLab Surveyor II was used for determination of these parameters (Mossier 1993).

Submergent Macrophytes

The distribution and identification (Fassett 1966) of submergent aquatic macrophytes in the selected lakes were determined in late summer. A modified, weighted garden rake with an attached line was used to sample submergent macrophytes on both sides of the boat running along a line perpendicular to the lake shore. Bays and other shoreline areas with representative submergent plant communities were sampled to the maximum depth at which the submergent macrophytes were found. The number of prevalent species was determined (Mossier 1993).

Quality Assurance

Water quality samples were preserved in the field and transported to the Idaho Bureau of Laboratories for appropriate chemical and biological analysis in accordance with Standard Methods (18th Edition 1992). Analyses were conducted in accordance with the Environmental Protection Agency and the American Public Health Association Standards. Duplicate or triplicate samples were tested for estimates of analytical accuracy and laboratory precision as well as sampling methods.

RESULTS AND DISCUSSION

Trophic characterization of freshwater lakes is best determined by using both water quality and biological indicators as measurements of lake productivity. Secchi depth, chlorophyll *a*, and total phosphorus were used as the primary parameters in evaluating lake trophic status (Wetzel 1983)(Table 43a).

Each lake was classified as eutrophic (geologically old, shallow, warm, supporting abundant plant and fish life), mesotrophic (between eutrophic and oligotrophic in character), or oligotrophic (geologically young, deep, cold, supporting little plant and fish life, low concentrations of algae ,and high concentrations of dissolved oxygen) These lakes were classified based on the collective numeral values (Wetzel 1983) (Table 43a) and best scientific judgement. The public generally considers the water quality of eutrophic lakes undesirable for recreation because of algae blooms, increased growth of submergent macrophytes, objectionable taste and odors. A lake becomes mesotrophic when nutrients, sediments, and organic materials enter the lake

causing the water body to become more biologically productive. The water clarity eventually becomes more cloudy. In the advanced stages of eutrophication algal productively increases and oxygen levels in the hypolimnion decrease or deplete. Sediment causes the lake to become shallow and aquatic plant life becomes more abundant. The lake eventually becomes eutrophic.

Chlorophyll *a* was one of the parameters used to evaluate the trophic status of each lake. Lakes were classified as eutrophic when they had a yearly average range of 3.0 ug/L- 78.0 ug/L of chlorophyll *a*, mesotrophic when yearly averages were 3.0 ug/L-11.0 ug/L, and oligotrophic if the yearly average was of 0.3 ug/L-4.5 ug/L (Wetzel 1993)(Table 43a).

Total phosphorus is another indicator used in this lake trophic classification. Lakes were classified as eutrophic if their yearly average was 0.016 mg/L - 0.39 mg/L, mesotrophic when averages ranged from 0.011 mg/L - 0.096 mg/L, and oilgotrophic if the yearly average of total phosphorus was in the 0.003 mg/L - 0.018 mg/L range (Wetzel 1983) (Table 43a).

Phosphorus is an essential nutrient for plant and animals that make up the aquatic food web. Since phosphorus is the nutrient in shortest supply in most fresh waters, even a modest increase in phosphorus can, under the right conditions, set off a chain of events in a lake or river, including accelerated plant growth, algae blooms, low D.O., and the death of certain fish, invertebrates, and other aquatic animals. There are many sources of phosphorus, both natural and human. These include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and crop land, failing septic systems, runoff from manure storage areas, disturbed land areas, drained wetlands, roadsalts (incorporates phosphorus compounds as anti-caking agents), and commercial cleaning preparations. These sources may reach the water body either by a pipe or stormwater runoff. The large number of sources and the variety of routes that phosphorus can take makes it difficult to pinpoint sources and identify causes of over enrichment.

Secchi depth was also used to classify lakes. Lakes were classified as eutrophic when they had a Secchi depth of less than 0.8 - 7.0 meters, mesotrophic if they had a Secchi depth of 1.5 - 8.1 meters, and oligotrophic if they had a Secchi depth from 5.4 - 28.3 + meters (Wetzel 1983) (Table 43a). Secchi disc transparency is a widely used, very simple means of determining lake productivity.

The maximum depth rooted aquatic plants grow is related to Secchi depth and provides another tool to evaluate lake trophic status. Submergent macrophyte communities provide another means of monitoring changes in trophic status of lakes. The total number of submergent species found in each lake was determined. Water depth and clarity (related to light availability), metal toxicity, nutrient levels, lake bottom substrate, wave action, and dissolved oxygen along with temperature

extremes all were controlling factors for submergent macrophytes.

Prevalent species were defined as those species found in at least 25% of the lake samples. Diversity of prevalent species generally demonstrated a twofold increase from eutrophic to mesotrophic to oilgotrophic lakes.

The use of prevalent species, rather than species diversity, appeared to be a more reliable indicator of lake trophic status. Total number of submergent species didn't appear to provide a definitive picture of lake trophic status. This may have been due to the masking effect of interacting factors affecting submergent macrophyte distribution and abundance (Mossier 1993).

Dissolved oxygen is an important indicator of lake health. Much information can be obtained through this single parameter. Concentrations of dissolved oxygen in the water collum determines the community of aerobic organisms that can live in a lake. Dissolved oxygen gradients can supply insight into the mixing patterns of a lake. Dissolved oxygen is also related to the photosynthetic activities of algae and weeds, providing insight to lake productivity. In addition dissolved oxygen has an influence on other physical-chemical properties of a lake.

The solubility of oxygen in water is temperature related. Oxygen is more soluble in cold water than in warm water and, consequently, temperature affects the oxygen levels of lakes. It also affects the mixing of the lake since water density is determined in part by temperature. Water temperature and water density changes from the water surface to the hypolimnion. If the difference in density is too great from one depth to another, there is a tendency for these layers of water to resist intermixing. This is important to the internal circulation patterns of lakes. In summer, if density of surface layers becomes much less than density of the hypolimnion layers the water column won't mix completely and the lakes are defined as stratified (bottom layers are not being circulated upward to the surface).

In fall, water temperatures become uniform from epilimnion to hypolimnion and density differences between layers become reduced. At this time lakes become susceptible to complete mixing. Stratification breaks down and lakes experience turnover. In larger lakes turnover may occur twice annually (spring and fall). Smaller lakes may remain constantly mixed.

Dissolved oxygen and temperature profiles taken at the peak of productivity (August) provided useful, reliable, and cost effective data for evaluating lake trophic status.

Parameters in the LWQA which were less essential and not as valuable in classifying lake trophic status include: total phosphorus, orthophosphate, pH, and total nitrogen. Total phosphorus measured one meter above the lake bottom appears to be related to anoxic conditions and was as indicator of eutrophic conditions.

Bonner Lake

General

Bonner Lake is located in Boundary County, Idaho, roughly 6 miles east of the town of Moyie Springs. The lake has 5,000 feet of shoreline and 23 acres of surface area. It has a maximum depth of 17.6 meters.

Beneficial Uses

Bonner Lake supports both warm and cold water biota and has primary and secondary contact recreational (Table 45). This lake has a fishery comprised of hatchery *Salmo gairdneri* (rainbow trout), *Micoopterus salmoides* (largemouth bass), and *Pomoxis nigromaculatus* (black crappie) (IDFG). Bonner Lake has a boat launch access for small boats and a "non-motorized" boat rule. Camping and sanitation facilities are located approximately 1 mile away (IDPR).

Trophic Status

In 1992 secchi depth in Bonner Lake ranged from 5.5 meters in August to 6.2 meters in October. The yearly average for 1992 was 5.8 meters. The water was clear during August sampling. Chlorophyll *a* concentrations in Bonner Lake during August were 2.3 ug/L and October had <1.0 ug/L. The 1992 average was 1.4 ug/L. Algal productivity was low. Total phosphorus concentrations averaged 0.027 mg/L during 1992. Total phosphorus levels in August were approximately 5 times higher in the hypolimnion of Bonner Lake than in the upper levels, which may indicate anaerobic bacterial decomposition (Table 1).

The phytoplankton community of Bonner Lake was dominated by green algae with diatoms second in order of abundance. Algae are found in all natural waters, even in hot springs. They contain chlorophyll and often other pigments. Algae form the broad base on which the food pyramids in lakes are built. Flagellates and blue green algae were, relatively, low in abundance (Table 44).

TABLE 1. Bonner Lake water quality data, 1992.

Date	8-20	8-20	10-14	10-14
Secchi Depth (meters)	5.5	5.5	6.2	6.2
Sample Depth (meters)	5.5	16.5	6.2	16.0
Max. Depth (meters)	17.6	17.6	17.6	17.6
T. Phosphorus (mg/L)	0.007	0.037	0.007	0.058
T. Ammonia (mg/L)	0.031	1.45	0.062	1.78
T. K. Nitrogen (mg/L)	0.59	1.92	0.06	2.25
T. NO2 & NO3 (mg/L)	0.006	0.016	< 0.005	<0.005
T. Hardness (mg/L)	192.0	----	168.0	----
T. Alkalinity (mg/L)	186.0	----	168.0	----
Chlorophyll *a* (ug/L)	2.2 & 2.4	----	<1.0	----

The parameters of Secchi disk transparency, chlorophyll *a*, and total phosphorus indicated this lake to have a trophic status of meso-oligotrophic (Table 43b).

Temperature And Oxygen Profiles

Bonner Lake's top to bottom temperature profile during August, 1992 indicated thermal stratification in the trophogenic zone at about 4 or 5 meters. The epilimnion temperature was 23°C and the hypolimnion was approximately 5.5°C (Table 2, Figure 1). The lake appears to be dimictic. It experiences a spring and fall turnover.

Dissolved oxygen concentration in the epilimnion (0-5 meters) averaged 8.3 mg/L. The oxygen levels started declining in the trophogenic zone and continued the trend until there was only a trace of oxygen at 8 meters and depletion in the hypolimnion. The distinct thermal stratification and relatively shallow depth may be the reasons for oxygen depletion in the lower hypolimnion.

TABLE 2. Summary of physical and chemical water quality in Bonner Lake during August and October, 1992.

Date	8-20				10-14			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	23.0	7.8	8.4	292	12.2	7.3	7.7	310
1	23.0	7.9	8.3	292	12.2	7.3	7.7	311
2	23.0	7.9	8.3	294	12.2	7.3	7.8	311
3	23.0	7.9	8.3	293	12.2	7.3	7.9	312
4	23.0	7.8	8.0	294	12.3	7.3	8.0	312
5	21.9	7.4	9.1	326	12.3	7.3	8.1	312
6	17.9	7.0	6.7	367	12.3	7.3	8.0	311
7	14.1	6.9	5.5	372	12.2	7.3	8.0	311
8	11.5	6.8	2.5	370	12.2	7.3	7.5	311
9	9.1	6.7	1.0	370	10.6	6.6	3.2	365
10	7.7	6.7	0.7	373	8.3	6.5	0.8	372
11	6.8	6.6	0.7	375	6.9	6.4	0.6	377
12	6.0	6.5	0.7	378	6.2	6.4	0.6	380
13	5.8	6.4	0.6	378	5.7	6.3	0.6	382
14	5.5	6.4	0.6	381	5.5	6.3	0.5	385
15	5.4	6.4	0.6	385	5.4	6.2	0.5	388
16	5.4	6.3	0.6	386	5.4	6.2	----	390
17	5.4	6.3	0.6	394	5.4	6.2	----	392
17.6	----	----	----	----	----	----	----	----

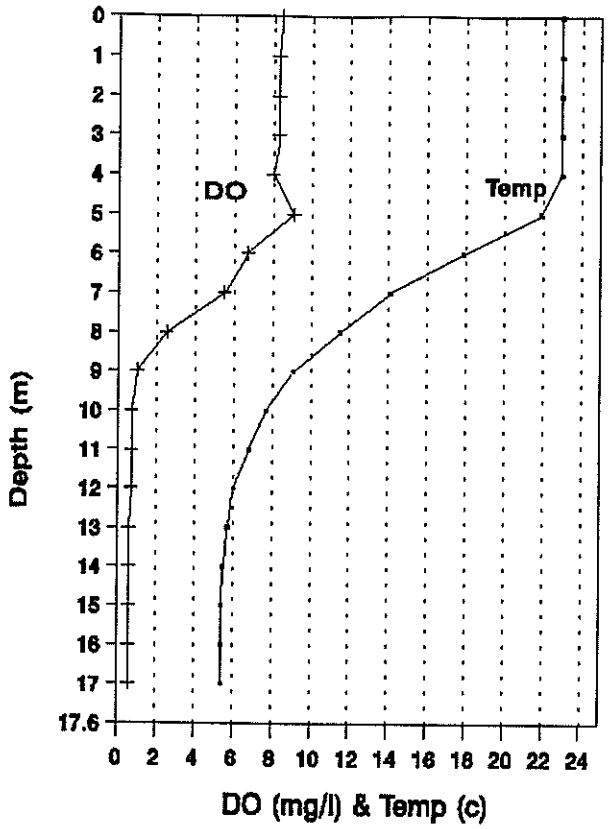


Figure 1. Dissolved oxygen and temperature profiles for Bonner Lake, August 27, 1992.

Submergent Macrophytes

Chara, Nitella (both muskgrass), and *Nuphar variegatum* (yellow water lily) were the only submergent macrophytes sampled in Bonner Lake during 1992. The muskgrass *Chara*, which has a musky order and usually found in hard water lakes, was the most prevalent rooted aquatic macrophyte in the lake. Bonner Lake had an average hardness of 180 mg/L accounting for the dominance of muskgrass. Geological formations may be largely the source of water hardness. Maximum depth of submergent macrophytes was 6.5 meters in the trophogenic zone when Secchi disk transparency was 6.2 meters (Table 3).

Table 3. Bonner Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 6.5 meters
Number of prevalent species[1] = 2
Total # of submergent species = 3
Maximum Secchi depth = 6.2 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Muskgrass (Chara)	94.3	71.0	4.6	30	2830
Yellow Water Lily	18.8	19.0	4.5	8	150
Muskgrass (Nitella)	5.0	10.0	4.0	4	20
Total		100.0		42	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Brush Lake

General

Brush Lake is located in Boundary County, Idaho and has 8,000 feet of shoreline, 29 acres of surface area and a maximum depth of 6.2 meters.

Beneficial Uses

Warm and cold water biota as well as primary and secondary contact recreational are beneficial uses of Brush Lake (Table 45). This lake has hatchery *Salmo gardner* (rainbow trout), *Micropterus salmoided* (largemouth bass), *Lepomis gibbosus* and (pumpkinseed). There is boating access and camping with sanitary facilities (IDFG).

Trophic Status

Secchi disk transparency in August and October of 1992 was 4.0 meters and 4.1 meters, respectively. The water was clear but had a brown tint which may have been caused by organic decay. Chlorophyll *a* ranged from 4.8 ug/L in August to <1.0 ug/L in October averaging 2.65 ug/L in 1992 (Table 4). At the time of sampling, algae productivity was moderate. The Brush Lake phytoplankton community was dominated by diatoms (microscopic, single-celled yellow-green algae) with flagellates being second most frequently sampled (Table 44). There are several thousand species of diatoms, including both salt and fresh water types. Total phosphorus for August averaged 0.014 mg\L and 0.018 mg/L in October. Yearly average for 1992 was 0.016 mg/L (Table 4). Brush Lake's trophic characterization is classified as a meso-oligotrophic lake (Table 43b).

TABLE 4. Bush Lake water quality data, 1992.

Date	8-27	10-13	DUPE
Secchi Depth (meters)	4.0	4.1	4.1
Sample Depth (meters)	4.0	4.1	4.1
Max. Depth (meters)	6.2	6.0	6.0
T. Phosphorus (mg/L)	0.015	0.018	0.017
T. Ammonia (mg/L)	0.031	0.006	0.065
T.K. Nitrogen (mg/L)	0.48	0.6	0.56
T. NO2 & NO3 (mg/L)	0.005	0.011	0.008
T. Hardness (mg/L)	28.0	24.0	----
T. Alkalinity (mg/L)	26.0	27.0	----
Chlorophyll *a* (ug/L)	4.8	<1.0	<1.0

TABLE 5. Summary of physical and chemical water quality in Brush Lake during August and October, 1991.

Date	8-27				10-13			
Depth meters	Temp C°	pH	D.O. mg/L	Cond. mhos/cm	Temp C°	pH	D.O. mg/L	Cond. umhos/cm
surface	17.1	6.6	6.8	59	11.2	6.4	8.5	57
1	16.8	6.6	6.7	59	11.1	6.4	8.7	57
2	16.5	6.6	6.6	58	10.8	6.4	8.7	57
3	16.4	6.6	6.6	58	10.7	6.4	8.5	58
4	16.3	6.5	6.6	58	10.6	6.4	8.4	58
5	16.2	6.5	6.3	58	10.6	6.4	8.3	58
6	14.7	5.8	1.0	70	----	----	----	----
6.2	----	----	----	----	----	----	----	----

Temperature and Oxygen Profiles

Brush Lake's temperature profile during August 1992 shows stratification occurred in the lake's very bottom (5 meters). Brush Lake had a wide thermocline (1-5 meters) and shows dissolved oxygen depletion in the lower 6 meters (hypolimnion). (Table 5, Figure 2).

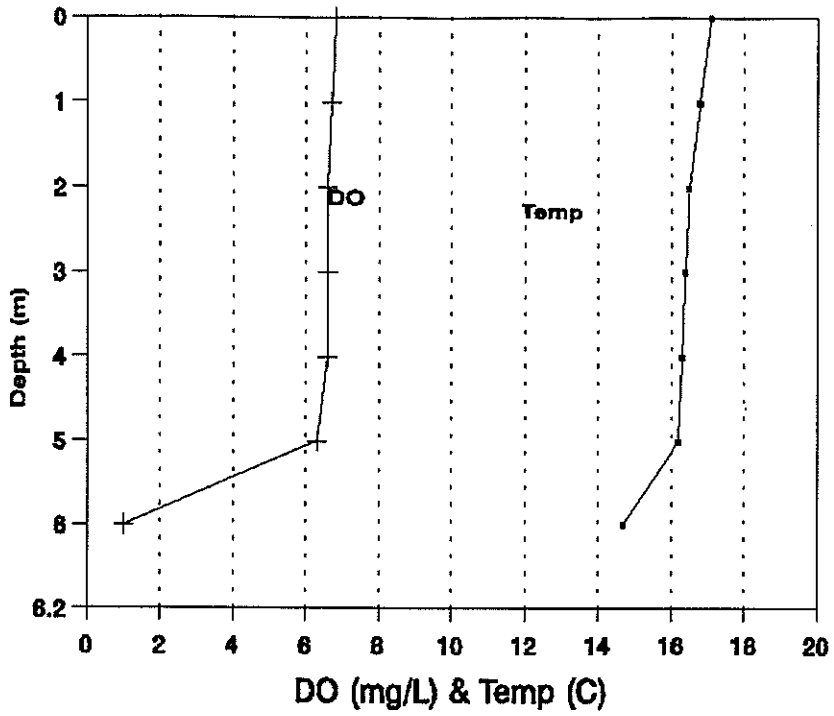


Figure 2. Dissolved oxygen and temperature profiles for Brush Lake, August 27, 1993.

Submergent Macrophytes

The maximum depth submergent macrophytes were found in Brush Lake was 2.6 meters. *Potamogeton amplifolius* (largeleaf pondweed) was the most prevalent species found. Pond weeds are perennial, growing mainly in cool regions. Several kinds of ducks feed on pondweed. Dense underwater growth provides cover for fish, snails, and other animals. *Nuphar advena* (yellow water lily), *Myriophyllum verticillatum* (green milfoil), and *Eleocharis acicularis* (needlerush) were also sampled in Brush Lake (Table 6).

Table 6. Brush Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 2.6 meters
Number of prevalent species[1] = 4
Total # of submergent species = 4
Maximum Secchi depth = 4.1 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Largeleaf Pondweed	82.4	56.7	3.6	17	1400
Yellow Water Lily	50.0	13.3	4.0	4	200
Green Milfoil	48.0	16.7	2.5	5	240
Needlerush	40.0	13.3	4.0	4	160
Total		100.0		30	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Chase Lake

General

Chase Lake is located in Boundary County, Idaho 1.5 miles south of the town of Coolin. Chase Lake has 12,000 feet of shoreline, 100 acres of surface area and a maximum depth of 3.3 meters.

Beneficial Uses

Both warm and cold water boita as well as primary and secondary contact recreational are beneficial uses of Chase Lake (Table 45). The fishery consists of *Perca flavescens* (perch), *Micropterus salmoided* (largemouth bass), and *Lepomis gibbosus*

(pumpkinseed). There is boating access, a "non-motorized" policy, and camping with sanitary facilities (IDFG).

Trophic Status

Chase Lake is a shallow lake. During July sampling the water was clear and the Secchi disk transparency was 2.5 meters (Table 7). Chlorophyll *a* was 6.4 ug/L. There was moderate algal productively in Chase Lake during July. Chase Lake is characterized as a meso-eutrophic lake (Table 43b). Total phosphorus was 0.011 mg/L for July, 1992 (Table 7).

Flagellates were the dominating phytoplankton in Chase Lake. Blue green algae was second in dominance with green algae third (Table 44). Flagellates are usually oval in shape and many have chlorophyll in their bodies. They are common in fresh water lakes.

Table 7. Chase Lake water quality data, 1992.

Date	7-9	DUPE
Secchi Depth (meters)	2.5	2.5
Sample Depth (meters)	2.5	2.5
Max. Depth	3.3	3.3
T. Phosphorus (mg/L)	0.011	0.011
T. Ammonia (mg/L)	0.018	0.012
T.K. Nitrogen (mg/L)	0.35	0.25
T. NO2 & NO3 (mg/L)	0.009	0.010
T. Hardness (mg/L)	8.0	----
T. Alkalinity (mg/L)	17.0	----
Chlorophyll *a* (ug/L)	6.4	6.7

Temperature and Oxygen Profiles

Chase Lake was shallow, mixed completely, and did not thermally stratified. Temperature ranged from 21°C in the epilimnion to 19.8°C at 2 meters near the hypolimnion. D.O. ranged from 7.7 mg/L to 8.1 mg/L in the eplimnion and hypolimnion, respectively (Table 8, Figure 3).

Table 8. Summary of physical and chemical water quality in Chase Lake during July, 1992.

Date	7-9			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. mhos/cm
surface	21.0	6.1	7.7	29.0
1	20.0	6.2	8.1	30.0
2	19.8	6.3	8.1	30.0
3	----	----	----	----

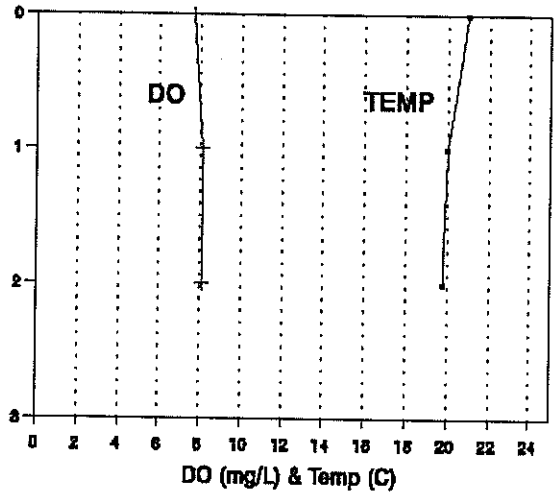


Figure 3 Dissolved oxygen and temperature profiles for Chase Lake, August 9, 1992.

Submergent Macrophytes

The total number of dominate submergent species was 9 with *Potamogeton praelongus* (whitestem pondweed) being the most abundant. *Brasenia schreberi* (water shield), *Nymphaea tuberosa* (white water lily), *Chara* (muskgrass), *Potamogeton natans* (floating pondweed), and *Nitella* (muskgrass) occurred in the samples 25% of the time (Table 9). Pondweeds are the largest family of truly aquatic seed plants. They are perennial, growing mainly in cool regions. More than 60 species grow in fresh water lakes.

Table 9. Chase Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 3.3 meters
Number of prevalent species[1] = 7
Total # of submergent species = 9
Maximum Secchi depth = 2.5 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Whitestem Pondweed	97.5	5.1	1.0	2	195
Water Shield	92.5	20.5	2.7	8	740
White Water Lily	78.3	15.4	3.0	6	470
Waterweed	69.3	20.5	2.7	8	485
Muskgrass (Chara)	66.7	7.7	2.0	3	200
Floatingleaf Pondweed	57.5	10.3	1.0	4	230
Muskgrass (Nitella)	55.0	10.3	2.0	4	220
Bladderwort[5]	50.0	2.6	1.0	1	50
Largeleaf Pondweed	20.0	7.7	1.5	3	60
Total		100.0		39	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Dawson Lake

General

Dawson Lake is located in Boundary County, Idaho roughly 4 miles west of Moyie Springs and has 6,000 feet of shoreline with 35 acres of surface area. Maximum depth of Dawson Lake is 6 meters.

Beneficial Uses

Beneficial uses of Dawson Lake include warm water biota, primary and secondary contact recreational (Table 45). *Microterus salmoids* (largemouth bass), *Pomoxis nigromaculatus* (black crappie), *Perca flavescens* (perch) and *Esox lucius* (northern pike) are warn water fish species supported in Dawson Lake. There are no maintained boat ramps, docks, campgrounds, or sanitary facilities on this lake (IDFG).

Trophic Status

In 1992 Secchi depth was 3.5 meters, 3.0 meters, and 3.2 meters in July, August, and October, respectively. Yearly average Secchi depth was 3.25 meters for Dawson Lake. Chlorophyll *a* was considerably higher in July than in August and October. Concentrations for 1992 average 8.5 ug/L. There was high algal productivity during July monitoring. Dissolved oxygen was depleted near 2 meters, however during August the productivity was moderate and the dissolved oxygen was somewhat higher. Concentrations of total phosphorus averaged 0.029 mg/L in July, 0.088 mg/L in August, and 0.029 mg/L in October, averaging 0.049 mg/L for 1992 (Table 10). These parameters characterize Dawson Lake as a meso-eutrophic lake (Table 43b).

Phytoplankton communities of Dawson Lake were dominated by blue-green algae in both July and August with green algae second in abundance (Table 44). Some forms of blue-green algae form slippery, dark coatings on rocks along the shores of rivers and lakes. Lakes with large numbers of algae (algae blooms) may look greenish or bluish-green.

Table 10. Dawson Lake water quality data, 1992.

Date	7-16	DUPE	7-16	8-19	8-19	10-7	DUPE
Secchi Depth (meters)	3.5	3.5	3.5	3.0	3.0	3.2	3.2
Sample Depth (meters)	3.5	3.5	5.0	3.0	4.0	3.2	3.2
Max. Depth (meters)	5.8	5.8	5.8	5.4	5.4	5.5	5.5
T. Phosphorus (mg/L)	0.022	0.023	0.036	0.037	0.14	0.029	0.028
T. Ammonia (mg/L)	0.024	0.030	0.034	0.152	0.065	0.094	0.084
T.K. Nitrogen (mg/L)	0.69	0.64	0.72	0.94	1.02	0.71	0.83
T. NO2 & NO3 (mg/L)	0.018	0.017	0.022	<0.005	<0.005	<0.005	0.036
T. Hardness (mg/L)	24.0	----	----	28.0	----	24.0	----
T. Alkalinity (mg/L)	27.0	----	----	30.0	----	30.0	----
Chlorophyll *a* (ug/L)	16.0	14.0	----	6.2 & 6.4	----	3.2	3.0

Table 11. Summary of physical and chemical water quality in Dawson Lake during July, August, and October, 1992.

Date	7-16				8-19				10-7			
Depth meters	Temp C°	pH	D.O. mg/L	Cond. umhos/cm	Temp C°	pH	D.O. mg/L	Cond. umhos/cm	Temp C°	pH	D.O. mg/L	Cond. umhos/cm
surface	20	6.5	1.5	60	23.2	6.7	7.0	62	12.3	6.2	6.6	62
1	19.7	6.5	1.1	60	23.1	6.6	6.9	62	12.2	6.1	6.3	62
2	19.3	6.5	1	60	22.5	6.6	6.5	62	12	6.1	6	63
3	19	6.3	0.8	60	21.1	6.3	3	61	11.8	6	5.9	63
4	17.6	5.9	0.5	61	18.1	5.9	0.5	65	11.7	6	5.8	63
5	14.2	5.7	0.4	72	15.6	5.8	0.5	120	11.7	6	5.7	63
6	----	----	----	----	----	----	----	----	----	----	----	-----

Temperature And Oxygen Profiles

Dawson Lake was thermally stratified in August, 1992, showing progressive oxygen depletion below the thermocline into the hypolimnion (Table 11, Figure 4). In October, after lake turnover, the hypolimnion dissolved oxygen levels were restored. Conductivity increased towards the lake bottom and pH dropped slightly during the month of August.

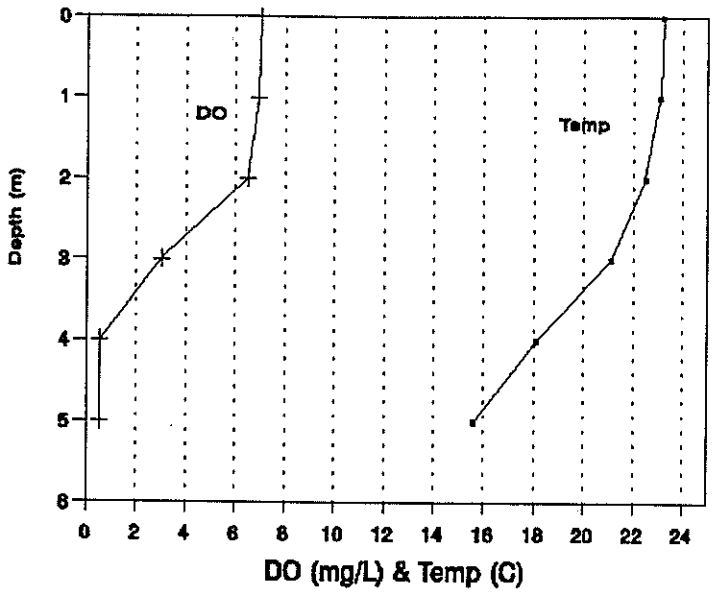


Figure 4. Dissolved oxygen and temperature profiles for Dawson Lake, August 19,1992.

Submergent Macrophytes

The submergent plant communities of Dawson Lake were dominated by seven species. *Nuphar advena* (yellow water lily) was the most prevalent species sampled. Maximum depth of sampling was 4.3 meters with a secchi depth clarity of 3.5 meters (Table 12). Yellow water lily grows from muddier bottoms of lakes. The root stock is stout and the leaves are round to near heart shaped.

Table 12. Dawson Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 4.3 meters
Number of prevalent species[1] = 3
Total # of submergent species = 9
Maximum Secchi depth = 3.5 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Yellow Water Lily	65.0	12.5	2.0	4	260
Largeleaf Pondweed	61.9	12.5	2.0	4	1115
Whitestem Pondweed	44.2	18.8	2.0	6	265
Potamogeton Pusillus[5]	100.0	3.1	1.0	1	100
Aquatic Moss[5]	52.5	12.5	1.3	4	100
Muskgrass (Nitella)[5]	48.8	12.5	1.3	4	195
Coontail	17.2	28.1	2.0	9	155
Total		100.0		32	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species through out the lake.

Freeman Lake

General

Freeman Lake is located in Boundary County, Idaho and has 6,000 feet of shoreline with 30 acres of surface water and a maximum depth of 6 meters.

Beneficial Uses

Freeman Lake sustains both cold and warm water biota,as well as primary and secondary contact recreational (Table 45). The lake has a public docks with motorless boating only. Camping with sanitary facilities is available. Freeman Lake fishery is comprised of hatchery *Salmo qairdneri* (rainbow trout), hatchery *Microopterus salmoides* (largemouth bass), hatchery *Perca flavescens* (yellow perch), *Pomoxis nigromaculatus* (black crappie), and *Lepomis gibbosus* (pumpkinseed).

Trophic Status

Secchi depth for Freeman Lake in 1992 ranged from 4.3 meters to 5.0 meters during August and October, respectively. Yearly average Secchi depth was 4.6 meters in 1992 (Table 13). The water in Freeman Lake had a brown tint indicating high dissolved organic matter. Chlorophyll *a* averaged 7.9 ug/L for August and <1.0 ug/L in October making the 1992 average 4.2 ug/L for Freeman Lake. Algal productivity was moderate and dissolved oxygen depletion in bottom waters occurred in both July and August. The phytoplankton community of Freeman Lake was dominated by flagellates and green algae were the second most abundant form (Table 44). Total phosphorus averaged 0.015 mg/L for 1992. Based on these limnological parameters, Freeman Lake is characterized as meso-eutrophic (Table 43b).

Table 13. Freeman Lake Water Quality Data, 1992.

Date	7-14	DUPE	8-18	10-9	DUPE
Secchi Depth (meters)	4.3	4.3	4.6	5.0	5.0
Sample Depth (meters)	4.3	4.3	4.6	5.0	5.0
Max. Depth (meters)	5.8	5.8	5.4	5.0	5.0
T. Phosphorus (mg/L)	0.015	0.016	0.021	0.01	0.011
T. Ammonia (mg/L)	0.049	0.051	0.16	0.05	0.035
T. K. Nitrogen (mg/L)	0.58	0.81	0.64	0.33	0.41
T. NO2 & NO3 (mg/L)	0.006	0.01	0.01	0.006	0.009
T. Hardness (mg/L)	36	----	36	44	----
T. Alkalinity (mg/L)	42	----	43	42	----
Chlorophyll *a* (ug/L)	----	----	7.4 & 8.4	<1.0	<1.0

Temperature and Oxygen Profiles

Freeman Lake oxygen profile during August 1992 indicated the dissolved oxygen dropped from 7.8 mg/L at the surface to .03 mg/L near the bottom. Temperature change was 5.7°C from the top to bottom. The oxygen and temperature profiles indicate Freeman Lake stratifies during the summer and is a dimictic lake. (turning over in the spring and fall) (Figure 5, Table 14).

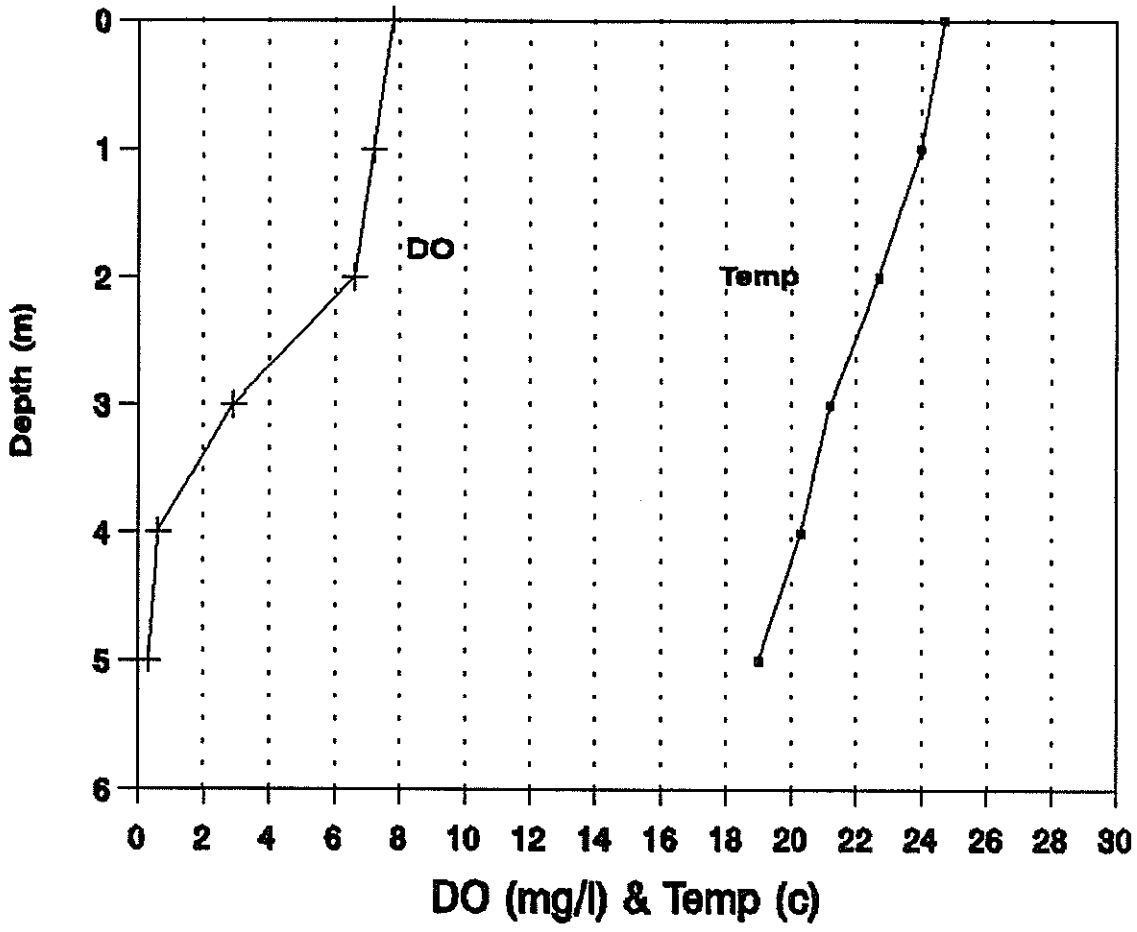


Figure 5. Dissolved oxygen and temperature profiles for Freeman Lake, August 18, 1992.

Table 14. Summary of physical and chemical water quality in Freeman Lake during July, August, and October, 1992.

Date	7-14				8-18				10-9			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	21.0	6.4	7.7	80	24.7	7.2	7.8	83	12.3	6.4	7.5	83
1	20.7	6.6	7.8	81	24.0	7.0	7.2	83	12.3	6.4	7.4	83
2	20.5	6.6	7.4	81	22.7	6.7	6.6	83	12.2	6.4	7.3	83
3	20.3	6.5	5.9	80	21.2	6.2	2.9	83	12	6.3	7.2	83
4	19.8	6.1	0.9	82	20.3	6.1	0.6	87	11.8	6.3	6.9	83
5	18.3	6.0	0.3	94	19.0	6.1	0.3	113	----	----	-----	----
6	----	-----	----	----	-----	----	----	----	----	----	-----	----

Submergent Macrophytes

Brasenia schreberi (water shield), *Potamogeton praelongus* (whitestem pondweed), *Potamogeton robbinsii* (robins pondweed), *Nitella* (muskgrass), *Myriophyllum verticillatum* (green milfoil), and *Utricularia vulgaris* (bladderwort) were the prevalent species found at least 25% of the rake tosses.

Table 15. Freeman Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 5.8 meters
Number of prevalent species[1] = 6
Total # of submergent species = 10
Maximum Secchi depth = 5.8 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Water Shield	77.0	6.9	3.0	5	385
Whitestem Pondweed	58.1	11.1	4.5	8	465
Robbins Pondweed	51.6	30.6	3.7	22	1135
Muskgrass (Nitella)	50.4	16.7	2.4	12	605
Green Milfoil	45.8	8.3	3.5	6	275
Bladderwort	34.2	8.3	3.0	6	205
Bushy Pondweed[5]	95.0	1.4	1.0	1	95
Fineleaf Pondweed	12.5	11.1	2.0	8	100
Largeleaf Pondweed	10.0	4.2	3.0	3	30
Yellow Water Lily	5.0	1.4	1.0	1	5
Total		100.0		72	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Gamble Lake

General

Gamble Lake is located in Bonner County, Idaho 5 miles East of Sagel. The lake has 10,500 feet of shoreline with 140 acres of surface water and a maximum depth of 10 meters.

Beneficial Uses

Gamble Lake supports warm water biota along with primary and secondary contact recreational (Table 45). Gamble Lake's fishery is comprised of *Microplerus salmoides* (largemouth bass), *Perca flavescens* (yellow perch), *Pomoxis nigromaculatus* (black crappie), and *Lepomis gibbosus* (pumpkin seed). Gamble Lake has a graveled boat ramp, parking spaces, and no developed campsites (IDFG).

Trophic Status

The water in Gamble Lake exhibited a sightly brown tint during the 1992 survey . Secchi depth was 4.3 meters in July, 5.6 meters in August, and 6.3 meters in October. The 1992 yearly average was 5.4 meters. Chlorophyll *a* averaged 2.53 ug/L in 1992 with 3.0 ug/L in July, 4.1 ug/L in August, and <1.0 ug/L in October. Algal productivity in August was moderate. Total phosphorus averaged 0.028 mg/L in July, 0.058 mg/L in August, and 0.017 mg/L in October (Table 16). Overall total phosphorus average was 0.028 mg/L for 1992. Gamble Lake is characterized as meso-oilgotrophic (Table 43b). Phytoplankton in Gamble Lake was dominated by flagellates with green algae second (Table 44).

Temperature and Oxygen Profiles

Gamble Lake appeared to be thermally stratified in 1992. The dissolved oxygen dropped in August from 7.3 mg/L at the surface to 0.6 mg/L at 6 meters. Dissolved oxygen depletion occurred in the thermocline but was replenished to the lake after fall turnover (Table 17, Figure 6).

TABLE 16. Gamble Lake water quality data, 1992.

Date	7-7	DUPE		DUPE	8-12		10-5	DUPE	
Secchi Depth(meters)	4.3	4.3	4.3	4.3	5.6	5.6	6.3	6.3	6.3
Sample Depth(meters)	4.3	4.3	8.5	8.5	5.6	8.5	6.3	6.3	8.5
Max. Depth(meters)	9.7	9.7	9.7	9.7	10.1	10.1	10	10	10
T. Phosphorus(mg/L)	0.009	0.01	0.05	0.045	0.013	0.045	0.008	0.007	0.044
T. Ammonia(mg/L)	0.034	0.226	0.121	0.143	0.056	0.046	0.077	0.091	0.394
T. K. Nitrogen(mg/L)	0.36	0.4	0.5	0.44	0.46	0.78	0.37	0.4	0.8
T. NO2 & NO3(mg/L)	0.019	0.21	0.031	<0.005	0.009	<0.005	0.014	0.018	0.01
T. Hardness(mg/L)	48	----	----	----	56	----	52	----	----
T. Alkalinity(mg/L)	48	----	----	----	54	----	50	----	----
Chlorophyll *a*(ug/L)	3.0	3.0	----	----	4.0 & 4.2	----	<1.0	<1.0	----

TABLE 17. Summary of physical and chemical water quality in Gamble Lake during July, August, and October, 1992.

Date	7-7				8-12				10-5			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	21.3	6.5	7.6	103	23.7	6.9	7.3	105	15.1	6.7	6.1	110
1	21.3	6.5	7.5	103	23.2	6.9	7.3	106	14.9	6.6	6.1	110
2	21.4	6.5	7.4	103	22.9	6.9	7.3	105	14.8	6.6	6.3	110
3	21.4	6.5	7.5	103	22.6	6.8	6.8	105	14.7	6.6	6.4	109
4	21.4	6.5	7.3	103	22.3	6.6	6.0	105	14.6	6.6	6.3	109
5	17.8	5.9	5.1	108	20.6	6.2	1.4	111	14.4	6.4	6.1	110
6	14.6	5.8	4.3	113	17.3	6.1	0.6	119	14.2	6.3	5.9	110
7	12.0	5.7	0.9	117	13.5	6.1	0.5	122	13.6	6.2	5.3	112
8	9.7	5.6	0.5	120	11.2	6.0	0.5	125	13.3	6.0	4.4	120
9	8.8	5.5	0.4	125	9.8	6.0	0.5	143	12	6.0	4.4	157
10	----	----	----	----	----	----	----	----	----	----	----	----

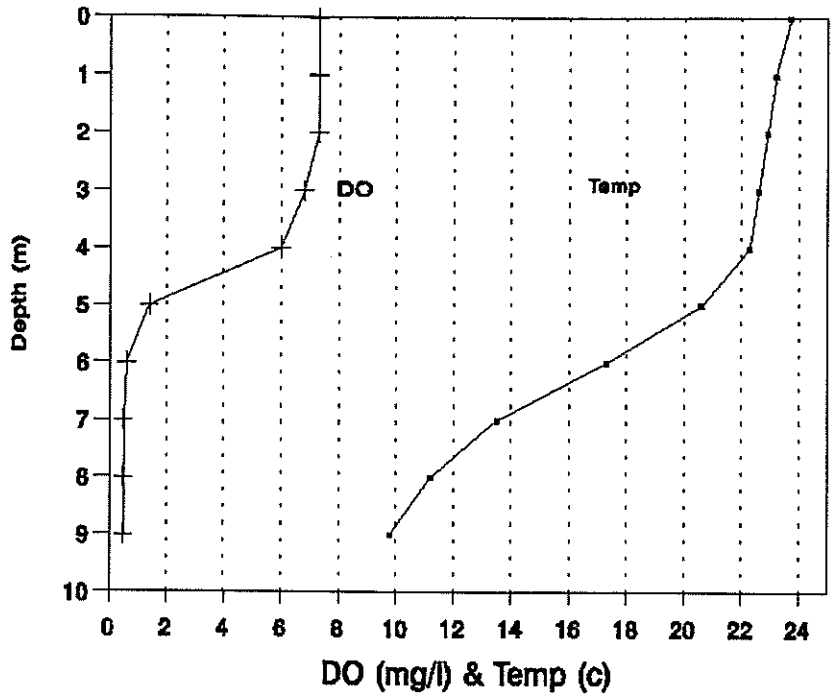


Figure 6. Dissolved oxygen and temperature profiles for Gamble Lake, August 12, 1992.

Submergent Macrophytes

Generally the submergent plant community of Gamble Lake was diverse and had a large variety of submergent aquatic macrophytes. The maximum depth of occurrence was 7.0 meters. Gamble Lake depth was 10 meters and water transparency was 6.3 meters. There was a total of 14 species of submergent macrophytes with 8 species being present in each sample 25% of the time. The most prevalent species were *Potamogeton praelongus* (white stem pondweed), *Brasenia schreberi* (water shield), *Nuphar variegatuno* (yellow water lily), *Potamogeton robbinsii* (robbins pondweed), *Anacharis canadensis* (waterweed), *Utricularia Vulgaris* (bladderwart), *Potamogetom amplifolius* (largeleaf pondweed) and *Potamogeton natans* (brownleaf pondweed). During the summer months, heavy growths of these pondweeds may interfere with boating, fishing and swimming.

Table 18. Gamble Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 7.0 meters
Number of prevalent species[1] = 8
Total # of submergent species = 14
Maximum Secchi depth = 6.3 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Whitestem Pondweed	56.1	13.3	3.5	14	785
Watershield	53.0	9.5	3.3	10	530
Yellow Water Lily	52.5	3.8	4.0	4	210
Robbins Pondweed	34.6	11.4	2.4	12	415
Waterweed	40.8	12.4	3.5	13	530
Bladderwort	36.0	9.5	3.3	10	360
Largeleaf Pondweed	25.0	6.7	3.5	7	175
Brownleaf Pondweed	20.5	9.5	3.3	10	205
Needlerush	15.0	3.8	4.0	4	60
Narrowleaf Pondweed	15.0	3.8	4.0	4	60
Bushy Pondweed	15.0	3.8	4.0	4	60
Unident. Aq. Grass	6.7	2.9	1.5	3	20
Aquatic Moss	5.0	3.5	2.3	7	35
Muskgrass (Nitella)[5]	51.7	2.9	1.0	3	155
Total		100.0		105	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Jewel Lake

General

Jewel Lake is located in Bonner County, Idaho approximately 15 miles southwest of Sandpoint. Jewel Lake has 5,000 feet of shoreline with 35 acres of surface water. Maximum depth of Jewel Lake is 8 meters.

Beneficial Uses

Beneficial uses of Jewel Lake include cold and warm water biota, primary and secondary contact recreational. The fishery includes hatchery *Oncorhynchus clarki* (cutthroat trout), hatchery *Oncorhynchus mykiss* (rainbow trout), and *Perca flavescens* (yellow perch) (Table 45). There is a "no motor rule" on Jewel Lake but launch facilities for motorless boats are available as well as camping areas, docks, and sanitation facilities (IDPR).

Trophic Status

Secchi depth ranged from 4.8 meters in July to 3.2 meters in October. Average secchi depth for 1992 was 4.2 meters. During sampling the water was clear but had a brown pigment color. Chlorophyll *a* averaged 3.3 ug/L in August and 21.0 ug/L in October with an overall average of 12.1 ug/L for 1992. There was a small phytoplankton bloom in August and algal productivity was high in October. Total phosphorus data indicate the deeper waters of Jewel Lake are slightly higher in phosphorus then surface water. Concentrations averaged 0.037 mg/L for July, 0.02 mg/L in August, and 0.026 mg/L in October. The yearly average for total phosphorus was 0.031 mg/L (Table 19). Jewel Lake typifies a meso-eutrophic lake (Table 43b).

Flagellates were the most abundant of the phytoplankton with green algae second in abundance (Table 44).Green Algae occurs in both fresh and salt water and large quantities of green algae may color a small lake like Jewel Lake.

TABLE 19. Jewel Lake water quality data, 1992.

Date	7-10	DUPE			8-13		10-9	DUPE	
Secchi Depth(meters)	4.8	4.8	4.8	4.8	4.3	4.3	3.2	3.2	3.2
Sample Depth(meters)	4.8	4.8	6.5	6.5	4.3	6.5	3.2	3.2	6.5
Max. Depth(meters)	8.0	8.0	8.0	8.0	7.8	7.8	7.6	7.6	7.6
T. Phosphorus(mg/L)	0.012	0.013	0.066	0.058	0.013	0.027	0.02	0.021	0.036
T. Ammonia(mg/L)	0.024	0.032	0.019	0.021	0.016	0.02	0.045	0.042	0.049
T. K. Nitrogen(mg/L)	0.25	0.23	0.49	0.49	0.45	0.45	0.44	0.36	0.51
T. NO2 & NO3(mg/L)	0.012	0.012	0.012	0.012	0.008	0.014	<0.005	<0.005	<0.005
T. Hardness(mg/L)	20	----	----	----	20	----	20	----	----
T. Alkalinity(mg/L)	22	----	----	----	22	----	23	----	----
Chlorophyll *a*(ug/L)	----	----	----	----	3.2 & 3.4	----	21	21	----

Temperature and Oxygen Profiles

On August 13, 1992, the dissolved oxygen diminish in Jewel Lake from 7.2 mg/L at the surface to 0.6 mg/L at 7 meters near the lake bottom (Table 20, Figure 7). Dissolved oxygen depletion occurred in the thermocline at approximately 4.5 meters. The lake appears to have a spring and fall turnover (dimictic).

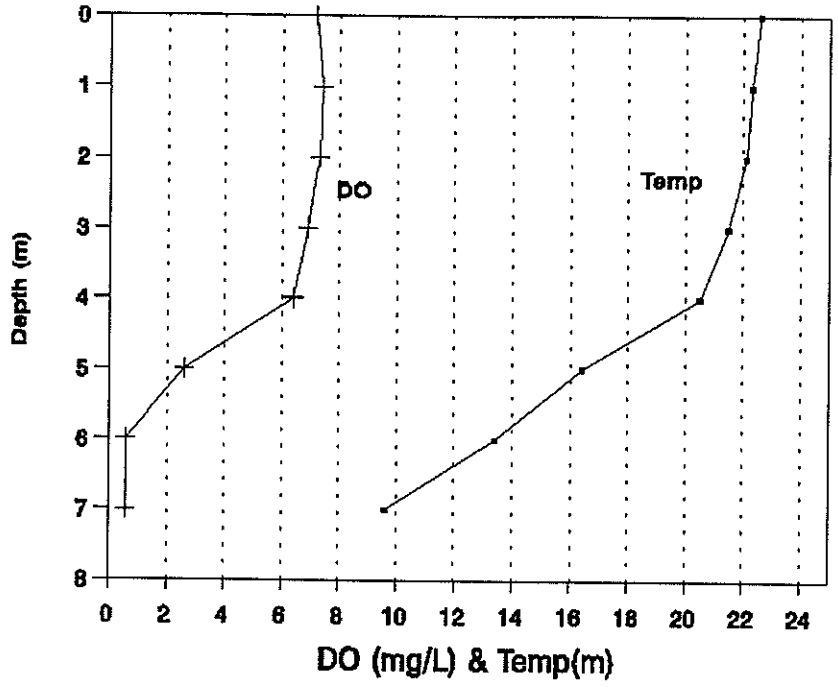


Figure 7. Dissolved oxygen and temperature profiles for Jewel Lake, August 13, 1992.

Table 20. Summary of physical and chemical water quality in Jewel Lake during July, August, and October, 1992.

Date	7-10				8-13				10-9			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	20.8	6.3	7.2	48	22.6	6.8	7.2	42	12.6	6.3	7.7	49
1	20.6	6.2	7.1	49	22.3	6.7	7.4	50	12.6	6.3	7.8	49
2	20.2	6.2	7.1	48	22.1	6.7	7.3	49	12.6	6.3	7.8	49
3	19.5	6.1	6.6	48	21.5	6.6	6.9	49	12.5	6.3	7.8	49
4	18.4	5.9	6.4	48	20.5	6.5	6.4	50	12.5	6.2	7.5	49
5	14.5	5.5	3.3	48	16.4	5.9	2.6	49	12.4	6.1	7.1	50
6	11.5	5.3	0.4	49	13.4	5.8	0.9	49	12.4	5.8	5.1	51
7	9.3	5.1	0.2	52	9.6	5.7	0.6	65	12.1	5.6	1.2	54
8	----	----	----	----	----	----	----	----	----	----	----	----

Submergent Macrophytes

The submergent aquatic macrophyte communities of Jewel Lake were diverse. Water clarity was 4.8 meters and no submergent macrophytes were found in water deeper than 6.5 meters. There were 10 species sampled with 4 species being prevalent 25% of each sample. *Nitella* (muskgrass), *Potamogeton robbinsii* (robins pondweed), *Nuphar variegatum* (yellow water lily), and *Ronunculus trichophyllus* (water buttercup) were the most prevalent species sampled.

Table 21. Jewel Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 6.5 meters
Number of prevalent species[1] = 4
Total # of submergent species = 10
Maximum Secchi depth = 4.8 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Muskgrass (Nitella)	75.0	3.9	1.0	2	150
Robbins Pondweed	67.3	47.1	3.1	24	1615
Yellow Water Lily	41.9	15.7	4.0	8	335
Water Buttercup	27.5	19.6	3.3	10	275
Muskgrass (Chara)[5]	40.0	2.0	1.0	1	40
Spikegrass[5]	30.0	2.0	1.0	1	30
Largeleaf Pondweed	13.3	5.9	3.0	3	40
Green Milfoil[5]	7.5	3.0	2.0	2	15
Total		100.1		51	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Killarney Lake

General

Killarney Lake is located in Kootenai County, Idaho west of highway 3 and south of the community of Rose Lake. Killarney Lake has approximately 44,000 feet of shoreline with 500 acres of surface water. It's maximum depth is 5 meters.

Beneficial Uses

Killarney Lake is in support of warm water biota and has primary and secondary contact recreational (Table 45). It has a public boat ramp, docks, camping, and sanitation facilities at this lake. *Esox lucius* (northern pike), *Micropterus salmoides* (largemouth bass), *Perca flavescens* (yellow perch), and *Pomoxis nigromaculastus* (black crappie) constitute the fisheries in Killarney Lake (IDFG).

Trophic Status

In July, Secchi depth was 2.3 meters. The water was clear with a brown tinge to it. In October, Killarney Lake had a Secchi depth of 2.0 meters. The season average for 1992 was 2.3 meters (Table 22).

Table 22. Killarney Lake water quality data, 1992.

Date	7-20	DUPE	8-21	10-16	DUPE
Secchi Depth (meters)	2.3	2.3	2.5	2.0	2.0
Sample Depth (meters)	2.3	2.3	2.5	2.0	2.0
Max. Depth (meters)	4.3	4.3	4.8	4.5	4.5
T. Phosphorus (mg/L)	0.012	0.011	0.015	0.019	0.022
T. Ammonia (mg/L)	0.007	<0.005	0.117	0.033	0.035
T. K. Nitrogen (mg/L)	0.14	0.15	0.07	0.16	0.15
T. NO2 & NO3 (mg/L)	0.038	0.04	<0.005	<0.005	0.005
T. Hardness (mg/L)	24	----	36	32	----
T. Alkalinity (mg/L)	22	----	23	24	----
Chlorophyll *a* (ug/L)	1.2	0.8	4.2	<1.0	<1.0

Chlorophyll *a* concentrations averaged 1.97 ug/L for 1992. In August the chlorophyll *a* level was 4.2 ug/L compared to the averages for July and October (1.0 ug/L). Productivity was highest in the month of August. Phytoplankton in Killarney Lake was dominated by diatoms and green algae (Table 44). Total phosphorus 1992 average was 0.015 mg/L. July total phosphorus was 0.011 mg/L, August-0.015 mg/L, and October-0.019 mg/L. (Table 22). These parameters indicate Killarney Lake has the characteristics of a mesotrophic water body (Table 43b).

Temperature and Oxygen Profiles

On July 20, 1992, the dissolved oxygen in Killarney Lake was 7.7 mg/L at the surface with slightly increasing D.O. through the trophogenic zone then dropping to 6.1 mg/L in the hypolimnion. Killarney Lake was isothermal until 1 meter off the bottom. The temperature was constant at 23° C from surface to 3 meters and dropped to 20 in the hypolimnion (Table 23, Figure 8).

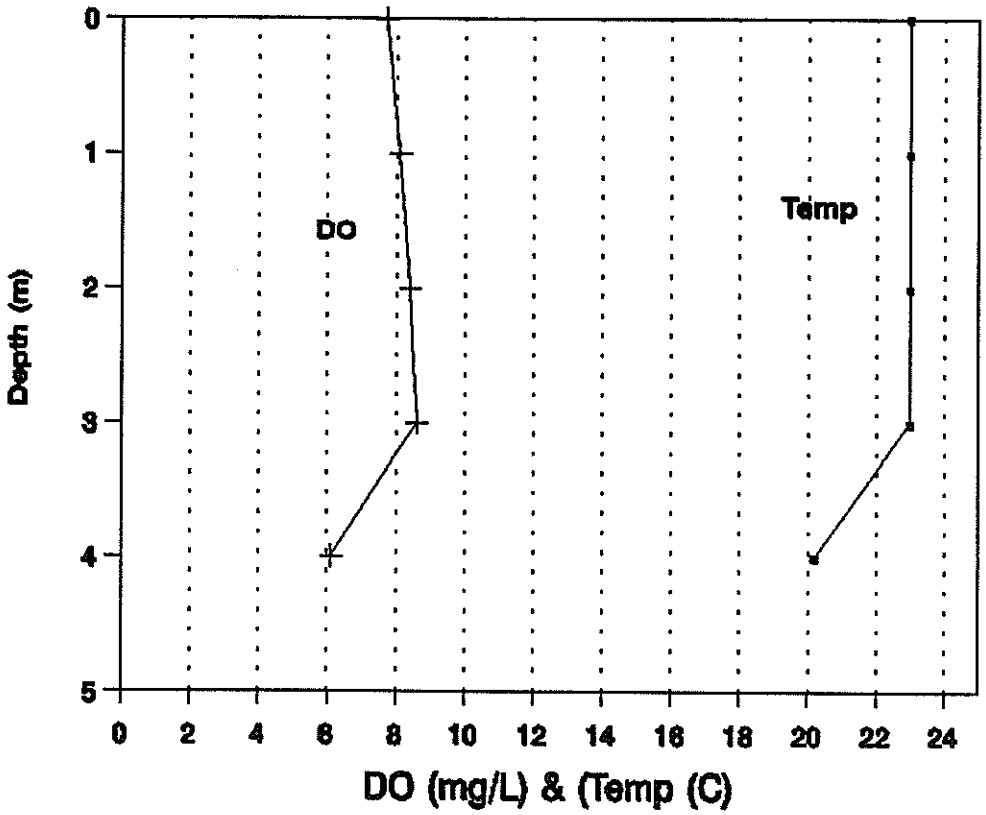


Figure 8. Dissolved oxygen and temperature profiles for Killarney Lake, August 21, 1992.

Table 23. Summary of physical and chemical water quality in Killarney Lake during July, August, and October, 1992.

Date	7-20				8-21				10-16			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	23	6.9	7.7	66	22.9	6.8	7.4	74	10.7	6.6	8.4	75
1	23	6.9	8.1	66	22.9	6.8	7.4	74	10.7	6.5	8.7	74
2	23	6.9	8.4	66	22.9	6.8	7.4	75	10.6	6.4	8.9	73
3	23	6.9	8.6	66	22.9	6.8	7.3	75	10.6	6.4	9.1	74
4	20.4	6.3	6.1	69	22.9	6.9	7.3	75	10.6	6.4	9	74
5	----	----	----	----	----	----	----	----	----	----	----	----

Table 24. Killarney Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 3.0 meters
Number of prevalent species[1] = 6
Total # of submergent species = 10
Maximum Secchi depth = 2.5 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Muskgrass (Nitella)	69.0	17.0	3.0	21	1445
#1 Fineleaf Pondweed	41.0	26.0	3.2	32	1300
#2 Fineleaf Pondweed	44.0	6.0	3.5	7	310
Largeleaf Pondweed	37.0	7.0	4.0	8	295
Waterweed	33.0	19.0	3.0	23	770
Brownleaf Pondweed	23.0	5.0	2.0	6	140
Green Milfoil (trace)[5]	100.0	1.0	1.0	1	100
Narrowleaf Pondweed (trace)	60.0	2.0	1.5	3	180
Coontail (trace)	8.0	10.0	2.0	12	90
Water Buttercup (trace)	9.0	5.0	2.0	6	55
Claspingleaf Pondweed (trace)	8.0	2.0	2.0	2	15
Total		100.0		121	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Submergent Macrophytes

The maximum depth of submergent macrophytes in Killarney Lake was 3.0 meters. Secchi depth on the day of collection (July 20, 1992) was 2.3 meters. The most prevalent species was *Nitella* (muskgrass) and was sampled at 1.1 meters and 2.6 meters. *Pusillus* (fine leaf pondweed) was second in abundance.

Mirror Lake

General

Mirror Lake is located in Bonner County, approximately 5 miles west of Sagle, Idaho. It has approximately 7,500 feet of shoreline and 90 acres of surface water with a maximum depth of 17 meters.

Beneficial Uses

Mirror Lake supports cold water biota, primary and secondary contact recreational. The fishery for Mirror Lake includes hatchery *Salvelinus fontinalis* (brook trout), hatchery *Oncorhynchus* (rainbow trout), hatchery *Oncorhynchus clarki* (cutthroat trout), hatchery *Salmo trutta* (brown trout), and hatchery *Oncorhynchus nerka* (kokanee). Mirror Lake has a "motorless boat" rule. Camping, sanitary facilities, docks, and boat ramps are all available at Mirror Lake (IDFG) (Table 45).

Trophic Status

The Secchi depth transparency in Mirror Lake was 5.0 meters in July, 5.8 meters in August, and 8.1 meters in October. It averaged 6.3 meters for the 1992 sampling season. Chlorophyll *a* ranged from 1.1 ug/L in July to 1.9 ug/L in August and averaged 1.25 ug/L during 1992. Algal productivity was relatively low (Table 25). The phytoplankton community of Mirror Lake was dominated by green algae with flagellates and diatoms being second and third in dominance (Table 44). Total phosphorus in Mirror Lake averaged 0.038 mg/L in July, 0.011 mg/L in August, and 0.205 mg/L in October and the average for 1992 was 0.057 mg/L (Table 25). The total phosphorus levels were higher in the hypolimnion than in the epilimnion. This may indicate internal phosphorus recycling occurring in Mirror Lake due to the low oxygen levels in the bottom waters. Mirror Lake is characterized as a meso-oligotrophic lake (Table 43b).

Table 25. Mirror Lake water quality data, 1992.

Date	7-7		DUPE	8-11		10-6	DUPE	
Secchi Depth (meters)	5.0	5.0	5.0	5.8	5.8	8.1	8.1	8.1
Sample Depth (meters)	5.0	5.0	15.5	5.8	15.0	8.1	8.1	15.0
Max. depth (meters)	16.8	16.8	16.8	16.4	16.4	16.5	16.5	16.5
T. Phosphorus (mg/L)	0.009	0.009	0.097	0.008	0.14	0.014	0.005	0.16
T. Ammonia (mg/L)	0.079	0.123	0.143	0.128	0.255	0.005	0.005	0.348
T.K. Nitrogen (mg/L)	0.21	0.2	0.55	0.16	0.46	0.34	0.3	0.83
T. NO2 & NO3 (mg/L)	0.014	0.021	0.007	<0.005	0.006	<0.005	<0.005	0.006
T. Hardness (mg/L)	32.0	----	----	28.0	----	32.0	----	----
T. Alkalinity (mg/L)	31.0	----	----	34.0	----	33.0	----	----
Chlorophyll *a* (ug/L)	1.6	1.1	----	1.9	----	<1.0	<1.0	----

Temperature and Oxygen Profiles

There was an increase in dissolved oxygen throughout the thermocline during August (Table 26a). This may be due to the temperature stratification. In mid-depth, temperatures were cool and the water was able to hold more oxygen. In the hypolimnion, oxygen levels were depleted. Cooler lake temperatures in October helped to increase the dissolved oxygen concentrations in the epilimnion (Table 26b, Figure 9).

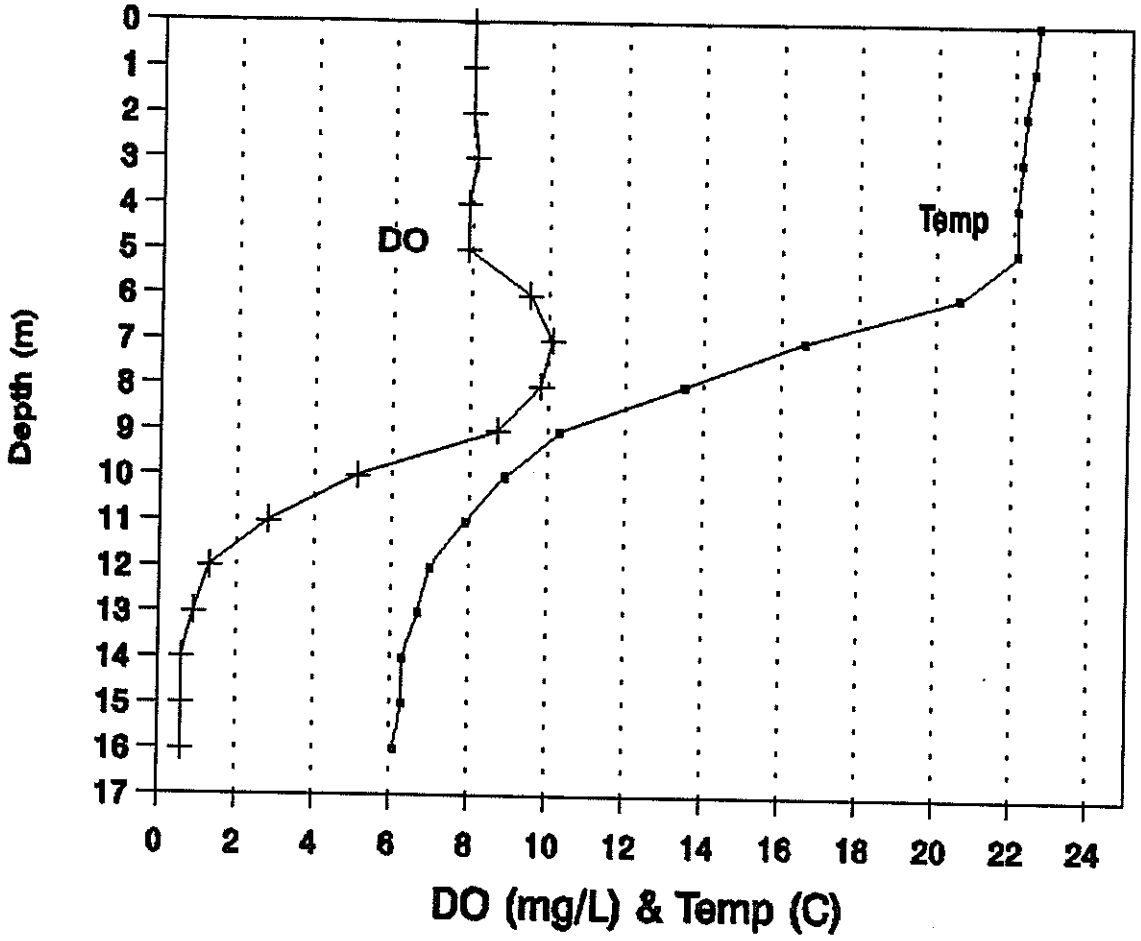


Figure 9. Dissolved oxygen and temperature profiles for Mirror Lake, August 11, 1992.

TABLE 26a. Summary of physical and chemical water quality in Mirror Lake during July, August, 1992.

Date	7-7				8-11			
Depth meters	Temp °C	pH	DO mg/L	Cond. umhos/cm	Temp °C	pH	DO mg/L	Cond. umhos/cm
surface	21	7.4	8.4	66	22.6	7.8	8.0	67
1	21	7.4	8.3	66	22.5	7.8	8.0	68
2	21	7.4	8.3	66	22.3	7.8	8.0	68
3	21	7.4	8.3	66	22.2	7.8	8.1	67
4	20.9	7.4	8.3	66	22.1	7.8	7.9	68
5	19.7	7.2	9.4	66	22.1	7.8	7.9	67
6	17	6.9	10	66	20.6	7.8	9.5	67
7	13.4	6.6	10.2	66	16.6	7.5	10.1	67
8	11.3	6.4	9.3	67	13.5	7.3	9.8	68
9	9.2	6.1	6.8	67	10.3	7.0	8.7	67
10	8	5.9	4.1	68	8.9	6.7	5.1	68
11	6.8	5.7	1.3	68	7.9	6.4	2.8	69
12	6.5	5.5	0.4	69	7	6.2	1.3	69
13	6.2	5.5	0.3	70	6.7	6.1	0.9	74
14	5.9	5.4	0.3	72	6.3	5.9	0.6	78
15	5.9	5.4	0.3	76	6.3	5.9	0.6	81
16	5.9	5.4	0.3	78	6.1	5.9	0.6	81
17	----	----	----	----	----	----	----	----

TABLE 26b. Summary of physical and chemical water quality in Mirror Lake during October, 1992.

Date	10-6			
Depth meters	Temp °C	pH	DO mg/L	Cond. umhos/cm
surface	14.4	6.9	10.2	68
1	14.4	6.9	9.7	68
2	14.4	6.9	9.1	68
3	14.3	6.9	8.9	68
4	14.3	6.9	8.8	68
5	14.3	7.0	8.7	67
6	14.3	7.0	8.7	67
7	14.2	7.0	8.7	67
8	14.2	6.9	8.6	67
9	13.4	6.5	8.0	67
10	10.4	6.1	6.3	69
11	8.2	5.9	2.5	71
12	7.3	5.8	1.5	73
13	7.0	5.8	1.3	80
14	6.8	5.8	1.1	83
15	6.6	5.8	1.0	85
16	6.6	5.7	----	86
17	----	----	----	----

Submergent Macrophytes

There were eight species of submergent macrophytes prevalent in Mirror Lake. The two most prevalent in each sample were *Potamogeton Robbinsii* (robbins pondweed), a shade tolerant species, and *Nitella* (muskgrass) (Table 27).

Table 27. Mirror Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 6.0 meters
Number of prevalent species[1] = 8
Total # of submergent species = 11
Maximum Secchi depth = 8.1 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Robbins Pondweed	46.0	24.0	2.6	26	1190
Muskgrass (Nitella)	40.0	9.0	1.7	10	400
Aquatic Grass	35.0	20.0	3.1	22	760
Largeleaf Pondweed	32.0	3.0	3.0	3	95
Bushy Pondweed	31.0	8.0	2.3	9	280
Needle Rush	31.0	8.0	2.3	9	275
Brownleaf Pondweed	30.0	4.0	4.0	4	120
Waterweed	26.0	12.0	2.2	13	340
Water Marigold	12.0	8.0	1.5	9	110
Whitestem Pondweed	10.0	1.0	1.0	1	10
Water Shield	5.0	3.0	3.0	3	15
Total		100.0		109	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Perkins Lake

General

Perkins Lake is located in Boundary County east of Moyie Springs, Idaho. It has approximately, 7,000 feet of shoreline and 60 acres of surface water. Maximum depth of Perkins Lake is 5.5 meters.

Beneficial Uses

Perkins Lake supports both cold and warm water biota along with primary and secondary contact recreational (Table 45). Perkins Lake fisheries includes hatchery *Salvelinus fontinalis* (brook trout), *Lepomis gibbosus* (pumpkinseed, *Micropterus salmoides* (large mouth bass) and *Ponoxis nigromaculatus* (black crappie). There are boat ramps, docks, camping, and sanitary facilities at Perkins Lake (IDFG).

Trophic Status

Secchi depth was 3.8 meters in July, 2.7 meters in August, and 3.8 meters in October and averaged 3.4 meters in the 1992 sample season. The water in Perkins Lake exhibited a brown tint which indicates dissolved organic matter. Chlorophyll *a* concentration were higher in July (averaging 50.5 ug/L) and August (averaging 36.5 ug/L) than in October (averaging 1.7 ug/L). The 1992 yearly average was 29.5 ug/L (Table 28). Phytoplankton productivity in Perkins Lake was dominated by flagellates in July and August (Table 44). Total phosphorus ranged from 0.04 to 0.026 mg/L and averaged 0.01 mg/L for 1992 (Table 28). Data for total phosphorus indicates the deeper hypolimnion samples had higher concentrations than samples from the epilimnion. Perkins Lake is characterized as a meso-eutrophic lake (Table 43b).

Table 28. Perkins Lake water quality data, 1992.

Date	7-22	DUPE		8-28		10-8	DUPE
Secchi Depth (meters)	3.8	3.8	3.8	2.7	2.7	3.8	3.8
Sample Depth (meters)	3.8	3.8	4.8	2.7	4.8	3.8	3.8
Max. depth (meters)	5.5	5.5	5.5	5.54	5.5	5.55	5.5
T. Phosphorus (mg/L)	0.056	0.054	0.26	0.04	0.133	0.065	0.071
T. Ammonia (mg/L)	<0.005	0.047	0.061	0.045	0.086	0.143	0.129
T.K. Nitrogen (mg/L)	0.58	0.55	0.49	0.6	0.54	0.45	0.44
T. NO2 & NO3 (mg/L)	0.049	0.052	0.043	<0.005	0.014	0.006	<0.005
T. Hardness (mg/L)	40	----	----	44	----	40	----
T. Alkalinity (mg/L)	45	----	----	44	----	49	----
Chlorophyll *a* (ug/L)	46 & 55	----	----	35 & 38	----	1.6	1.8

Temperature and Oxygen Profiles

Perkins Lake was thermally stratified in August 1992 and demonstrated oxygen depleting from near the surface through the hypolimnion. Once the lake turned over in the fall, the dissolved oxygen level was relatively uniform and restored through the water column (Table 29, Figure 10).

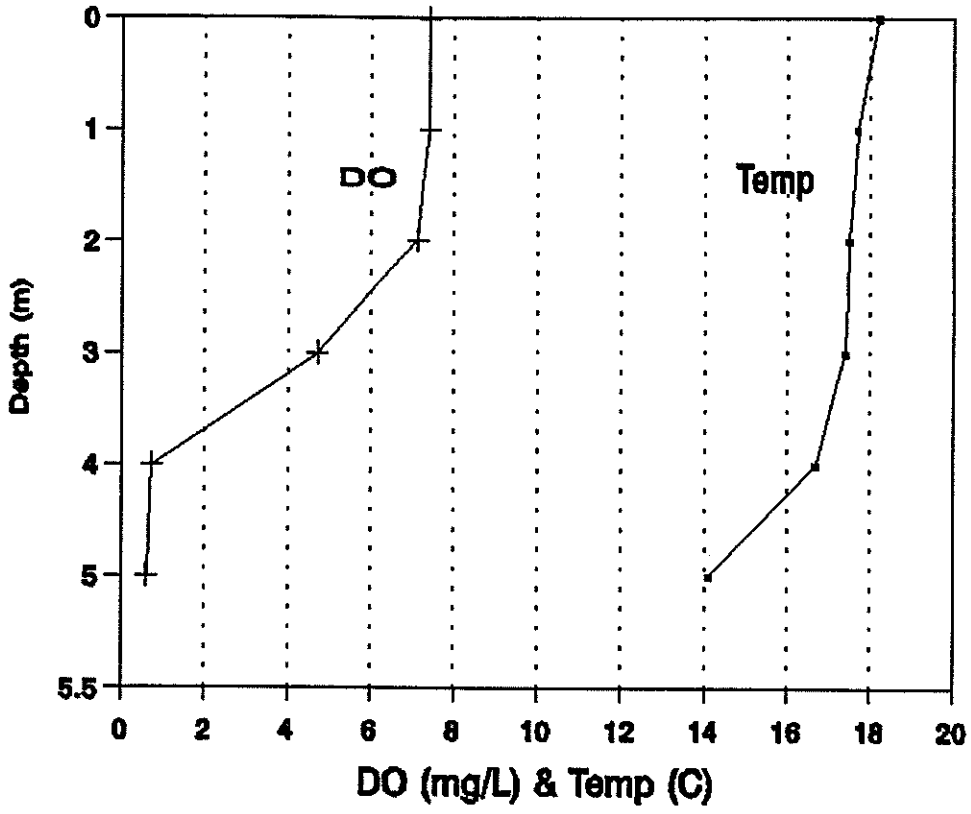


Figure 10. Dissolved oxygen and temperature profiles for Perkins Lake, August 28, 1992.

TABLE 29. Summary of physical and chemical water quality in Perkins Lake during July, August, and October, 1992.

Date	7-20				8-21				10-16			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	22.4	6.7	6.5	82	18.2	6.8	7.4	85	12.2	6.2	4.7	92
1	22.1	6.7	----	82	17.7	6.7	7.4	86	12.2	6.2	4.5	92
2	21.4	6.4	----	83	17.5	6.7	7.1	85	12.1	6.2	4.3	92
3	20.3	6.3	5.2	84	17.4	6.5	4.7	86	12.1	6.1	4.3	92
4	17.1	6.0	----	101	16.7	6.1	0.7	91	12.1	6.1	4.2	91
5	12.7	6.0	0.4	128	14.1	6.1	0.6	158	11.8	6.1	3.5	90
5.5	----	----	----	----	----	----	----	----	----	----	----	----

Submergent Macrophytes

Perkins Lake submergent macrophytes were very diverse. The maximum depth of occurrence was 4.5 meters. Secchi depth was 3.8 meters. There were 4 prevalent species out of a total of 10 collected. The 2 most prevalent species were *Ceratophyllum demersum* (coontail) and *Fontinalis SPP.* (water moss) (Table 30). Coontail grows beneath the surface in quiet waters and the seeds of coontail are eaten by waterfowl. Water moss grows in cool climates. It is found most commonly as a tangled mat of feathery green filaments on submerged or partially submerged objects along lake shores. A variety of small animals may live in this dense growth.

Table 30. Perkins Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 4.5 meters
Number of prevalent species[1] = 4
Total # of submergent species = 10
Maximum Secchi depth = 3.8 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Coontail	57.0	34.6	3.1	27	1540
Water Moss	42.5	10.3	4.5	8	340
Robbins Pondweed	32.2	23.1	3.8	18	580
Yellow Water Lily	26.3	5.1	2.0	4	105
Bladderwort	22.1	9.0	1.4	7	155
Water Shield	20.0	6.4	2.5	5	100
Largeleaf Pondleaf	18.3	3.8	1.0	3	55
Waterweed[5]	30.0	2.6	2.0	2	60
Sago Pondweed[5]	30.0	2.6	1.0	2	60
Flatstem Pondweed	7.5	2.6	1.0	2	15
Total		100.1		78	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Robinson Lake

General

Robinson Lake is located in Boundary County, approximately 5.5 miles south of Eastport near the Idaho-Canadian border. This lake has 11,000 feet of shoreline and 60 acres of surface water with a maximum depth of 8 meters when full.

Beneficial Uses

Robinson Lake's beneficial uses include both cold and warm water biota, as well as primary and secondary contact recreational (Table 45). There is access on the south end at a U.S. Forest Service camp ground. The campground has water and sanitary facilities and there are boat ramps for motorless boats only. The fishery is comprised of hatchery *Oncorhynchus mukiss* (rainbow trout), wild *Micropterus salmoides* (large mouth bass), and wild *Lepomis gibbosus* (pumpkinseed) (IDFG).

Trophic Status

Secchi depth of Robinson Lake in July was 4.7 meters, 4.2 meters in August, and 5.5 meters in October and averaged 4.8 meters for 1992. The water was relatively clear. Chlorophyll *a* concentrations in Robinson Lake ranged from 7.2 ug/L in late July to 1.0 ug/L in mid October. The overall average for 1992 was 1.5 ug/L. Algae productivity was moderate in July and low in August (Table 31). The phytoplankton was dominated by diatoms in July and flagellates in August (Table 44). Total phosphorus averaged 0.014 mg/L for 1992. July's average was 0.016 mg/L, August's one sample was 0.013 mg/L, and October averaged 0.01 mg/L. Phosphorus levels were somewhat higher in the hypolimnetic water than in the epilimnion.
These parameters indicate Robinson Lake is a meso-oligotrophic lake (Table 43b).

Table 31. Robinson Lake water quality data, 1992.

Date	7-21	DUPE		DUPE	8-27	10-13	DUPE
Secchi Depth (meters)	4.7	4.7	4.7	4.7	4.2	5.5	5.5
Sample Depth (meters)	4.7	4.7	6.5	6.5	4.2	5.5	5.5
Max. depth (meters)	7.5	7.5	7.5	7.54	7	7.5	7.5
T. Phosphorus (mg/L)	0.01	0.011	0.023	0.022	0.013	0.01	0.011
T. Ammonia (mg/L)	<0.005	0.04	0.023	0.132	0.025	0.055	0.051
T.K. Nitrogen (mg/L)	0.35	0.37	0.46	0.36	0.39	0.46	0.46
T. NO2 & NO3 (mg/L)	0.046	0.047	0.046	0.061	<0.005	0.005	<0.005
T. Hardness (mg/L)	20	----	----	----	28	28	----
T. Alkalinity (mg/L)	25	----	----	----	25	26	----
Chlorophyll *a* (ug/L)	2.6	----	----	----	1.6 & 2.4	<1.0	1.8

Temperature and Oxygen Profiles

Robinson Lake is shallow and completely mixed. Dissolved oxygen was 8.1 mg/L through the entire water column in July and water temperature ranged from 23.4°C at the surface to 15.7°C one meter from the bottom. Robinson Lake does not appear to have had a fall turned over. The dissolved oxygen maintained a 7.4 mg/L to 8mg/L range throughout the 1992 sampling season (Table 32, Figure 11).

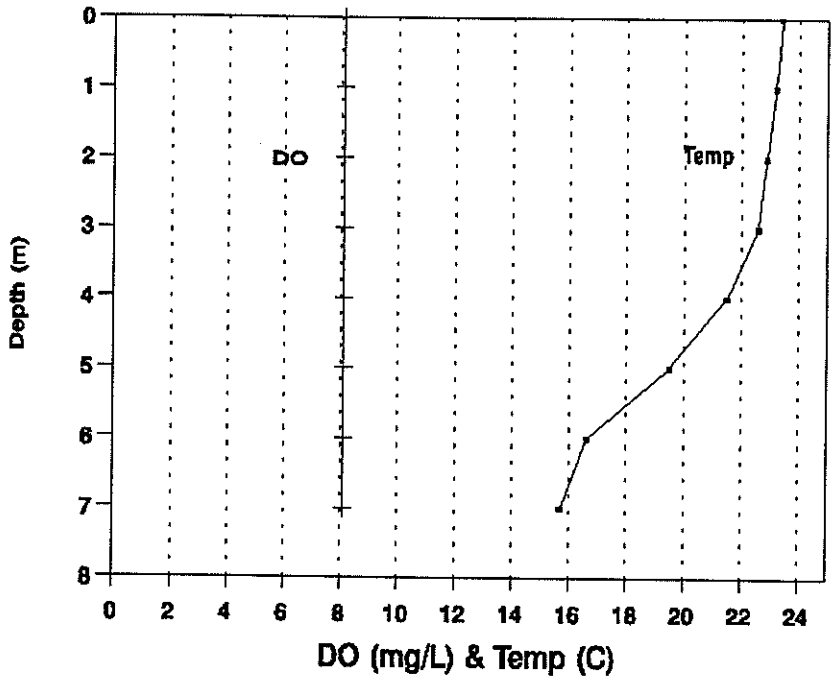


Figure 11. Dissolved oxygen and temperature profiles for Robinson Lake, July 21, 1992

TABLE 32. Summary of physical and chemical water quality in Robinson Lake during July, August, and October, 1992.

Date	7-20				8-21				10-16			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	23.4	7.1	8.1	51	18.4	6.9	7.8	54	12	6.3	8	52
1	23.2	7.1	8.1	51	18	6.9	7.9	54	11.7	6.3	8	52
2	22.9	7.1	8.1	51	17.6	6.9	8.2	54	11.4	6.3	8	53
3	22.6	7.1	8.1	51	17.5	6.9	8.2	54	11.3	6.3	8	53
4	21.5	6.6	8.1	51	17.1	6.8	8.5	53	11.3	6.2	7.9	53
5	19.5	6	8.1	56	16.9	6.7	8.6	53	11	6.2	7.8	53
6	16.6	5.8	8.1	56	16.8	6.7	7.4	53	11	6.2	7.8	53
7	15.7	5.8	8.1	57	----	----	----	----	----	----	7.4	----
8	----	----	----	----	----	----	----	----	----	----	----	----

Submergent Macrophytes

Nuphar variegatum (yellow water lily) was the most prevalent species sampled. There are more than 100 species of water lilies distributed in lakes, slow rivers, and shallow ponds. Many small aquatic animals lay their eggs on the leaves and stems of water lilies. Yellow water lily was found at depths ranging from 1 to 1.5 meters. *Anacharis canadensis* (waterweed) was second in abundance during sampling. Sampling depth ranged from 1.5 meters to 3 meters. Waterweed is closely related to *Elodea* which is used in home aquariums.

Table 33. Robinson Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 4.5 meters
Number of prevalent species[1] = 6
Total # of submergent species = 8
Maximum Secchi depth = 5.5 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Yellow Water Lily	83.8	10.3	4.0	4	335
Waterweed	82.0	12.8	2.5	5	410
Whitestem Pondweed	77.9	17.9	2.3	7	545
Muskgrass (Nitella)	64.0	12.8	2.5	5	320
Variable Pondweed	63.0	12.8	2.5	5	315
Brownleaf Pondweed	25.0	15.4	3.0	6	150
Pot. Pusillus	20.0	10.3	4.0	4	80
Green Milfoil	15.0	7.7	1.5	3	45
Total		100.0		39	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Shepherd Lake

General

Shepherd Lake is located in Bonner County, approximately 6.5 miles southeast of Sandpoint, Idaho on Talache Road. This lake has 11,000 feet of shoreline with 120 acres of surface water and a depth of 13 meters.

Beneficial Uses

Shepherd Lake supports warm water biota and primary and secondary contact recreational (Table 45). There is public access on east and west sides of the lake with camping and picnicking areas. There are also boat launching ramps, sanitary facilities, and docks on the lake. The fishery is comprised of *Micropterus salmoides* (largemouth bass), *Pomoxis nigromaculatus* (black crappie), *Perca flavescens* (yellow perch), *Lepomis gibbosus* (pumpkinseed), *Lepomis macrochirus* (bluegill), and *Esox amentus* (tiger muskie). Tiger muskies are a hybrid cross between a muskie and northern pike and are not capable of reproduction (IDFG).

Trophic Status

Secchi depth in Shepherd Lake was 3.6 meters in July, 4.6 meters in August and 4.8 meters in October. The water had a slight brown tint but clear. The average transparency of Shepherd Lake for 1992 was 4.3 meters. Chlorophyll *a* productivity was low to moderate in 1992. Concentrations ranged from 2.7 ug/L in July to 3.8 ug/L in October. The yearly average was 3.5 ug/L (Table 34). Phytoplankton communities were dominated by flagellates in July, August, and October during 1992 (Table 44). Total Phosphorus concentrations averaged 0.08 mg/L in July, 0.013 mg/L in August, and 0.06 mg/L in October. Total phosphorus was higher in the hypolimnion than in the epilimnion. Near surface samples of total phosphorus were 0.01 mg/L to 0.011 mg/L and the deeper samples were from 0.17 mg/L to 0.175 mg/L. Overall average for 1992 was 0.069 mg/L (Table 34). Shepherd Lake has the characteristics of a mesotrophic lake (Table 43b).

Table 34. Shepherd Lake water quality data, 1992.

Date	7-6	DUPE		8-10		10-5	DUPE	
Secchi Depth (meters)	3.6	3.6	3.6	4.6	4.6	4.8	4.8	4.8
Sample Depth (meters)	3.6	3.6	11.5	4.6	11.2	4.8	4.8	11
Max. depth (meters)	12.9	12.9	12.9	12.9	12.9	12.2	12.2	12.2
T. Phosphorus (mg/L)	0.011	0.01	0.175	0.008	0.19	0.011	0.01	0.17
T. Ammonia (mg/L)	0.132	0.034	0.369	0.071	0.402	0.005	<0.005	0.519
T.K. Nitrogen (mg/L)	0.56	0.55	0.8	0.57	0.82	0.53	0.48	1.15
T. NO2 & NO3 (mg/L)	<0.005	0.026	0.019	<0.005	<0.005	<0.005	<0.005	0.007
T. Hardness (mg/L)	12	----	----	16	----	16	----	----
T. Alkalinity (mg/L)	16	----	----	17	----	11	----	----
Chlorophyll *a* (ug/L)	3	2.7	----	3.6	----	3.8	3.8	----

Temperature and Oxygen Profiles

The dissolved oxygen in Shepherd Lake dropped from 6.4 mg/L at the surface to < 1 mg/L at 6 meters. The thermocline was depleted of dissolved oxygen and the depletion extended through the hypolimnion. The upper 5 meters of the epilimnion was mixed and fairly uniform in temperature. After fall turnover dissolved oxygen was replenished throughout the water column (Table 35).

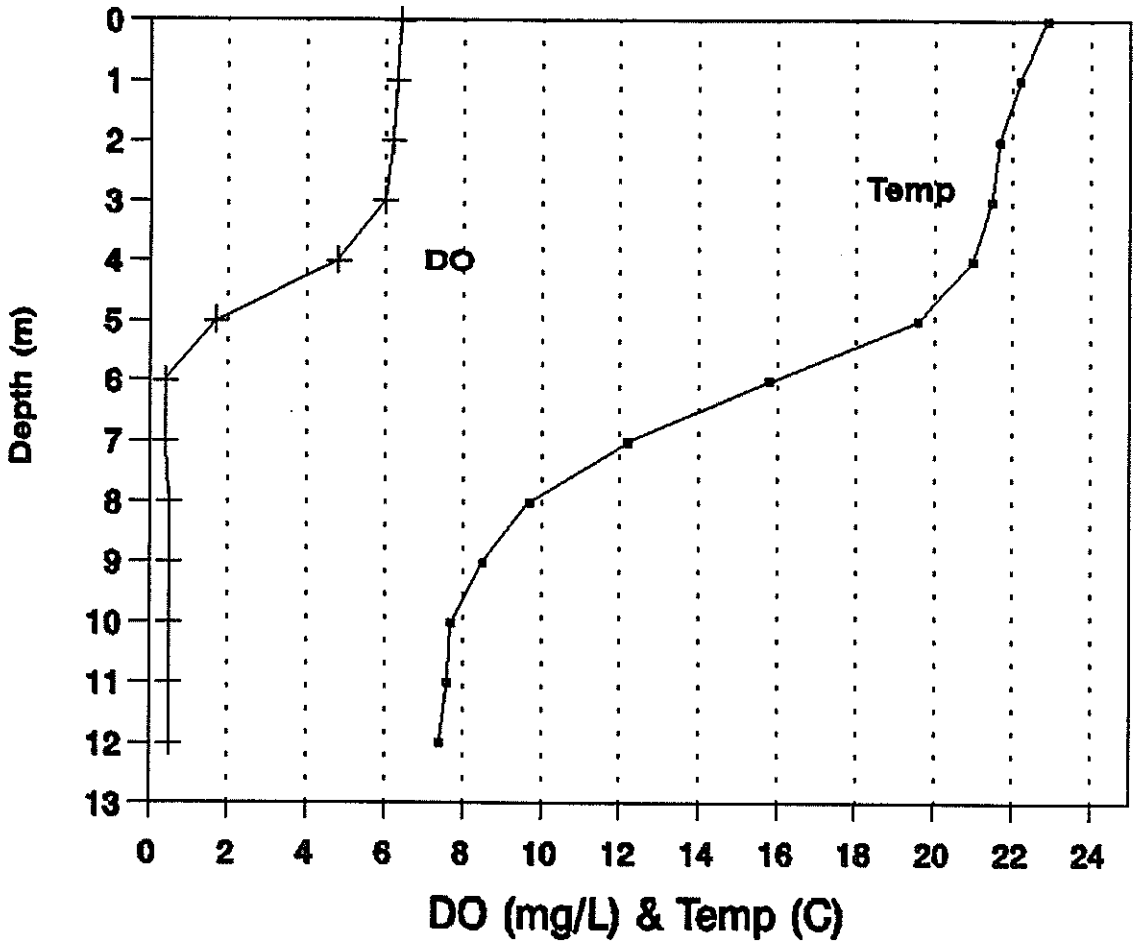


Figure 12. Dissolved oxygen and temperature profiles for Shepherd Lake, August 10, 1992.

TABLE 35. Summary of physical and chemical water quality in Shepherd Lake during July, August, and October, 1992.

Date	7-6				8-10				10-5			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	21.2	5.8	6.9	39	22.9	6.2	6.4	40	14	6.3	6.5	41
1	21.2	5.8	6.8	39	22.2	6.1	6.3	39	13.9	6.2	6.5	41
2	21.2	5.8	6.8	39	21.7	6.1	6.2	39	13.7	6.2	6.7	41
3	21.2	5.7	6.8	39	21.5	6.1	6	39	13.7	6.2	6.8	41
4	21.2	5.7	6.8	39	21	5.9	4.8	39	13.7	6.2	6.9	41
5	17.6	5.8	7.3	40	19.6	5.7	1.7	40	13.7	6.2	7.2	40
6	14.6	5.4	2.7	40	15.8	5.5	0.4	40	13.6	6.1	7.1	41
7	12	5.2	0.4	44	12.2	5.6	0.4	45	12.9	5.8	6.3	42
8	9	5.1	0.3	45	9.7	5.5	0.5	48	11.4	5.5	4.8	52
9	7.9	5.2	0.3	55	8.5	5.7	0.5	60	9.6	5.6	4.3	63
10	7.3	5.2	0.3	58	7.7	5.7	0.5	63	8.9	5.6	3.6	67
11	7	5.2	0.3	58	7.6	5.7	0.5	62	8.3	5.6	3.1	69
12	6.9	5.2	0.2	59	7.4	5.7	.0.5	64	8.1	5.6	2.5	70
13	----	----	----	----	----	----	----	----	----	----	----	----

Submergent Macrophytes

Potamogeton pusillus, berchtoldii (fine-leaf pondweed) was the most abundant submergent macrophyte found in Shepherd Lake. *Brasenia schriberi* (water shield) was the second in abundance. The maximum depth of submergent macrophytes was 5.2 meters. Secchi depth transparency was 4.8 meters in August 1992 (Table 36).

Table 36. Shepherd Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 5.2 meters
Number of prevalent species[1] = 7
Total # of submergent species = 11
Maximum Secchi depth = 4.8 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Fine-leaf Pondweed	75.0	5.7	4.0	4	300
Water Shield	68.8	11.4	5.0	8	550
Robbins Pondweed	60.0	17.1	4.3	12	720
Whitestem Pondweed	39.0	7.1	2.5	5	195
Waterweed	26.5	14.3	2.5	10	265
Bladderwort	25.7	21.4	2.5	15	385
Largeleaf Pondweed	25.0	2.9	2.0	2	50
Coontail	16.3	5.7	2.0	4	65
Yellow Water Lily	10.0	1.4	1.0	1	10
Unident. sp #1	7.5	8.6	3.0	6	45
Aquatic Moss	5.0	4.3	1.5	3	15
Total		99.9		70	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sumof % recovery of a species throughout the lake.

Smith Lake

General

Smith Lake is located in Boundary County, approximately 5 miles north of Bonners Ferry, Idaho. This lake has 6,000 feet of shoreline and 30 acres of surface water with a depth of 11 meters.

Beneficial Uses

Smith Lake supports both cold and warm water biota as well as primary and secondary contact recreation (Table 45). There are boat ramps and docks on Smith Lake plus camping and sanitary facilities available. The fishery is made up of hatchery *Oncorhynchus mykiss* (rainbow trout), *Lepomis gibbosus* (pumpkinseed), and *Micropterus salmoides* (largemouth bass) (IDFG).

Trophic Status

Secchi depth transparency in Smith Lake was 2.3 meters in July, 3.8 meters in August and 4.9 meters in October. The overall average was 3.7 meters in 1992. The water was slightly brown tinted. In July chlorophyll *a* was sampled at 1 meter and 2.3 meters plus a composite sample from both levels. Chlorophyll *a* average was calculated from the 1 meter depth sample only. In July chlorophyll *a* was 5.6 ug/L, 2.7 ug/L as August average, and averaging 1 ug/L for October giving an overall average of 3.1 ug/L for 1992. There didn't appear to be a substantial difference in the algal productivity occurring at secchi depth (2.3 meters) and at 1 meter below the surface (Table 37). Green algae was the most abundant phytoplankton found in Smith Lake. The highest green algae % frequency for 1992 occurring in October. Blue green algae were the second most abundant form during 1992 (Table 44). Total phosphorus averaged 0.095 mg/L in July, 0.186 mg/L in August, and 0.158 mg/L in October. Overall average for 1992 was 0.146 mg/L of total phosphorus (Table 37). Smith Lake is representative of a meso-eutrophic lake (Table 43b).

Table 37. Smith Lake water quality data, 1992.

Date	7-15				8-19		10-7		
Secchi Depth (meters)	2.3	2.3	2.3	2.3	3.8	3.8	4.9	4.9	4.9
Sample Depth (meters)	2.3	2.3	9.5	9.5	3.8	9	4.9	4.9	9
Max. depth (meters)	10.4	10.4	10.4	10.4	10.2	10.2	10	10	10
T. Phosphorus (mg/L)	0.02	0.02	0.17	0.17	0.021	0.351	0.027	0.016	0.43
T. Ammonia (mg/L)	0.019	0.028	0.238	0.278	0.101	0.791	0.075	0.069	0.872
T.K. Nitrogen (mg/L)	0.73	0.68	0.98	0.9	0.08	1.21	0.75	0.75	2.19
T. NO2 & NO3 (mg/L)	0.023	0.022	0.016	0.015	<0.005	0.013	<0.005	<0.005	0.006
T. Hardness (mg/L)	44	----	----	----	48	----	48	----	----
T. Alkalinity (mg/L)	48	----	----	----	43	----	50	----	----
Chlorophyll *a* (ug/L) (1 meter)	5.6	----	----	----	2.6 & 2.8	----	1	1	----
Chlorophyll *a* (ug/L) (@ secchi depth)	6.9	4.8	----	----	----	----	----	----	----
Chlorophyll *a* (ug/L) (composite)	----	6.9	----	----	----	----	----	----	----

Temperature and Oxygen Profiles

During the months of July and August the dissolved oxygen in Smith Lake decreased from 7.7 mg/L at the surface to 7.3 mg/L at 3 meters and continued to deplete through the thermocline into the hypolimnion. The lake appears to experience a fall turnover and dissolved oxygen in October was somewhat restored and the lake was well mixed (Table 38).

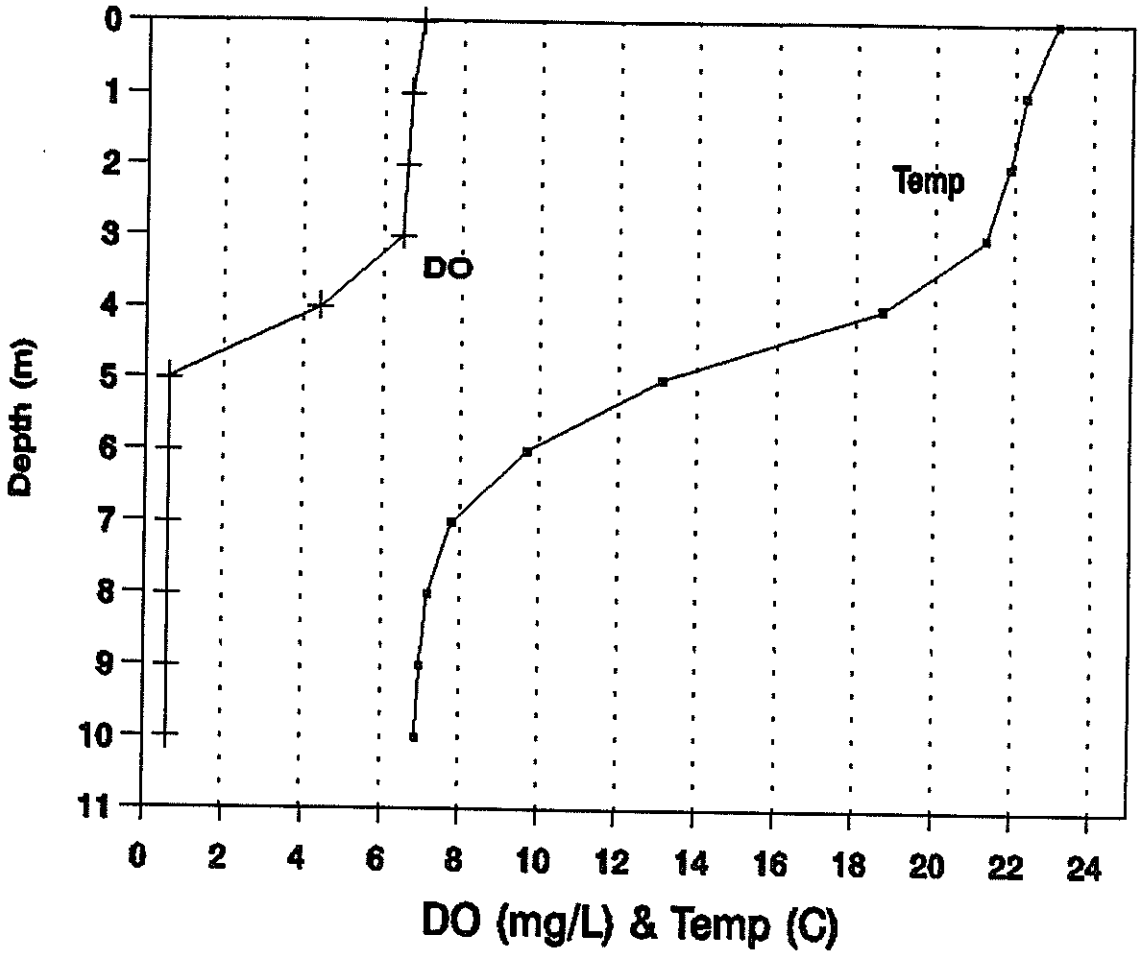


Figure 13. Dissolved oxygen and temperature profiles for Smith Lake, August 19, 1992.

TABLE 38. Summary of physical and chemical water quality in Smith Lake during July, August, and, October, 1992.

Date	7-15				8-19				10-7			
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Temp °C	pH	D.O. mg/L	Cond. umhos/cm
surface	21	7.1	7.7	106	23.1	6.8	7	111	12.1	6.6	7.5	110
1	19.8	7.1	7.4	106	22.3	6.8	6.7	110	11.7	6.6	7.9	110
2	19.4	7.1	7.1	106	21.9	6.9	6.6	110	11.6	6.6	7.8	109
3	19.2	7.1	7.3	106	21.3	6.8	6.5	110	11.6	6.6	7.7	109
4	15.3	6.2	1.9	107	18.7	6.5	4.4	110	11.5	6.5	7.6	109
5	12.1	6.1	0.4	108	13.1	6.1	0.6	110	11.5	6.4	6.9	109
6	8.6	6	0.3	111	9.7	6	0.6	114	10.8	6.1	4.5	113
7	7.2	6	0.2	114	7.8	6	0.6	118	9.5	5.9	1.1	102
8	7	5.9	0.2	115	7.2	6	0.6	120	8	5.9	1.1	128
9	6.7	5.9	0.2	118	7	6	0.6	122	7.6	5.9	1.1	129
10	6.6	5.9	0.2	118	6.9	5.9	0.6	124	----	----	----	----
11	----	----	----	----	----	----	----	----	----	----	----	----

Submergent Macrophytes

Potamogeton praelongus (whitestem pondweed) was the most prevalent of the submergent macrophytes sampled in Smith Lake. *Ceratophyllum demersum* (coontail) was second most prevalent with *Myriophyllum verticillatum* (green milfoil) being third. Milfoil may interfere with boating, swimming, and fishing. Fragments of milfoil are transported from lake to lake on boats and trailers. New plants can grow from these small pieces.

Table 39. Smith Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 3.7 meters
Number of prevalent species[1] = 4
Total # of submergent species = 7
Maximum Secchi depth = 4.9 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Whitestem Pondweed	82.1	29.2	3.5	7	575
Coontail	73.3	25.0	2.0	6	440
Green Milfoil	65.0	25.0	2.0	6	390
Yellow Water Lily	28.3	12.5	1.5	3	85
Aquatic Moss	5.0	8.3	1.0	2	10
Total		100.0		24	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Redfish Lake

General

Redfish lake is located in Custer County, approximately 3 miles south of Stanley, Idaho in the Sawtooth Valley. This lake has 1500 acres of surface water with nearly 8 miles of shoreline. The maximum depth is 81 meters.

Beneficial Uses

Redfish Lake supports cold water biota, primary and secondary contact recreational (Table 45). The fishery in this lake is comprised of *Salvelimus confluentus* (bulltrout), *Oncorhynchus nerka* (kokanee), and hatchery *Oncorhynchus mykiss* (rainbow trout) (IDFG). The lake has boating ramps, docks, and campsites with sanitary facilities (IDPR).

Trophic Status

The 1992 average Secchi depth transparency was 13 meters. During the August 5th sampling of Redfish Lake the winds were in excess of 20 miles/hour and smoke from local forest fires made monitoring impossible until the next day. Chlorophyll *a* averaged 0.6 ug/L in 1992. Algal productivity was relatively low. Total phosphorus averaged 0.031 mg/L for the year (Table 40). All samples taken at the Secchi depth were less than detection limits. Total phosphorus at 68 meters was 0.5 mg/L. Redfish Lake is classified as a highly oligotrophic lake (Table 43b).

TABLE 40. Redfish Lake water quality date, 1992.

Date	8-6	8-6	8-6 DUPE	10-13 TRIP.	10-13 TRIP.	10-13 TRIP.	10-13
Secchi Depth (meters)	11.5	11.5	11.5	14.5	14.5	14.5	14.5
Sample Depth (meters)	11.5	68	11.5	14.5	14.5	14.5	80
Max. Depth (meters)	81	81	81	81	81	81	81
T. Phosphorus (mg/L)	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
T. Ammonia (mg/L)	0.042	0.05	0.033	<0.005	0.03	0.01	0.033
T.K. Nitrogen (mg/L)	----	0.18	0.15	0.13	0.12	0.12	0.12
T. NO2 & NO3 (mg/L)	0.012	0.016	0.011	0.0007	0.006	0.007	0.039
T. Hardness (mg/L)	12	----	12	----	14	----	12
T. Alkalinity (mg/L)	<1	----	<1	----	13	----	12
Chlorophyll *a* (ug/L)	0.6	----	0.6	0.3	0.1	----	----

TABLE 41a. Summary of physical and chemical water quality in Redfish Lake during August, 1992.

Date	8-7						
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Depth meters	Temp °C	D.O. mg/L
surface	18.1	----	8.4	----			
1	18.1	----	8.4	----	25	5.3	10.1
2	18	----	8.3	----	26	5.2	10.1
3	18	----	8.4	----	27	5.2	10.1
4	18	----	8.4	----	28	5.2	10.0
5	18	----	8.4	----	29	5.1	9.9
6	17.9	----	8.4	----	30	5.0	9.9
7	17.9	----	8.4	----	31	5.0	9.9
8	17.1	----	9.0	----	32	5.0	10.0
9	15.6	7.1	9.7	35	33	5.0	10.0
10	13.6	----	10.3	----	34	5.0	9.9
11	12.8	----	10.4	----	35	4.9	9.8
12	11.4	----	10.6	----	36	4.8	9.7
13	10.9	----	10.7	----	37	4.8	9.7
14	10.4	----	10.7	----	38	4.8	9.6
15	8.9	----	10.7	----	39	4.8	9.6
16	8.4	----	10.6	----	40	4.7	9.5
17	8.1	----	10.6	----	44	4.6	9.3
18	6.9	----	10.5	----	49	4.5	9.1
19	6.5	----	10.4	----	54	4.5	9.0
20	6.1	----	10.3	----	59	4.4	9.0
21	5.9	----	10.3	----	64	4.4	8.4
22	5.8	----	10.2	----	69	4.3	8.8
23	5.5	----	10.1	----	74	4.3	8.4
24	5.4	----	10.0	----	79	4.5	8.2

TABLE 41b. Summary of physical and chemical water quality in Redfish Lake during October, 1992.

Date	10-13						
Depth meters	Temp °C	pH	D.O. mg/L	Cond. umhos/cm	Depth meters	Temp °C	D.O. mg/L
surface	11	----	8.72	----			
1	11.4	----	8.73	----	25	5.5	9.41
2	11.4	----	8.75	----	26	----	----
3	11.4	----	8.73	----	27	5.4	9.3
4	11.4	----	8.74	----	28	----	----
5	11.4	----	8.76	----	29	5.2	9.18
6	11.4	----	8.75	----	30	----	----
7	11.4	----	8.76	----	31	5.1	9.25
8	11.3	----	8.75	----	32	----	----
9	11.3	----	8.76	----	33	5	9.16
10	11.3	----	8.69	----	34	----	----
11	11.3	----	8.75	----	35	4.9	9.12
12	11.3	----	8.76	----	36	----	----
13	11.3	----	8.75	----	37	----	----
14	11.3	8.3	8.72	33	39	----	----
15	11.3	----	8.73	----	40	4.8	8.88
16	11.3	----	8.72	----	42	----	----
17	10.2	----	9.24	----	45	4.7	8.7
18	8.4	----	10.15	----	50	4.6	8.59
19	7.6	----	10.08	----	55	----	----
20	7	----	10.09	----	60	4.5	8.52
21	6.5	----	9.92	----	65	----	----
22	6.1	----	9.74	----	70	4.4	8.19
23	5.9	----	9.73	----	75	----	----
24	5.8	----	9.5	----	78	4.3	8.2

Temperature and Oxygen Profiles

Redfish Lake's temperature profile during August 1992 indicates thermal stratification in the trophogentic zone at approximately 17.5 meters. Surface temperature was 18.1°C and the bottom temperature was 4.5°C (Table 41a, Figure 14).

Dissolved oxygen concentrations in Redfish Lake were high through the water column during summer stratification (August). Dissolved Oxygen levels were highest in the metalimnion due to temperatures. The level of dissolved oxygen was to 8.2 mg/L in the deepest part of the hypolimnion illustrating the oligotrophic nature of Redfish Lake (Table 41a, Figure 14).

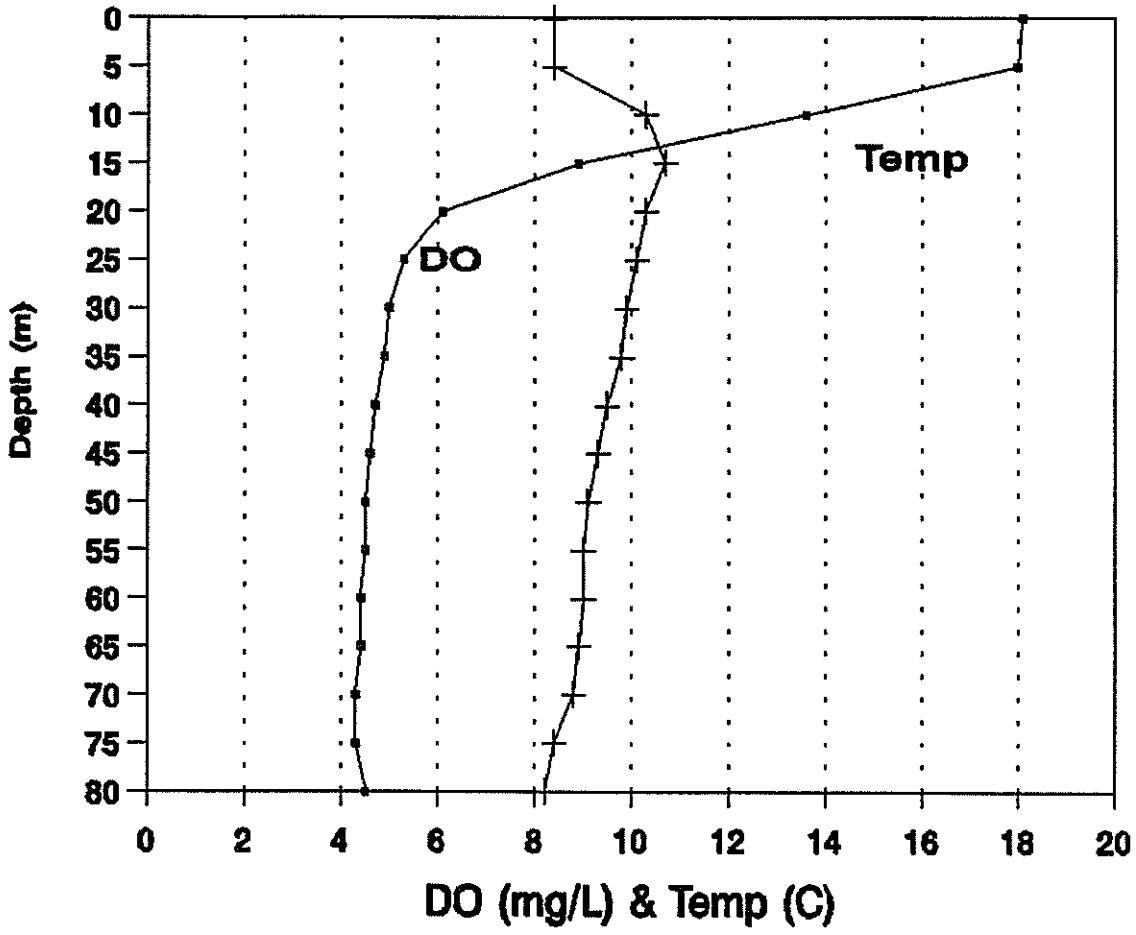


Figure 14. Dissolved oxygen and temperature profiles for Redfish Lake, August 7, 1992.

Table 42. Redfish Lake submergent macrophytes, 1992.

Maximum depth of submergent macrophytes = 5 meters
Number of prevalent species[1] = 3
Total # of submergent species = 3
Maximum Secchi depth = 11.5 meters

Species	Mean %[2] Recovery	Relative %[3] Recovery	Density[4] Rating (1-5)	Total[6] Points of Occurrence	Total %[7] of all Points
Variable Pondweed	85.7	70	2	7	600
Muskgrass (Nitella)	50	10	1	1	50
Reed Grass	75	20	1	2	150
Total		100.0		10	

[1]A submergent macrophyte species was considered prevalent if it occurred in at least 25% of the rake tosses.
[2]Mean % recovery is the total % recovery for all points of occurrence for a species divided by the total points of occurrence for that species.
[3]Relative % recovery is the total points of occurrence for a species divided by the total of all points of occurrence for all of the species.
[4]EPA density rating is a rating where 1 is the species found in 1 of 4 rake tosses and where 5 is all of the rake tosses filled all the teeth of the rake.
[5]Occurred in only a limited number of rake tosses, insufficient for assessment for prevalent species classification (trace amount).
[6]Total points of occurrence is the number of sampling sites at which species were found.
[7]Total % of all points is the sum of % recovery of a species throughout the lake.

Sybmergent Macrophytes

Potamogeton gramineus (variable pondweed) was the most prevalent submergent macrophyte species sampled in Redfish Lake. Variable pondweed grows mainly in cool climates. It has broad elliptical floating leaves with somewhat narrower submergent leaves. It is widely distributed in North American waters. There were only three macrophyte species found. This low number of species present in Redfish Lake is an indicator of low nutrients and the oilgotrophic nature of the lake.

Table 43a. Trophic classifications according to Wetzel, 1983.

Classification	Chlorophyll *a* (ug/L)	Total Phosphorus (mg/L)	Secchi Depth (meters)
Oligotrophic	range 0.3 - 4.5	range 0.003 - 0.018	range 5.4 - 28.3
Mesotrophic	range 3.0 - 11.0	range 0.011 - 0.096	range 1.5 - 8.1
Eutrophic	range 3.0 - 78	range 0.016 - 0.39	range 0.8 - 7.0

TABLE 43b. Trophic classifications of 14 Idaho lakes based on chlorophyll *a*, total phosphorus, and Secchi depth, 1992.

Lake	Classification	Chlorophyll *a* (mg/L)	Total Phosphorus (mg/L)	Secchi Depth (meters)
Bonner Lake	Meso-oligotrophic	1.4	0.027	5.8
Brush Lake	Meso-oilgotrophic	2.65	0.016	4.05
Chase Lake	Meso-eutrophic	6.4	0.011	2.5
Dawson Lake	Meso-eutrophic	8.5	0.049	3.25
Freeman Lake	Meso-eutrophic	4.2	0.015	4.6
Gamble Lake	Meso-oilgotrophic	2.53	0.028	5.4
Jewel Lake	Mesotrophic	12.1	0.031	4.2
Killarney Lake	Meso-eutrophic	1.97	0.015	2.3
Mirror Lake	Meso-oligotrophic	1.25	0.057	6.3
Perkins Lake	Meso-eutrophic	29.5	0.01	3.4
Robinson Lake	Meso-oligotrophic	1.5	0.014	4.8
Shepherd Lake	Mesotrophic	3.5	0.069	4.3
Smith Lake	Meso-eutrophic	3.1	0.146	3.7
Redfish Lake	Oligotrophic	0.6	0.031	13.0

Table 44. Total percent frequency of algal groups for July, August, & October of 1992 in 14 Idaho Lakes.

Lake	Blue Green Algae			Flagellates			Diatoms			Green Algae			Other Algal Groups		
	J	A	O	J	A	O	J	A	O	J	A	O	J	A	O
Bonner	--	17	0	--	20	0	--	40	77	--	100	40	--	0	33
Bush	--	27	0	--	50	67	--	40	114	--	26	27	--	80	30
Chase	27	--	--	77	--	--	0	--	--	13	--	--	77	--	--
Dawson	123	244	0	0	0	83	0	0	0	104	77	74	0	77	54
Freeman	0	10	7	63	126	80	33	0	0	13	77	20	43	63	17
Gamble	0	10	0	60	120	73	0	0	10	90	37	23	27	33	13
Jewel	0	10	0	106	60	30	10	0	0	40	90	23	0	23	93
Killarney	27	77	0	20	0	0	87	93	97	63	67	63	0	0	0
Mirror	0	33	0	30	33	30	33	23	47	83	23	87	0	0	0
Perkins	0	3	23	127	100	0	0	0	0	43	63	67	0	0	0
Robinson	23	0	0	0	67	60	87	33	30	40	53	0	0	43	63
Shepherd	0	13	0	100	107	90	40	0	0	0	0	37	63	30	110
Smith	107	70	0	17	37	23	0	0	20	17	43	153	0	0	0

Table 45. Beneficial Uses of 15 Idaho Lakes Monitored in 1992. All waters in the state are designated for industrial water supply, wildlife, and Aesthetics.

Name of Lake	Domestic Water Supply	Ag Water Supply	Cold Water Biota	Warm Water Biota	Salmonid Spawning	Primary Contact Recreation	Secondary Contact Recreation	Special Resource Water
Bonner		X	X	X		X	X	
Brush		X	X	X		X	X	
Chase		X	X	X		X	X	
Dawson		X	X	X		X	X	
Freeman		X	X	X		X	X	
Gamble		X		X		X	X	
Jewel		X	X	X		X	X	
Killarney		X		X		X	X	
Mirror		X	X			X	X	
Perkins		X	X	X		X	X	
Robinson		X	X	X		X	X	
Shepherd		X		X		X	X	
Smith		X	X	X		X	X	
Redfish		X	X			X	X	X

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