Distribution of Benthic Invertebrates in the Lost Streams of Idaho

DOUGLAS A. ANDREWS and G. WAYNE MINSHALL
Department of Biology, Idaho State University, Pocatello 83209

ABSTRACT: The Lost Streams of Idaho (Big Lost and Little Lost rivers; Birch, Medicine Lodge, Beaver and Camas creeks) constitute a unique set of isolated lotic environments. The streams are all similar in size (discharge 1.5-2.5 m^3/sec) except for Camas Creek which is 3-4 times larger. Likewise, chemical conditions are similar in all streams except Camas Creek which has generally lower values. The Lost Streams are well-buffered and rich in calcium bicarbonate (100-250 mg/liter as $CaCO_3$).

Sixty-one invertebrate taxa were found in the comparative collections, but only 10 (excluding Chironomidae) occurred in all six streams: a beetle (*Optioservus quadrimaculatus*), two dipterans (*Simulium* sp., *Tipula* sp.) three mayflies (*Baetis tricaudatus, Ephemerella grandis, E. inermis*), two stone flies (*Acroneuria pacifica, Isoperla fulva*), and two caddis flies (*Brachycentrus occidentalis, Hydropsyche* sp.). Examination of invertebrate collections from both sides of the 80-95 km wide Snake River Plain suggest that the faunas were established before isolation of the Lost Streams during the early Pleistocene.

INTRODUCTION

The Lost Streams of Idaho constitute a unique set of isolated lotic environments located along a 146-km front in the Upper Snake River Valley of eastern Idaho (Fig. 1). The streams originate in the Rocky Mountains bordering the Continental Divide and flow in a southeasterly direction to the edge of the Snake River Plain. The Snake River Plain is a high plateau built up of basalt lava flows that erupted

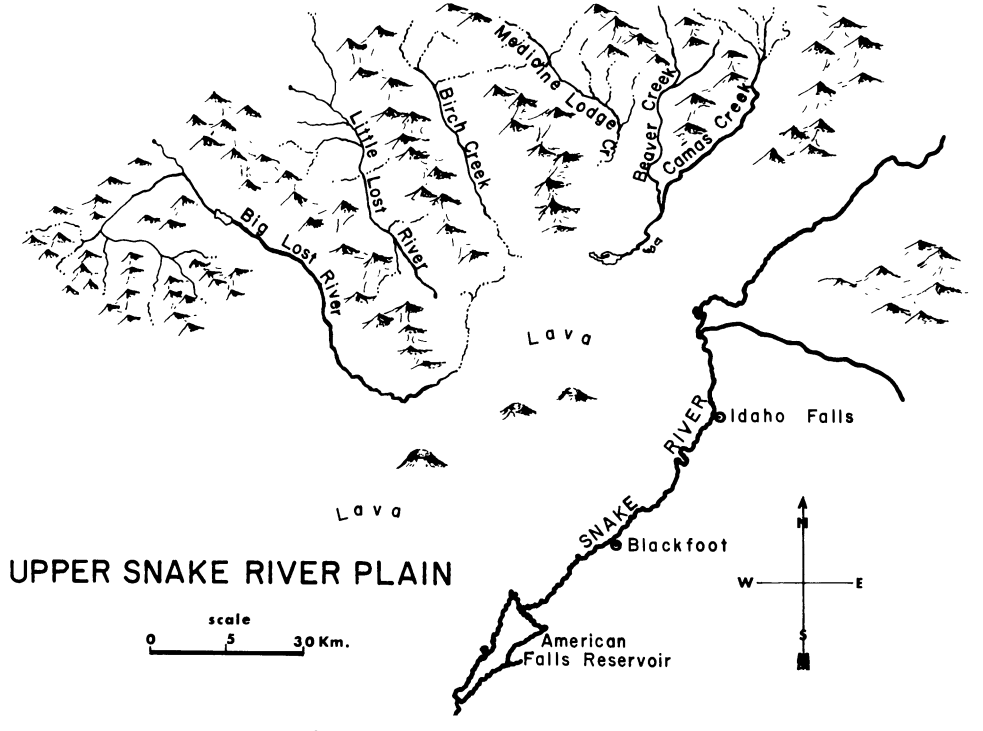

Fig. 1.—Map showing the location of the Lost Streams of Idaho in relation to the Snake River

during the past several million years. The lava flows are very porous and the streams contacting them disappear from the surface—hence the name "lost" streams. At least some of the Lost Streams are thought to emerge from the Plain, as the once spectacular Thousand Springs, 160-210 km SW of their overland terminus, and to enter the Snake River near Twin Falls, Idaho. The Lost Streams have been isolated from the Snake River since the early Pleistocene (Stearns *et al.*, 1938).

The isolation of the Lost Streams from the Snake River and from each other presents a unique opportunity for comparative studies as well as studies in zoogeography. In spite of this, there has been no intensive research on the biota of the streams; the benthic fauna has been especially neglected. DeCosta (1966) did some preliminary work on the macrobenthic invertebrates, but since his specimens were only identified to order, the findings are of limited value.

The main objectives of the present study were: (1) to describe the limnological conditions of the Lost Streams, including water chemistry, annual temperature range, discharge and substrate type; (2) to determine the species composition of the benthic community, and (3) to determine whether the Snake River Plain has acted as a barrier to aquatic invertebrate migration. Study sites were selected on Big Lost River and Birch, Medicine Lodge, Beaver and Camas creeks to correspond to one (No. 3) of several stations on the Little Lost River. Elevations (1647 m), substratum type (gravel), streamside vegetation and water flow (riffle areas) were matched as closely as possible.

METHODS

Benthic invertebrates and water samples were collected monthly from the Little Lost River and for three seasons—autumn (October), winter (February), spring (May)—from the other streams. Benthos samples from each of the streams were taken with an aquatic dip net (1-mm mesh) over a wide variety of habitats. One-liter water samples were obtained from the center of the stream, treated with 5 ml of chloroform, and returned to the laboratory for chemical analysis. The methods used are the same as those described by Minshall and Andrews (1973). Discharge was calculated from stream velocity, depth and width. Velocities were measured with a small Ott C-1 current meter.

DESCRIPTION OF THE LOST STREAMS AND COLLECTING SITES

The Lost Streams rise in rugged mountainous terrain but eventually enter and traverse alluvial-filled glacial valleys. The gravel-sized alluvium is several hundred to several thousand meters thick and extremely porous. The substratum of the stream is derived from this material and is quite similar for all sites.

The streams lie at the northern edge of the Great Basin province. The climate is cool (mean annual temperature 6 C) and dry (30-76 cm of precipitation/year). Summer temperatures rarely exceed 25 C. About twice as much precipitation falls on the mountains as in the valleys. Most of the stream flow comes from the mountains and originates as snowmelt. Sparse stands of coniferous trees characterize the mountains, while the vegetation of the valleys is largely sagebrush and grass. Near the stream mouths, where they enter the Snake River Plain, some agricultural use occurs.

Big Lost River.—The Big and Little Lost rivers arise in a mountainous area that includes Hyndman Peak and Mount Borah, the two tallest peaks in Idaho. The upper valley of the East Fork of the Big Lost River is known as Copper Basin and lies 24 km W of the Big Lost River Valley. Below the East Fork the river enters a gravel-filled valley, averaging about 6.5 km in width, and flows nearly 97 km to the edge of the Snake River Plain, below the town of Arco. From here the river flows to the

base of the Lemhi Mountain Range, where it accumulates in a large shallow depression known as the Big Lost River Sinks.

The site chosen for this study is located about 1.6 km N of the town of Darlington, in the middle of the Big Lost River Valley. Balsam poplars (*Populus balsamifera*) and some willows (*Salix* spp.) are present. The channel was altered for flood control work some time in the past, and it was not possible to locate an unaltered site within the general elevation.

Little Lost River.—The headwaters of the Little Lost River are in Sawmill Canyon. After leaving the canyon it is joined by Summit Creek and flows down the center of a large glacial valley. Most of the streams entering the valley from side canyons sink into alluvium (up to 900 m deep in places) before reaching the river, except possibly during times of high runoff. The river disappears in an ephemeral playa, known locally as the "sinks," near the margin of the Snake River Plain and approximately 85 km from its source. The study site (Station 3) is about 17 km NW of the village of Howe and 67 km from the headwaters. The surrounding vegetation of the valley floor is a mixture of sagebrush (*Artemisia tridentata*), crested wheat grass (*Agropyron cristatum*) and rabbitbrush (*Chrysothamnus nauseosus*). Willows line the stream banks.

Birch Creek.—Birch Creek derives most of its water from springs and consequently has comparatively uniform flow throughout the year. A large alluvial fan has built up where the stream flows out on the Snake River Plain; at the S margin of this fan are the Birch Creek Sinks. River birch (*Betula fontinalis*) are common along the creek. The collecting station was located 3.2 km downstream from Reno, Idaho. Scattered beds of *Chara* sp. found here were not present at the other collecting sites. During the January visit to this stream some anchor ice was observed, but there was no surface ice even though the snow at streamside was over 1 m deep.

Medicine Lodge Creek.—Medicine Lodge Creek is largely spring-fed. The creek loses water rapidly after reaching the Snake River Plain and disappears completely about 6.4 km S of the village of Medicine Lodge. Ranches are located along the stream from the edge of the plain to about half the distance to the sinks. River birch and wild rose (*Rosa woodsii*) are the main woody plants along the stream. The collecting station is 2 km upstream from the village of Medicine Lodge. When the stream was visited in May 1970, *Cladophora* was abundant, and some *Nostoc* was present. Ice prevented sampling of the stream during January 1971, so another visit was made on 10 March to obtain a "winter" collection.

Beaver Creek.—Beaver Creek flows from the Centennial Mountains in a narrow canyon to just below the village of Spencer, and then into a lava gorge about 15 m deep, S across the Snake River Plain for 10 km to a point 2 km from the town of Dubois. After reaching Dubois, the stream percolates rapidly into the coarse gravel over which it flows and seldom reaches Camas Creek. The collecting station for Beaver Creek was about 100 m downstream from the gorge in a riffle area.

Camas Creek.—Camas Creek has several headwater branches in the Centennial Mountains; these unite in Camas Meadows, a high basin with numerous springs. Below Camas Meadows the stream flows in a lava-walled canyon to a point 1 km above the old Jacoby Ranch, due E of Dubois. The collection station was just above Jacoby Ranch homestead. The same streamside vegetation found at the other streams is present here, with willows being especially abundant.

RESULTS

Limnological parameters.—All the streams were similar in *p*H, alkalinity, hardness and specific conductance, except Camas Creek, which always had lower values (Table 1). Camas Creek had the highest discharge (9.4 m^3/sec), three times higher

than that of any of the other streams. Water analysis records of the U.S. Geological Survey (H. A. Ray, pers. comm.) confirm our findings. The streams are all high in total milli-equivalents per liter (3.30-5.40) except Camas Creek, which averages 1.50 me/liter. The same is true for calcium. The range was 42-68 mg/liter except at Camas Creek, where the concentration was 19 mg/liter. The highest values for both total milli-equivalents per liter and calcium ion concentrations are found in Medicine Lodge Creek.

Invertebrate fauna of the Lost Streams.—Sixty-one taxa were found, with 31 occurring in three or more of the Lost Streams (Table 2). Only 10 taxa (excluding Chironomidae) were found in all six streams; a beetle (*Optioservus quadrimaculatus*), two dipterans (*Simulium* sp., *Tipula* sp.), three mayflies (*Baetis tricaudatus,*

TABLE 1.—Limnological parameters of the Lost Streams of Idaho, 1970-1971

Parameter		Big Lost River	Little Lost River	Birch Creek	Medicine Lodge Creek	Beaver Creek	Camas Creek
Water temp. C (15 May 1970)	Spring	14	12	19	12	6	6
(23 Nov. 1970)	Autumn	3	4	2	0	0	0
(22 Jan. 1971)	Winter	–0.5	4	–0.5	3	ICE	2
Discharge m^3/sec	Spring	3.194	2.659	2.605	1.603	3.220	9.426
	Autumn	1.428	1.400	2.573	ICE	ICE	ICE
	Winter	2.152	2.049	2.215	1.523	ICE	ICE
Specific conductance	Spring	580	650	650	785	790	300
μmhos/cm at 25 C	Autumn	590	820	530	660	665	275
	Winter	570	780	580	820	ICE	280
*p*H	Spring	8.2	8.1	8.2	8.0	8.1	7.3
	Autumn	8.0	8.1	8.2	7.9	8.1	7.8
	Winter	8.5	8.9	8.3	8.0	ICE	7.4
Bicarbonate alkalinity as	Spring	140	176	160	200	204	80
$CaCO_3$-mg/liter	Autumn	122	192	144	182	234	90
	Winter	116	190	140	214	ICE	84
Hardness as $CaCO_3$-mg/liter	Spring	142	180	128	224	224	80
	Autumn	188	220	168	214	234	84
	Winter	150	214	160	244	ICE	80
Turbidity-J.T.U.	Spring	30	65	54	22	51	51
	Autumn	6	14	4	16	4	3
	Winter	8	44	39	26	ICE	20
Phosphate (PO_4)-mg/liter	Spring	.48	.50	.23	.44	.44	.57
(Total)	Autumn	.40	.50	.22	.40	.27	.38
	Winter	.53	.34	.38	.45	ICE	.51
Nitrate (NO_3)-mg/liter	Spring	Trace	1.3	Trace	Trace	Trace	Trace
	Autumn	.10	.4	.15	.10	.05	.04
	Winter	.18	.5	.15	.18	ICE	.92

TABLE 2.—The invertebrate fauna of the Lost Streams of Idaho arranged according to frequency of occurrence. Those taxa marked with an asterisk (*) also are present on the S side of the Snake River Plain in tributary streams of the Snake River

Number of streams present in	Taxon		Big Lost River	Little Lost River	Birch Creek	Medicine Lodge Creek	Beaver Creek	Camas Creek
6	**Baetis tricaudatus* Dodds	(Ephemeroptera)	X	X	X	X	X	X
	**Ephemerella grandis* McDunnough	(Ephemeroptera)	X	X	X	X	X	X
	**E. inermis* Eaton	(Ephemeroptera)	X	X	X	X	X	X
	**Acroneuria pacifica* Banks	(Plecoptera)	X	X	X	X	X	X
	**Isoperla fulva* Claassen)	(Plecoptera)	X	X	X	X	X	X
	**Brachycentrus occidentalis* Banks	(Trichoptera)	X	X	X	X	X	X
	**Hydropsyche* sp.	(Trichoptera)	X	X	X	X	X	X
	**Chironomidae	(Diptera)	X	X	X	X	X	X
	**Simulium* sp.	(Diptera)	X	X	X	X	X	X
	**Tipula* sp.	(Diptera)	X	X	X	X	X	X
	**Optioservus quadrimaculatus* (Horn)	(Coleoptera)	X	X	X	X	X	X
5	**Pteronarcella badia* (Hagen)	(Plecoptera)	X	X	X	X	X	....
	**Glossosoma* sp.	(Trichoptera)	X	X	X	X	....	X
	**Arcynopteryx parallela* (Frison)	(Plecoptera)	....	X	X	X	X	X
4	**Isogenus* sp.	(Plecoptera)	X	X	X	X	....	....
	**Arctopsyche grandis* (Banks)	(Trichoptera)	X	X	X	X	....	....
	**Rhithrogena hageni* Eaton	(Ephemeroptera)	X	X	X	X	....	....
	**Lepidostoma* sp.	(Trichoptera)	X	X	X	....	X	....
	**Paraleptophlebia heteronea* McDunnough	(Ephemeroptera)	X	X	....	....	X	X
	Claassenia sabulosa (Banks)	(Plecoptera)	X	X	X	....	....	X
	**Alloperla* sp.	(Plecoptera)	X	X	X	....	....	X
	**Hirudinea*	(Annelida)	....	X	X	X	....	X
3	**Lymnaea* sp.	(Mollusca)	X	....	X	....	X	....
	Callicorixa sp.	(Hemiptera)	X	....	....	....	X	X
	**Gyraulus* sp.	(Mollusca)	....	X	X	X	....	....
	**Pisidium* sp.	(Mollusca)	....	X	X	X	....	....
	**Rhyacophila acropedes* Banks	(Trichoptera)	....	X	X	X	....	....
	Dicranota sp.	(Diptera)	....	X	X	X	....	....
	**Physa* sp.	(Mollusca)	....	X	X	....	X	....
	Bidessus sp.	(Coleoptera)	....	X	....	X	X	....
2	**Hydracarina*	(Acarina)	X	X	....	....	....	....
	**Limnephilus* sp.	(Trichoptera)	X	....	....	....	....	X
	**Turbellaria	(Platyhelminthes)	....	X	X	....	....	....
	**Isoperla mormona* Banks	(Plecoptera)	....	X	X	....	....	....
	**Pteronarcys californica* Newport	(Plecoptera)	....	X	X	....	....	....
	**Capnia* sp.	(Plecoptera)	....	X	....	X	....	....
	**Heleidae	(Diptera)	....	X	....	....	....	X
	**Hesperophylax* sp.	(Trichoptera)	....	....	X	....	....	X
	**Helicopsyche borealis* (Hagen)	(Trichoptera)	....	....	....	....	X	X
	**Sialis* sp.	(Neuroptera)	....	....	....	....	X	X
	**Gammarus lacustris* Sars	(Amphipoda)	....	....	....	....	X	X

Ephemerella grandis, E. inermis), two stone flies (*Acroneuria pacifica, Isoperla fulva*) and two caddis flies (*Brachycentrus occidentalis, Hydropsyche* sp.). *Ephemerella inermis* and *B. tricaudatus* are common in streams throughout the state (Jensen, 1966). Forty-one taxa were found in Little Lost River at Station 3. This high number is attributed to more intensive collecting. Birch Creek had the next highest number, with 33; Beaver Creek had the lowest number, with only 23 collected. The collecting station on the Big Lost River was in an area of channel alterations for flood control work; this probably is the main reason that only 24 invertebrate taxa were found, none being unique to that stream.

DISCUSSION

Invertebrate fauna.—The class Insecta is well represented in the Lost Streams, with *Trichoptera* having the most taxa. An uncommon genus in Idaho, *Sialis* sp. (*Neuroptera*) was taken in two of the streams. Although DeCosta (1966) indicated that Amphipoda and Mollusca were absent from the Lost Streams, they were collected in the present study but in very few numbers.

Comparison with other Rocky Mountain streams.—The benthic invertebrate composition of 12 Rocky Mountain streams is presented in Table 3 for comparison. Mayflies were the predominant component in seven streams including Little Lost River. Trichoptera were predominant in four, and generally second in abundance in the other streams. Diptera were predominant only in the Portneuf River, a polluted stream.

The mayfly *Baetis tricaudatus* comprised 47% of the mayfly fauna of the Little

TABLE 2.—(continued)

Number of streams present in	Taxon		Big Lost River	Little Lost River	Birch Creek	Medicine Lodge Creek	Beaver Creek	Camas Creek
	**Hyalella azteca* (Saussure)	(Amphipoda)	....	X	....	....	....	....
	Ephemerella flavilinea McDunnough	(Ephemeroptera)	....	X	....	....	....	....
	**Ameletus oregonensis* McDunnough	(Ephemeroptera)	....	X	....	....	....	....
	A. velox Dodds	(Ephemeroptera)	....	X	....	....	....	....
	Drusinus sp.	(Trichoptera)	....	X	....	....	....	....
	**Parapsyche elsis* Milne	(Trichoptera)	....	X	....	....	....	....
	**Cinygmula* sp.	(Ephemeroptera)	....	X	....	....	....	....
	Rhyacophila vaccua Milne	(Trichoptera)	....	....	X	....	....	....
1	*Hydaticus* sp.	(Coleoptera)	....	....	X	....	....	....
	**Dubiraphia* sp.	(Coleoptera)	....	....	....	X	....	....
	**Pericoma* sp.	(Diptera)	....	....	....	X	....	....
	**Nemoura* sp.	(Plecoptera)	....	....	....	X	....	....
	Micrasema sp.	(Trichoptera)	....	....	....	X	....	....
	**Oecetis* sp.	(Trichoptera)	....	....	....	....	X	....
	**Sphaerium* sp.	(Mollusca)	....	....	....	....	....	X
	**Athripsodes* sp.	(Trichoptera)	....	....	....	....	....	X
	Chimarra sp.	(Trichoptera)	....	....	....	....	....	X
	**Argia* sp.	(Odonata)	....	....	....	....	....	X
	**Ophiogomphus* sp.	(Odonata)	....	....	....	....	....	X
Totals	(48) 61		24	41	33	28	23	29

TABLE 3.—Benthos composition (% of total numbers in quantitative collection) for several Rocky Mountain streams

Stream	Location	Ephemeroptera	Plecoptera	Trichoptera	Diptera	Others	Reference
Little Lost R.	Idaho	61.5%	12.4%	14.4%	10.3%	1.4%	Andrews and Minshall (unpubl.)
Morrell Cr.	Montana	65.0	14.5	4.4	16.0 —combined—		Newell (1970)
Deer Cr.	Utah	63.9	2.2	17.9	12.3	3.4	Gaufin (1959)
Trail Cr.	Idaho	52.0	6.0	6.0	16.0	20.0	Winger (1968)
Pine Cr.	Idaho	48.0	7.0	18.0	9.0	18.0	Winger (1968)
Mink Cr.	Idaho	46.5	13.6	9.6	12.9	17.4	Minshall and Minshall (unpubl.)
Viviana Park Cr.	Utah	43.5	26.8	5.7	14.4	9.6	Gaufin (1959)
Provo R.	Utah	23.2	13.7	28.6	21.1	13.4	Gaufin (1959)
Madison R.	Yellowstone Park	22.5	1.8	35.4	23.8	16.5	Heaton (1966)
Bridger Cr.	Montana	9.2	1.7	71.9	12.2	5.0	Logan (1963)
Aspen Grove Cr.	Utah	8.9	11.4	56.9	5.3	15.5	Gaufin (1959)
Portneuf R.	Idaho	3.0	0.2	10.8	72.0	14.0	Minshall and Andrews (1973)

Lost River, while in Mink Creek *Baetis intermedius* Dodds accounted for 38% of the group total (Minshall and Minshall, unpubl. data). The predominance of *Baetis* differs from the Madison River where *Ephemerella inermis* was the most abundant mayfly (Heaton, 1966). Among the caddis flies of the Little Lost River, *Glossosoma* spp. was the most numerous taxon. *Glossosoma* also was abundant in Morrel Creek (Newell, 1970) and Mink Creek (Minshall and Minshall, 1977).

The Snake River Plain as a barrier.—The Snake River Plain (Fig. 1) has been thought to be a barrier to aquatic invertebrate migration, especially to mayflies (Jensen, 1966). The Upper Snake River Plain for close to 580 km has no streams that cross it or any permanent ponds or lakes within it, except for Mud Lake, into which Camas Creek flows. The plain is mostly sagebrush steppe with numerous barren lava flows and averages 80-95 km in width. Any movement of aquatic invertebrates across this plain would have to be by aerial means. Most aquatic invertebrates have adult stages that are terrestrial and capable of flight. Those such as Mollusca and Amphipoda, which do not have terrestrial stages, become attached to waterfowl and thereby move between bodies of water (Macan, 1963).

Examination of published records and of collections of aquatic invertebrates at Idaho State University was undertaken to answer the question of the effect of the Snake River Plain on the aquatic fauna of the Lost Rivers. The taxa in Table 2 marked with an asterisk (*) also were found in tributaries of the Snake River: Pine Creek, Trail Creek, Portneuf River, Mink Creek, Pocatello Creek and Bruneau River. Of 61 invertebrate taxa found in the Lost Streams, 48 (79%) also were found S of the Snake River Plain. Most of the missing taxa were not common in the Lost Streams, and one would expect that more intensive sampling would show more of these taxa to be present on both sides of the plain.

The Ephemeroptera, a group which has a fragile adult life (Berner, 1959) and possibly could not cross 80-95 km of barren lava desert, is of particular interest. Nineteen species of mayflies occur in the Lost Streams (Andrews and Minshall, unpubl. data); of these only three (*Ameletus velox, Ephemerella hystrix* and *E. spinifera*) were not recorded as occurring S of the Snake River. Two species found S of the plain, *Ephemerella grandis ingens* and *Epeorus grandis,* were considered by Jensen (1966) to belong to the Canadian distribution type and to be restricted to the area N of the plain. Therefore, although the Snake River Plain appears to be an effective barrier to aquatic invertebrate migration, it has had no appreciable effect on the species composition of the surrounding streams. The most likely explanation to account for the invertebrate distribution is that they had dispersed throughout the area before the Lost Streams were isolated from the Snake River.

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