U.S. Department of the Interior
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Prepared in cooperation with
Idaho Department of Environmental Quality

Evaluation of Macroinvertebrate Assemblages in Idaho Rivers Using Multimetric and Multivariate Techniques, 1996–98

Water-Resources Investigations Report 01–4145

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Cover photo: Clockwise from top left: Sampling for benthic macroinvertebrates in the Big Lost River, Idaho (photograph by T.R. Maret, U.S. Geological Survey); the caddisfly *Wormaldia*; the stonefly *Hesperoperla*; the mayfly *Ameletus*; the mayfly *Drunella*; the caddisfly *Psychoglypha* (Photographs of invertebrates courtesy of Steven V. Fend and James L. Carter, National Research Program, U.S. Geological Survey, Menlo Park, California; and Saelon Renkes, freelance photographer, published with permission)

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CONVERSION FACTORS, VERTICAL DATUM, AND OTHER ABBREVIATED UNITS

Multiply	By	To obtain
centimeter (cm)	0.3937	inch
cubic meter per second (m^3/s)	35.31	cubic foot per second
hectare (ha)	2.471	acre
kilometer (km)	0.6214	mile
liter (L)	0.2642	gallon
meter (m)	3.281	foot
millimeter (mm)	0.03937	inch
square meter (m^2)	10.76	square foot
square kilometer (km^2)	0.3861	square mile

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

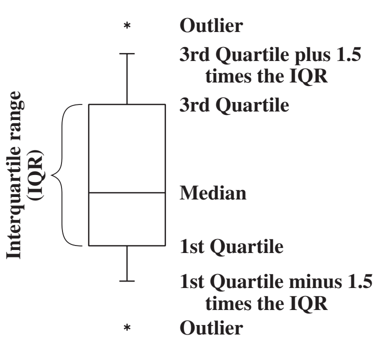
$$°F=(1.8)\ (°C)+32$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Other abbreviated units:

µm micrometer
µS/cm microsiemens per centimeter
mg/L milligram per liter

Explanation for boxplots shown in figures 3 and 6



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Abstract

Macroinvertebrate assemblages and environmental variables were evaluated as part of the Idaho statewide surface-water quality monitoring program during 1996–98. Two assessment approaches were used to evaluate the macroinvertebrate data collected from Idaho rivers—biological metrics and multivariate statistical analyses. A total of 247 macroinvertebrate taxa were identified in semiquantitative riffle habitat (richest targeted habitat; RTH) and qualitative multiple habitat (QMH) samples, which were collected from 40 sampling sites. Riffles supported most of the taxa collected at all sites. One hundred and eighty-four taxa (74 percent of total taxa) were identified in the RTH samples. Taxa considered abundant in RTH samples included Oligochaeta, *Baetis tricaudatus*, *Hydropsyche*, Simuliidae, Chironomidae pupae, *Cricotopus*, *Eukiefferiella*, and *Orthocladius* complex. Comparisons of RTH and QMH sample types indicated little difference in various metrics evaluated; either sample type could be used to evaluate biological condition. Fourteen coldwater taxa were collected during this study at 12 sampling sites, representing only about 6 percent of all taxa collected and a frequency of occurrence of 30 percent for all sites. An evaluation of the Idaho Department of Environmental Quality invertebrate river index (IRI) identified statistically significant differences between high- and low-quality sites, providing evidence that the index can successfully discriminate impairment. IRI scores for all sampling sites identified 25 percent of the sites with poor biotic condition and 68 percent with good biotic condition. Maximum temperatures at 62 percent of all sampling sites exceeded Idaho's instantaneous coldwater temperature criteria of 22°C. No correspondence was evident between ecoregion percentages upstream from each site and macroinvertebrate assemblages. Multivariate analyses of RTH samples identified various environmental variables operating at different spatial scales that affect the macroinvertebrate assemblages in Idaho rivers. Six environmental variables—percent forested land, percent agricultural land, urban land, maximum water temperature, percent substrate fines, and stream gradient—were significant in describing variance in the macroinvertebrate assemblages. Two distinct groups of sites and associated taxa were identified: one represented high-gradient, coldwater, forested and rangeland sites, and the other represented sites influenced by human disturbance, indicated by increased percent substrate fines and increased water temperatures typically associated with agricultural and (or) urban land uses.

INTRODUCTION

In 1990, the U.S. Geological Survey (USGS), in cooperation with the Idaho Department of Environmental Quality (IDEQ), implemented a statewide water-quality monitoring program (SWQP) in response to Idaho's antidegradation policy as required by the Clean Water Act (Clark, 1990). The program objective was to provide water-quality managers with a coordinated, statewide network to detect trends in surface-water quality. A consistent, integrated assessment of water quality will provide water managers, policy makers, and the public with an improved scientific basis for evaluating effectiveness of water-quality management programs in principal river basins throughout Idaho.

Human activities can alter the physical, chemical, or biological processes of surface water. Such alterations, in turn, can cause changes in the resident aquatic biological assemblages. Monitoring the health of these assemblages can complement other physical and chemical water-quality assessment methods and, thus, can provide a more complete evaluation of water-resource conditions (Karr, 1991). According to Allan and Flecker (1993), protecting or managing ecosystems and associated biological diversity requires development of ways to monitor ecosystem health. Measuring changes in fish, macroinvertebrate, and algal assemblages can provide an index of water quality and trends that affect beneficial uses of surface-water resources, detect problems that other methods might miss or underestimate, and provide a systematic process for measuring progress of pollution abatement programs (Intergovernmental Task Force on Monitoring, 1995).

Macroinvertebrates have been used extensively to assess the status and trends of aquatic life in rivers. Hardy and others (1995) reported trends in benthic invertebrates, along with other physical and chemical measures of stream water quality, for a cooperative program between the USGS and Chester County, Pennsylvania. Maret (1995) summarized a number of studies that have used macroinvertebrates to assess water quality of streams in the upper Snake River Basin. Macroinvertebrates inhabit most streams and are a key component in processing of organic material and in nutrient cycling and are an important food source for fish and other aquatic organisms. These organisms are easy to collect, relatively sessile, and have specific environmental requirements to complete their life cycle. Macroinvertebrate assemblages are excellent indicators of long-term environmental changes such as siltation (Lenat and others, 1981) and point-source pollutants of short duration (Prophet and Edwards, 1973). Macroinvertebrates integrate the effects of upstream land and water uses in a basin over the long term (months to years) because most of their life cycle is spent in the water.

Use of biological attributes, or metrics, to describe water quality is increasing. Recent State and Federal program developments in biological monitoring have emphasized more direct measures of biotic integrity to assess beneficial use status and trends (Plafkin and others, 1989; Hayslip, 1993). A metric is an enumeration representing an assemblage characteristic or combination of characteristics that changes in a predictable way with increased human influence (Karr and others, 1986). Several macroinvertebrate indices using a variety of metrics have been developed in the Northwest as tools to help evaluate water quality and biotic integrity. Among these are an index identifying urban effects in the Puget Sound Lowlands in Washington (Kleindl, 1995), forestry effects in Oregon (Fore and others, 1996), and an evaluation of least-disturbed small streams in the Cedar River watershed of Washington (Black and MacCoy, 2000). The IDEQ recently has developed biological monitoring protocols to assess beneficial uses of medium and large rivers (Grafe, 2000) based, in part, on studies by the Idaho State University, Stream Ecology Center (Royer and Minshall, 1996; Royer and others, 2001). In addition, the USGS, through the National Water-Quality Assessment (NAWQA) Program, has included comprehensive monitoring protocols to assess aquatic life and associated habitat quality (Gurtz, 1994). These studies have shown that aquatic biological assemblages are effective integrators of stream conditions, including chemical and habitat changes that have resulted from human activities in river basins. Therefore, evaluation of these assemblages can be useful in assessing biotic integrity and associated designated beneficial uses such as coldwater biota and salmonid spawning.

The Idaho SWQP, which began with a focus on water chemistry, was expanded in 1996 to a more integrated monitoring network that included biological information to more effectively assess instream beneficial uses. Major components of this assessment were the collection of aquatic macroinvertebrates from a variety of stream habitats and measurement of associated environmental variables.

Two assessment approaches were used to evaluate the macroinvertebrate data collected from Idaho rivers—biological metrics and multivariate statistical analyses. First, biological metrics relate specific measures of assemblage structure, composition, and functional attributes to a minimally disturbed system (Karr and others, 1986). The metric approach is dependent on regional biological and environmental reference information to score individual metrics (Miller and others, 1988). A metric score can be used as a single numeric index, such as the number of species (or taxa), or combined into a comparative rating of multiple metrics, such as U.S. Environmental Protection Agency's (USEPA) rapid bioassessment protocols (Plafkin and others, 1989; Barbour and others, 1999). The multimetric approach has been advocated because several metrics, each measuring a different component of the assemblage, are believed to provide a more robust assessment of ecological integrity (Fore and others, 1996). The biological metrics approach also is most amenable to nonexperts. In this study, the multimetric approach will be evaluated.

Second, ecologists have used multivariate analyses to identify and interpret patterns in macroinvertebrate assemblage structure as they relate to environmental conditions (Gauch, 1982; Richards and others, 1993; Frenzel, 1996). These multivariate analyses summarize patterns of association within a species-by-sample data matrix for purposes of classification. Multivariate analyses are effective for identifying similarities among sites with respect to various physical, chemical, and biological characteristics and for depicting relations between assemblage patterns and environmental gradients. Hypotheses also can be formulated from these exploratory analyses about relations between macroinvertebrate assemblages and environmental variables.

Few studies have examined relations between macroinvertebrate assemblages and measured environmental variables across the major environmental settings of Idaho. Most macroinvertebrate studies have been conducted on small, wadeable streams (fourth order or less, after Strahler, 1957); large-river studies remain limited. Robinson and Minshall (1998) studied wadeable streams across three major ecoregions of Idaho. Mebane (2001) studied relations among macroinvertebrate metrics, fine-grained sediment, and metals in wadeable streams across four ecoregions of Idaho. Royer and Minshall (1996) and Royer and others (2001) sampled a number of medium- to large-river sites for IDEQ to develop multimetric indices using macroinvertebrates. They developed an invertebrate river index (IRI) that appears to function well as a bioassessment tool for both medium and large rivers in Idaho. However, their index consisted of only 22 sites and 6 validation sites from rivers across Idaho. The investigation documented in this report offers an independent evaluation of the IRI encompassing a wider variety of medium- to large-river sites and environmental conditions by using similar collection methods but a different laboratory for taxonomic processing. In addition, a number of basin-level variables were determined with a geographic information system (GIS) to assess landscape-scale influences, such as basin area and land-use variables, on macroinvertebrate assemblages. These quantitative measures of basin and habitat data facilitate evaluation of metric responsiveness to multiple measures of impairment, as well as to natural influences on macroinvertebrate assemblages.

Purpose and Scope

This report characterizes macroinvertebrate assemblages in medium to large rivers (fourth through seventh order) and a few spring streams throughout Idaho. Macroinvertebrate and environmental data for the SWQP were collected during 1996–98. Purposes of this report are to (1) compare results of two macroinvertebrate sampling methods—qualitative multiple habitat (QMH) samples and semiquantitative riffle habitat (richest targeted habitat, RTH); (2) characterize macroinvertebrate assemblages by using various metrics that previously have been identified as useful for evaluating Idaho rivers; (3) provide an independent evaluation of IDEQ's recently developed IRI; (4) describe relations between macroinvertebrates and measured environmental variables at the landscape and stream habitat scale; and (5) suggest changes to improve the SWQP on the basis of evaluation of the data.

Description of Idaho Statewide Surface-Water Quality Monitoring Program

The SWQP during 1990–95 consisted of chemical analyses of water samples collected at 56 sites on the Bear, Clearwater, Kootenai, Pend Oreille, Salmon, Snake, and Spokane Rivers and their tributaries (fig. 1). Water samples were collected bimonthly at sites on a rotation of annual, biennial, or triennial schedule. A detailed description of the SWQP sampling schedule is given in a report by Clark (1990). Onsite and laboratory analyses included discharge, specific conductivity, pH, water temperature, dissolved oxygen, bacteria, alkalinity, major ions, nutrients, trace elements, turbidity, and suspended sediment (O'Dell and others, 1998). To provide continuous discharge records for all sites, sampling sites are located at existing USGS surface-water gaging stations. The USGS actively maintains the chemical, physical, and hydrologic data collected for this program in the National Water Information System data base. Data collected as part of this program also have been published in Idaho's biennial water-quality status reports (Clark, 1998).

In 1996, the Idaho SWQP was redesigned to include collection of macroinvertebrates, fish, fish tissue

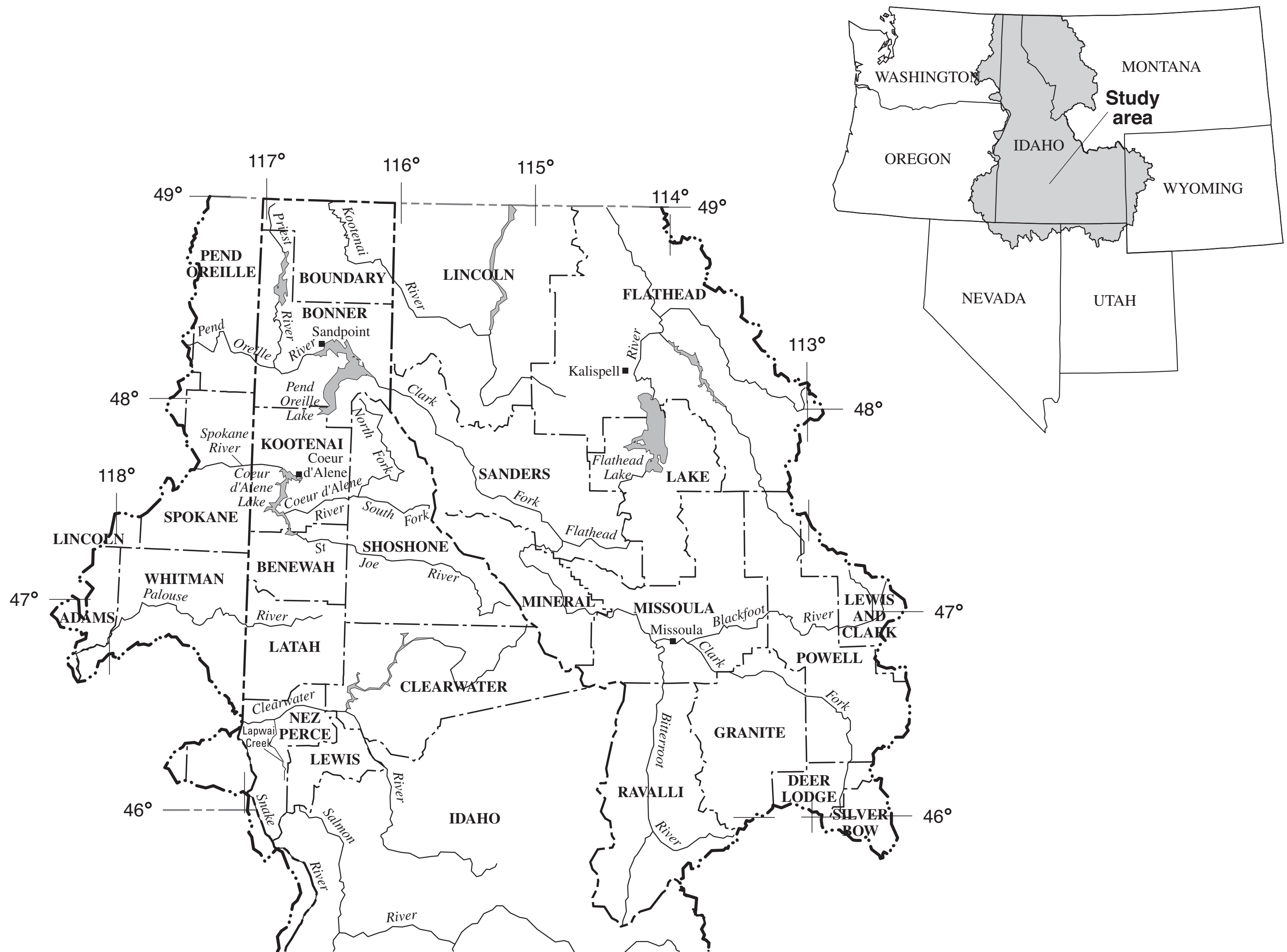

Figure 1. Location of the area comprising the Idaho statewide surface-water quality monitoring program.

Base from U.S. Geological Survey digital data,
1:250,000, 1994; Albers Equal-Area projection
Standard parallels 43° 30', 47° 30',
and -114° 00', 41° 45'
No false easting or false northing

0 25 50 75 100 MILES
0 25 50 75 100 KILOMETERS

contaminants, and associated stream habitat parameters at 40 of the 56 SWQP sites to more effectively assess the status and trends of stream quality in Idaho. Much of the biological data collected for this program can be accessed on the World Wide Web (idaho.usgs.gov/public/wq/index.html). In addition, chemical analysis sampling frequency was increased to monthly from April to September—a period of increased recreational use of Idaho rivers. Biological sampling was targeted for summer/fall low-flow conditions, when coldwater biota (a primary beneficial use) are most limited as a result of reduced streamflow, which causes thermal stress and habitat loss. SWQP biological monitoring sites were divided into three regions—southeastern, southwestern, and northern. Biological monitoring sites were sampled once over a 3-year rotation in each of the three regions. All biological monitoring sites in the SWQP were sampled once during 1996–98 for macroinvertebrates (fig. 1). These collections included both RTH and QMH samples. Also during this time, 15 of these sites were sampled to characterize the fish assemblages and analyze fish tissue for organic and inorganic contaminants (not evaluated in this report). Basin and site characteristics for all sites in the SWQP are shown in table 1.

Description of Study Area

Idaho consists of a vast and varied geography throughout 11 ecoregions (Omernik and Gallant, 1986, table 1). Ecoregions are areas with similar land use, vegetation, soils, and land surface forms and have been found to be useful in organizing water-resource information (Hughes and Larsen, 1988; Whittier and others, 1988).

The State spans 7 degrees of latitude from 42°N at its southern border with Nevada to 49°N at its northern border with Canada. Major river basins include the Bear, Clearwater, Kootenai, Pend Oreille, Salmon, Snake, and Spokane and their tributaries. Most of the sampling sites in this study are located in the Snake River Basin/High Desert and Central Basin and Range ecoregions.

Rangeland and forested land dominate the landscape and compose almost 80 percent of the State (fig. 2). Agriculture composes only 14.5 percent of the landscape but is the primary water user. Although Idaho has a small population of just over 1 million, it has one of the largest amounts of irrigated cropland (fifth in the Nation), according to the 1997 Census of Agriculture (U.S. Department of Agriculture, Farm and Ranch Irrigation Survey, Census of Agriculture, table 4, accessed April 2000, online). Most of the surface water in Idaho is appropriated for urban and agriculture uses (Frenzel, 1987). In the central part of the State, much of the land is national forest and wilderness, and water use is minimal.

Nonpoint-source pollution and water diversions are the predominant influences on surface-water quality in the State (Idaho Department of Health and Welfare, 1998). Pollutants of greatest concern that have been associated with habitat degradation of streams include nutrients, fine-grained sediment, bacteria, organic waste, and elevated water temperature. Beneficial uses of streams most impaired by pollutants include coldwater biota, salmonid spawning, and water contact recreation (Idaho Department of Health and Welfare, 1998). Water transfer from one river basin to irrigate crops in another is common practice in most of southern Idaho. The ecological consequences of this practice include changes in streamflow, introduction of exotic species, alteration of habitat, and changes in water quality (Meador, 1992).

Elevations range from about 225 m above sea level where the Snake River leaves Idaho to 3,859 m at Borah Peak in east-central Idaho. Sampling site elevations range from about 300 m to just over 2,000 m. Precipitation varies widely with topography; average rainfall is about 56 cm a year (Frenzel, 1987). The climate of Idaho is primarily arid during summer. Precipitation is primarily winter snowfall, and peak flows in streams result from spring snowmelt.

The southern basins are mainly in semiarid, high desert plains and contain the greatest population densities. For example, the population of two counties outside the city of Boise (Ada and Canyon), constitutes more than a third of the population in the State. The basins toward the north are mainly forested and sparsely populated; logging, mining, and grazing are the predominant land uses. Because of the diversity of the State's landscape, it is a popular destination for sports enthusiasts and tourists. More than 60 percent of the land is federally owned and available for recreational activities such as hiking, fishing, hunting, and whitewater rafting.

Most rivers in Idaho are presumed or explicitly designated such that their water quality supports coldwater biota (Grafe, 2000). Idaho's Water Quality Standards have adopted the criteria of a maximum of 22°C

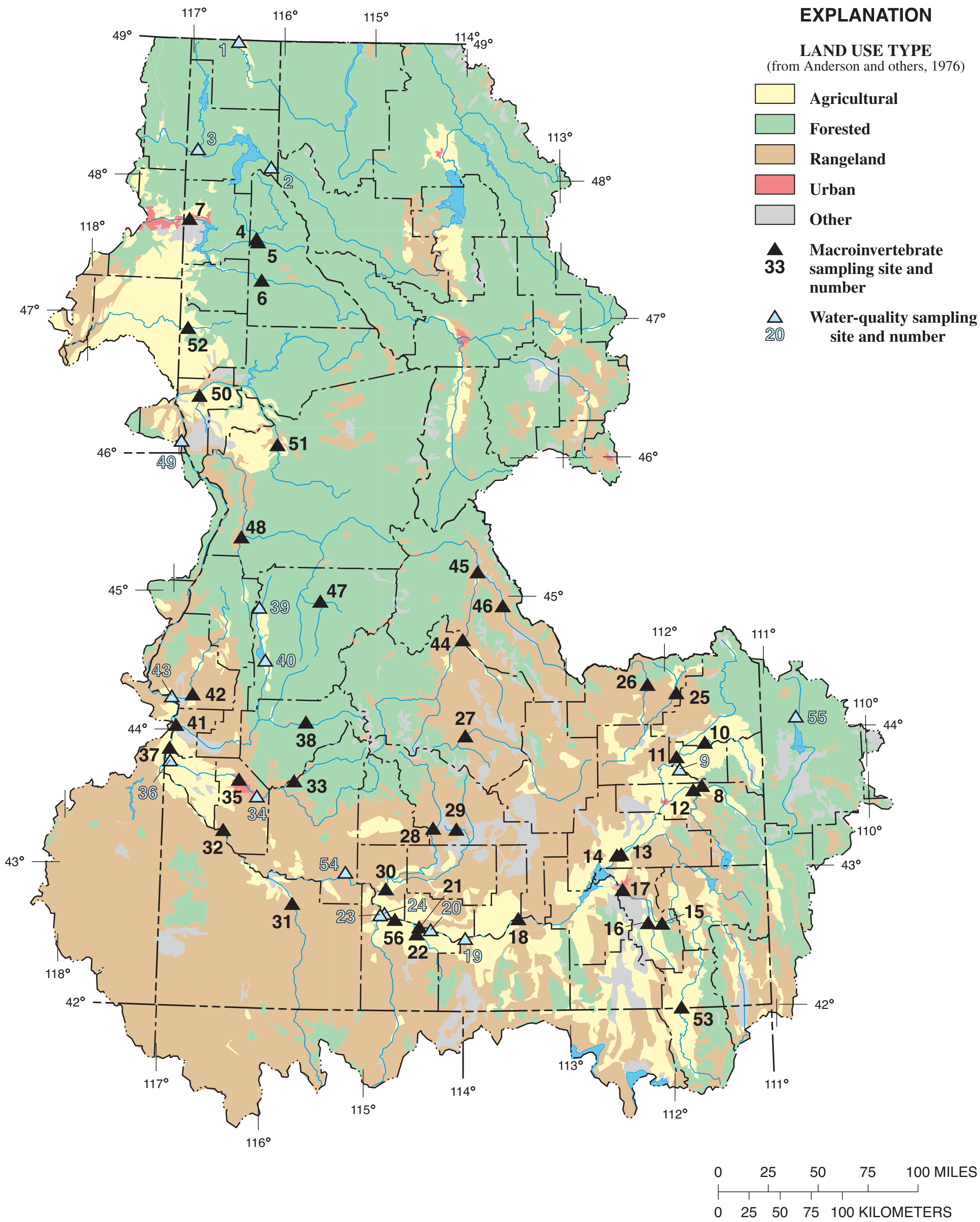

Figure 2. Major land uses and locations of macroinvertebrate and other sampling sites in the Idaho statewide surface-water quality monitoring program. (Basin and site characteristics shown in table 1)

Table 1. Basin and site characteristics for all sites in the Idaho statewide surface-water quality monitoring program, 1996−98

[Site locations shown in figure 1; No., number; USGS, U.S. Geological Survey; latitude and longitude in degrees, minutes, and seconds; m, meters; km^2, square kilometers; R., River; nr, near; N., North; S., South; Cr., Creek; Wash., Washington; Wyo., Wyoming; sites where only water-quality data were collected are shaded]

Site No.	Site name	USGS site identification	Latitude/longitude	Elevation (m above sea level)	Stream order	Population density (people/km^2)	Basin area (km^2)	Land use (in percent): Urban land	Agricultural land	Rangeland	Forested land	Other land
1	Kootenai R. at Porthill	12322000	48°59'47"/116°30'22"	518	5	2.08	12,409	0.4	3.0	3.0	91.4	2.3
2	Clark Fork R. below Cabinet Gorge Dam	12392000	48°05'30"/116°07'00"	628	6	4.48	55,614	.6	6.4	14.5	72.8	5.7
3	Priest R. nr Priest R.	12395000	48°12'31"/116°54'49"	637	5	.61	2,460	.6	.8	1.4	93.1	4.0
4	N. Fork Coeur d'Alene R. at Enaville	12413000	47°34'21"/116°15'11"	640	5	.36	2,325	0	.2	1.8	97.6	.3
5	S. Fork Coeur d'Alene R. nr Pinehurst	12413470	47°33'06"/116°14'13"	667	5	16.11	738	2.6	.1	6.3	88.6	2.5
6	St Joe R. at Calder	12414500	47°16'29"/116°11'17"	662	5	.12	2,679	0	0	7.1	92.6	.2
7	Spokane R. nr Post Falls	12419000	47°42'11"/116°58'37"	625	6	.09	10,162	.4	0	9.7	81.5	8.4
8	Snake R. nr Heise	13037500	43°36'45"/111°39'33"	1,528	6	1.28	14,841	.3	5.9	25.3	60.5	8.0
9	Snake R. at Lorenzo	13038500	43°44'06"/111°52'33"	1,478	6	1.42	14,981	.3	6.4	25.2	60.1	8.0
10	Teton R. nr St Anthony	13055000	43°55'38"/111°36'55"	1,515	5	1.78	2,294	.2	39.5	14.9	38.3	7.0
11	Henrys Fork nr Rexburg	13056500	43°49'34"/111°54'15"	1,465	6	4.33	8,337	.4	25.9	19.3	49.6	4.8
12	Willow Cr. nr Ririe	13058000	43°35'02"/111°44'44"	1,509	6	.46	1,661	0	21.4	50.7	21.7	6.2
13	Blackfoot R. nr Blackfoot	13068500	43°07'50"/112°28'35"	1,347	6	1.33	2,851	.1	13.7	60.2	20.8	5.1
14	Snake R. nr Blackfoot	13069500	43°07'31"/112°31'06"	1,341	7	5.47	31,555	.6	19.1	28.7	44.9	6.6
15	Portneuf R. at Topaz	13073000	42°37'30"/112°05'20"	1,499	5	1.03	1,520	.2	33.6	53.3	11.5	1.4
16	Marsh Cr. nr McCammon	13075000	42°37'48"/112°13'29"	1,405	5	1.86	885	1.0	52.1	32.3	14.4	.2
17	Portneuf R. at Pocatello	13075500	42°52'20"/112°28'05"	1,347	6	8.53	3,292	1.3	36.2	51.2	10.5	.8
18	Snake R. nr Minidoka	13081500	42°40'23"/113°29'58"	1,259	7	5.26	48,830	.7	23.0	37.8	32.8	5.7
19	Snake R. at Milner	13088000	42°31'41"/114°01'04"	1,238	7	5.10	57,826	.7	22.9	39.2	29.8	7.6
20	Snake R. nr Kimberly	13090000	42°35'28"/114°21'28"	1,025	7	5.07	59,097	.7	23.4	39.3	29.2	7.3
21	Blue Lakes Spring	13091000	42°36'53"/114°28'06"	1,006	1	0	3	0	0	100	0	0
22	Rock Cr. at Daydream Ranch	13092747	42°33'47"/114°29'42"	1,106	5	11.36	623	1.8	22.8	52.4	22.9	.1
23	Box Canyon Springs	13095500	42°42'29"/114°48'35"	920	1	0	3	0	0	100	0	0
24	Salmon Falls Cr. nr Hagerman	13108150	42°41'47"/114°51'15"	881	6	.23	5,362	0	5.1	85.1	9.4	.4
25	Camas Cr. at Red Road	13108900	44°17'20"/111°53'31"	1,457	4	0	660	0	17.5	40.9	40.5	1.2
26	Beaver Cr. at Spencer	13113000	44°21'20"/112°10'45"	1,783	4	.03	328	.2	0	68.8	29.7	1.4
27	Big Lost R. nr Chilly	13120500	43°59'54"/114°01'12"	2,018	5	.40	1,141	0	.2	48.9	31.0	19.8
28	Big Wood R. nr Bellevue	13141000	43°19'40"/114°20'25"	1,469	5	5.73	2,128	.9	5.1	45.2	41.1	7.8
29	Silver Cr. nr Picabo	13150430	43°19'22"/114°06'29"	1,478	4	1.21	152	.1	35.6	63.6	.7	0
30	Malad R. nr Gooding	13152500	42°53'12"/114°48'08"	1,019	5	2.52	8,607	.4	14.2	64.7	12.8	7.9
31	Bruneau R. nr Hot Spring	13168500	42°46'16"/115°43'10"	792	6	.10	6,766	0	.4	90.4	8.9	.3
32	Snake R. nr Murphy	13172500	43°17'31"/116°25'12"	692	7	4.29	129,052	.6	19.8	54.2	19.7	5.7
33	Boise R. nr Twin Springs	13185000	43°39'33"/115°43'34"	992	6	.01	2,148	0	0	7.9	88.0	4.1
34	Boise R. below Diversion Dam	13203510	43°32'23"/116°05'37"	838	6	.23	6,970	0	.5	27.9	68.7	2.9
35	Boise R. at Glenwood Bridge	13206000	43°39'37"/116°16'41"	792	6	8.41	7,463	.7	.7	31.5	64.4	2.7
36	Boise R. nr Parma	13213000	43°46'54"/116°58'17"	669	6	26.23	10,141	2.5	12.5	34.4	47.9	2.6
37	Snake R. at Nyssa	13213100	43°52'34"/116°58'53"	661	7	5.02	171,363	.6	16.5	59.4	18.8	4.9
38	S. Fork Payette R. at Lowman	13235000	44°05'07"/115°37'16"	1,155	5	.16	1,157	.1	0	8.8	83.8	7.3
39	N. Fork Payette R. at McCall	13239000	44°54'27"/116°07'04"	1,514	4	4.07	379	1.9	.2	2.5	88.9	6.5
40	N. Fork Payette R. at Cascade	13245000	44°31'30"/116°02'45"	1,439	6	2.93	1,601	.8	11.9	5.5	71.8	10.0
41	Payette R. nr Payette	13251000	44°02'33"/116°55'27"	652	6	3.15	8,536	.5	9.4	25.2	61.7	3.2
42	Weiser R. nr Weiser	13266000	44°16'03"/116°46'16"	672	6	.95	3,800	.2	11.8	48.2	39.7	.2
43	Snake R. at Weiser	13269000	44°14'44"/116°58'48"	636	7	4.98	184,995	.6	16.2	57.5	21.1	4.7
44	Pahsimeroi R. at Ellis	13302005	44°41'34"/114°02'51"	1,413	5	.05	2,151	0	7.5	66.7	14.2	11.5
45	Salmon R. at Salmon	13302500	45°11'00"/113°53'40"	1,192	6	.61	12,982	.3	4.8	50.3	37.0	7.6
46	Lemhi R. nr Lemhi	13305000	44°56'24"/113°38'16"	1,512	5	.25	2,349	.1	8.6	60.5	24.9	5.9
47	Johnson Cr. at Yellow Pine	13313000	44°57'44"/115°29'58"	1,419	4	0	555	0	0	2.3	97.2	.5
48	Little Salmon R. at Riggins	13316500	45°24'47"/116°19'29"	536	5	1.04	1,491	.2	4.8	6.0	88.6	.4
49	Snake R. nr Anatone, Wash.	13334300	46°05'50"/116°58'36"	246	8	3.83	258,802	.5	13.8	52.1	29.2	4.4
50	Lapwai Cr. nr Lapwai	13342450	46°25'36"/116°48'15"	264	5	4.09	682	.4	48.9	14.0	36.5	.2
51	S. Fork Clearwater R. at Stites	13338500	46°05'12"/115°58'32"	400	5	2.19	3,016	.3	19.0	3.9	76.4	.4
52	Palouse R. nr Potlatch	13345000	46°54'55"/116°57'00"	748	4	3.02	822	.4	23.6	.9	75.0	.1
53	Bear R. at Idaho-Utah State Line	10092700	42°00'47"/111°55'14"	1,845	6	3.59	5,139	.6	29.5	37.1	23.3	9.7
54	Snake R. at King Hill	13154500	43°00'08"/115°12'06"	760	7	4.31	92,941	.6	20.2	50.2	22.6	6.4
55	Snake R. at Flagg Ranch, Wyo.	13010065	44°05'21"/110°41'38"	2,073	4	.06	1,324	0	0	8.6	82.8	8.6
56	Snake R. nr Buhl	13094000	42°39'58"/114°42'41"	900	7	4.67	76,104	.7	21.3	45.8	25.4	6.8

Table 1. Basin and site characteristics for all sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Site No.	Site name	Ecoregions (in percent): Columbia Plateau	Blue Mountains	Snake River Basin/ High Desert	Central Basin and Range	Northern Rockies	Montana Valley and Foothill Prairies	Middle Rockies	Wyoming Basin	Wasatch and Uinta Mountains	Canadian Rockies	Northern Basin and Range
1	Kootenai R. at Porthill	0	0	0	0	95.9	0	0	0	0	3.4	0
2	Clark Fork R. below Cabinet Gorge Dam	0	0	0	0	59.0	16.8	0	0	0	24.1	0
3	Priest R. nr Priest R.	0	0	0	0	100	0	0	0	0	0	0
4	N. Fork Coeur d'Alene R. at Enaville	0	0	0	0	100	0	0	0	0	0	0
5	S. Fork Coeur d'Alene R. nr Pinehurst	0	0	0	0	100	0	0	0	0	0	0
6	St Joe R. at Calder	0	0	0	0	100	0	0	0	0	0	0
7	Spokane R. nr Post Falls	0	2.9	32.6	17.6	10.1	.1	12.8	1.9	1.5	0	20.6
8	Snake R. nr Heise	0	0	.2	.2	0	0	98.8	.8	0	0	0
9	Snake R. at Lorenzo	0	0	.8	.2	0	0	98.2	.8	0	0	0
10	Teton R. nr St Anthony	0	0	52.5	0	0	0	47.5	0	0	0	0
11	Henrys Fork nr Rexburg	0	0	39.8	0	0	.4	59.8	0	0	0	0
12	Willow Cr. nr Ririe	0	0	12.7	65.0	0	0	22.2	0	0	0	0
13	Blackfoot R. nr Blackfoot	0	0	9.3	77.1	0	0	13.6	0	0	0	0
14	Snake R. nr Blackfoot	0	0	23.9	10.7	0	.1	64.9	.4	0	0	0
15	Portneuf R. at Topaz	0	0	0	100	0	0	0	0	0	0	0
16	Marsh Cr. nr McCammon	0	0	0	100	0	0	0	0	0	0	0
17	Portneuf R. at Pocatello	0	0	.5	99.5	0	0	0	0	0	0	0
18	Snake R. nr Minidoka	0	0	32.5	25.2	0	.1	41.9	.2	0	0	0
19	Snake R. at Milner	0	0	38.8	25.5	0	.1	35.4	.2	0	0	0
20	Snake R. nr Kimberly	0	0	40.0	25.0	0	.1	34.6	.2	0	0	.1
21	Blue Lakes Spring	0	0	100	0	0	0	0	0	0	0	0
22	Rock Cr. at Daydream Ranch	0	0	42.0	27.0	0	0	0	0	0	0	31.0
23	Box Canyon Springs	0	0	100	0	0	0	0	0	0	0	0
24	Salmon Falls Cr. nr Hagerman	0	0	3.5	31.5	0	0	0	0	0	0	65.0
25	Camas Cr. at Red Road	0	0	28.2	0	0	.1	71.7	0	0	0	0
26	Beaver Cr. at Spencer	0	0	3.3	0	0	29.5	67.1	0	0	0	0
27	Big Lost R. nr Chilly	0	0	0	0	100	0	0	0	0	0	0
28	Big Wood R. nr Bellevue	0	0	11.7	0	88.3	0	0	0	0	0	0
29	Silver Cr. nr Picabo	0	0	100	0	0	0	0	0	0	0	0
30	Malad R. nr Gooding	0	0	64.9	0	35.1	0	0	0	0	0	0
31	Bruneau R. nr Hot Spring	0	0	6.6	19.5	0	0	0	0	0	0	73.9
32	Snake R. nr Murphy	0	0	39.6	22.9	5.7	.1	18.3	2.7	2.1	0	8.4
33	Boise R. nr Twin Springs	0	0	0	0	100	0	0	0	0	0	0
34	Boise R. below Diversion Dam	0	0	23.2	0	76.8	0	0	0	0	0	0
35	Boise R. at Glenwood Bridge	0	0	28.3	0	71.7	0	0	0	0	0	0
36	Boise R. nr Parma	0	0	47.2	0	52.8	0	0	0	0	0	0
37	Snake R. at Nyssa	0	0	33.9	19.0	7.4	.1	13.8	2.1	1.6	0	22.1
38	S. Fork Payette R. at Lowman	0	0	0	0	100	0	0	0	0	0	0
39	N. Fork Payette R. at McCall	0	0	0	0	100	0	0	0	0	0	0
40	N. Fork Payette R. at Cascade	0	8.3	0	0	91.7	0	0	0	0	0	0
41	Payette R. nr Payette	0	17.5	13.5	0	69.0	0	0	0	0	0	0
42	Weiser R. nr Weiser	0	97.7	2.3	0	0	0	0	0	0	0	0
43	Snake R. at Weiser	0	0	23.4	4.1	0	.1	71.9	.4	0	0	0
44	Pahsimeroi R. at Ellis	0	0	47.0	0	53.0	0	0	0	0	0	0
45	Salmon R. at Salmon	0	0	27.5	0	69.4	.2	2.9	0	0	0	0
46	Lemhi R. nr Lemhi	0	0	41.0	0	41.7	1.4	16.0	0	0	0	0
47	Johnson Cr. at Yellow Pine	0	0	0	0	100	0	0	0	0	0	0
48	Little Salmon R. at Riggins	0	58.9	0	0	41.1	0	0	0	0	0	0
49	Snake R. nr Anatone, WA	2.1	12.3	25.3	12.5	18.6	.1	9.3	1.4	1.1	0	17.3
50	Lapwai Cr. nr Lapwai	76.8	23.2	0	0	0	0	0	0	0	0	0
51	S. Fork Clearwater R. at Stites	21.2	0	0	0	78.8	0	0	0	0	0	0
52	Palouse R. nr Potlatch	15.6	0	0	0	84.4	0	0	0	0	0	0
53	Bear R. at Idaho-Utah State Line	0	0	0	35.5	0	0	6.7	41.8	16.0	0	0
54	Snake R. at King Hill	0	0	45.2	17.9	7.9	.2	24.2	.1	0	0	4.5
55	Snake R. at Flagg Ranch	0	0	0	0	0	0	100	0	0	0	0
56	Snake R. nr Buhl	0	0	43.9	19.6	5.7	.2	29.5	.2	0	0	.9

instantaneous water temperature and a maximum of 19°C daily average temperature for the protection of coldwater biota beneficial use (Idaho Department of Health and Welfare, accessed August 2000, online). Waters designated for coldwater biota beneficial use have characteristics that support the maintenance and propagation of coldwater-adapted fish and other aquatic life. According to a presettlement account by Gilbert and Evermann (1895), salmon spawned in most of the large rivers in southern Idaho, indicating that suitable conditions existed to support coldwater aquatic life. For several of the large rivers in Idaho, this is no longer true (Idaho Department of Health and Welfare, 1995).

Rivers in forested and rangeland basins are typified by coarse substrate (gravel and cobbles), high-gradient habitats, and sparse macrophyte growth. In general, the spring sites sampled had relatively fine substrate (sand and gravel), low gradients, and abundant macrophyte growth. Large rivers (larger than sixth order) in agricultural basins typically have fine-grained substrate, low gradients, and abundant macrophyte growth.

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DATA COLLECTION METHODS

Forty sites were selected for macroinvertebrate sampling from a network of 56 sites. Macroinvertebrate sampling and habitat surveys were conducted during base-flow conditions in summer and fall 1996 through 1998 (fig. 2, table 2). Representative reaches for each site were selected on the basis of criteria outlined by Meador and others (1993). Reach lengths varied with stream size (table 2) and usually contained repeating geomorphic channel units of riffles, runs, or pools.

Macroinvertebrate Collection and Processing

QMH and RTH macroinvertebrate samples were collected and processed using procedures described in a report by Cuffney and others (1993). At each site, qualitative samples were collected from all accessible instream habitats and composited to form a single QMH sample. QMH samples were collected using a D-frame kick net equipped with a 210-μm-mesh net. Handpicking and scraping of large substrate such as wood snags, macrophytes, and large rocks also supplemented this sample type. The effort generally consisted of two people spending about 1 hour of collection time within a reach. An effort was made to sample each habitat type for an amount of time proportional to the relative abundance of macroinvertebrates in the stream reach. The QMH sample provided a comprehensive estimate of the variety of taxa present at each site. Five separate RTH samples (total area of 1.25 m^2) were collected from one or more riffles and composited to form a single RTH sample at each of the 40 sites. The RTH samples were collected using a 0.25-m^2 Slack rectangular kick net (0.5 m wide and 0.25 m high) equipped with a 425-μm-mesh net (Cuffney and others, 1993). The sampling area was delineated by a metal frame attached to the front of the sampler. Large gravel and cobbles within each 0.25-m^2 area were brushed to dislodge organisms, then this entire area was disturbed by kicking for 30 seconds. Samples were collected in upstream order to prevent disturbance of the streambed prior to sampling.

Onsite processing consisted of elutriation of each sample by repeated washing with a 425-μm-mesh sieve. Large substrate and other organic debris such as large leaves and twigs were removed. The composited samples were placed in labeled, 1-L plastic jars; fixed with 10-percent-buffered formalin, and shipped to the contract laboratory, Aquatic Biology Associates, Inc., Corvallis, Oregon, for taxonomic processing.

In the laboratory, a minimum of 500 organisms were randomly subsampled using a tray marked with a series of grids. Organisms were sorted, identified, and enumerated by experienced technicians using a dissecting scope at 6X or 12X power. A large-rare search of organisms was done after sorting, and these organisms were added to the sample total. A sorting efficiency of 95 percent or better was maintained by a random check on at least 10 percent of the samples. Standard bench sheets were used to record the counts, and these were transferred to electronic files (Aquatic Biology Associates, Inc., accessed April 2000, online). All taxonomic data were tabulated and reported for each site by sample type (table A, back of report). Selected taxa were retained for voucher specimens and deposited in the Orma J. Smith Museum of Natural History, Albertson College, Caldwell, Idaho.

Macroinvertebrate Onsite and Laboratory Quality Assurance

So that taxonomic consistency among laboratories could be compared, composite samples were split onsite at three sites to evaluate intra- and interlaboratory precision for QMH and RTH samples (table B, back of report). One of each of the sample splits was sent to the contract laboratory, and the other was sent to the USGS National Water Quality Laboratory in Denver, Colorado, for processing.

Generally, the intralaboratory sample comparisons for the contract lab showed an acceptable level of precision. Intralaboratory comparisons were made for two RTH samples (sites 21 and 26, table B). Relative differences in total number of taxa for these sites were 12 and 11 percent, respectively. Relative differences in abundance (individuals/m^2) were 31 and 23 percent, respectively. EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa differed by only one taxon for both sites, 4 versus 5 (site 21) and 23 versus 24 (site 26). The final IRI scores were identical for both intralaboratory comparisons.

Interlaboratory duplicate sample comparisons for QMH and RTH samples were variable. Relative differences in total number of taxa and EPT taxa for the only QMH sample split (site 21) were 6 and 40 percent, respectively. The relative differences should be interpreted with caution, especially with low numbers of taxa, which can greatly influence this statistic. The QMH comparison for site 21 showed differences in the level of taxonomic resolution reported by each laboratory. For example, the contract laboratory reported the New Zealand mud snail to species level (*Potamopyrgus antipodarum*), whereas the USGS laboratory assigned these to the family Hydrobiidae. The contract lab also assigned many of the gastropods to a lower level of taxonomy. This is likely due to the contract laboratory personnel having more knowledge of local and regional species occurrences and taxonomy.

Interlaboratory sample comparison showed the greatest variability for the RTH split sample—relative differences in total number of taxa and EPT taxa were 71 and 91 percent, respectively. Again, the level of taxonomy reported from each laboratory is the primary reason for these higher percent differences. The main discrepancy between these samples was the absence of chironomid taxa in the sample processed by the contractor. The lack of chironomid taxa in this sample was probably the result of the unusually high abundance of Hydropsyche (more than 34,000/m^2) that were counted before chironomid larvae were encountered in the subsampling grids. Also, because of the small size of these taxa, they would not have been selected as part of the large-rare search upon completion of the subsampling (Bob Wisseman, Aquatic Biology Associates, Inc., Corvallis, Oregon, oral commun., 2000). The relative difference in RTH abundance (individuals/m^2) between laboratories was 50 percent, somewhat larger than the intralaboratory comparisons. Even though there were large differences in the total number of taxa and EPT taxa, the IRI scores for split samples (IRI scores of 11 and 5) both indicated poor habitat condition (IRI score less than or equal to 13).

The large interlaboratory differences indicate the importance of using the same laboratory for consistency in taxonomic determinations and also of standardizing the resolution required for determination of metric values used to calculate biotic indices such as the IRI. In contrast, intralaboratory variations did not significantly affect the IRI scores. These quality assurance samples provide valuable information about the performance standards of laboratories and should continue be a vital part of the monitoring program to ensure the integrity of the taxonomic data.

Table 2. Habitat characteristics for macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[Site locations shown in fig. 2; No., number; m, meters; m^3/s, cubic meters per second; m/s, meters per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; °C, degrees Celsius; N., north; R., river; S., south; nr, near; Cr., creek; (H), high-quality site; (L), low-quality site; Site type: F, forested; A, agricultural; R, rangeland; LR, large river; S, spring; e, estimated value from discharge measurement]

Site No.	Site name	Sample date	Site type	Reach length (m)	Stream depth[1] (m)	Stream width (m)	Discharge (m^3/s)	Stream velocity[1] (m/s)	Specific conductance (µS/cm)	Percent open canopy[1]	Percent substrate fines[1]
4	N. Fork Coeur d'Alene R. at Enaville (H)	6/16/98	F	479	0.30	61	42.20	0.98	43	68	0
5	S. Fork Coeur d'Alene R. nr Pinehurst	6/18/98	F	292	.18	19	14.16	.92	162	16	10
6	St Joe R. at Calder (H)	7/8/98	F	899	.25	80	39.65	.79	54	30	0
7	Spokane R. nr Post Falls (L)	8/3/98	F	973	.25	55	31.15	.62	53	29	0
8	Snake R. nr Heise (H)	9/12/96	F	940	.22	110	267.62	.62	311	23	10
10	Teton R. nr St Anthony	9/11/96	A	800	.19	e50	21.01	.70	335	26	0
11	Henrys Fork nr Rexburg	8/6/96	A	730	.30	74	41.91	.39	196	6	45
12	Willow Cr. nr Ririe	8/7/96	R	150	.31	e5	1.22	.44	409	25	15
13	Blackfoot R. nr Blackfoot (L)	8/7/96	A	200	.28	14	4.19	.81	320	31	10
14	Snake R. nr Blackfoot	9/10/96	LR	885	.31	e90	64.43	.64	321	9	5
15	Portneuf R. at Topaz (L)	8/14/96	A	351	.21	25	4.19	.74	727	9	25
16	Marsh Cr. nr McCammon	8/13/96	A	160	.22	10	1.30	.17	780	35	30
17	Portneuf R. at Pocatello (L)	8/8/96	A	320	.15	12	2.92	.61	632	72	5
18	Snake R. nr Minidoka (L)	7/30/96	LR	515	.48	e119	286.03	.69	333	3	10
21	Blue Lakes Spring	7/31/96	S	187	.26	e22	4.53	.35	653	55	5
22	Rock Cr. at Daydream Ranch	7/29/96	A	236	.36	e15	4.13	.94	655	59	20
25	Camas Cr. at Red Road	7/8/97	R	194	.27	19	2.77	.44	149	13	15
26	Beaver Cr. at Spencer	7/8/97	R	155	.21	9	.84	.65	426	8	5
27	Big Lost R. nr Chilly (H)	8/4/96	R	303	.20	17	6.51	.46	194	47	5
28	Big Wood R. nr Bellevue (H)	7/23/97	R	321	.24	30	11.33	.91	251	22	5
29	Silver Cr. nr Picabo	7/24/97	S	232	.42	16	3.77	.31	369	9	35
30	Malad R. nr Gooding (L)	7/15/97	A	209	.27	22	7.08	.74	311	20	30
31	Bruneau R. nr Hot Spring	7/10/97	R	246	.32	24	12.40	.83	122	22	20
32	Snake R. nr Murphy (L)	7/16/97	LR	574	.21	141	225.14	.85	393	48	5
33	Boise R. nr Twin Springs (H)	9/3/97	F	438	.17	38	15.21	.85	80	24	5
35	Boise R. at Glenwood Bridge	9/11/97	R	314	.22	45	25.77	.74	78	57	15
37	Snake R. at Nyssa (L)	8/6/97	LR	1,120	.25	187	324.55	.64	468	6	5
38	S. Fork Payette R. at Lowman (H)	8/31/98	F	465	.15	55	13.03	.60	85	41	0
41	Payette R. nr Payette	8/7/97	A	728	.22	87	50.13	.99	162	19	5
42	Weiser R. nr Weiser	7/14/97	A	250	.21	63	10.76	.54	121	18	5
44	Pahsimeroi R. at Ellis (H)	9/1/98	R	201	.14	21	5.41	.75	383	29	0
45	Salmon R. at Salmon (H)	9/1/98	R	777	.20	100	28.89	1.60	255	30	0
46	Lemhi R. nr Lemhi (H)	9/2/98	R	230	.16	14	4.02	.62	513	74	2
47	Johnson Cr. at Yellow Pine (H)	9/3/98	F	322	.26	20	2.80	1.78	92	78	0
48	Little Salmon R. at Riggins (H)	9/17/98	F	310	.23	22	8.35	.52	146	38	4
50	Lapwai Cr. nr Lapwai (L)	9/15/98	A	150	.17	36	.27	.45	311	51	0
51	S. Fork Clearwater R. at Stites	9/16/98	F	510	.17	43	5.66	.51	65	34	0
52	Palouse R. nr Potlatch (L)	9/15/98	A	195	.13	11	.20	.55	83	37	0
53	Bear R. at Idaho-Utah State Line (L)	8/15/96	A	300	.25	e35	12.04	.31	840	5	20
56	Snake R. nr Buhl (L)	7/30/97	LR	1,285	.26	127	104.78	.60	549	31	15

Environmental Variables

Site characterization was based on a tiered design that incorporated information at various spatial scales (Meador and others, 1993). A variety of environmental variables consisting of basin, reach, and instream habitat characteristics were evaluated for each site (tables 1 and 2). Several sources were used to construct geographic data layers for some characteristics. Basin size, ecoregion, land use, and stream order were determined using ArcView, a GIS application. Basin boundaries were delineated using the hydrography and hydrologic unit boundary data layers (U.S. Geological Survey, 1975). Ecoregions were determined from a report by Omernik and Gallant (1986). Land use was modified

Table 2. Habitat characteristics for macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Site No.	Site name	Sample date	Percent substrate embeddedness[1]	Stream gradient	Dissolved oxygen (mg/L)	Dissolved oxygen saturation (percent)	pH (standard units)	Maximum water temperature[2] (°C)	Habitat quality index (percent)[3]
4	N. Fork Coeur d'Alene R. at Enaville (H)	6/16/98	0	0.02	10.4	116	7.6	21.9	84
5	S. Fork Coeur d'Alene R. nr Pinehurst	6/18/98	15	.01	14.0	140	7.3	23.7	68
6	St. Joe R. at Calder (H)	7/8/98	15	.06	10.1	113	7.4	23.1	78
7	Spokane R. nr Post Falls (L)	8/3/98	15	.18	8.8	115	7.7	27.1	72
8	Snake R. nr Heise (H)	9/12/96	15	.36	8.7	104	8.0	16.9	96
10	Teton R. nr St. Anthony	9/11/96	12	.19	9.1	106	8.3	21.0	79
11	Henrys Fork nr Rexburg	8/6/96	50	.02	8.5	99	8.0	24.4	59
12	Willow Cr. nr Ririe	8/7/96	0	.26	10.3	110	8.3	16.0	71
13	Blackfoot R. nr Blackfoot (L)	8/7/96	37	.34	8.7	103	8.2	25.4	62
14	Snake R. nr Blackfoot	9/10/96	15	.07	10.5	128	8.5	25.1	67
15	Portneuf R. at Topaz (L)	8/14/96	25	.35	7.0	88	7.8	24.9	32
16	Marsh Cr. nr McCammon	8/13/96	50	.07	8.0	99	8.1	24.4	38
17	Portneuf R. at Pocatello (L)	8/8/96	0	.49	8.7	105	8.3	24.8	53
18	Snake R. nr Minidoka (L)	7/30/96	15	.01	8.3	110	8.7	23.6	68
21	Blue Lakes Spring	7/31/96	0	.10	9.4	108	7.7	17.8	92
22	Rock Cr. at Daydream Ranch	7/29/96	50	.92	10.4	124	8.2	21.6	70
25	Camas Cr. at Red Road	7/8/97	25	.17	12.2	175	8.6	22.9	54
26	Beaver Cr. at Spencer	7/8/97	25	.62	8.8	100	8.4	21.4	79
27	Big Lost R. nr Chilly (H)	8/4/96	15	.57	12.0	132	8.1	17.3	81
28	Big Wood R. nr Bellevue (H)	7/23/97	15	.55	8.3	96	7.8	21.8	61
29	Silver Cr. nr Picabo	7/24/97	50	.10	8.4	104	7.8	22.3	85
30	Malad R. nr Gooding (L)	7/15/97	63	1.64	7.7	101	8.6	28.2	53
31	Bruneau R. nr Hot Spring	7/10/97	15	.65	9.8	117	8.2	28.2	67
32	Snake R. nr Murphy (L)	7/16/97	25	.04	11.7	147	8.3	26.8	69
33	Boise R. nr Twin Springs (H)	9/3/97	15	.34	10.2	120	7.5	22.9	75
35	Boise R. at Glenwood Bridge	9/11/97	25	.36	8.7	102	7.4	19.7	67
37	Snake R. at Nyssa (L)	8/6/97	50	.08	10.3	131	8.1	26.9	61
38	S. Fork Payette R. at Lowman (H)	8/31/98	15	.83	9.0	102	7.8	19.3	67
41	Payette R. nr Payette	8/7/97	25	.25	9.7	119	7.9	27.3	52
42	Weiser R. nr Weiser	7/14/97	25	.12	9.0	109	8.1	29.0	63
44	Pahsimeroi R. at Ellis (H)	9/1/98	15	.18	9.8	107	8.2	20.1	91
45	Salmon R. at Salmon (H)	9/1/98	15	.57	9.2	113	8.5	22.4	68
46	Lemhi R. nr Lemhi (H)	9/2/98	15	.82	8.7	96	8.1	18.0	73
47	Johnson Cr. at Yellow Pine (H)	9/3/98	10	1.20	9.1	97	7.8	18.0	82
48	Little Salmon R. at Riggins (H)	9/17/98	25	1.90	9.1	101	8.5	20.5	63
50	Lapwai Cr. nr Lapwai (L)	9/15/98	25	.97	8.5	105	8.8	29.1	73
51	S. Fork Clearwater R. at Stites	9/16/98	25	.59	9.1	100	7.9	26.9	77
52	Palouse R. nr Potlatch (L)	9/15/98	50	.09	7.2	85	7.7	29.2	59
53	Bear R. at Idaho-Utah State Line (L)	8/15/96	35	.04	8.4	111	8.3	25.1	17
56	Snake R. nr Buhl (L)	7/30/97	50	.07	8.3	101	8.5	22.1	53

[1]Average measurements taken at each riffle collection site.

[2]From continuous records, July-September 1996–98.

[3]Scores calculated using reports by Plafkin and others (1989); Hayslip (1993).

from 1:250,000-scale digital data (U.S. Geological Survey, 1986) consisting of Anderson levels I and II land-use classifications at a 16-ha mapping resolution (Anderson and others, 1976). Land use consisted of agricultural land (including pasture land), rangeland, forested land, urban land, and other (water bodies, barren rock, and tundra). Population density for each basin was calculated from digital data available on the World Wide Web (U.S. Geological Survey, digital map file of 1990 population and housing data for the United States, accessed April 2000, online). Stream elevation, latitude, and longitude were determined from 1:24,000-scale topographic maps. Basin size and land use for springs could not be determined from maps because of the small size of springs and so were estimated on the basis of onsite observation.

Stream habitat characterization included data on reach length, stream depth, wetted stream width, discharge, stream velocity, specific conductance, percent open canopy, percent substrate fines, percent substrate embeddedness, stream gradient, dissolved oxygen, percent dissolved oxygen saturation, pH, maximum water temperature, and habitat quality index (HQI) (table 2). Stream width usually was determined at 3 to 5 equally spaced points within the reach. In a few cases, this measurement had to be estimated from discharge records. Discharge was estimated using information from continuous records collected at USGS gaging stations. Onsite parameters were determined following guidelines described by Wilde and Radtke (1998). Upon each site visit, instantaneous specific conductance and water temperature were measured using a calibrated Orion model 122 meter. Stream gradient was determined using 7.5-minute topographic maps. Dissolved oxygen and percent dissolved oxygen saturation were measured with a calibrated Orion model 260 dissolved oxygen meter. A calibrated Orion model 250A pH meter was used to measure pH. Maximum summer (July–September) water temperatures were determined by selecting the highest temperature recorded at a site using temperature data loggers manufactured by Onset Computer Corporation. Loggers were placed instream following procedures reported by Stevens and others (1975) and were preset to record continuous hourly water temperature. Information on instream and riparian variables was collected and summarized using the qualitative HQI developed by USEPA (Plafkin and others, 1989; Hayslip, 1993). HQI values were expressed as a percentage of the total maximum score.

Instream habitat data were collected according to methods presented by Meador and others (1993) and Platts and others (1983). These data included measurements of percent open canopy, percent substrate fines, percent embeddedness of substrate, water depth, and water velocity. Measurements were made in association with macroinvertebrate collection at each riffle site. Percent open canopy for left and right banks at each collection site was estimated using a clinometer. Percent substrate fines and percent embeddedness were estimated visually to the nearest 10 percent. Percent substrate fines were defined as those particles less than 2 mm in diameter (sand or smaller particles). Water depth was measured at each riffle collection site, and velocity was estimated at 0.6 of the depth using a Marsh-McBirney meter. A mean value was calculated to represent those habitat variables that were measured multiple times. Photographs were taken of all reaches and specific riffle habitats were sampled.

ANALYTICAL METHODS

General Approach

The diverse range of stream types composing Idaho's SWQP and the limited number of sampling sites distributed throughout Idaho (40 total) made it difficult to focus on questions relating to specific geographic areas. Therefore, the analysis focused on identifying general patterns and relations by using graphic displays of various macroinvertebrate metrics and exploratory multivariate statistical tools. Multimetric analyses incorporate more descriptive ecological information, whereas multivariate analyses are based on statistical algorithms.

Multivariate analyses of macroinvertebrate assemblage and environmental data consisted of principal components analysis (PCA), detrended correspondence analysis (DCA), and canonical correspondence analysis (CCA). Each of these exploratory tools provided both graphical and correlative statistics to evaluate the data. PCA was used to summarize subsets of environmental data by identifying groups of variables that were highly correlated. PCA also was used to evaluate relations among macroinvertebrate metrics. DCA was used to identify major patterns in macroinvertebrate assemblages and to determine whether the species data generally followed a unimodal pattern for further analysis by CCA (Gauch, 1982). CCA was used to evaluate the degree to which environmental variables were associated with macroinvertebrate taxa and abundances. This final analysis provided a summary of the most important relations among measured environmental variables and macroinvertebrate taxa collected for all sites. Multimetric and multivariate analyses will be explained in more detail in the sections "Macroinvertebrate Assemblages and Metrics" and "Multivariate Analyses."

Preliminary analysis revealed that macroinvertebrate assemblages did not correspond to ecoregions upstream from the sampling sites. This was not surprising because most sampling sites are large rivers that drain areas representing a mixture of ecoregions (table 1). Furthermore, according to Norris (1995), evidence suggests that macroinvertebrate assemblages are controlled more by local, rather than regional, conditions.

To facilitate data analysis, each sampling site was categorized into distinct site types on the basis of stream size and a priori classification of percentages of agricultural land, forested land, and rangeland upstream from each site (table 2). Generally, irrigated agriculture and row crop production comprised more than 10 percent of the land use in basins represented by agricultural site types; rangeland comprised more than 40 percent of the land use in basins represented by rangeland site types; and forested land comprised more than 60 percent of the land use in basins represented by forested land site types. Maret (1997) found that fish assemblages in the upper Snake River Basin corresponded to these environmental variables. Large-river sites (larger than sixth order) were combined into a separate large-river group because aquatic assemblages in large rivers are known to differ substantially from those in smaller streams (Vannote and others, 1980). In addition, two sites were assigned to a spring category because of their small size and proximity to spring sources.

RTH and QMH samples collected at each sampling site were compared to evaluate whether sampling methods provided different information that may be useful in water-quality studies. This type of evaluation is important because if only one sampling method is required to assess water quality, monitoring costs can be reduced. The results of this comparison revealed little difference between sample types. In addition, semi-quantitative (RTH) samples targeted riffle areas, which effectively normalized this habitat sampled across all sites and made site comparison more appropriate. For these reasons, RTH samples (summarized in table 3) were used in all subsequent metric and multivariate analyses.

IRI scores for each site were calculated using the metrics percent dominant taxon, total number of taxa, EPT taxa, percent Elmidae, and percent predators (Grafe, 2000). Comparison of IDEQ's IRI with the 1996–98 data sets consisted of selecting a subset of least- (high-quality) and most- (low-quality) disturbed sites by using various indicators of human disturbance. Generally, streams larger than fourth order were selected for this comparison to reduce the influence of stream size. A few additional metrics—percent coldwater taxa, number of coldwater taxa, and abundance—also were included in the data analysis to offer additional information useful for evaluating macroinvertebrate data. These additional metrics have been found to be useful for evaluating fish or macroinvertebrate assemblages in Western rivers (Maret, 1997; Mullins, 1999; Zaroban and others, 1999). The selected metrics were evaluated using boxplots and correlation matrices and by statistically testing medians between least- and most-disturbed sites. Metrics also were evaluated using multivariate analyses to examine site patterns and relations with land use.

Macroinvertebrate Assemblages and Metrics

Prior to analysis, ambiguous taxa were removed from the data matrix to avoid overestimating taxa richness and diversity as a result of problems associated with taxonomic processing. The taxonomic contractor assisted with this process. Ambiguous taxa occur when the parent (next-highest taxonomic level) of a taxon exists in the data set. This happens most frequently when members of a genus either are too immature or damaged to be identified to species at one or more sites. This ambiguity was resolved by combining the species with the genus for all sites. In some cases, when the genus was reported but the species were very abundant, the genus either was dropped or its abundance was distributed among the species. If the ambiguity involved a single genus and species, the genus usually was reclassified to the species level. The resulting taxonomic data set provides consistency in the level of identification for all sites and increases the validity of comparisons among sites.

Macroinvertebrate assemblage data were summarized on the basis of eight metrics (table 4). These metrics consisted of the five metrics used to calculate the IRI (percent dominant taxon, total number of taxa, EPT taxa, percent Elmidae, and percent predators) and an additional three metrics (abundance, percent coldwater taxa, and number of coldwater taxa) that were considered to be useful for evaluating the data. Characteristics of an effective metric for measuring human disturbance include (1) relevance to the assemblage and sites being studied, (2) sensitivity to human stressors, (3) low natural variability but large response to human stressors, and (4) sampling cost effectiveness (Fore and others, 1996; Karr and Chu, 1997).

The following definitions of metrics making up the IRI and their responses to human disturbance were taken primarily from a report by Grafe (2000). Percent dominant taxon is the relative abundance of the most

Table 3. Relative total abundances and occurrence of taxa in richest targeted habitat (riffle) samples collected from 40 macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[Coldwater taxa are shaded; taxa in alphabetical order and grouped by major taxonomic categories; Abundant, greater than 1 percent of total abundance and greater than or equal to 75 percent occurrence; Common, less than 1 percent but greater than or equal to 0.005 percent of total abundance, and greater than 5 percent but less than 75 percent occurrence; Rare, less than 0.005 total abundance and less than 5 percent occurrence; No., number]

Taxon	Abundant	Common	Rare	Total abundance[1]	Percent abundance	No. of sites where taxon was collected	Percent occurrence
Noninsect							
Acari		X		2,909	0.759	29	72.5
Ferrissia		X		43	.011	2	5.0
Fluminicola		X		4,969	1.297	10	25.0
Gammarus		X		1,517	.396	2	5.0
Gonidea angulata			X	2	.001	1	2.5
Gyraulus		X		341	.089	2	5.0
Helisoma anceps		X		21	.005	1	2.5
Hirudinea		X		126	.033	5	12.5
Hyalella azteca		X		31,028	8.101	6	15.0
Nematoda		X		750	.196	13	32.5
Oligochaeta	X			4,572	1.194	31	77.5
Ostracoda		X		52	.014	4	10.0
Pacifasticus		X		20	.005	2	5.0
Physella		X		231	.060	7	17.5
Porifera			X	12	.003	1	2.5
Potamopyrgus antipodarum		X		26,764	6.987	5	12.5
Pyrgulopsis		X		20	.005	1	2.5
Radix auricularia		X		66	.017	2	5.0
Sphaeriidae		X		437	.114	6	15.0
Stagnicola		X		436	.114	5	12.5
Turbellaria		X		1,371	.358	11	27.5
Valvata humeralis		X		107	.028	2	5.0
Vorticifex effusa		X		19	.005	1	2.5
Insect							
Odonata							
Argia		X		161	.042	3	7.5
Coenagrionidae			X	2	.001	1	2.5
Ophiogomphus		X		31	.008	2	5.0
Ephemeroptera							
Acentrella		X		5,835	1.523	24	60.0
Ameletus[2]		X		43	.011	4	10.0
Attenella margarita		X		291	.076	5	12.5
Baetidae		X		2,314	.604	8	20.0
Baetis tricaudatus	X			42,921	11.206	38	95.0
Barbaetis			X	5	.001	1	2.5
Caenis		X		360	.094	2	5.0
Caudatella[3]		X		171	.045	4	10.0
Centroptilum		X		9	.002	2	5.0
Choroterpes		X		19	.005	1	2.5
Cinygmula		X		365	.095	5	12.5
Diphetor hageni		X		342	.089	13	32.5
Drunella coloradensis/flavilinea		X		124	.032	3	7.5
Drunella doddsi[3]		X		334	.087	9	22.5
Drunella grandis/spinifera		X		320	.084	9	22.5
Epeorus		X		93	.024	4	10.0
Epeorus albertae		X		345	.090	6	15.0
Epeorus deceptivus[3]		X		552	.144	3	7.5
Epeorus grandis[3]		X		65	.017	3	7.5
Epeorus longimanus			X	12	.003	1	2.5
Ephemera			X	2	.001	1	2.5
Ephemerella aurivillii		X		23	.006	2	5.0
Ephemerella inermis/infrequens		X		6,760	1.765	19	47.5
Ephoron		X		38	.010	1	2.5
Heptagenia/Nixe		X		638	.167	12	30.0
Paraleptophlebia		X		1,288	.336	12	30.0
Paraleptophlebia bicornuta			X	8	.002	1	2.5

Table 3. Relative total abundances and occurrence of taxa in richest targeted habitat (riffle) samples collected from 40 macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Taxon	Abundant	Common	Rare	Total abundance[1]	Percent abundance	No. of sites where taxon was collected	Percent occurrence
Ephemeroptera—Continued							
Rhithrogena		X		3,833	1.001	22	55.0
Serratella		X		475	.124	6	15.0
Stenonema		X		672	.175	9	22.5
Tricorythodes		X		201	.052	2	5.0
Tricorythodes minutus		X		11,221	2.930	21	52.5
Plecoptera							
Calineuria californica		X		54	.014	5	12.5
Chloroperlidae		X		264	.069	7	17.5
Claassenia sabulosa		X		189	.049	9	22.5
Doroneuria[2]			X	7	.002	1	2.5
Hesperoperla pacifica		X		543	.142	11	27.5
Isogenoides		X		44	.011	1	2.5
Isoperla		X		2,672	.698	16	40.0
Perlodidae		X		153	.040	10	25.0
Pteronarcella		X		179	.047	5	12.5
Pteronarcys californica		X		123	.032	6	15.0
Skwala		X		81	.021	4	10.0
Sweltsa		X		142	.037	3	7.5
Zapada cinctipes		X		119	.031	6	15.0
Trichoptera							
Amiocentrus aspilus		X		78	.020	3	7.5
Apatania[2]		X		10	.003	2	5.0
Arctopsyche grandis		X		842	.220	9	22.5
Brachycentrus americanus		X		753	.197	12	30.0
Brachycentrus occidentalis		X		11,077	2.892	22	55.0
Ceraclea		X		19	.005	1	2.5
Cheumatopsyche		X		6,789	1.772	15	37.5
Chimarra			X	12	.003	1	2.5
Culoptila		X		29	.008	2	5.0
Dicosmoecus gilvipes		X		10	.003	2	5.0
Dolophilodes		X		79	.021	2	5.0
Glossosoma		X		651	.170	10	25.0
Helicopsyche borealis		X		564	.147	5	12.5
Hydropsyche	X			90,195	23.548	39	97.5
Hydroptila		X		2,991	.781	13	32.5
Lepidostoma-sand case larvae		X		1,222	.319	10	25.0
Leucotrichia		X		817	.213	6	15.0
Micrasema		X		14	.004	2	5.0
Nectopsyche		X		81	.021	2	5.0
Neophylax rickeri		X		14	.004	3	7.5
Neotrichia		X		210	.055	2	5.0
Ochrotrichia		X		1,830	.478	9	22.5
Oecetis			X	2	.001	1	2.5
Onocosmoecus unicolor			X	15	.004	1	2.5
Polycentropus			X	6	.002	1	2.5
Protoptila		X		508	.133	4	10.0
Psychomyia		X		128	.033	3	7.5
Rhyacophila Angelita Group		X		40	.010	3	7.5
Rhyacophila Brunnea Group		X		24	.006	1	2.5
Rhyacophila Coloradensis Group		X		107	.028	6	15.0
Tinodes		X		120	.031	1	2.5
Wormaldia		X		36	.009	2	5.0
Lepidoptera							
Petrophila		X		3,773	.985	19	47.5
Coleoptera							
Brychius		X		49	.013	2	5.0
Cleptelmis		X		19	.005	2	5.0
Dubiraphia		X		64	.017	2	5.0
Dytiscidae		X		17	.004	3	7.5
Eubrianax edwardsi			X	7	.002	1	2.5
Gyrinidae		X		25	.007	1	2.5
Haliplus			X	2	.001	1	2.5
Heterlimnius		X		13	.003	2	5.0

Table 3. Relative total abundances and occurrence of taxa in richest targeted habitat (riffle) samples collected from 40 macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Taxon	Abundant	Common	Rare	Total abundance[1]	Percent abundance	No. of sites where taxon was collected	Percent occurrence
Coleoptera—Continued							
Hydrophilidae			X	8	0.002	1	2.5
Lara avara			X	14	.004	1	2.5
Microcylloepus		X		1,774	.463	13	32.5
Narpus		X		45	.012	3	7.5
Optioservus		X		7,134	1.862	26	65.0
Ordobrevia nubifera		X		146	.038	3	7.5
Peltodytes			X	2	.001	1	2.5
Psephenus		X		15	.004	3	7.5
Stenelmis		X		22	.006	1	2.5
Zaitzevia		X		1,510	.394	13	32.5
Diptera							
Antocha		X		899	.235	12	30.0
Atherix		X		464	.121	10	25.0
Blephariceridae[2]		X		162	.042	5	12.5
Brachycera			X	16	.004	1	2.5
Ceratopogoninae		X		79	.021	6	15.0
Chelifera		X		41	.011	3	7.5
Clinocera		X		8	.002	2	5.0
Cryptolabis			X	4	.001	1	2.5
Deuterophlebia[2]		X		25	.007	2	5.0
Dicranota		X		46	.012	2	5.0
Empididae		X		70	.018	5	12.5
Hemerodromia		X		157	.041	11	27.5
Hexatoma		X		211	.055	11	27.5
Limnophora			X	2	.001	1	2.5
Rhabdomastix[2]			X	5	.001	1	2.5
Simuliidae	X			19,453	5.079	35	87.5
Stratiomyidae		X		612	.160	2	5.0
Tanyderidae		X		15	.004	2	5.0
Tipula			X	3	.001	1	2.5
Tipulidae			X	4	.001	1	2.5
Chironomidae							
Apedilum			X	16	.004	1	2.5
Cardiocladius		X		2,133	.557	19	47.5
Chaetocladius			X	2	.001	1	2.5
Chironomidae-pupae	X			6,612	1.726	37	92.5
Cladotanytarsus		X		541	.141	7	17.5
Corynoneura		X		14	.004	2	5.0
Cricotopus	X			21,831	5.699	31	77.5
Cricotopus (Nostococladius)		X		18	.005	3	7.5
Cryptochironomus		X		98	.026	5	12.5
Diamesa		X		71	.019	5	12.5
Dicrotendipes		X		200	.052	4	10.0
Eukiefferiella	X			5,818	1.519	31	77.5
Hydrobaenus		X		27	.007	2	5.0
Limnophyes			X	4	.001	1	2.5
Micropsectra		X		307	.080	14	35.0
Microtendipes		X		457	.119	7	17.5
Nanocladius		X		38	.010	4	10.0
Odontomesa			X	12	.003	1	2.5
Orthocladiinae		X		126	.033	2	5.0
Orthocladius Complex	X			16,023	4.183	30	75.0
Pagastia		X		869	.227	9	22.5
Parachironomus			X	8	.002	1	2.5
Paracladius			X	2	.001	1	2.5
Parakiefferiella		X		120	.031	1	2.5
Parametriocnemus		X		134	.035	4	10.0
Paraphaenocladius		X		170	.044	3	7.5
Paratanytarsus		X		615	.161	7	17.5
Pentaneura		X		164	.043	3	7.5
Phaenopsectra		X		46	.012	3	7.5
Polypedilum		X		3,665	.957	24	60.0
Potthastia Gaedii Group		X		78	.020	3	7.5

Table 3. Relative total abundances and occurrence of taxa in richest targeted habitat (riffle) samples collected from 40 macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Taxon	Abundant	Common	Rare	Total abundance[1]	Percent abundance	No. of sites where taxon was collected	Percent occurrence
Chironomidae—Continued							
Potthastia Longimana Group		X		79	0.021	2	5.0
Pseudochironomus		X		188	.049	1	2.5
Rheocricotopus		X		48	.013	3	7.5
Rheotanytarsus		X		3,652	.953	21	52.5
Saetheria			X	8	.002	1	2.5
Stempellinella		X		20	.005	4	10.0
Synorthocladius		X		158	.041	2	5.0
Tanytarsus		X		58	.015	2	5.0
Thienemanniella		X		187	.049	12	30.0
Thienemannimyia Group		X		652	.170	16	40.0
Tvetenia		X		1,321	.345	18	45.0

[1]Individuals per square meter can be derived by dividing the total abundance by number of sites where taxon was collected.
[2]Coldwater taxa designation (Michael Edmondson, Idaho Department of Environmental Quality, written commun., 2000).
[3]Coldwater taxa designation (Bob Wisseman, Aquatic Biology Associates, Inc., and Gary Lester, Ecoanalysts, Inc., written and oral communs., 2000).

common taxon in the sample. It is a simple measure of assemblage balance. An increase in dominance is considered indicative of a decrease in the health of the assemblage and is associated with increased human disturbance. The total number of taxa (richness) measures the overall variety of macroinvertebrates in a sample. This metric is one of the most commonly used in biomonitoring. Increasing richness is thought to indicate increasing health of the assemblage. EPT taxa is the number of distinct taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These orders generally are considered to be intolerant of poor water quality. As with total number of taxa, this metric decreases with human disturbance. Percent Elmidae is the relative abundance of riffle beetles. This family of beetles is expected to decrease with increased human disturbance. Percent predators is the relative abundance of the functional feeding group, predators. The abundance of predators declines as human disturbance increases, owing to the decrease in abundance and diversity of prey.

IRI scores for each site were calculated using the approach outlined by Grafe (2000), whereby each metric was scored a 1, 3, or 5, except percent predators. Percent predators were downscaled and scored only a 1 or 3 because of this metric's weaker discriminatory power. IRI scores 16 or greater indicated a site with good biotic condition, scores 13 or less indicated poor biotic condition, and scores of 14 and 15 indicated intermediate condition.

The abundance metric is defined as the number of individuals per square meter (individuals/m^2). This metric has been used to evaluate fish food abundance and generally is thought to increase with increased nutrient enrichment as a result of human disturbance. It also may decrease as a result of severe pollution effects. Percent coldwater taxa and number of coldwater taxa were evaluated because of their potential to help evaluate coldwater habitats, which is one of the primary beneficial uses assigned to most waters in Idaho. Coldwater taxa designations (table A, back of report) were made using a data base compiled by IDEQ (M. Edmondson, Idaho Department of Environmental Quality, written commun., 2000), which was based on the literature and the criteria of a maximum instantaneous water temperature of 22°C and an average daily water temperature of 19°C. Regional experts also were consulted regarding temperature preferences (Bob Wisseman, Aquatic Biology Associates, Inc., Corvallis, Oregon; Gary Lester, EcoAnalyst, Moscow, Idaho, written and oral communs., 2000). The number and percent coldwater taxa generally are thought to decrease with increases in human disturbance.

The IRI was evaluated by first classifying an equal number of sites into high- or low-quality groups (12 sites in each group). To achieve a high degree of certainty in the categorization process, multiple measures of resource conditions were examined (table 2), including habitat quality scores, percent agricultural land, maximum water temperature, and professional judgment. For example, the HQI for high-quality sites gen-

Table 4. Macroinvertebrate metrics and invertebrate river index (IRI) scores for selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[QMH, qualitative multiple habitat; RTH, richest targeted habitat; metrics included in the IRI are shaded; No., number; EPT, Ephemeroptera, Plecoptera, and Trichoptera]

Site No.	Site name	QMH or RTH	Total abundance[1]	No. of cold-water taxa	Percent cold-water taxa	Percent dominant taxon	Total No. of taxa	EPT taxa	Percent Elmidae (riffle beetles)	Percent predators	IRI score
4	North Fork Coeur d'Alene River	QMH	3,300	2	4.18	20.36	59	26	3.83	14.08	23
	at Enaville	RTH	3,005	3	.83	28.59	50	27	3.52	3.2	21
5	South Fork Coeur d'Alene River	QMH	1,632	3	16.24	19.73	37	17	0	11.69	19
	near Pinehurst	RTH	1,905	1	28.03	34.17	25	11	.63	3.46	19
6	St. Joe River at Calder	QMH	3,220	1	.47	14.75	56	21	.76	5.78	21
		RTH	2,416	2	.66	27.15	50	30	3.04	3.52	23
7	Spokane River near Post Falls	QMH	1,833	0	0	26.35	24	7	0	3.09	13
		RTH	9,808	0	0	52.85	15	5	0	1.47	9
8	Snake River near Heise	QMH	22,481	0	0	18.68	35	14	.18	4.98	17
		RTH	19,243	0	0	24.75	26	11	0	3.88	17
10	Teton River near St. Anthony	QMH	10,128	0	0	11.06	47	14	6.45	4.89	21
		RTH	26,400	0	0	23.30	37	13	7.76	6.44	21
11	Henrys Fork near Rexburg	QMH	3,018	0	0	27.63	38	8	.99	2.79	15
		RTH	1,280	0	0	19.06	43	13	2.34	8.74	21
12	Willow Creek near Ririe	QMH	7,308	0	0	35.14	14	1	0	.49	9
		RTH	20,590	0	0	39.52	14	4	0	0	7
13	Blackfoot River near Blackfoot	QMH	515	0	0	34.76	36	9	5.04	1.68	17
		RTH	13,100	0	0	26.53	33	14	14.51	2.29	19
14	Snake River near Blackfoot	QMH	3,006	0	0	21.56	38	11	.2	1.97	17
		RTH	9,961	0	0	27.87	35	16	.19	3.2	15
15	Portneuf River at Topaz	QMH	7,575	0	0	15.25	43	9	3.96	1.6	19
		RTH	6,633	0	0	36.18	32	10	10.54	.94	19
16	Marsh Creek near McCammon	QMH	6,684	0	0	28.37	40	6	.7	3.19	15
		RTH	5,822	0	0	31.71	33	7	5.15	2.18	17
17	Portneuf River at Pocatello	QMH	2,705	0	0	56.01	31	8	1.29	2.57	13
		RTH	11,118	0	0	79.61	19	4	3.66	2.31	11
18	Snake River near Minidoka	QMH	7,665	0	0	24.27	30	7	0	.99	13
		RTH	39,264	0	0	87.96	9	3	0	0	5
21	Blue Lakes Spring	QMH	25,720	0	0	49.92	31	4	0	.22	13
		RTH	63,000	0	0	46.67	23	4	0	.19	11
22	Rock Creek at Daydream Ranch	QMH	20,200	0	0	83.96	18	6	.98	.2	9
		RTH	23,400	0	0	75.00	19	8	3.2	0	11
25	Camas Creek at Red Road	QMH	3,544	1	.31	27.91	51	23	4.17	3.04	21
		RTH	1,777	0	0	19.41	47	17	6.46	6.65	23
26	Beaver Creek at Spencer	QMH	14,160	1	.14	19.63	50	21	2.54	5.36	21
		RTH	7,450	1	.20	20.03	41	24	3.37	3.58	21
27	Big Lost River near Chilly	QMH	7,920	2	3.79	17.80	45	18	.95	10.44	21
		RTH	6,859	5	1.25	55.04	39	23	.36	7.07	19
28	Big Wood River near Bellevue	QMH	8,295	1	.36	38.70	35	17	.18	4.14	21
		RTH	1,203	1	.33	31.84	34	16	.18	4.25	19
29	Silver Creek near Picabo	QMH	4,048	0	0	33.72	34	11	0	1.31	15
		RTH	1,231	0	0	20.47	36	10	4.67	3.01	19
30	Malad River near Gooding	QMH	1,499	0	0	29.42	39	12	2.84	.85	19
		RTH	1,088	0	0	27.39	33	12	8.03	1.81	19
31	Bruneau River near Hot Spring	QMH	2,745	0	0	25.68	34	11	10.2	1.28	19
		RTH	1,021	0	0	43.19	27	12	2.44	1.32	19
32	Snake River near Murphy	QMH	1,282	0	0	39.47	37	11	0	1.11	13
		RTH	5,763	0	0	50.91	16	7	0	0	7
33	Boise River near Twin Springs	QMH	4,817	3	1.02	11.00	56	25	4.1	4.4	23
		RTH	1,780	2	4.83	33.60	29	13	1.08	2.52	17
35	Boise River at Glenwood Bridge	QMH	39,480	0	0	43.16	30	7	0	.75	11
		RTH	4,984	0	0	51.52	25	9	0	2.4	13
37	Snake River at Nyssa	QMH	3,300	0	0	43.82	25	7	0	.54	11
		RTH	2,480	0	0	53.87	22	9	.65	.16	13
38	South Fork Payette River at Lowman	QMH	3,978	3	.75	19.16	56	25	6.43	14.6	23
		RTH	4,340	6	5.23	27.81	45	25	2.7	7.43	23
41	Payette River near Payette	QMH	2,112	0	0	25.76	20	4	.19	2.46	11
		RTH	3,944	0	0	28.40	24	7	.61	5.06	17

Table 4. Summary of macroinvertebrate metrics and invertebrate river index (IRI) scores for selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Site No.	Site name	QMH or RTH	Total abundance[1]	No. of cold-water taxa	Percent cold-water taxa	Percent dominant taxon	Total No. of taxa	EPT taxa	Percent Elmidae (riffle beetles)	Percent predators	IRI score
42	Weiser River near Weiser	QMH	3,132	2	0.13	21.71	47	15	2.55	2.05	19
		RTH	4,293	1	1.72	32.15	25	12	3.43	2.05	19
44	Pahsimeroi River at Ellis	QMH	11,490	1	.26	41.78	41	15	11.88	6.27	19
		RTH	13,920	0	0	38.97	29	13	11.38	6.54	19
45	Salmon River at Salmon	QMH	7,700	0	0	31.17	35	13	.39	1.95	17
		RTH	15,936	0	0	33.43	33	15	0	2.55	15
46	Lemhi River near Lemhi	QMH	13,180	0	0	45.68	40	17	3.19	2.12	19
		RTH	15,096	0	0	26.55	31	16	3.5	7.15	21
47	Johnson Creek at Yellow Pine	QMH	687	7	6.11	10.04	57	32	5.24	10.49	23
		RTH	2,836	6	8.99	13.54	50	30	5.6	19.34	23
48	Little Salmon River at Riggins	QMH	6,310	2	.32	32.64	39	19	2.37	2.86	21
		RTH	4,024	2	.60	34.19	35	21	1	4.58	21
50	Lapwai Creek near Lapwai	QMH	7,400	0	0	20.95	45	13	7.03	12.59	21
		RTH	5,720	0	0	21.26	34	13	.42	2.1	17
51	South Fork Clearwater River at Stites	QMH	7,890	1	.19	17.30	56	24	6.55	4.88	23
		RTH	3,460	2	.81	26.36	45	20	3.61	2.79	21
52	Palouse River near Potlatch	QMH	2,810	1	.36	13.88	44	10	4.62	7.49	21
		RTH	3,485	0	0	37.79	31	10	10.1	1.84	17
53	Bear River at Idaho-Utah State Line	QMH	5,100	0	0	18.04	29	9	8.04	.98	19
		RTH	9,640	0	0	51.55	26	11	.58	.77	15
56	Snake River near Buhl	QMH	8,640	0	0	38.37	33	7	0	2.59	11
		RTH	6,184	0	0	73.61	27	8	1.29	1.81	11

[1] RTH samples are expressed as individuals per square meter.

erally was greater than 65, agricultural land use was less than 10 percent, and maximum water temperature was less than 22°C. Boxplots were used to evaluate the metrics and IRI scores. Median values for each group were tested for statistical differences using nonparametric t-tests. These statistical and graphical analyses were performed using SYSTAT (Wilkinson, 1998).

Multivariate Analyses

Multivariate analyses are an effective way to examine the distribution patterns of taxa and assemblages in relation to environmental variables (Gauch, 1982). These analyses were done to generate hypotheses about relations between macroinvertebrate assemblages and environmental variables. The use of several types of multivariate analyses was essential to reduce the number of variables and to assess complex relations between macroinvertebrate assemblages and environmental variables measured.

Normal probability plots and univariate statistics for all environmental variables and macroinvertebrate metrics were used to evaluate frequency distributions and skewness. Log transformations of the environmental variables (percent forested land, basin area, discharge, stream width, and percent agricultural land) and the metrics (abundance, coldwater taxa, percent coldwater taxa, percent Elmidae, and percent predators) were performed prior to multivariate analyses to enhance normality. Because variables were measured in different units, those used in the multivariate analyses were standardized by the various statistical analysis programs to a mean of 0 and a variance of 1.

Preliminary multivariate analyses were performed on macroinvertebrate taxa presence or absence, relative abundance, and log-transformed taxa abundance data. Rare taxa (less than 5 percent frequency of occurrence) were excluded from the data set, as recommended by Gauch (1982), or were downweighted. In this preliminary analysis, the abundant taxa (table 3) also were excluded using steps similar to those used by Danehy and others (1999), who found that the exclusion of abundant taxa improved their ability to identify relations between environmental gradients and macroinvertebrate assemblages. Rahel (1990) suggested examining different levels of numerical resolution and censuring taxa data when searching for patterns in biological data. However, none of these approaches for censuring the macroinvertebrate data enhanced the ordination analyses.

All multivariate results presented in this report are for the RTH macroinvertebrate composition data for each site, expressed as percent relative abundance. This approach effectively reduced the influence of abnormally large numbers of an individual taxon at a site. Using only RTH samples for intersite comparison in the multivariate analyses effectively normalized the data to riffle habitat across all sites. Rare taxa were retained in all analyses and were not downweighted. The presence of rare taxa at a particular site often indicates specific habitat conditions (such as coldwater habitat) and, therefore, provides critical information regarding ecological conditions.

PRINCIPAL COMPONENTS ANALYSIS

PCA and correlation matrices were used to identify the environmental variables that distinguish each type of stream and to reduce the environmental variables in subsequent analyses. PCA was performed using SYSTAT (Wilkinson, 1998) to group and summarize environmental variables. This analysis was used to shorten an otherwise long list of environmental variables containing redundant information. PCA is appropriate for analyzing data that have an underlying linear structure and summarizes the variance-covariance or correlation structure of a data set (Gauch, 1982). Relations between the eight macroinvertebrate metrics also were evaluated using PCA.

A principal component is a group of related environmental variables that are combined into a surrogate variable. For example, basin area, discharge, stream order, and stream width are combined to indicate stream size. The degree of association between a variable and a principal component is expressed by a factor loading. If a group of variables have high factor loadings (absolute value greater than 0.50) on a particular principal component, then the variables all express similar information about that component. For this study, principal components with eigenvalues greater than 1.0 were retained and rotated by use of the Varimax procedure (Wilkinson, 1998). Eigenvalues equal the maximum dispersion of the variable scores on the ordination axis and are a measure of importance of the ordination axis (Jongman and others, 1995).

DETRENDED CORRESPONDENCE ANALYSIS

Macroinvertebrate taxa were evaluated using DCA, a form of indirect gradient analysis, where the ordination is not constrained by the environmental variables. DCA was performed using the computer program CANOCO (Ter Braak and Smilauer, 1998). The ordination produced by this analysis was examined to determine site groups with similar taxa composition and spatial patterns.

This analysis also was used to determine whether the taxa data showed a unimodal response, a necessary requirement for subsequent direct gradient analysis using CCA (Ter Braak and Smilauer, 1998). If gradient lengths determined in this analysis approach 4 standard deviation units, then the taxa data show a unimodal response.

CANONICAL CORRESPONDENCE ANALYSIS

Macroinvertebrate assemblages were related to multiple environmental variables using CCA (Ter Braak, 1986). This analytical technique was used to perform direct gradient analysis whereby ordination axes were chosen on the basis of taxa and environmental data. CCA was designed to detect patterns of variation in taxa data that were explained best by the observed environmental variable. CCA was applied using the computer program CANOCO (Ter Braak and Smilauer, 1998). CANOCO depicts species (or taxa) and sites in an ordination diagram by assuming that species exhibit Gaussian-type responses to environmental gradients; that is, taxa are depicted at various locations along an environmental gradient and exhibit a peak in occurrence at an optimum value along that gradient. In the ordination diagram, environmental gradients are displayed as vectors. Vector direction and length indicate the relative magnitude and influence of a particular variable on the taxa. The main axes are a combination of the environmental variables that best define the site positions on the CCA diagram. Sites with the most taxa in common are clustered in the ordination diagram.

The environmental variables used to represent major gradients were derived from PCA and correlation analysis of basin, hydrologic, and habitat characteristics. In a few cases, additional variables were evaluated if they were judged to be potentially important. Ten biologically relevant variables out of 24 total were selected (table 5) for CCA—percent forested land, basin area, percent agricultural land, maximum water temperature, dissolved oxygen saturation, stream gradient, elevation, percent substrate fines, percent urban land, and percent open canopy.

Forward selection in CCA was applied on these 10 variables to determine which had the most influence on macroinvertebrate taxa. Forward selection identifies a minimum number of environmental variables to help explain the taxa composition. A Monte Carlo test of 199 permutations determined the significance of each environmental variable during the forward selection process (Ter Braak and Smilauer, 1998). Only variables determined to be significant at the 0.05 probability level were included in the final CCA. Inflation factors for the environmental variables were less than 20, which indicates that variables were not highly correlated. The environmental gradient scores were correlated to the axes scores to show the strength of the relation between the environmental gradient and the axes. Canonical coefficients, which are analogous to regression coefficients, were examined for significance against the first two axes. The statistical significance of the relation between the taxa and the whole set of environmental variables also was determined using the global permutation test. Two test statistics were used: one based on the first canonical eigenvalue and one based on the sum of all canonical eigenvalues. The resulting tests determined the significance of the first ordination axis and that of all canonical axes together (entire model), respectively. Both tests were carried out by a Monte Carlo test of 199 permutations. All other parameters in CCA were set at the default settings (Ter Braak and Smilauer, 1998).

Table 5. Principal component factor loadings for environmental variables from principal components analysis (PCA) for all sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[Groups of closely associated variables with high absolute values of loadings >0.50 and variables selected for canonical correspondence analysis shown in **bold**; all other loading values shown are >0.30; a negative number reflects an opposite relation]

Environmental variable	Principal component							
	1	2	3	4	5	6	7	8
Percent forested land[1]	**-0.89**							
Percent rangeland	**.85**							
Latitude (north)	**-.70**					0.43		
Specific conductance	**.65**		0.32			-.39		0.33
Basin area[1]		**0.91**						
Discharge[1]		**.89**						
Stream order		**.84**						
Stream width[1]		**.84**						
Percent agricultural land[1]			**.79**					
Habitat quality index			**-.71**					
Maximum water temperature			**.63**			.60		
Stream velocity		.36	**-.53**					
Percent embeddedness			**.53**				0.52	
Dissolved oxygen saturation				**0.94**				
Dissolved oxygen				**.90**				
Stream gradient					**0.82**			
pH			.44		**.66**			
Elevation						**-.88**		
Longitude (west)						**.85**		
Stream depth							**.80**	
Percent substrate fines			.34				**.74**	
Population density								**.86**
Percent urban land								**.81**
Percent open canopy			-.50				-.49	
Percent variance explained	21	17	11	9	7	6	5	5

[1]Variable was $\log_{10}$ (x+1) transformed for analysis.

RESULTS OF MACROINVERTEBRATE TAXA AND METRICS

Two hundred and forty-seven macroinvertebrate taxa were identified in RTH and QMH samples collected from the 40 sampling sites (table A, back of report). Riffles supported most of the taxa collected at all sites. One hundred and eighty-four taxa (74 percent of total taxa) were identified in the RTH samples. The most abundant taxa (greater than 1 percent of total abundance and identified in 75 percent or more of the RTH samples) were Oligochaeta, *Baetis tricaudatus*, *Hydropsyche*, Simuliidae, Chironomidae pupae, *Cricotopus*, *Eukiefferiella*, and *Orthocladius* complex (table 3). Thirty rare taxa (composing less than 0.005 percent total abundance and identified in less than 5 percent of RTH samples) were collected. Many of the taxa identified in the QMH samples that were not identified in the RTH samples consisted of insect taxa in the orders Odonata (dragonflies), Hemiptera (bugs), and Diptera (flies). Many of these taxa are associated with nearshore, backwater, riparian habitats that were not sampled as part of the RTH sample collections.

Total abundance (density expressed as individuals/m^2) for RTH samples (table 4) ranged from 1,021 to 63,000 individuals/m^2 at the Bruneau River near Hot Spring (site 31) and Blue Lakes Spring (site 21), respectively. The extremely high abundance at site 21 was due to the large numbers of *Hyalella azteca* (scuds) and *Potamopyrgus antipodarum* (New Zealand mud snail), a recently introduced gastropod in the Hagerman Valley (along the Snake River in Gooding County, downstream from Twin Falls), thought to be inadvertently introduced from commercial movement of aquaculture products such as trout eggs and live fish (Zaranko and others, 1997). According to Bowler (1991), *P. antipodarum* was the most dominant species of mollusk in all habitats of the middle Snake River (Gooding through Minidoka Counties) and some tributaries by 1989. Crowding due to immense population densities of *P. antipodarum* (about 6,400 individuals/m^2) is suspected to cause resource competition with native taxa (T.J. Frest, Deixis Consultants, Seattle, Wash., oral commun., 2000). During this study, *P. antipodarum* abundances were as high as 17,550 individuals/m^2 in the RTH sample from Rock Creek at Daydream Ranch (site 22). Maret (1990) did not report finding this species in macroinvertebrate riffle samples collected from six Rock Creek sites between 1981 and 1988. This species also was found at sites 11, 32, 37, 44, and 56, which indicates it is spreading from its area of introduction. This species was the dominant taxon at two of the sites, where it was identified in RTH samples composing about 14 and 75 percent of all individuals at sites 21 and 22, respectively.

The total number of taxa and EPT taxa varied greatly among sites for both sample types (fig. 3 and table 4). Total number of taxa identified in QMH samples ranged from 14 at Willow Creek near Ririe (site 12) to 59 at North Fork Coeur d'Alene River at Enaville (site 4). The Willow Creek near Ririe site is immediately downstream from Ririe Lake dam, which may be limiting the diversity of taxa at this location. Sampling sites such as this are not representative of the basin upstream and could be dropped from the SWQP. Total number of taxa identified in RTH samples ranged from 9 at the Snake River near Minidoka (site 18) to 50 at each of three sites: North Fork Coeur d'Alene River at Enaville (site 4), St. Joe River at Calder (site 6), and Johnson Creek at Yellow Pine (site 47). EPT taxa identified in QMH samples ranged from 1 at Willow Creek near Ririe (site 12) to 32 at Johnson Creek at Yellow Pine (site 47). EPT taxa identified in RTH samples ranged from 3 at Snake River near Minidoka (site 18) to 30 at each of two sites: St. Joe River at Calder (site 6) and Johnson Creek at Yellow Pine (site 47). The Snake River near Minidoka site is located immediately downstream from Lake Walcott dam, which may be limiting the diversity of taxa at this location.

Comparison of RTH and QMH Sample Types

The macroinvertebrate metrics total abundance, number of coldwater taxa, percent coldwater taxa, percent dominant taxon, total number of taxa, EPT taxa, percent Elmidae, percent predators, and IRI scores for both sample types are summarized in table 4. RTH and QMH sample types were compared to evaluate the final IRI score and the five metrics composing this index developed by IDEQ to evaluate medium to large rivers in Idaho (Grafe, 2000). Median values for total number of taxa and percent dominant taxon were significantly different ($p<0.05$) between RTH and QMH samples (fig. 3). It is not surprising that the total number of taxa is significantly larger for QMH samples because these samples include taxa collected from additional habitat types not sampled by RTH methods. The percent dominant taxon for RTH samples was significantly higher than for QMH samples, resulting from the dominance of large numbers of riffle-adapted taxa such as *Baetis tricaudatus* and *Hydropsyche* in the RTH sample type.

There was no statistical difference in median IRI scores between sample types. There was only one instance (site 41) where a site was misclassified as having good or poor condition by using the different sample types (see table 4, IRI scores). This statistical similarity indicates that either sample type could be used to evaluate biological condition by using the IRI. Targeting riffle areas using the RTH method also provides consistency in habitat sampled and can provide estimates of macroinvertebrate densities. Riffles generally were common at most SWQP sites and were easily accessible by wading from shore. Measures of riffle habitat parameters (such as depth, velocity, and embeddedness) at points where RTH samples are collected also can provide information that can be used to relate macroinvertebrate data to measured environmental variables. For these reasons, QMH samples could be dropped from the SWQP. In rare cases where riffle habitats may not be available, then QMH samples could be collected as a replacement for RTH samples.

Summary of Coldwater Taxa

Fourteen coldwater taxa were collected during this study (table A, back of report) at 12 sampling sites. This represents only about 6 percent (14 of 247) of all taxa collected and a frequency of occurrence of 30 percent

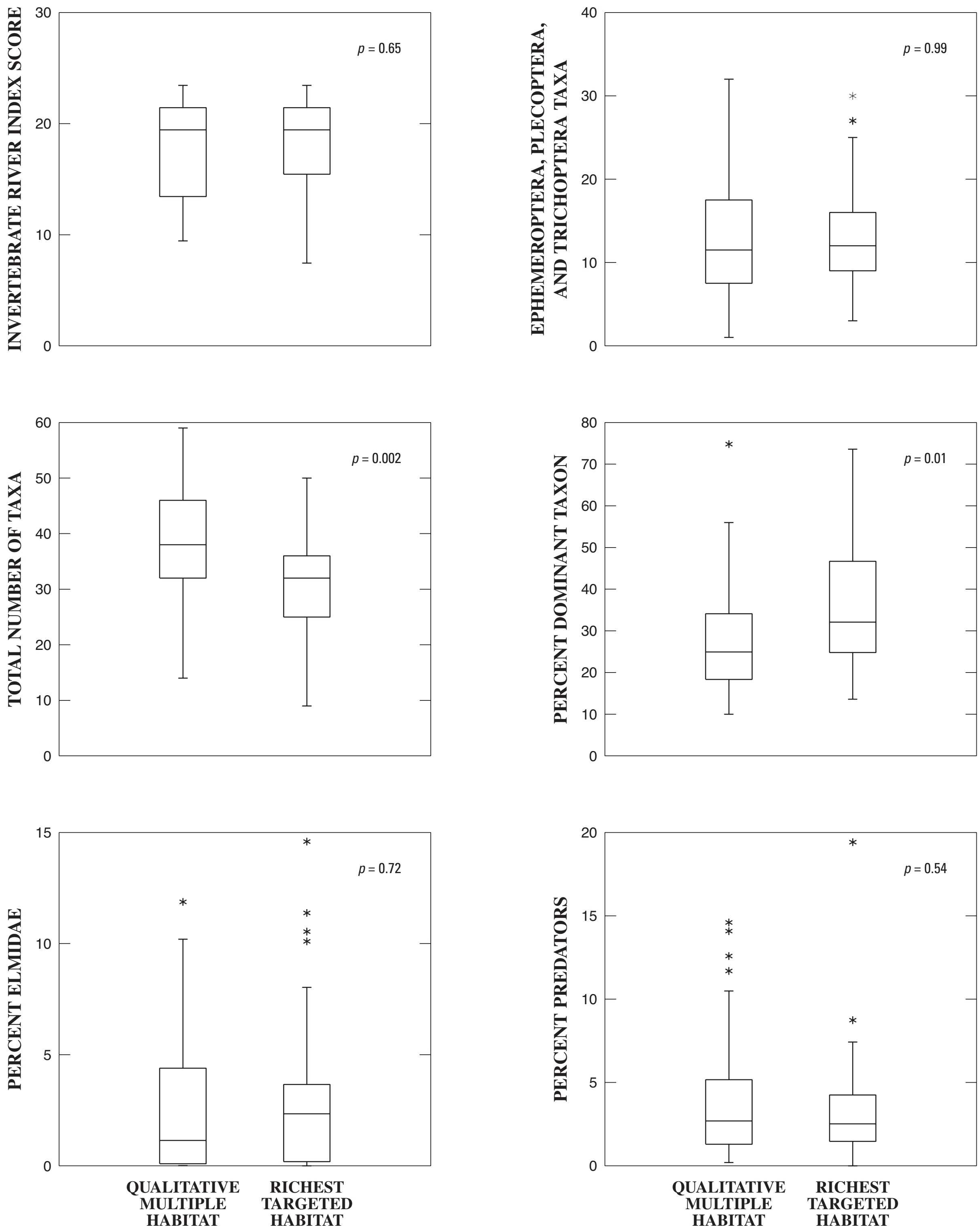


Figure 3. Invertebrate river index (IRI) scores in relation to selected metrics for the qualitative multiple habitat (QMH) and richest targeted habitat (RTH) samples collected from macroinvertebrate sampling sites, Idaho statewide surface-water quality monitoring program, 1996–98. (*p*, probability level determined from Wilcoxon signed-rank-paired test)

(12 of 40) for all sites. The coldwater taxa were *Ameletus*, *Caudatella*, *Drunella doddsi*, *Epeorus deceptivus*, *E. grandis*, Capniidae, *Doroneuria*, Taeniopterygidae, *Apatania*, Blephariceridae, *Deuterophlebia*, *Rhabdomastix*, *Heleniella*, and *Stempellina*. Ten of these coldwater taxa were identified in RTH samples (table 3) at 12 sites. Most of these coldwater taxa were collected at forested sites (fig. 4); the most abundant taxon was *E. deceptivus*, a mayfly typically associated with high-gradient mountain streams. Generally, where coldwater taxa were identified in RTH samples, they composed a small proportion (less than 10 percent) of the total abundance, except at the South Fork Coeur d'Alene River near Pinehurst (site 5), where *E. deceptivus* composed almost 30 percent of the total abundance.

It is not surprising that more coldwater taxa were not collected because maximum temperatures at 62 percent (25 out of 40; table 2) of the sampling sites exceeded Idaho's instantaneous coldwater temperature criteria of 22 °C during 1996–98. Maximum temperatures exceeded the criteria at 5 of the 12 sites where coldwater taxa were identified in RTH samples. The most extreme example of occurrence of coldwater taxa in reaches where the water temperature exceeded criteria was Weiser River near Weiser (site 42), an agricultural site. Blephariceridae, a coldwater dipteran, was collected at this site where the maximum water temperature was 29 °C. Two coldwater taxa, *Ameletus* and *D. doddsi*, also were collected at the South Fork Clearwater River at Stites (site 51), where the maximum temperature was almost 27 °C.

Six coldwater taxa were collected at both the South Fork Payette River at Lowman (site 38) and Johnson Creek at Yellow Pine (site 47), the largest number for all sites (fig. 4). Maximum water temperatures were less than 20 °C and surface-water gradients were relatively high (greater than 0.8 percent) at both of these forested sites. Five coldwater macroinvertebrate taxa also were collected at the Big Lost River near Chilly (site 27). This high-elevation (2,018 m) rangeland site had one of the lowest maximum temperatures (17.3 °C) for sites where coldwater taxa were collected.

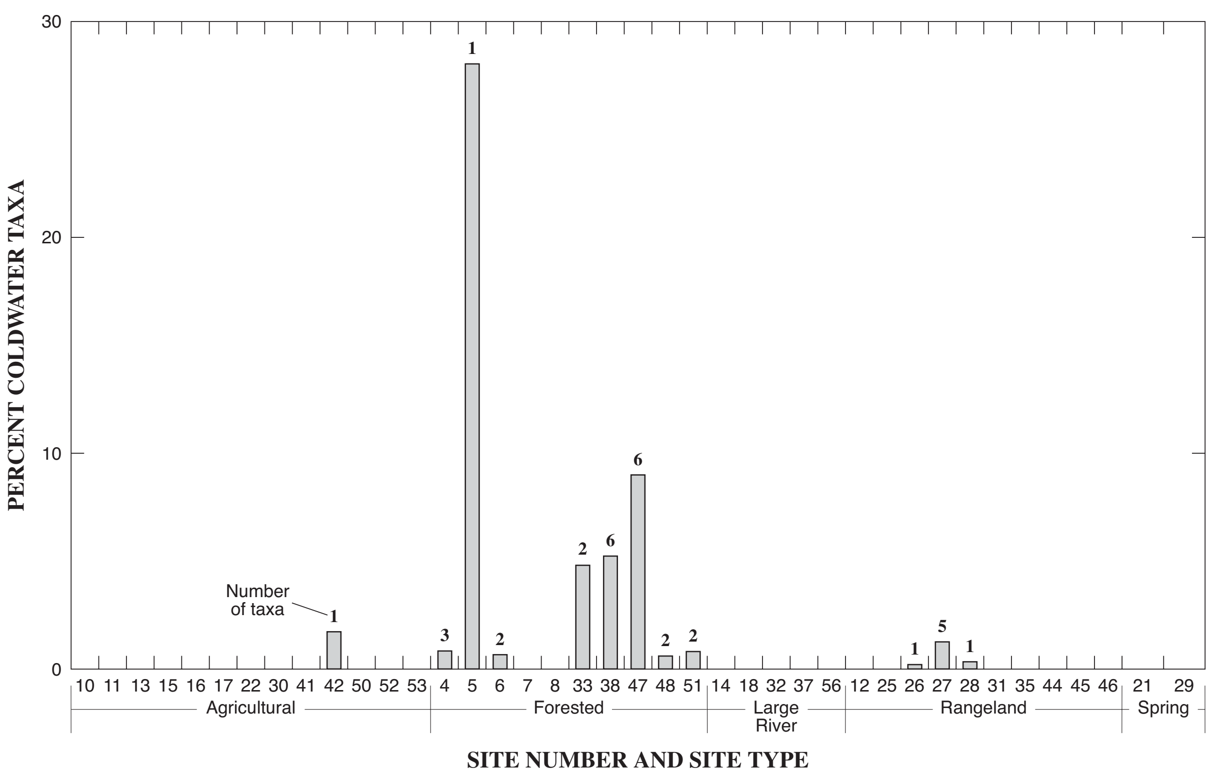


Figure 4. Percent and number of coldwater taxa collected by site type for richest targeted habitat (riffle) samples, Idaho statewide surface-water quality monitoring program, 1996–98. (Site types shown in table 2)

No coldwater taxa were collected at the five large-river sites, all of which are located on the main-stem Snake River in the southern part of the State. Maximum temperatures for these sites ranged from 22.1 to 26.9 °C. Coldwater taxa also were not collected at spring sites 21 and 29, even though maximum temperatures at these sites were 22 °C or below. These discrepancies and the absence of coldwater taxa at spring sites indicate that the taxa currently designated as coldwater adapted need to be further evaluated.

Recent work by the IDEQ on 12 southwestern Idaho streams demonstrated that the distribution of coldwater macroinvertebrate taxa corresponded well to measures of low water temperature; coldwater indicators were observed only at sites that did not exceed Idaho temperature water-quality criteria (W.H. Clark, Idaho Department of Health and Welfare, written commun., 1997). The data collected as part of the SWQP show some discrepancies in exceedances of maximum water temperature criteria and associated coldwater taxa occurrence. Essig (1998) demonstrated similar problems with Idaho temperature criteria and fishery information, where salmonid spawning and multiple age classes are present coincidentally with measured temperature criteria exceedances. These findings and the results of monitoring at SWQP sites indicate that the uniform temperature criteria may not reflect the range of stream temperatures in such an ecologically diverse State as Idaho.

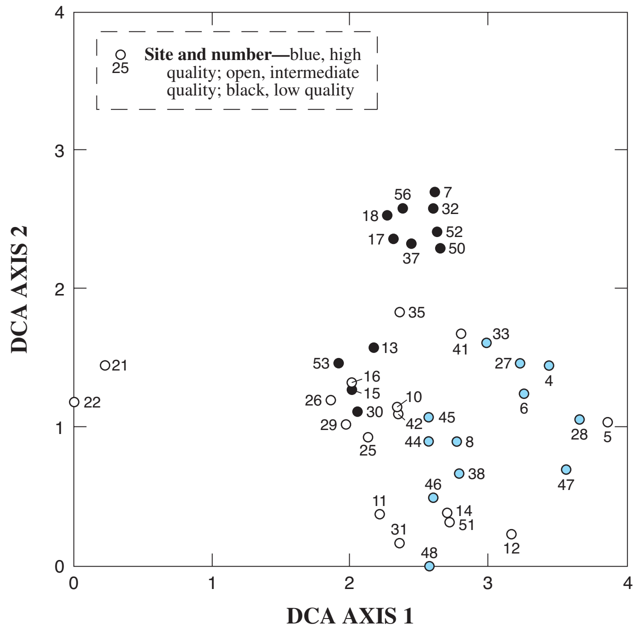


Figure 5. Detrended correspondence analysis (DCA) ordination plot of macroinvertebrate sampling sites, Idaho statewide surface-water quality monitoring program, 1996–98. (Site names shown in table 1; locations shown in figure 2. Site quality shown in table 2)

Evaluation of the Invertebrate River Index

A subset of 24 sites (noted in table 2) representing 12 high-quality and 12 low-quality sites were selected to validate the IRI. These sites were grouped, independently from IRI rankings, on the basis of multiple measures of human disturbance. A previous discussion, "General Approach," described how these sites were grouped. DCA ordination of all sites generally supports these site groups with similar taxa composition (fig. 5). In this ordination, macroinvertebrate assemblages are similar for those sites that plotted nearest one another. The high-quality and low-quality sites generally grouped together in the lower right and upper center part of the plot, respectively. However, the separation between these two site groups is not as pronounced as might be expected. The tight cluster of low-quality sites 7,17,18, 32, 37, 50, 52, and 56 in the upper part of the plot typically had a small number of EPT taxa (less than 10) and no coldwater taxa. In addition, facultative organisms such as *Baetis tricaudatus*, *Cheumatopsyche*, *Cricotopus*, *Hydropsyche*, *Petrophila*, Simuliidae, and *Tricorythodes minutus* were the predominant taxa collected at these sites. Sites 21 and 22 are distinctly different from all other sites, primarily because of the large number of *P. antipodarum* collected at these sites.

The relative magnitude of eigenvalues for each DCA axis is an expression of the relative importance of each axis. Both axes indicated good separation of taxa with eigenvalues of 0.68 and 0.38. It is also noteworthy that there are taxa in the data that exhibit unimodal response along axis 1 with a gradient of 3.8 standard deviation units. A unimodal response approaching 4 standard deviation units is considered ideal for analysis using CCA (Ter Braak and Smilauer, 1998).

Results of the IRI scores in relation to the five metrics are shown in figure 6. Between high- and low-quality sites, the IRI median values were significantly different, providing evidence that the index can successfully discriminate impairment. However, some values overlapped, as indicated by the boxplots. This is to be expected because the high-quality sites were not selected specifically as reference sites in this study and,

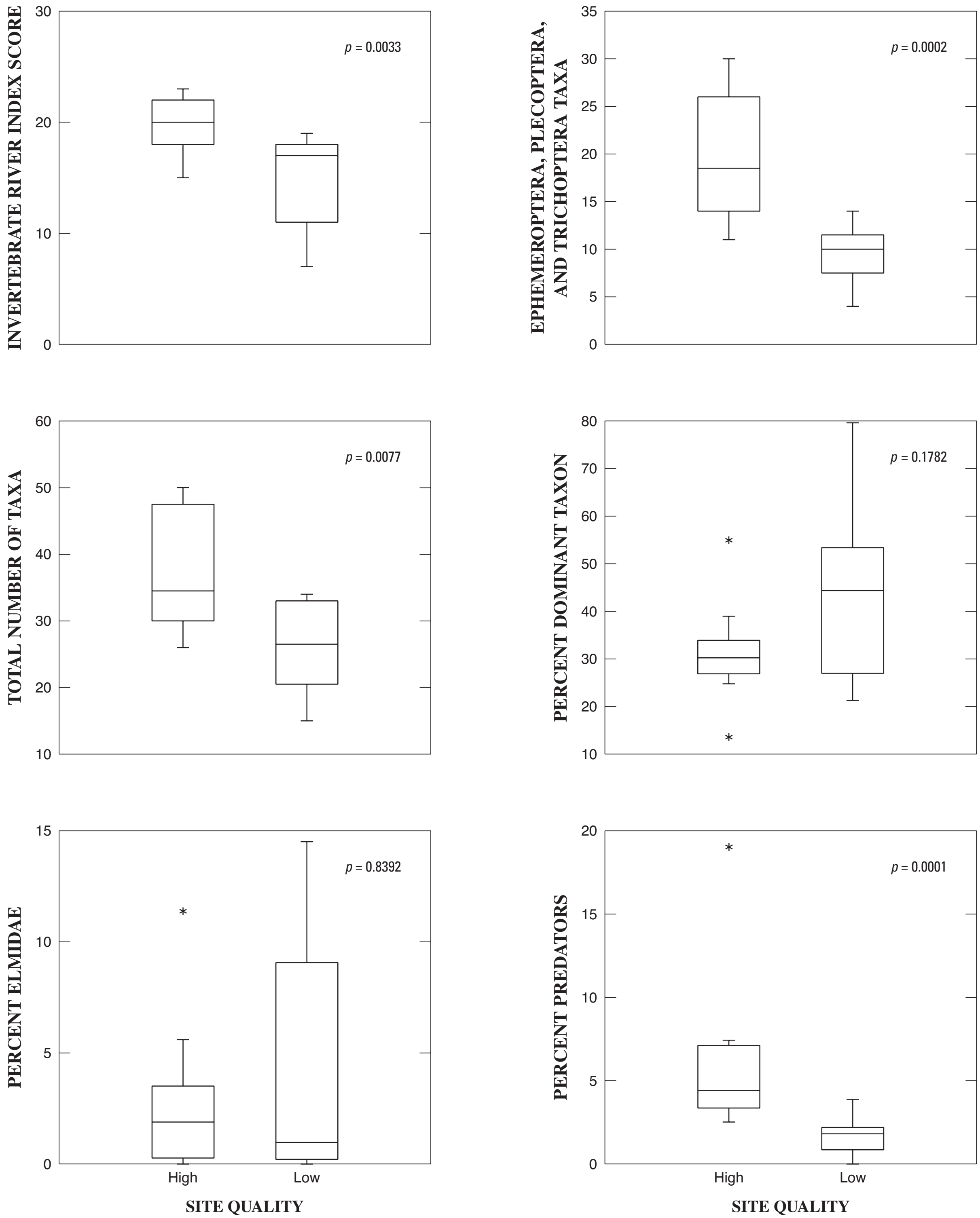


Figure 6. Invertebrate river index (IRI) scores in relation to selected metrics for high-quality (12) and low-quality (12) sites, Idaho statewide surface-water quality monitoring program, 1996–98. (Specific site information shown in table 2; *p*, probablility level determined from Mann-Whitney t-test)

therefore, would be expected to show some impairment and more overlap with the low-quality sites.

Of the five metrics included in the IRI, median values for total number of taxa, EPT taxa, and percent predators were significantly different between high- and low-quality sites. The EPT taxa and percent predators showed a strong separation between site groups (no overlap of interquartile ranges), which indicates that these metrics were the most effective at discriminating between high- and low-quality sites. Median values for percent dominant taxon and percent Elmidae were not significantly different between site groups, which indicates that these metrics were relatively ineffective for discriminating between high- and low-quality sites. Contrarily, percent Elmidae was useful in other Idaho studies for discriminating reference sites from test or adversely affected sites (Robinson and Minshall, 1998; Schomberg and others, 1998). Fore and others (1996) used percent dominant taxon as a metric for evaluating Oregon streams and concluded this metric did not distinguish between least- and most-disturbed sites. Both percent dominant taxon and percent Elmidae metrics displayed a great deal of variability for the low-quality site group, which indicates that they are of limited value to the IRI scores. Reexamination of these two metrics would help determine whether they are providing useful information to the overall IRI score. Some metrics that compose the IRI were redundant. The correlation coefficient between EPT taxa and total number of taxa was 0.87 ($p<0.05$), which indicates that these two metrics are strongly correlated.

Correlation among the eight metrics (total number of taxa, EPT taxa, percent predators, percent Elmidae, percent dominant taxon, total abundance, number of coldwater taxa, and percent coldwater taxa), final IRI scores, and the HQI (expressed as percent of total score) did not reveal any significant ($p<0.05$) relations. Stauffer and Goldstein (1997) noted similar results in their evaluation of the HQI and fish metrics. They attributed index ineffectiveness to variability as a result of subjectivity in scoring attributes, stream size differences, and redundancy in the attributes making up the index. These

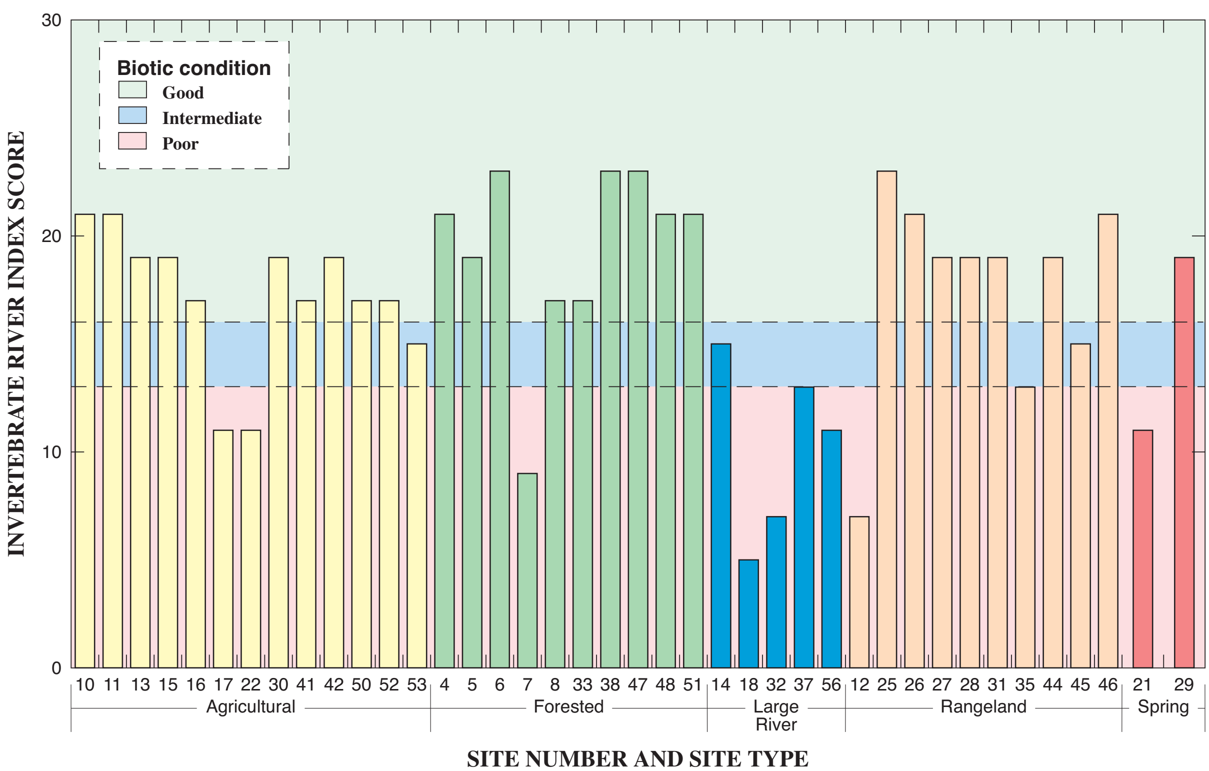


Figure 7. Invertebrate river index (IRI) scores in relation to biotic condition categories for macroinvertebrate sampling sites, by site type, Idaho statewide surface-water quality monitoring program, 1996–98. (Site types shown in table 2)

findings indicate that the HQI may not be very useful for evaluating the condition of Idaho's larger rivers.

Summary of Invertebrate River Index Scores and Metrics

Results of the final IRI scores for all sites by site type are illustrated in figure 7. Biotic condition for 25 percent of the sites (10 of 40) was categorized as poor (IRI score ≤13). Four of these were large-river sites; the remainder of the site types were two agricultural, one forested, two rangeland, and one spring. Biotic condition for 68 percent of the sites (27 of 40) was categorized as good (IRI score ≥16); biotic condition for only three sites was categorized as intermediate. The narrow range separating good from poor biotic condition sites (only 2 score values) is problematic; expansion of this range would improve the discriminatory power of the index.

For example, site 53 appears to be miscategorized according to its placement in the PCA ordination with other sites with poor condition scores (fig. 8). Expanding the scoring criteria from 0 to 100 points (percentages) may be one simple way to improve separation of biotic condition categories. This final scoring criteria also would be more familiar to resource managers and the public.

The PCA ordination of the eight metrics used to summarize macroinvertebrate assemblage data showed clear separation of IRI poor and good biotic condition (fig. 8). Axes 1 and 2 accounted for 38 and 31 percent of the variance among sites, respectively. Metrics with high factor loadings on axis 1 (>0.60) included total number of taxa, percent Elmidae, percent predators, and percent dominant taxon. Number of coldwater taxa, percent coldwater taxa, and EPT taxa had high factor loadings on axis 2. Total abundance did not have a high factor loading on either axis, which indicates that this metric was not useful for evaluating biotic condition. Sites with good IRI biotic condition scores (lower and upper right) typically had a large total number of taxa, percent Elmidae, and percent predators (axis 1); and a large number of coldwater taxa, percent coldwater taxa, and EPT taxa (axis 2). These metrics were typically just the reverse for sites with poor biotic condition scores (lower left), and percent dominant taxon was higher.

Many of the sites with increasing values on axis 2 diverged as a result of the coldwater taxa metrics and

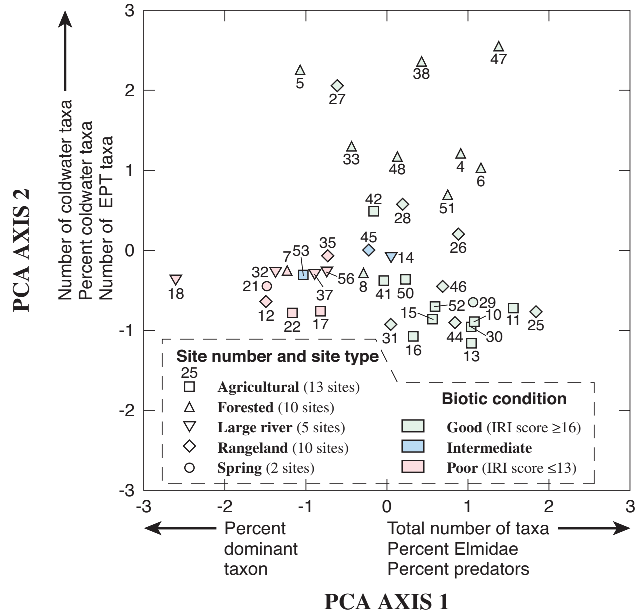


Figure 8. Principal components analysis (PCA) ordination plot of macroinvertebrate sampling sites, by site type, based on eight metrics, Idaho statewide surface-water quality monitoring program, 1996–98. [Metrics shown in table 4, metrics with high factor loadings (absolute value >0.60) are listed along axes 1 and 2; arrows indicate their direction of increase. EPT, Ephemeroptera, Plecoptera, and Trichoptera]

typically were forested or rangeland site types. These results indicate that coldwater metrics may be providing useful information for describing macroinvertebrate assemblages. Further examination of these metrics would help determine whether their inclusion in the IRI would improve its discriminatory power.

RELATION OF MACROINVERTEBRATE ASSEMBLAGES TO ENVIRONMENTAL VARIABLES

Representative environmental variables consisting of basin, site, and habitat characteristics (tables 1 and 2) were analyzed in relation to the macroinvertebrate data by CCA. Because the original list of environmental variables was too large to be interpreted by CCA, a subset of these variables was selected using PCA and a Monte Carlo forward selection process. This analysis helped reduce the redundancy in the environmental variables and select a subset of ecologically relevant variables for subsequent direct gradient analyses. These final CCA ordination plots depict the main patterns of variation in assemblage composition as accounted for by the environmental variables.

Principal Components Analysis

PCA of the 24 environmental variables identified 8 principal components with eigenvalues greater than 1 (table 5). These 8 principal components explained 81 percent of the variance in the data set. Loadings with an absolute value greater than 0.5 for each principal component (shown in bold, table 5) indicated a number of groups of closely associated variables. From these groups, 10 surrogate variables were selected to represent each group: percent forested land, basin area, percent agricultural land, maximum water temperature, dissolved oxygen saturation, stream gradient, elevation, percent substrate fines, percent urban land, and percent open canopy. In a few instances, more than one variable was selected from the same group because of the variable's ecological relevance. For example, maximum water temperature was selected along with percent agricultural land because of the known influence of temperature on macroinvertebrate assemblages (Hynes, 1970; Richards and Host, 1994). The HQI and stream velocity were inversely related to percent agricultural land, and specific conductance was inversely related to percent forested land (table 5).

A scatterplot of PCA axis 1 scores and number of EPT taxa (fig. 9) shows a significant inverse relation (r=-0.50, p=0.001). PCA axis 1 represents a linear combination of percent forested land, latitude, percent rangeland, and specific conductance (table 5). The number of EPT taxa decreases as the percent of forested land and latitude decrease and percent of rangeland and specific conductance increase. This inversion reflects a complex relation of land use and natural factors that influence this important biological metric used in water-quality assessments. Corkum (1989) also noted a strong association between distributional patterns of benthic invertebrates and landscape variables of rivers in northwestern North America.

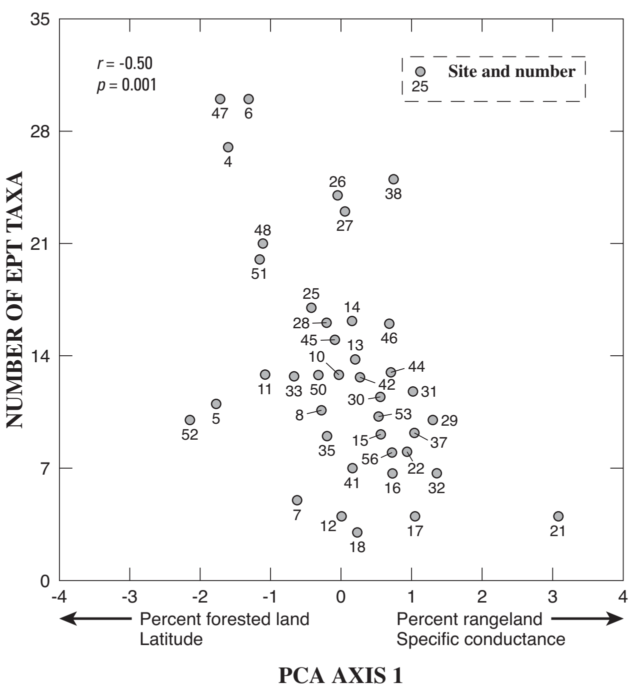


Figure 9. Principal components analysis (PCA) axis 1 scores in relation to number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa for macroinvertebrate sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98. [Environmental variables shown in table 5; variables with high factor loadings (absolute value >0.60) are listed along axis 1; arrows indicate their direction of increase. Site names shown in table 1; locations shown in figure 2. *r*, Pearson's correlation coefficient; *p*, probability level]

Canonical Correspondence Analysis

Percent forested land, percent agricultural land, urban land, maximum water temperature, percent substrate fines, and stream gradient were identified in the forward selection process by CCA as significant (p<0.05) in the ordination of species data.

Two CCA ordination plots are shown for all sites (fig. 10) and taxa scores (fig. 11) in relation to the six selected environmental variables. The eigenvalues of the first two CCA axes illustrate the strength of the relation between taxa and environmental variables (table 6). Both axes accounted for about the same amount of variance with eigenvalues of 0.35 and 0.34, respectively. Correlations among taxa and environmental variables for the first and second axes were 0.84 and 0.88, respectively, and explained 46 percent of the joint variance between the macroinvertebrate taxa and environmental variables. The Monte Carlo test of variables along all canonical axes was significant (p=0.005) and indicates that the model (ordination diagram) represents a good fit of the macroinvertebrate taxa and environmental data. The environmental variables with long vectors are more strongly correlated with the ordination axes than are those with short vectors. In other words, long vectors depict greater influence of that environmental variable in structuring the macroinvertebrate assemblages. These vectors also extend an equivalent length into the opposite quadrant (but are not shown on the graph) to represent the effect of low values of the environmental variables. These ordination analyses were constrained by the environmental variables shown in figures 10 and 11 and directly relate the environmental gradients to the macroinvertebrate assemblages. The location of a taxon relative to an axis is the taxon's optimum set of conditions that compose the axis (fig. 11). That location is the mode of the unimodal distribution of that taxon's abundance in the gradient expressed by the axis.

Most of the variability in environmental variables was accounted for by forested, urban, and agricultural land uses with eigenvalues of 0.32, 0.31, and 0.26, respectively (table 6). Land use can be an important, large-scale factor affecting the composition and structure of macroinvertebrate assemblages (Richards and Host, 1994; Schomberg and others, 1998). Corkum

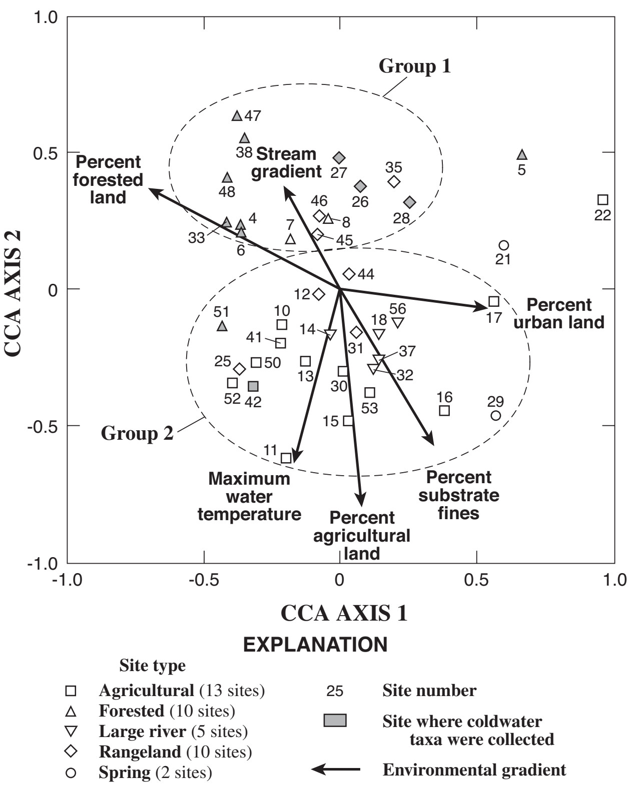


Figure 10. Canonical correspondence analysis (CCA) ordination plot of macroinvertebrate sampling sites in relation to selected environmental variables, Idaho statewide surface-water quality monitoring program, 1996–98. [All environmental variables were significant (p<0.05) with one or both axes. Site names shown in table 1; locations shown in figure 2. Coldwater taxa identified in table A, back of report]

Table 6. Summary of correspondence analysis including canonical coefficients and t-values of canonical coefficients for environmental variables, Idaho statewide surface-water quality monitoring program, 1996–98.

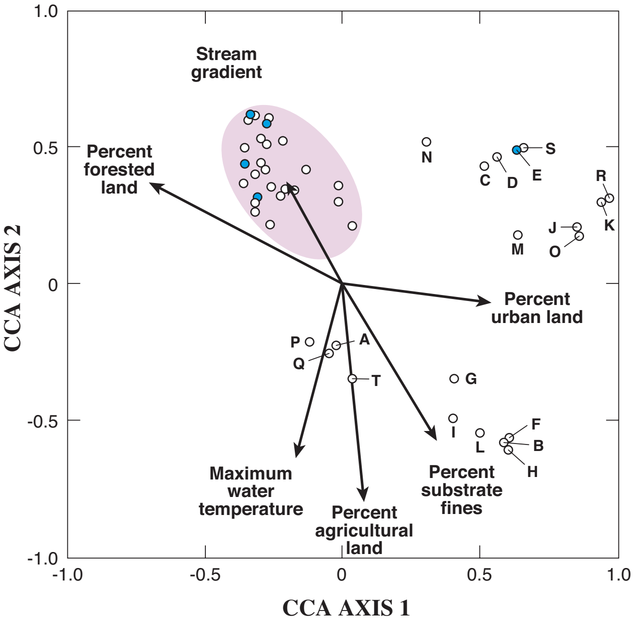
[Significant canonical coefficients with t-values greater than the absolute value of 2.1 (p<0.05) are shown in **bold**; eigenvalues for axis 1 and axis 2 were 0.35 and 0.34, respectively (see figures 10 and 11)]

Environmental variable	Eigenvalue	Canonical coefficient		Canonical coefficient t-value	
		Axis 1	Axis 2	Axis 1	Axis 2
Forested land	0.32	-0.81	0.06	**-6.24**	0.54
Urban land	.31	.73	.31	**5.91**	**2.97**
Agricultural land	.26	-.28	-.55	-2.07	**-4.83**
Percent substrate fines	.22	-.01	-.33	-.08	**-2.98**
Maximum water temperature	.21	-.25	-.46	-1.98	**-4.41**
Stream gradient	.17	-.10	.23	-.83	**2.35**

(1990) noted that agricultural land overrode the effect of natural vegetation patterns on macroinvertebrate assemblages. In this study, there was a significant inverse relation (r=-0.56, p<0.05), between percent agricultural land and the number of coldwater taxa.

Even though urban land composed a small percentage of most basins (less than 3 percent), it was identified as an important environmental gradient in the CCA. For example, sites 17 and 22 are at the upper end of the urban land-use gradient (fig. 10). Both of these sites are within the city limits of Pocatello and Twin Falls. Maret (1990) characterized the macroinvertebrates collected from riffle habitats in lower Rock Creek (near site 22) as composed primarily of the facultative taxa *Hydropsyche*, *Tricorythodes minutus*, and *Baetis tricaudatus*. Jones and Clark (1987) concluded that urbanization has a major effect on benthic invertebrate assemblages by reducing diversity and total number of most taxa while increasing the relative abundance of chironomids. Kleindl (1995) found that as urbanization increased in Puget Sound basins of Washington, the number of macroinvertebrate taxa, number of intolerant taxa, and number of predators declined while the relative number and abundance of tolerant taxa increased.

Canonical coefficients for all six environmental variables were significant (p<0.05) with axis 1 or 2 (table 6). Forested land (-0.81) and urban land (0.73) were significant (t>$\pm$2.1) with axis 1. Urban land (0.31), agricultural land (-0.55), percent substrate fines (-0.33), maximum water temperature (-0.46), and stream gradient (0.23) were significant with axis 2. Greater absolute values of canonical coefficients indicated stronger correlation between a variable and the



EXPLANATION

○ **Site where taxa were collected**—Letter identifies taxa listed below

● **Site where coldwater taxa were collected**—Coldwater taxa identified in bold in list below

← **Environmental gradient**

Ameletus		*Rhyacophila Coloradensis* Group	
Apatania		*Sweltsa*	
Arctopsyche grandis		*Zapada cinctipes*	
Atherix		Acari	A
Brachycentrus americanus		*Chaetocladius*	B
Calineuria californica		*Clinocera*	C
Caudatella		*Drunella coloradensis/flavilinea*	D
Chloroperlidae		***Epeorus deceptivus***	E
Claassnia sabulosa		*Ephemera*	F
Diamesa		*Fluminicola*	G
Dolophilodes		*Haliplus*	H
Drunella doddsi		Hirudinea	I
Drunella grandis/spinifera		*Hyalella azteca*	J
Epeorus albertae		*Parakiefferiella*	K
Epeorus grandis		*Pentaneura*	L
Eukiefferiella		*Potamopyrgus antipodarum*	M
Glossosoma		*Rhyacophila Angelita* Group	N
Hesperoperla pacifica		Stratiomyidae	O
Micrasema		*Thienemanniella*	P
Narpus		*Thienemannimyia* Group	Q
Neophylax rickeri		*Tinodes*	R
Pteronarcys californica		Tipulidae	S
Rithrogena		*Tricorythodes minutus*	T

Figure 11. Canonical correspondence analysis (CCA) ordination plot of taxa in relation to selected environmental variables, Idaho statewide surface-water quality monitoring program, 1996–98. [All environmental variables were significant (p<0.05) with one or both axes. The 46 taxa most influencing the ordination are shown]

axis tested. Correlations were strongest for variables that most influenced taxa composition. Previous studies have demonstrated that the habitat variables stream gradient, water temperature, and percent substrate fines affect macroinvertebrate assemblages (Hynes, 1970; Richards and others, 1993; Tate and Heiny, 1995; Lammert and Allan, 1999).

Basin size and elevation were not identified as important environmental variables in this analysis; however, stream gradient could be considered a surrogate for these variables. Because dams and diversions affect many Idaho rivers, the use of additional surrogate measures of hydrologic stability, such as the coefficients of variation of annual discharge and stream power (basin area x slope), to define the effects of hydrologic modifications on macroinvertebrate assemblages could be beneficial for future studies. Both measures have been used to evaluate hydrologic effects on aquatic life in streams (Poff and Allan, 1995; Kaufmann and others, 1999).

The CCA ordination (fig. 10) appeared to better differentiate between agricultural sites and forested or rangeland sites than did the IRI (fig. 7). Two distinct groups of sites were identified in the CCA ordination. Group 1, primarily above the origin, represented high-gradient, coldwater, forested and rangeland sites; group 2, primarily below the origin, represented sites influenced by human disturbance, increased percent substrate fines, and increased water temperatures that typically are associated with agricultural and (or) urban land uses. All five large-river sites on the main-stem Snake River grouped together in the ordination plot (group 2), which indicates their similarity in taxa and environmental conditions. At the 14 forested and rangeland sites (group 1), the mean number of EPT taxa was 19, and at the 23 agricultural and urban sites (group 2), the mean number was 11.

Sites 5, 21, and 22 (fig. 10, upper right quadrant) are outliers, not closely associated with either site group, primarily as the result of the abundance of the introduced species *P. antipodarum* at sites 21 and 22 and the abundance of the coldwater species *E. deceptivus* at site 5 (fig. 11, upper right quadrant). Site 5 on the South Fork Coeur d'Alene River is downstream from areas of extensive mining activities, and the macroinvertebrate assemblages have been impaired by habitat degradation and the toxic effects of trace elements (Maret and Dutton, 1999).

Forty-six taxa (about 25 percent of the total RTH taxa collected) that most influence the ordination analyses are shown in figure 11. A tight cluster of 26 taxa that were associated primarily with group 1 in figure 10 was identified. This group comprised most of the coldwater taxa characteristic of group 1 (above origin, fig. 11): *Ameletus*, *Apatania*, *Caudatella*, *Drunella doddsi*, and *Epeorus grandis*. Some of the other closely associated taxa in this group may be prime candidates for evaluating as possible coldwater or intolerant indicator taxa. According to Wisseman (1996), many of the taxa in this group also would be considered intolerant to human disturbance.

The lower site group in figure 10 (below origin) would be considered more facultative and tolerant to human disturbance such as Acari, *Thienemanniella*, *Thienemannimyia* Group, Hirudinea, *Tricorythodes minutus*, *Fluminicola*, and *Pentaneura* (Wisseman, 1996). Site 50, Lapwai Creek near Lapwai, has been characterized (Delong and Brusven, 1998; Waite, 1994) as having a relatively homogeneous macroinvertebrate assemblage that is tolerant of agricultural nonpoint-source pollution. The position of this site in the ordination plot in relation to the environmental variables (fig. 10) supports this characterization. Silver Creek near Picabo (site 29, fig. 10) contained only the taxa *Ephemera*, *Haliplus*, and *Chaetocladius* (fig. 11). This is a relatively small, low-gradient site with an abundance of fine substrates.

The CCA has demonstrated that various factors operating at different spatial scales are affecting the macroinvertebrate assemblages in Idaho rivers. The large-scale environmental gradients of basin land use were identified as most important; however, more site-specific habitat measures that relate to land use such as maximum water temperature, and substrate characteristics such as percent substrate fines, are also important. Instream measures of these habitat variables should be continued and expanded to all SWQP sites. The summer continuous temperature monitoring is particularly important for describing temperature extremes and duration of exposure for coldwater resources, particularly because elevated water temperature is the second most common cause of surface-water quality impairment in Idaho and the Western United States (Woodruff, 2000). As more data of this type are collected concurrently with biological assemblage information, more refinements in water-quality criteria and use designations can be made. Ultimately, this type of information can be used to effectively manage, protect, and enhance water resources for human health and environmental quality.

SUMMARY AND CONCLUSIONS

In 1996, the Idaho statewide surface-water quality monitoring program (SWQP) was redesigned to include aquatic biological collections of macroinvertebrates, fish, fish tissue contaminants, and associated stream habitat parameters to more effectively assess the status and trends of stream quality in Idaho. Forty sites were selected for macroinvertebrate sampling and habitat assessment from a network of 56 sampling sites.

Quality assurance samples were collected at three sites to evaluate intralaboratory and interlaboratory precision for qualitative multiple habitat (QMH) and richest targeted habitat (RTH) samples. Interlaboratory comparisons indicated the importance of using the same laboratory for consistency in taxonomic determinations and also in standardizing the resolution required for determination of metric values used in calculating biotic indices such as the IRI. In addition, these quality assurance samples provided valuable information about the performance standards of laboratories and should continue to be a vital part of the monitoring program to ensure the integrity of the taxonomic data.

A variety of environmental variables consisting of basin, hydrologic, and habitat characteristics were evaluated for each site. Site characterization was based on a tiered design that incorporated information at basin, reach, and site levels. Preliminary analysis indicated no correspondence between ecoregion percentages upstream from each site and macroinvertebrate assemblages.

Two hundred and forty-seven macroinvertebrate taxa were identified in RTH and QMH samples collected from the 40 sampling sites. Riffles (RTH samples) supported 184 taxa (74 percent) of the total taxa collected. The most abundant taxa identified in RTH samples were Oligochaeta, *Baetis tricaudatus*, *Hydropsyche*, Simuliidae, Chironomidae pupae, *Cricotopus*, *Eukiefferiella*, and *Orthocladius* complex.

Abundance (density expressed as individuals/m^2) for RTH samples ranged from 1,021 at Bruneau River at Hot Spring (site 31) to 63,000 at Blue Lakes Spring (site 21). The extremely high abundance at site 21 was due to the large numbers of *Hyalella azteca* (Amphipod) and *Potamopyrgus antipodarum* (New Zealand mud snail), a recently introduced gastropod in the Hagerman Valley, thought to have originated from commercial movement of aquaculture products such as trout eggs and live fish. This species also was found at sites 11, 32, 37, 44, and 56, which indicates that it is spreading from its area of introduction.

The total number of taxa and Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa varied greatly among sites for both sample types. Total number of taxa identified in QMH samples ranged from 14 at Willow Creek near Ririe (site 12) to 59 at North Fork Coeur d'Alene River at Enaville (site 4). Site 12 is immediately downstream from Ririe Lake dam, which may be limiting the diversity of taxa at this location. Sampling sites such as this are not representative of the upstream basin characteristics and could be dropped from the SWQP.

RTH and QMH sample types were evaluated using final invertebrate river index (IRI) scores and the five individual metrics (total number of taxa, EPT taxa, percent predators, percent Elmidae, and percent dominant taxon) composing this index. Median values for total number of taxa and percent dominant taxon were significantly different ($p<0.05$) between RTH and QMH samples. There was no statistical difference in median IRI scores between sample types. This statistical similarity indicated that either sample type could be used to evaluate biological condition by using the IRI and that the QMH sample did not provide additional information to help assess water quality by using the IRI. These findings indicated that QMH samples could be dropped from the SWQP. In rare cases where riffle habitat may not be available, then QMH samples could be collected as a replacement for RTH samples.

Fourteen coldwater taxa were collected during this study at 12 sampling sites. This represented only about 6 percent (14 of 247) of all taxa identified in both RTH and QMH samples; frequency of occurrence was 30 percent (12 of 40) for all sites. Most of these coldwater taxa were collected at forested sites; the most abundant taxon was *E. deceptivus*, a mayfly typically associated with high-gradient mountain streams. Generally, where coldwater taxa were identified in RTH samples, they composed a small proportion (less than 10 percent) of the total abundance, except at the South Fork Coeur d'Alene River near Pinehurst (site 5), where *E. deceptivus* composed almost 30 percent of the total abundance.

It is not surprising that more coldwater taxa were not collected because maximum water temperature at 62 percent of the sampling sites exceeded Idaho's instantaneous coldwater temperature criteria of 22 °C. Conversely, maximum temperature exceeded 22 °C at 5 of the 12 sites where RTH samples contained coldwater taxa. No coldwater taxa were collected at the five large-river sites on the main-stem Snake River in the southern part of the State. Maximum temperatures at these sites ranged from 22.1 to 26.9 °C. Coldwater taxa also were not found at spring sites 21 and 29, even though maximum temperatures at these sites were 22 °C or below. These discrepancies and the absence of coldwater taxa at spring sites indicated that the uniform temperature criteria may not reflect the range of stream temperatures in such an environmentally diverse State as Idaho.

A subset of 24 sites representing 12 high-quality and 12 low-quality sites were selected on the basis of multiple measures of human disturbance, and the IRI scores of these 24 sites were compared to validate the index. Detrended correspondence analysis (DCA) of all sites supported these site groups with similar taxa composition. Between high- and low-quality sites, the IRI median values were significantly different, providing evidence that the index can successfully discriminate impairment. Of the five metrics included in the IRI, median values for total number of taxa, EPT taxa, and percent predators were significantly different between high- and low-quality sites. The EPT taxa and percent predators showed a strong separation between site groups (no overlap of interquartile ranges), which indicated that these metrics were the most effective at discriminating between high- and low-quality sites. Median values for percent dominant taxon and percent Elmidae were not significantly different between site groups, which indicated that these metrics were relatively ineffective at discriminating between high- and low-quality sites. Reexamination of these two metrics would help determine whether they are providing useful information to the overall IRI score.

Correlation among the original eight metrics (the five metrics used to calculate the final IRI plus total abundance, percent coldwater taxa, and number of coldwater taxa), final IRI scores, and the habitat quality index (HQI), expressed as percent of total score, did not reveal any significant ($p<0.05$) relations. These findings indicated that the HQI may not be very useful for evaluating the condition of Idaho's larger rivers.

Biotic condition for 25 percent of the 40 sampling sites was categorized as poor (IRI score $\leq$13). Four of these were large-river sites; the remainder of the site types were two agricultural, one forested, two rangeland, and one spring. Biotic condition for 68 percent of the sites (27 of 40) was categorized as good (IRI score $\geq$16); biotic condition for only three sites was categorized as intermediate. The narrow range separating good from poor biotic condition sites (only 2 score values) is problematic; expansion of this range would improve the discriminatory power of the index. Expanding the scoring criteria from 0 to 100 points (percentages) may be one simple way to improve separation of biological condition categories. This final scoring criteria also would be more familiar to resource managers and the public.

Principal components analysis (PCA) revealed that coldwater taxa metrics were associated with forested or rangeland site types, which typically had good biotic condition scores. These results indicated that coldwater metrics may be providing useful information for describing macroinvertebrate assemblages. Further examination of these metrics would help determine whether their inclusion in the IRI would improve its discriminatory power.

PCA of the 24 environmental variables identified 8 principal components with eigenvalues greater than 1. From groups of closely associated variables, 10 surrogate variables were selected to represent each group: percent forested land, basin area, percent agricultural land, maximum water temperature, dissolved oxygen saturation, stream gradient, elevation, percent substrate fines, percent urban land, and percent open canopy.

A scatterplot of PCA axis 1 scores and number of EPT taxa showed a significant inverse relation (r=-0.50, p=0.001). The number of EPT taxa decreased as percent forested land and latitude decreased and percent rangeland and specific conductance increased. This inversion reflected a complex relation of land uses and natural factors that influence this important biological metric used in water-quality assessments.

Percent forested land, percent agricultural land, urban land, maximum water temperature, percent substrate fines, and stream gradient were identified in the forward selection process by canonical correspondence analysis (CCA) as significant (p<0.05) in the ordination of species data. The first two axes accounted for 46 percent of the joint variance between the macroinvertebrate taxa and environmental variables. The Monte Carlo test of variables along all canonical axes was significant (p=0.005) and indicated that the model (ordination diagram) represented a good fit of the macroinvertebrate taxa and environmental data. Most of the variability in environmental variables was accounted for by forested, urban, and agricultural land uses with eigenvalues of 0.32, 0.31, and 0.26, respectively. Canonical coefficients for all six environmental variables were significant (p<0.05) with axis 1 or 2. Forested land (-0.81) and urban land (0.73) were significant with axis 1. Urban land (0.31), agricultural land (-0.55), percent substrate fines (-0.33), maximum water temperature (-0.46), and stream gradient (0.23) were significant with axis 2.

The CCA ordination identified two distinct groups of sites—those representing more high-gradient, coldwater, forested and rangeland sites and those representing sites influenced by human disturbance, indicated by increased percent substrate fines and increased water temperatures that typically are associated with agricultural and urban land uses. At the 14 forested and rangeland sites (group 1), the mean number of EPT taxa was 19, and at the 23 agricultural and urban sites (group 2), the mean number was 11.

The CCA demonstrated that various factors operating at different spatial scales are affecting the macroinvertebrate assemblages in Idaho rivers. The large-scale environmental gradients of basin land use were identified as most important; however, more site-specific habitat measures that relate to land use such as maximum water temperature, and substrate characteristics such as percent substrate fines also are important. Instream measures of these habitat variables should be continued and expanded to all SWQP sites.

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SUPPLEMENTAL INFORMATION

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[N., North; R., River; nr, near; S., South; Cr., Creek; USGS, U.S. Geological Survey; ID, identification; site locations shown in figure 1; QMH, qualitative multiple habitat reported in total abundance; RTH, richest targeted habitat (riffles) reported in abundance (individuals per square meter); No., number; coldwater taxa are shaded]

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Noninsect																												
Acari	12					4	7		40	112	180	500	42	60			1	175	6	94	105	162	12	81		21	15	
Aeshnidae							3																					
Branchiobdellida																												
Caecidotea							3																					
Ferrissia																			6	38			36					
Fluminicola											580	1,880	66				10		6	19			408	312	1,515	64		
Gammarus															312	1,500												
Gonidea angulata																												
Gyraulus	6																										570	338
Helisoma anceps																												
Helobdella stagnalis											100																	
Hirudinea													6				1		6				12	35	30		15	
Hyalella azteca											140	50	294	2			1				195		108	300			1,335	1,238
Hydra													6		24								12					
Margaritifera					5																							
Nematoda	6					4							12	2					12		15	512	24				30	
Oligochaeta	24	15			5	4	3		1,720	300	1,120	500	834	82	2,520	750	11	25	210	56	270		432	381	155	279	1,215	
Ostracoda											40		48	2					30	19	330		432		25		15	
Pacifasticus																						12						
Physella	6	5					23				860		516			38	1		42		15		96	35			180	113
Planorella subcrenata											20																	
Porifera																						12						
Potamopyrgus antipodarum														2														
Pyrgulopsis												20																
Radix auricularia											680	50																
Sphaeriidae					5						200	150	114		12				42	19			72	81	55		15	
Stagnicola											900	150					7	25	234	244		12	12				495	
Turbellaria	6	10	33				57	144				100										12	36		10			
Valvata humeralis												100																
Vorticifex effusa																				19								
Insect																												
Odonata																												
Argia																		25			30							
Calopteryx																												
Coenagrionidae					5								6	2									12					

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect—Continued																												
Odonata—Continued																												
Gomphus																									5			
Macromia																												
Octogomphus																									5			
Ophiogomphus																	1		6									
Ephemeroptera																												
Acentrella	330	859	8		190	656	37	464	120	300	60	400		25				600		225								
Acerpenna pygmaea																												
Ameletus[1]	84		25		15																							
Attenella margarita	18	5			85	24			40					2														
Baetidae		19			15	4					320		42				179	1,225			405	362						
Baetis tricaudatus	390	274	188	174	235	224	97	544	4,200	4,388	640	5,100	18	2	12	150	14	550	42	375	1,155		132	196	80	300	465	1,800
Barbaetis													6	5														
Caenis													6	35			8	325										
Callibaetis					140						60		72										36					
Caudatella[2]																												
Centroptilum	90				475	4			40				462	5					48									
Choroterpes																			6	19								
Cinygma																												
Cinygmula		5				4																						
Diphetor hageni	42	134	5			4					140			8														
Drunella coloradensis/flavilinea	12	10	44	105	5																							
Drunella doddsi[2]		10				8																						
Drunella grandis/spinifera						8																						
Epeorus																												
Epeorus albertae	36	154			20	108																						
Epeorus deceptivus[2]		10	235	534		8																						
Epeorus grandis[2]																												
Epeorus longimanus																												
Ephemera																												
Ephemerella aurivillii																												
Ephemerella inermis/infrequens	84	10	5		30				400	188	80	1,400					1	75	156	2,381		12						
Ephoron																												
Heptagenia/Nixe	12	43			5	56					80		12	2			5	100	6	56								
Paraleptophlebia	84	14							40		120	100				38		25	96			25						

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																												
Ephemeroptera — Continued																												
Paraleptophlebia bicornuta																												
Rhithrogena		5			50	276			240	150	120	400								300				12				
Serratella	36	125	3	6	40	148																						
Siphlonurus			109		50																							
Stenonema																		250		56					15	21		
Timpanoga hecuba					20																							
Tricorythodes																												
Tricorythodes minutus		5									120		48	138		38	84	3,475	210	56	210	450			95		480	788
Plecoptera																												
Calineuria californica	12	5				8																						
Capniidae[1]																												
Chloroperlidae	48	38	25	24	20	40				38																		
Claassenia sabulosa		10				8			40	38		50								19								
Doroneuria[1]																												
Hesperoperla pacifica						16						50																
Isogenoides																												
Isoperla		5				4			400	525	100	850		2			1	50	12	281		12						
Perlodidae										38										19								
Pteronarcella	192	62	5	9																								
Pteronarcys californica						4						50																
Skwala												50																
Sweltsa				3																								
Taeniopterygidae[1]																												
Zapada cinctipes																								12				
Hemiptera																												
Ambrysus																												
Belostoma																												
Corixidae	6				125																							
Gerris			3		5																							
Trichoptera																												
Amiocentrus aspilus						4															15							
Apatania[1]	54	5																										
Arctopsyche grandis						4																						
Brachycentrus americanus	36	62	19	9		52																						

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect—Continued																												
Trichoptera—Continued																												
Brachycentrus occidentalis					180	172			321	825		150						50	6		45	38	648	588		21		
Ceraclea							3													19								
Cheumatopsyche							176	1,920															24	12				
Chimarra																												
Culoptila						4															15	25						
Dicosmoecus gilvipes	12		3		5		3																					
Dolophilodes																												
Glossosoma		5		3		4																						
Helicopsyche borealis									80		40																15	
Hydropsyche	6	106	76	126	10	64	483	5,184	1,000	1,763	940	6,150		22		38	20	1,775	90	1,294	1,020	1,025	588	1,846	305	8,851	1,860	34,538
Hydroptila														15			1	50		38	45		96	81			30	
Lepidostoma-sand case larvae	672	58				8				150																		
Lepidostoma-turret case larvae	102				265																							
Leucotrichia							183	736																				
Limnephilidae																												
Limnephilus																											15	
Micrasema	6		14			4			40																			
Mystacides					10																							
Nectopsyche																		25							55			
Neophylax rickeri	24	5				4																						
Neotrichia																												
Neureclipsis																												
Ochrotrichia														2							15	25					60	
Oecetis											20														50			
Oligophlebodes																												
Onocosmoecus unicolor	6		3																						5			
Polycentropus																												
Protoptila												50								19								
Psychoglypha bella	30																											
Psychoglypha subborealis	6				5																							
Psychomyia																			6	112								
Pycnopsyche																									5			

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect—Continued																												
Trichoptera—Continued																												
Rhyacophila Angelita Group			8	15																								
Rhyacophila Brunnea Group																												
Rhyacophila Coloradensis Group									40																			
Tinodes																												
Wormaldia																												
Lepidoptera																												
Petrophila							47	368			80	1,100					1	300	12	300		38				21	15	112
Coleoptera																												
Amphizoa																												
Brychius	6															38												
Cleptelmis	6																											
Dubiraphia													24				2						24	58	25			
Dytiscidae			134	3	5								42				1				30							
Eubrianax edwardsi																												
Gyrinidae																		25										
Haliplus																												
Helichus																												
Heterlimnius																												
Hydrophilidae																					15							
Lara avara																												
Microcylloepus														5			2	500			45	125		12	10	407		
Narpus																												
Optioservus	60	14		12	20				40		320	800	6	25			23	1,400	6	19	255	575	24	219				
Ordobrevia nubifera	24	77																										
Peltodytes													6	2														
Psephenus																											15	
Stenelmis																												
Zaitzevia	42	14			5						340	1,250												12				
Diptera																												
Antocha		5	3			24		32																				
Atherix	6	5	3	3		4					80	200																
Blephariceridae[1]																												
Brachycera																												
Ceratopogoninae	6	5											6	2									12				15	
Chelifera		5																										
Clinocera				6																								

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																												
Diptera — Continued																												
Cryptolabis																												
Culicidae					10																							
Deuterophlebia[1]																												
Dicranota																												
Empididae					5																	12						
Ephydridae																									5			
Forcipomyiinae																												
Hemerodromia			5								20							50			15		96			21		
Hexatoma	24	5				4																						
Limnophora														2														
Limonia																												
Rhabdomastix[1]																												
Simuliidae	48	72	30	9	20	20	7	64	2,720	4,763	180	1,300			48	712		175		19	315	25	1,896	392	35	42	75	281
Stratiomyidae																								12				
Tabanidae			3												12													
Tanyderidae																												
Tipula			76	3															6									
Tipulidae					10	4													6									
Chironomidae																												
Ablabesmyia	6				10																							
Apedilum							7	16																				
Boreoheptagyia																												
Brillia	12				10																							
Cardiocladius				6			53	144	520	112	160	450														193	45	
Chaetocladius																												
Chironomidae-pupae		101	38	153	20	88	17	16	640	488	40	450	12	95	204	2,100	6	200	42	319	105	75	24	104	10		75	56
Chironomus													12						102				12				15	
Cladotanytarsus						4							24	8				25					48	46				
Corynoneura	12				10						80		12	8							30							
Cricotopus	6		16		170		47		2,920	2,363	248	1,750	24	244	1,032	6,750	38	75	300	2,776	375	50	696	646	30	364	345	
Cricotopus (Nostococladius)																												
Cryptochironomus					10								18	55			1							12	5			
Cryptotendipes																	5											
Demicrypto-chironomus																												
Diamesa		5		6		8																						
Dicrotendipes							230		120		40	50		15					648	112			96	23			150	

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																												
Chironomidae— Continued																												
Eukiefferiella	6	19	60	27	10	20	7	16	920	150	40	250		8	132	150			18	38	120	100		12	5	21	15	
Glyptotendipes																												
Harnischia													18															
Heleniella[1]			5																									
Hydrobaenus																												
Limnophyes					10				120												30							
Lopescladius																												
Macropelopia																							12					
Micropsectra	36	5	22	6	45	4	13		400	150			30		84						30		12					
Microtendipes	18	110				8			200	150	40					150					30	12	12					
Monodiamesa																												
Nanocladius											20		12	8							30	12	48					
Nilotanypus	18																1								5			
Odontomesa					25																810			12				
Orthocladiinae																												
Orthocladius Complex	66	298	322	651	55	88	320	96	1,440	1,313		350		82	2,568	8,138		50		169							30	
Pagastia	12	5			10	16			400	375											30	75						
Parachironomus																												
Paracladius																												
Paracladopelma																												
Parakiefferiella																			18		120		12					
Paralauterborniella																												
Paramerina																												
Parametriocnemus																												
Paraphaenocladius									200	38	20										60			12				
Paratanytarsus					35								66	168			15	50	234	75			48	69			45	
Paratendipes			11		10								6															
Pentaneura					10																180		204	104				
Phaenopsectra					10				200					15	216				216		30				5	21		
Polypedilum	108	158	11		160	136			120		60		30	15			30	800	48	319	225	88	24	12	95	300	15	
Potthastia Gaedii Group	6		27			4																						
Potthastia Longimana Group															132		1											
Procladius											20																	
Psectrocladius																												
Pseudochironomus																					600	188						
Pseudosmittia																			18									

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	N. Fork Coeur d'Alene R. at Enaville		S. Fork Coeur d'Alene R. nr Pinehurst		St. Joe R. at Calder		Spokane R. nr Post Falls		Snake R. nr Heise		Teton R. nr St. Anthony		Henrys Fork nr Rexburg		Willow Cr. nr Ririe		Blackfoot R. nr Blackfoot		Snake R. nr Blackfoot		Portneuf R. at Topaz		Marsh Cr. nr McCammon		Portneuf R. at Pocatello		Snake R. nr Minidoka	
Year sampled	1998		1998		1998		1998		1996		1996		1996		1996		1996		1996		1996		1996		1996		1996	
USGS site ID	12413000		12413470		12414500		12419000		13037500		13055000		13056500		13058000		13068500		13069500		13073000		13075000		13075500		13081500	
Site No.	4		5		6		7		8		10		11		12		13		14		15		16		17		18	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																												
Chironomidae— Continued																												
Rheocricotopus																												
Rheotanytarsus	6	5			25	36							30	28			9	425		38	60	25		12	15	21		
Robackia																												
Saetheria														8							30							
Stempellina[1]																												
Stempellinella	30																											
Stilocladius					10																							
Symposiocladius																												
Synorthocladius							7		120	150	160			8			2											
Tanytarsus											60	50		8			2		18									
Thienemanniella	24	5			395				520	38	400		30	8			28	50			30	12	96		10			
Thienemannimyia Group	222	19	11	6	115				120		40	50		48			1	150	36		30	38	60	81	20	43		
Tvetenia			44	6		4		64	2,000	338	20	50					1				60	62			20	107		
Zavrelimyia	150				25																							

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Noninsect																										
Acari	2,400	720	40	300	230	109	80		105	25	30	2		7	6		25	8	24	21	71	10	120	72		20
Aeshnidae																										
Branchiobdellida																										
Caecidotea																								60		
Ferrissia																										
Fluminicola		1,640	2,160										728	252			55	6	22							36
Gammarus															17	2								360		
Gonidea angulata																	2									
Gyraulus		80					3							17												

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Noninsect—Continued																										
Helisoma anceps																										
Helobdella stagnalis																										
Hirudinea						3							38	25	2	4										
Hyalella azteca	1,400	29,400													280				26							
Hydra																										
Margaritifera																										
Nematoda	80			50	11		40		30	88		4		2	2		5		10	11	42		60	8		
Oligochaeta	960	720	120		114	32	1,020	266	180	25		2	113	44	9	6	45		2		289		8,580	472	6	4
Ostracoda	1,200					16	20	15	15				8				5		4				60			
Pacifasticus																										
Physella	120						320	30											2							
Planorella subcrenata																										
Porifera																										
Potamopyrgus antipodarum	12,840	9,120	16,960	17,550															2							4
Pyrgulopsis																										
Radix auricularia																										
Sphaeriidae			80	150	28	35						2	323		4											
Stagnicola																										
Turbellaria	320	960	40	50	6	3									2	4			10						48	8
Valvata humeralis														7												
Vorticifex effusa																			2							
Insect																										
Odonata																										
Argia		120																	2							
Calopteryx																										
Coenagrionidae	40																									
Gomphus																										
Macromia																										
Octogomphus																										
Ophiogomphus																										
Ephemeroptera																										
Acentrella								15	15		90	11	8		2	2	70	6	114	160	99	54	960	232	102	136
Acerpenna pygmaea													23													
Ameletus[1]									15	12											7					
Attenella margarita					6		360	236			30												60			

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Ephemeroptera — Continued																										
Baetidae	160				17								218	54	6		10									
Baetis tricaudatus	840	4,560	1,000	1,800	480	115	1,480	295	885	388	150	32	413	239	400	298	135	69	20		78	83	17,040	1,088	270	88
Barbaetis					11																					
Caenis					6																					
Callibaetis																										
Caudatella[2]								15		12											7					
Centroptilum					40										15		90									
Choroterpes																										
Cinygma																										
Cinygmula										12	555	90														
Diphetor hageni					6	10	80	15			315	30		22		2		2			7					
Drunella colora-densis/flavilinea					6		20				45	9														
Drunella doddsi[2]										12	30	4									28	38				
Drunella grandis spinifera								30		25											56	13				
Epeorus										25		2														
Epeorus albertae					6						45	9						2								
Epeorus deceptivus[2]																										
Epeorus grandis[2]																										
Epeorus longimanus										12																
Ephemera													8	2												
Ephemerella aurivillii					17	16																				
Ephemerella inermis/infrequens							100	15	285	138	150	49	23	70						11	28	6				
Ephoron																			2							
Heptagenia/Nixe					46	35	120	59			30				4	2								8		
Paraleptophlebia					34	32	60					2	23	122												
Paraleptophlebia bicornuta																										
Rhithrogena							20		75	712							20	15			64	16	420	16		4
Serratella							300	118			135	51									14					
Siphlonurus																										
Stenonema															47	8			12	32					60	80
Timpanoga hecuba											15															

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Ephemeroptera — Continued																										
Tricorythodes															2				26	21			60		18	180
Tricorythodes minutus			80	250	183	125			15				225	128	441	224		2	24	32				8	168	208
Plecoptera																										
Calineuria californica																					14					
Capniidae[1]							20		285																	
Chloroperlidae									60	88	15	17														
Claassenia sabulosa										12											7					
Doroneuria[1]																										
Hesperoperla pacifica							40	30	45	25	15															
Isogenoides																										
Isoperla							440	74	90	150		2														
Perlodidae						22				2		4									42					
Pteronarcella							20	15			30	21														
Pteronarcys californica																										
Skwala					34			15													7					
Sweltsa									30	38																
Taeniopterygidae[1]																										
Zapada cinctipes							100	30	15	25											7					
Hemiptera																										
Ambrysus																										
Belostoma																										
Corixidae					46		60						15		26				128				840		12	
Gerris																										
Trichoptera																										
Amiocentrus aspilus				50																						
Apatania[1]																										
Arctopsyche grandis									315	25											14	26				
Brachycentrus americanus									120	125	90	81		11							49	6				
Brachycentrus occidentalis			120	650	51	26	2,780	739							19	54	135	171			289	13				
Ceraclea																										
Cheumatopsyche					6	10										2	5		148	1,334	7		60	88	48	144
Chimarra										12																

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Trichoptera — Continued																										
Culoptila																										
Dicosmoecus gilvipes																										
Dolophilodes																										
Glossosoma					11			15	30								10	12				13				
Helicopsyche borealis				450	34	48		44					120				650	17								
Hydropsyche		2,520	40	800	325	272	1,900	1,034		712			8	43	30	102	15	10	506	2,934	409	448	7,380	2,568	756	1,336
Hydroptila	320	1,560	40	100	6	13		783					15	2	4	10		8	4							12
Lepidostoma-sand case larvae						3			120	12	30										155	45				
Lepidostoma-turret case larvae	40				17		20																			
Leucotrichia																			2					8		
Limnephilidae									30																	
Limnephilus																										
Micrasema									15																	
Mystacides																										
Nectopsyche																										
Neophylax rickeri																										
Neotrichia						3	40	20																		
Neureclipsis																										
Ochrotrichia			80	100	6	6	580	1,492								26		2								
Oecetis																2										
Oligophlebodes																										
Onocosmoecus unicolor							20	15																		
Polycentropus						6																				
Protoptila															2		5		18		21					
Psychoglypha bella																					7					
Psychoglypha subborealis																										
Psychomyia																					7			8		
Pycnopsyche																										
Rhyacophila Angelita Group								15																		

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Trichoptera — Continued																										
Rhyacophila Brunnea Group																										
Rhyacophila Coloradensis Group										12											14	16				
Tinodes		120																								
Wormaldia					57	6	60	30																		
Lepidoptera																										
Petrophila		240														8		4	8					8		4
Coleoptera																										
Amphizoa																										
Brychius																										
Cleptelmis							20	15						4												
Dubiraphia					29	6									4		5									
Dytiscidae					6	3	80		30		15	11														
Eubrianax edwardsi																										
Gyrinidae																					14					
Haliplus														2												
Helichus																	5									
Heterlimnius																										
Hydrophilidae									15																	
Lara avara																										
Microcylloepus			80	450					30						39	66	90	23								16
Narpus										12																
Optioservus			200	300	69	64	300	236	45	12	15	2		52			20				191	13				
Ordobrevia nubifera																										
Peltodytes																										
Psephenus																		2								
Stenelmis																22										
Zaitzevia					51	45	40							2			25	2			7	6				
Diptera																										
Antocha		120						15													7	10				
Atherix										25											7					
Blephariceridae[1]										38											7	35				
Brachycera					6																					
Ceratopogoninae	40				6	38	60	30			15		8	2				2								
Chelifera									120	12																

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Diptera— Continued																										
Clinocera												2														
Cryptolabis												4														
Culicidae																										
Deuterophlebia[1]										12												13				
Dicranota							20		60	25																
Empididae								15							2							3		32		
Ephydridae	40																									
Forcipomyiinae																										
Hemerodromia														2					6		7		60	16		4
Hexatoma					6	29			15	62	45										7					
Limnophora																										
Limonia	40																									
Rhabdomastix[1]																										
Simuliidae	200	120	1,080	50	343	64	720	325	780	3,775	1,530	383	1,365	11	21	62	5	2	30	683	21	598	180	64	1,446	52
Stratiomyiidae	200	600																								
Tabanidae																			2							
Tanyderidae																								8		
Tipula																							60			
Tipulidae					6																7					
Chironomidae																										
Ablabesmyia																										
Apedilum																							120			
Boreoheptagyia																					49					
Brillia																							180			
Cardiocladius			40		29	6					195	15	8			12	35	12			49		120	40	12	
Chaetocladius														2												
Chironomidae-pupae	40	480			51	67	100	148	60		90	96	8	11	15	36	145	73	16	139	113	90	240	48	6	16
Chironomus																	10								6	
Cladotanytarsus					40	6			75				15			2			20				60			
Corynoneura						6			45		45		8		2											
Cricotopus	720	3,480	80	50	989	345	100		135		480	11	68	8	57	88	705	441	18	107	353	6	1,200	80	180	100
Cricotopus (Nostococladius)						6	20		30																	
Cryptochironomus														4	2				2						6	
Cryptotendipes																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98—Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect—Continued																										
Chironomidae—Continued																										
Demicryptochironomus													23													
Diamesa																										
Dicrotendipes	600																									
Eukiefferiella	400	2,880		150	11	42	800	487	165	88	390	9			2	2					226	42	240	8	6	
Glyptotendipes																									12	
Harnischia																										
Heleniella[1]																										
Hydrobaenus																										
Limnophyes																4										
Lopescladius																										
Macropelopia																										
Micropsectra					40	6						2		4		2					49	3		8		
Microtendipes	40																		2	11						
Monodiamesa																					28					
Nanocladius					11		60	15											4			3				
Nilotanypus											45										28					
Odontomesa							60		45		45										28					
Orthocladiinae		120																6								
Orthocladius Complex	280				69	41	320		600	12	3,210	229	46	2	11	4	90	100	10	11	233	55	540	48	42	
Pagastia							520	236		50																
Parachironomus																			2							
Paracladius												2			2											
Paracladopelma							20														78				12	
Parakiefferiella	80	120											8				20						60		6	
Paralauterborniella																										
Paramerina																					78					
Parametriocnemus						6	200						8		2											
Paraphaenocladius		120							480																	
Paratanytarsus	200	240			29	6																	60			
Paratendipes																										
Pentaneura							20						68	41												
Phaenopsectra						10															402					
Polypedilum			80	100	40	10			195			11	8		6	18	90	12		11	530	106			54	24
Potthastia Gaedii Group																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Blue Lakes Spring		Rock Cr. at Daydream Ranch		Camas Cr. at Red Road		Beaver Cr. at Spencer		Big Lost R. nr Chilly		Big Wood R. nr Bellevue		Silver Cr. nr Picabo		Malad R. nr Gooding		Bruneau R. nr Hot Spring		Snake R. nr Murphy		Boise R. nr Twin Springs		Boise R. at Glenwood Bridge		Snake R. at Nyssa	
Year sampled	1996		1996		1997		1997		1996		1997		1997		1997		1997		1997		1997		1997		1997	
USGS site ID	13091000		13092747		13108900		13113000		13120500		13141000		13150430		13152500		13168500		13172500		13185000		13206000		13213100	
Site No.	21		22		25		26		27		28		29		30		31		32		33		35		37	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Chironomidae — Continued																										
Potthastia Longimana Group							20	74																		
Procladius													15													
Psectrocladius																										
Pseudochironomus	40																									
Pseudosmittia																										
Rheocricotopus								15	165							4										
Rheotanytarsus	320	2,520			40						45		60	19	2	4	20	12	50	245	78	10			12	4
Robackia																										
Saetheria															6											
Stempellina[1]					11																					
Stempellinella						6								2			10									
Stilocladius																										
Symposiocladius									45																	
Synorthocladius																	35		2				120			
Tanytarsus							80				45				2		100				99				6	
Thienemanniella	40		40				20		1,410		45			4	13	2	55				254				6	
Thienemannimyia Group					29	10	120	89	45					2	6	4							120	32		
Tvetenia						6	360	103	555	12	240	2	8	7							28		60	16		
Zavrelimyia																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Noninsect																										
Acari	6	21	8	16	28	7			10	24	20							8		14	40	11	70	281	15	24
Aeshnidae																										
Branchiobdellida					4																					
Caecidotea																										
Ferrissia																						5				
Fluminicola			20				375	216	720	24																
Gammarus							15														15					
Gonidea angulata																										
Gyraulus																										
Helisoma anceps																					300	21				
Helobdella stagnalis																										
Hirudinea																								56		
Hyalella azteca							15																30	38	30	
Hydra																										
Margaritifera							30																			
Nematoda			12	16		24			20	24	1		10									5				
Oligochaeta	30	14	136	8	36		45	24	220	24	300	24	44	24	80	56	120	112	30	48	15	5		262	450	8
Ostracoda			8																		10		10		60	
Pacifasticus																	20	8								
Physella							15				80								30	5	25	5				
Planorella subcrenata																										
Porifera									60																	
Potamopyrgus antipodarum							15																		645	88
Pyrgulopsis																										
Radix auricularia																					210	16				
Sphaeriidae											20								15						45	
Stagnicola											40								45	5						
Turbellaria			24					24									10						260		60	56
Valvata humeralis																										
Vorticifex effusa																										
Insect																										
Odonata																										
Argia																	70				20	16				
Calopteryx																	30				10					
Coenagrionidae																	40				125				15	
Gomphus																					15					
Macromia																					10					
Octogomphus																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Odonata— Continued																										
Ophiogomphus						7				24											5					
Ephemeroptera																										
Acentrella	6	34	84	736	156	199	390	336	120	216	20				100	128	10		120	14		27				
Acerpenna pygmaea																										
Ameletus[1]	6	7											4	10					15	14						
Attenella margarita					8					24																
Baetidae						7			30								30		45		10	5	330	638		
Baetis tricaudatus	720	1,207	188	384	680	790	4,800	5,424	2,400	5,328	1,700	4,008	59	230	2,060	1,376	1,550	128	1,080	130	25	27	710	525	435	232
Barbaetis																										
Caenis																										
Callibaetis																					15					
Caudatella[2]		14											9	130												
Centroptilum					68																					
Choroterpes																										
Cinygma													69													
Cinygmula														254	10											
Diphetor hageni		7				7	90	96			20		2		10					5						
Drunella coloradensis/ flavilinea																										
Drunella doddsi[2]	18	178											12	62		8				14						
Drunella grandis/ spinifera	42	27									120	144	3	19	20	40			15	14						
Epeorus																	10	56		10						
Epeorus albertae	6	14											10	58			10									
Epeorus deceptivus[2]																										
Epeorus grandis[2]		14											3	43		8										
Epeorus longimanus																										
Ephemera																										
Ephemerella aurivillii						7																				
Ephemerella inermis/ infrequens	54	75							240	456	100	24	47	72	1,120	1,040		8	1,365	730						
Ephoron																								38		
Heptagenia/Nixe					8				50	264								8	15	5			10			
Paraleptophlebia							15		20		40	24	2	29	50		340	824	120	53						
Paraleptophlebia bicornuta																		8	15							
Rhithrogena	54	398		64	20	30	15	192	110	576	40	48	38	384	110	96	20	64	90	43	15	32				
Serratella	48	27																								

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Ephemeroptera — Continued																										
Siphlonurus																										
Stenonema				16																	10	59		150		
Timpanoga hecuba	6																									
Tricorythodes																										
Tricorythodes minutus				8	48		45		20	240								32	105	29			920	4,969		16
Plecoptera																										
Calineuria californica						7				24			2	10												
Capniidae[1]							30						3													
Chloroperlidae													3	19												
Claassenia sabulosa										24			1	14					15	14						
Doroneuria[1]		7																								
Hesperoperla pacifica	36	7					15	24	20	72	60	240	12	34	20	40			15	5						
Isogenoides					24	44																				
Isoperla	42	21					435	312			40	312			60	56			45			16				
Perlodidae	6	7								24		24	1	5		8			30							
Pteronarcella							15				60	72														
Pteronarcys californica	36	27									20	24	2	10	20	8			15							
Skwala															10	8	10	8								
Sweltsa	18												16	101												
Taeniopterygidae[1]													2		10											
Zapada cinctipes	24	34											1	10	10	8										
Hemiptera																										
Ambrysus					4																					
Belostoma																					5					
Corixidae					28				10		120						10				5				75	
Gerris																	90		15		10					
Trichoptera																										
Amiocentrus aspilus																									15	24
Apatania[1]													7	5												
Arctopsyche grandis	342	165					165	96		24	20	168	29	326	20	8										
Brachycentrus americanus	78	82					255	240				24	17	53	10	8										
Brachycentrus occidentalis	762	597			324	1,380			10	144	6,020	3,744			470	752	40	24	825	912				19	15	8

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Trichoptera — Continued																										
Ceraclea																										
Cheumatopsyche				8	68	288				120						8	470	1,216	120	34	380	997			15	608
Chimarra																										
Culoptila																										
Dicosmoecus gilvipes																			15	5		5				
Dolophilodes	12	21											7	58												
Glossosoma	96	309					15	48			80		34	226	10	16			45							
Helicopsyche borealis					16														75			5				
Hydropsyche	204	521	184	1,120	256	1,151	270	168	330	3,360	160	240	8	72	860	8	1,150	1,136	795	408	390	1,317	290	581	3,315	4,552
Hydroptila																	20		30		5		110	319	30	
Lepidostoma-sand case larvae								72	10		1,660	792	6	5					105	77						
Lepidostoma-turret case larvae																										
Leucotrichia					28	7											90	40		10						16
Limnephilidae																										
Limnephilus																										
Micrasema													7	10												
Mystacides																					10					
Nectopsyche			4																				30	56		
Neophylax rickeri	6												1	5												
Neotrichia																										
Neureclipsis																					5					
Ochrotrichia																							310	169	75	8
Oecetis					4				10																	
Oligophlebodes													1													
Onocosmoecus unicolor																										
Polycentropus																										
Protoptila					4		30	120															20	319		
Psychoglypha bella	6																									
Psychoglypha subborealis																										
Psychomyia																8										
Pycnopsyche																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Trichoptera — Continued																										
Rhyacophila Angelita Group	6													10												
Rhyacophila Brunnea Group								24																		
Rhyacophila Coloradensis Group		21									20	24		10		24										
Tinodes																										
Wormaldia																										
Lepidoptera																										
Petrophila				32	8					48							180	824		38	5	101		75	75	152
Coleoptera																										
Amphizoa	6																									
Brychius																					5	11				
Cleptelmis					4																					
Dubiraphia					12														15		40					
Dytiscidae	36												1						15							
Eubrianax edwardsi		7																								
Gyrinidae					4																					
Haliplus																										
Helichus																										
Heterlimnius	12												1	5	10	8										
Hydrophilidae	6				4																					8
Lara avara	6	14																								
Microcylloepus		16	4	8	48	44																	390	38		80
Narpus		14												19					30							
Optioservus	210	89		16	16	89	1,365	1,584			420	504	33	120	100	32	390	568	105	34	90	336	20	19		
Ordobrevia nubifera																	50	64		5						
Peltodytes																					5					
Psephenus					4													8	15	5						
Stenelmis																										
Zaitzevia	30					15			30			24	2	14	40		80	24	375	86		16				
Diptera																										
Antocha	24						30	288	10	48	120	264	8	10	20		30	16	15	67						
Atherix	60	62			4				10	24	120	120	4	5	20	16										
Blephariceridae[1]	6	7			4	74							2		10	8					10					
Brachycera																										16
Ceratopogoninae																										
Chelifera								24																		

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Diptera — Continued																										
Clinocera																										
Cryptolabis																										
Culicidae																										
Deuterophlebia[1]																										
Dicranota	12	21																								
Empididae				8																						
Ephydridae																	10									
Forcipomyiinae	6																									
Hemerodromia				8												8		16		5		11				16
Hexatoma	6	14						24	10	24			1	14	10	16	10		75	14	5	5				
Limnophora																										
Limonia	6																10									
Rhabdomastix[1]														5												
Simuliidae	18	7	384	512	20	30	945	2,088	1,290	216	240	2,472	3		10	16	250		15		45	11	690	38	150	
Stratiomyiidae																										
Tabanidae																										
Tanyderidae		7																								
Tipula																										
Tipulidae											20															
Chironomidae																										
Ablabesmyia																										
Apedilum																					20				30	
Boreoheptagyia													2													
Brillia																										
Cardiocladius			52	176	12	7	90	408	90	168		192			40		550	48	105	48		16			210	80
Chaetocladius																										
Chironomidae-pupae	18	21	52	184	20	15	180	120	90	216	20	240	5	34	40	40	30	40	60	72	10	53	30	112	90	16
Chironomus																	240		585						150	
Cladotanytarsus					12																		30	450		
Corynoneura																	40		60							
Cricotopus	6		292	384	468	37	780	384	240	600		48	2	5	160	64	380	208	75	106	230	229	50		990	32
Cricotopus Nostococladius		7							10					5												
Cryptochironomus	6			8							20												10	19		
Cryptotendipes																										
Demicrypto-chironomus																										
Diamesa	60	14											18	38												
Dicrotendipes																	20				130				120	

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Chironomidae— Continued																										
Eukiefferiella	60	7	40	8	24		360	312	430	384	660	408	15	106	240	40	110		165	10		16			780	8
Glyptotendipes																										
Harnischia																							10			
Heleniella[1]																										
Hydrobaenus													3	19		8										
Limnophyes							15																		60	
Lopescladius																			15							
Macropelopia																			15							
Micropsectra							45				80	96			10		70	8	135	5						8
Microtendipes	18				12				20						10			16	15							
Monodiamesa																										
Nanocladius															10		20				10		10			
Nilotanypus																										
Odontomesa							15				100															
Orthocladiinae																										
Orthocladius Complex	330	158	52	16	48		315	1,200	610	1,800	460	672	57	38	490	48	160	32	285	149	140	101			390	72
Pagastia	18	21					15				40	72	5	19												
Parachironomus																										8
Paracladius																										
Paracladopelma					12																					
Parakiefferiella					12																					
Paralauterborniella																							30			
Paramerina																										
Parametriocnemus							15	24		96	20					8										
Paraphaenocladius																										
Paratanytarsus						7																			30	
Paratendipes																										
Pentaneura	6																						20	19		
Phaenopsectra	120		12		36		45		150						10		40									
Polypedilum	42	7	544	200	384	22	15		190	1,008	20	24					40	24			10		190	244	120	16
Potthastia Gaedii Group																		16		58						
Potthastia Longimana Group																				5						
Procladius																									30	
Psectrocladius																					315					
Pseudochironomus																										
Pseudosmittia																										

Table A. Macroinvertebrates collected from selected sampling sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	S. Fork Payette R. at Lowman		Payette R. nr Payette		Weiser R. nr Weiser		Pahsimeroi R. at Ellis		Salmon R. at Salmon		Lemhi R. nr Lemhi		Johnson Cr. at Yellow Pine		Little Salmon R. at Riggins		Lapwai Cr. nr Lapwai		S. Fork Clearwater R. at Stites		Palouse R. nr Potlatch		Bear R. at Idaho-Utah State Line		Snake R. nr Buhl	
Year sampled	1998		1997		1997		1998		1998		1998		1998		1998		1998		1998		1998		1996		1997	
USGS site ID	13235000		13251000		13266000		13302005		13302500		13305000		13313000		13316500		13342450		13348500		13345000		10092700		13094000	
Site No.	38		41		42		44		45		46		47		48		50		51		52		53		56	
QMH or RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH	QMH	RTH
Insect — Continued																										
Chironomidae — Continued																										
Rheocricotopus							15						15	29												
Rheotanytarsus				8	12					96					10		90	48	45	5	20		150	75	30	16
Robackia																			45							
Saetheria																										
Stempellina[1]																										
Stempellinella	72	7											2						75	5						
Stilocladius	6																									
Symposiocladius													2													
Synorthocladius					24														45							
Tanytarsus			12		36																				60	
Thienemanniella	36				68		75		70		40		8	10			330	32	60	5	35	5	70		30	16
Thienemannimyia Group					12	22	15		20				2				130	48	60	10			40			
Tvetenia	72						60	24	40	216	20		33	43					135	130			260	131		
Zavrelimyia																										

[1]Coldwater taxa designation (Michael Edmondson, Idaho Department of Environmental Quality, written commun., 2000).

[2]Coldwater taxa designation (Bob Wisseman, Aquatic Biology Associates, Inc., and Gary Lester, Ecoanalysts, Inc., written and oral communs., 2000).

Table B. Comparison of macroinvertebrate quality assurance data for selected sites in the Idaho statewide surface-water quality monitoring program, 1996–98

[Each sample represents a field split; No., number; USGS, U.S. Geological Survey; QMH, qualitative multiple habitat, reported in total abundance except for USGS laboratory; RTH, richest targeted habitat (riffles) reported in abundance (individuals per square meter); EPT, Ephemeroptera-Plecoptera-Trichoptera; P, present; NC, not calculated]

	Site name and No.							
	Blue Lakes Spring near Twin Falls 21				Beaver Creek at Spencer 26		Snake River near Minidoka 18	
Taxon	USGS lab QMH[1]	Contract lab QMH	Contract lab RTH	Contract lab RTH	Contract lab RTH	Contract lab RTH	USGS lab RTH	Contract lab RTH
Noninsect								
Turbellaria	P	320	960	1,120				
Nematoda		80						
Oligochaeta	P	960	720	160	168	266		
Gastropoda							50	
Fluminicola (Gastropoda)	P	1,640	2,160	720				
Gyraulus (Gastropoda)		80					706	338
Hydrobiidae (Gastropoda)	P							
Physella (Gastropoda)	P	120			8	30		113
Potamopyrgus antipodarum (Gastropoda)		12,840	9,120	6,160				
Pseudosuccinea (Gastropoda)	P							
Ostracoda		1,200				15		
Pacifasticus				80				
Acari		2,400	720	320	8			
Hydrachnidia (Acari)							152	
Aeshnidae	P							
Amphipoda (immature)							604	
Hyalella azteca (Amphipoda)	P	1,400	29,400	19,920			1,562	1,238
Insect								
Odonata								
Argia (Agrionidae)	P		120	320				
Coenagrionidae		40						
Enallagma/Ischnura (Agrionidae)		40						
Ephemeroptera								
Acentrella						15		
Attenella margarita					224	236		
Baetidae (immature)		160					302	
Baetis tricaudatus	P	840	4,560	2,880	400	295	756	1,800
Callibaetis	P							
Caudatella					48	15		
Diphetor hageni					80	15		
Drunella grandis/spinifera					64	30		
Ephemerella aurivillii					8			
Ephemerella inermis/infrequens					80	15		
Heptagenia/Nixe					48	59		
Rhithrogena					8			
Serratella					176	118		
Tricorythodes sp.							706	
Tricorythodes minutus					8			788
Plecoptera								
Hesperoperla pacifica					16	30		
Isoperla					16	74		
Pteronarcella					80	15		
Skwala					8	15		
Zapada cinctipes						30		
Hemiptera								
Corixidae	P							
Trichoptera								
Amiocentrus aspilus	P							
Brachycentrus occidentalis					512	739		
Glossosoma					24	15		

Table B. Comparison of macroinvertebrate quality assurance data for selected sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Site name and No.							
	Blue Lakes Spring near Twin Falls 21				Beaver Creek at Spencer 26		Snake River near Minidoka 18	
	USGS lab QMH[1]	Contract lab QMH	Contract lab RTH	Contract lab RTH	Contract lab RTH	Contract lab RTH	USGS lab RTH	Contract lab RTH
Insect — Continued								
Trichoptera – Continued								
Helicopsyche borealis					16	44		
Hydropsyche sp.	P		2,520	3,040	656	1,034	8,214	34,538
Hydropsyche californica							5,646	
Hydropsychidae (immature)							3,578	
Hydroptila	P	320	1,560	1,120	496	783	50	
Lepidostoma-turret case larvae	P	40						
Neotrichia					56	207		
Ochrotrichia				560	1,088	1,492		
Onocosmoecus unicolor						15		
Psychomyia sp.							50	
Rhyacophila Angelita Group						15		
Tinodes			120	80				
Wormaldia					16	30		
Lepidoptera								
Petrophila			240	320				112
Coleoptera								
Dytiscidae					24			
Cleptelmis (Elmidae)	P			80	24	15		
Optioservus (Elmidae)					232	236		
Zaitzevia (Elmidae)					24			
Hydrophilidae					8			
Diptera								
Alotanypus	P							
Caloparyphus sp. (Stratiomyidae)	P							
Ceratopogoninae		40			16	30		
Empididae					8	15		
Ephydridae		40						
Simuliidae	P	200	120	240	184	325	606	281
Stratiomyidae	P	200	600	160				
Antocha			120	80		15		
Dicranota					8			
Limonia	P	40						
Chironomidae								
Chironomidae-pupae		40	480	320	72	148	50	56
Cricotopus	P	720	3,480	2,480	8		302	
Cricotopus (*Nostococladius*)					32			
Dicrotendipes	P	600						
Eukiefferiella	P	400	2,880	2,320	464	487		
Micropsectra					8			
Microtendipes		40						
Nanocladius					16	15		
Orthocladiinae	P		120				50	
Orthocladius Complex	P	280		160				
Pagastia					168	236		
Parachironomus							50	
Parakiefferiella		80	120					
Parametriocnemus					8			
Paraphaenocladius			120	80				
Paratanytarsus	P	200	240	160			50	
Polypedilum				80				
Potthastia Longimana Group					8	74		
Pseudochironomus		40						
Rheocricotopus				720		15		

Table B. Comparison of macroinvertebrate quality assurance data for selected sites in the Idaho statewide surface-water quality monitoring program, 1996–98 — Continued

Taxon	Site name and No.							
	Blue Lakes Spring near Twin Falls 21				Beaver Creek at Spencer 26		Snake River near Minidoka 18	
	USGS lab QMH[1]	Contract lab QMH	Contract lab RTH	Contract lab RTH	Contract lab RTH	Contract lab RTH	USGS lab RTH	Contract lab RTH
Insect–Continued								
Chironomidae–Continued								
Rheotanytarsus	P	320	2,520					
Thienemanniella	P	40						
Thienemannimyia Group					72	89		
Tvetenia					32	103		
Total individuals per square meter	NC	NC	63,000	43,680	5,728	7,450	23,484	39,264
Total number of taxa	30	32	23	26	46	41	19	9
EPT taxa	6	4	4	5	23	24	8	3
Invertebrate river index score	NC	NC	11	11	21	21	11	5

[1]Presence only.

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