A SURVEY OF ALPINE LAKES IN GRAND TETON NATIONAL PARK

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Objectives

The major objective of this study was to provide baseline data on alpine lakes located within Grand Teton National Park. Park management requires baseline data to assess possible future perturbations to the lakes (e.g., acid rain and other human impacts). Another objective was to analyze the data in a manner that provides useful interpretations for other scientists and for park managers.

Methods

Thirty lakes were sampled during the 2nd field season (June-September, 1983) of the 2-year study. Twenty of these lakes were considered to be alpine lakes as their elevations were greater than 2700 m.

During both the 1982 and 1983 field seasons a total of 70 lakes were sampled, with 46 of them being over 2700 m in elevation. Lakes were surveyed in most major drainages; Webb canyon, North and South Snowshoe canyons, Moran canyon, Paintbrush canyon, North and South Cascade canyons, Avalanche canyon, North and South Death canyons, and Glacier Gulch. Thus, both lakes with high human impact (e.g., Paintbrush and North Cascade canyon lakes) and with low human impact (e.g., North Snowshoe and Moran canyon lakes) were sampled.

Each lake was sampled by a two man crew (Gulley and helper). Day trips were made to the lower elevation lakes and multiday backpacking trips were made to the higher elevation lakes. The maximum length of multiday trips was limited by the weight of equipment, food and supplies. Light weight chemical analysis kits and biological sampling devices were assembled to minimize the weight of equipment and supplies required to sample the lakes.

An outline map of each lake to be surveyed was prepared from USGS maps prior to the field season. In the field, the accuracy of each outline was verified, and depth soundings were recorded. From these maps morphological parameters (e.g., volume, surface area, shoreline length) were measured or calculated for each lake.

Values for all major ions were measured or calculated. The analyses of cloride and sulfate were performed using reagents obtained from the Hach Chemical Company. Their methods were modified to obtain greater sensitivity. However, the sulfate concentrations of the alpine lakes were still too low to be accurately detected with the modified Hach Method.

Analyses for calcium, hardness, magnesium (calculated from hardness and calcium), alkalinity, carbon dioxide (calculated from alkalinity and pH), and dissolved oxygen were performed according to Standard Methods for the Examination of Water and Wastewater. Conductivity and pH were measured with portable meters. All analyses were performed in the field.

Biological samples were collected at each lake. Phytoplankton were collected by preserving measured volumes of lake water. Qualitative collections of zooplankton were made with a number 20 net towed vertically (bottom to surface) from a raft. Several tows were taken at various locations on the lake and pooled. Periphyton was collected by scraping the surface of submerged objects such as rocks and logs. Benthic invertebrates were collected with a drag sampler. This specially designed lightweight sampler has a scoop to scrape the bottom and looks somewhat like a weighted dip net without a handle.

Results and Discussion

Summary statistics are presented on the surface water quality of the 20 alpine lakes surveyed in 1983 Table 1. These 1983 values are very similar to those measured in 1982 and are typical of high elevation oligotrophic lakes. Concentrations of ions and conductivity are characteristically low, as is the alkalinity or buffering capacity. The latter is particularly important if acid precipitation were to occur in the Tetons.

Our best estimator of lake sensitivity to acid precipitation is the acid buffering capacity of water from each lake. Alkalinity is easy to measure and indicates the amount of excess hydrogen ions the water can neutralize. Lakes with alkalinity values less than 200 µeq/l (10 ppm) calcium carbonate are most susceptible to acidification (Impact Assessment Working Group, 1981). Of the 46 alpine lakes surveyed all but 4 had alkalinities less than 200 µeq/l. Thus, almost all of the alpine lakes are susceptible to acid precipitation. A more detailed examination of the water chemistry of each lake in relation to human use, drainage basin, and sensitivity to acid rain is in progress.

Identification and enumeration of zooplankton and phytoplankton collected at each lake is also currently in progress. Hence, these data are not included in this report.

Identification of all benthic macroinvertebrates is complete. Sixty-one different genera were collected from high and low elevation lakes combined. Twenty-seven of these genera were collected from the 46 alpine lakes and are listed in Table 2 along with the drainages in which they were collected. Generic classification of Ephemeroptera and Trichoptera were verified by R. D. Waltz, Purdue University, Department of Entomology. We are very grateful for Mr. Waltzs' help.

A computer graphics program was written to map the distribution of each of the 61 genera collected. Figure 1 is an example of the output from this program.

Table 1. Descriptive statistics for chemical data of surface waters from 20 alpine lakes (>2700 m) in Grand Teton National Park. Data were collected between June - September, 1983. A "<" indicates less than the accompanying limit of detection.

Chemical Test	Minimum	Maximum	Mean	Standard Deviation
pH	5.3	8.2	7.2	0.8
Conductivity (μmhos at 25°C)	3	57	18	17
Total Hardness (as ppm $CaCO_3$)	0.4	59.7	10.2	14.6
Ca^{2+} (ppm)	<0.1	14.0	2.8	3.8
Mg^{2+} (ppm)	<0.1	1.9	0.5	0.5
Alkalinity (as ppm $CaCO_3$)	0.4	38.0	6.7	9.8
Cl^- (ppm)	1.0	13.3	3.9	2.7
CO_2 (ppm)	<0.1	23.3	2.5	5.3

Table 2. Benthic macroinvertebrates collected during the summers of 1982 and 1983 from 46 alpine lakes (>2700 m) in Grand Teton National Park.

Order	Family	Genus	Drainages[a]
Amphipoda	Talitridae	Hyalella	NS
Anostraca	Branchinectidae	Branchinecta	MO,SC,SD
Coleoptera	Dytiscidae	Agabinus	PB
Coleoptera	Dytiscidae	Agabus	WB,NS,MO,NC,SC,GR,SD
Coleoptera	Dytiscidae	Copelatus	SD
Coleoptera	Dytiscidae	Hydaticus	NS,SD
Coleoptera	Dytiscidae	Hydroporus	NC
Coleoptera	Dytiscidae	Hydrovatus	WB,SD
Coleoptera	Dytiscidae	Hygrotus	WB,GR,SD
Coleoptera	Elmidae	Stenelmis	SC
Diptera	Chrironomidae	-	WB,NS,MO,LE,PB,NC,SC, GR,AV,SD
Diptera	Culicidae	Ades	SD
Diptera	Culicidae	Chaoborus	PB
Ephemeroptera	Baetidae	Callibaetis	PB
Ephemeroptera	Siphlonuridae	Ameletus	WB,NS,MO,NC,GG
Ephemeroptera	Siphlonuridae	Siphlonurus	SD,AV
Hemiptera	Gerridae	Gerris	SD
Oligochaeta	-	-	WB,LE,PB,GR,AV
Pelecypoda	Sphaeriidae	-	WB,NS,MO,PB,GR,SD
Plecoptera	Chloroperlidae	-	LE
Plecoptera	Perlodidae	Arcynopteryx	NC
Trichoptera	Limnephilidae	Desmona	NS,MO,LE,PB,SD
Trichoptera	Limnephilidae	Hesperophylax	WB,NS,MO,LE,GR
Trichoptera	Limnephilidae	Pseudostenophylax	SD
Trichoptera	Limnephilidae	Psychoglypha	NS,PB
Tricladida	Planariidae	Polycelis	WB,NS,AV,SD

[a] WB = Webb, NS = North Snowshoe, MO = Moran, LE = Leigh, PB = Paintbrush, NC = North Cascade, SC = South Cascade, GG = Glacier Gulch, GR = Garnet, AV = Avalanche, SD = South Death.

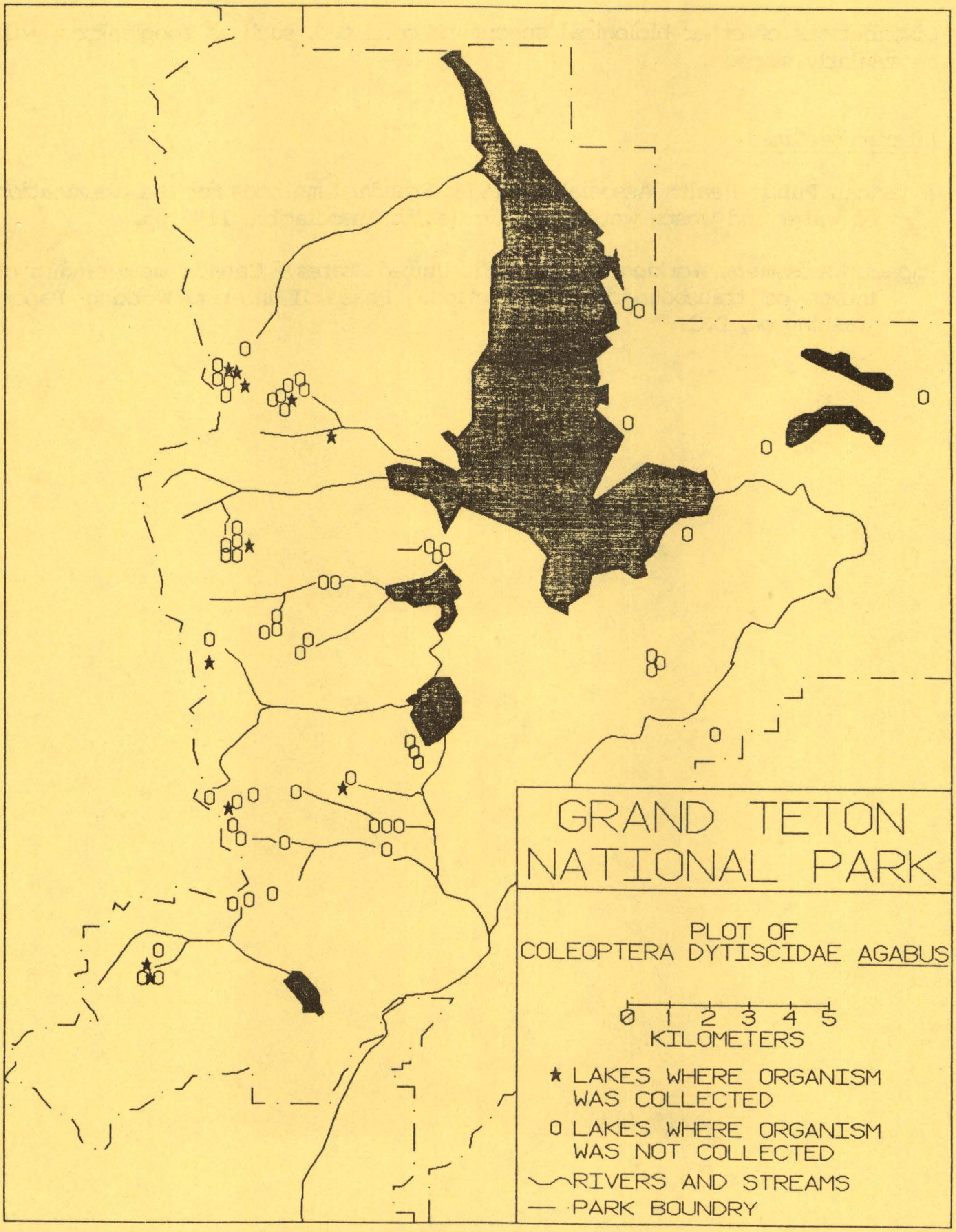

Figure 1. An example of a genus distribution map.

Distributions of other biological specimens collected, such as zooplankton, will be similarly mapped.

Literature Cited

American Public Health Association. 1976. Standard methods for the examination of water and waste water. Public Health Association. 1193 pp.

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