Volume 64 | Number 1 Article 16

2-20-2004

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Western North American Naturalist 64(1), ©2004, pp. 131–134

GROUNDWATER INVERTEBRATE FAUNA OF THE BEAR RIVER RANGE, UTAH

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Key words: groundwater, aquatic invertebrates, Stygobromus, *Utah.*

The chance discovery of an undescribed species of blind subterranean amphipod within the *Stygobromus hubbsii* group in a cave in northern Utah prompted us to question the possible distribution and occurrence of additional groundwater fauna in this area. Groundwater biota in western North America have not been particularly well studied (cf. Stanford and Gaufin 1974, Ward 1977, Pennak and Ward 1986, Stanford and Ward 1988, Stanford et al. 1994, Ward and Voelz 1994, Ward et al. 1994, Drost et al. 1997, Canton and Chadwick 2000), especially when compared with studies of western surface water systems or groundwater systems of eastern North America, where karst topography is more prevalent overall and less disjunct (Ritter 1986, also see Culver 1997 [http://www.utexas.edu/depts/tnhc/.www/biospeleology/uskarst.jpg]). The objective of our study was to follow up on this chance find by more intensively sampling the aquatic macroinvertebrates present in this area of northern Utah.

This study was conducted in Cache Valley and the Bear River Mountain Range in Cache County, Utah. Cache Valley is an elongated graben formed by normal high-angle faults typical of basins in the Basin and Range Province (Fenneman 1931). The Bear River Mountains, which are immediately east of Cache Valley, are composed of sedimentary and metamorphic rock of Permian to Precambrian age, including limestone, dolomite, quartzite, sandstone, mudstone, siltstone, and shale (Kariya et al. 1994). Groundwater in Cache Valley and the Bear River Mountain Range, originating from infiltration of precipitation and seepage from streams, is considered a shallow and unconfined, unglaciated karst system (Kariya et al. 1994).

Sampling locations included a stream flowing within Logan Cave and 27 spring outflows (Table 1). These springs generally flow directly or indirectly from fractures, faults, joints, and solution channels in carbonate rocks (Bjorklund and McGreevy 1971). Sixty spring sites were initially identified for sampling from topographic maps, but after visiting each spring we excluded many from the study because of lack of water or extensive human alteration, e.g., dewatering caused by construction of livestock watering ponds. Most studies of groundwater fauna have been based on collections from either wells or caves, but spring outflows also can be used as collection sites of groundwater organisms (Nielsen 1950, Erman et al. 1995).

We sampled aquatic invertebrates at 5 locations in fall 1998, and all 28 sites were sampled at various times between May and November 1999. The stream within Logan Cave was sampled at several locations approximately 400–1000 m from the cave entrance. Springs were sampled at their point of discharge. Within Logan Cave we set 3 drift nets (10-cm diameter, 250-micron mesh) in the stream at approximately mid-depth. At each spring location, a short length (0.5 m) of 10- or 16-cm-diameter polyvinyl chloride (PVC) pipe, depending on spring outflow volume, was driven about 0.3 m into the hillside where the spring exited the ground. These pipes limited collection of downstream surface water organisms by capturing 100% of the flow at each spring. A 250-micron nylon mesh bag installed over the pipe outlet filtered all water exiting each spring. Nets were left in place at all sites for 1 week, after which all material collected in the nets was preserved in 70% ethanol and returned to the laboratory.

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TABLE 1. Location of sampling sites within the Bear River Range and number of *Stygobromus* collected at each site.

Sampling location	Latitude (N)	Longitude (W)	County, State	*Stygobromus* collected
Logan Cave, 3 sampling locations	41.8000	111.6250	Cache County, Utah	28
Beaver Mountain Spring	41.9611	111.5342	Cache County, Utah	5
Beaver Spring	41.9545	111.5857	Cache County, Utah	1
Box Spring	41.7265	111.6240	Cache County, Utah	
Card Canyon Spring	41.7530	111.6520	Cache County, Utah	1
Coldwater Spring	41.7178	111.5998	Cache County, Utah	
Coldwater Spring by Tony Grove	41.8822	111.6462	Cache County, Utah	
Franklin Basin, unnamed spring # 2	41.9615	111.5952	Cache County, Utah	
Franklin Basin, unnamed spring # 3	41.9745	111.5987	Cache County, Utah	3
Grey Cliff Spring	41.6731	111.6173	Cache County, Utah	
Hodges Spring	41.9806	111.4851	Cache County, Utah	
Millville Srping	41.6587	111.7698	Cache County, Utah	
Mosslander Spring	41.6578	111.6199	Cache County, Utah	7
North Cheney Spring	41.8930	111.4683	Cache County, Utah	
Pig Hole Spring	41.6543	111.6355	Cache County, Utah	4
Pine Spring	41.7288	111.6172	Cache County, Utah	
Pleasant Val Spring	41.6477	111.5787	Cache County, Utah	
Pole Hole Spring	41.6590	111.5713	Cache County, Utah	
Porcupine Reservoir Spring	41.5190	111.7545	Cache County, Utah	2
Rock Spring	41.7863	111.5395	Cache County, Utah	
Sadduccee Spring	41.0513	111.4600	Rich County, Utah	
Sow Hole Spring	41.6561	111.6068	Cache County, Utah	
Spring at Spring Campground	41.6333	111.6500	Cache County, Utah	
Spring Hollow	41.7572	111.7188	Cache County, Utah	
St. Charles Spring	42.1120	111.4473	Bear Lake County, Idaho	4
Upper Sow Hole Spring	41.6560	111.6047	Cache County, Utah	1
Wind Cave	41.7625	111.7035	Cache County, Utah	
Worm Fence Spring	41.8597	111.5500	Cache County, Utah	1

All organisms from each sample were removed and identified to the lowest possible taxonomic level. Dr. John Holsinger (Old Dominion University, VA) verified amphipod identifications.

Habitat conditions in Logan Cave and at the point where samples were collected at the spring sites were similar. Substrate consisted of gravel with some silt deposits. Organic matter was present at all sites and consisted primarily of roots, small branches, and fine debris. Organic matter within Logan Cave was visibly less than that found downstream of the collection points at the spring sites, as there were no larger pieces of wood or moss growing within the cave. Water temperatures were highly similar among all sites and ranged from 5°C to 7°C. Ranging from 7.1 to 8.4, pH was also fairly similar among sites. Specific conductance within Logan Cave was 315 μS cm^{-1} near the mouth of the cave and 359 μS cm^{-1} deeper into the cave. Specific conductance at spring sites was 160–525 μS cm^{-1} and averaged 305 μS cm^{-1}.

From the 28 sites, we collected and identified 6443 individuals and 44 genera of aquatic macroinvertebrates (Table 2). Most individuals were small and immature, which made identifications beyond family and genera difficult if not impossible. Invertebrate genera richness varied from 2 to 17 at individual sites. No aquatic vertebrates were collected. We did, however, collect an undescribed species within the *Stygobromus hubbsii* group (Dr. John Holsinger personal communication) from 12 spring sites and Logan Cave. The most frequently collected organisms were Chloroperlidae, Capniidae, Collembola, Dytiscidae, *Ameletus*, and *Stygobromus hubbsii* group. All taxa collected in Logan Cave also were collected at spring outflows.

The invertebrate fauna we collected is similar to that collected in Roaring Springs Cave, Grand Canyon, Arizona, by Drost and Blinn (1997). *Stygobromus* is the only obligate groundwater fauna we collected; the other taxa are considered occasional hyporheic dwellers (Boulton 2000) and are commonly found in the Logan River (Vinson unpublished data). Since

TABLE 2. List of taxa and number of individuals collected in Logan Cave (indicated by an *) and 28 spring outflows in the Bear River Mountain Range, northern Utah.

Taxon	Individuals collected
Annelida	
Oligochaeta	95
Arthropoda	
Arachnida	
Trombidiformes*	673
Entognatha	
Collembola*	37
Diplura*	2
Insecta	
Coleoptera	3
Curculionidae	2
Dytiscidae, unidentified	9
Agabus	75
Deronectes	4
Hydroporus	311
Hydrovatus	29
Oreodytes	1
Elmidae	
Heterlimnius	22
Narpus	3
Ordobrevia	1
Stenelmis	2
Hydraenidae	
Hydraena	1
Hydrophilidae	
Ametor	10
Paracymus	7
Diptera	2
Ceratopogonidae, unidentified	5
Probezzia	3
Chironomidae, unidentified	1006
Dixidae	
Dixa	19
Empididae	
Clinocera	4
Ephydridae	1
Muscidae	19
Psychodidae	
Pericoma	2
Simuliidae	
Simulium	58
Stratiomyidae	
Caloparyphus	10
Euparyphus	9
Tabanidae	
Tabanus	2
Tipulidae, unidentified	1
Dicranota	17
Limonia	3
Ormosia	10
Pedicia	1
Tipula	2
Ephemeroptera	
Ameletidae	
*Ameletus**	20
Baetidae	36
Baetis	901
Ephemerellidae	4
Heptageniidae, unidentified	9
Cinygmula	5
Epeorus	3
Hemiptera	
Gerridae	
Aquarius	1
Lepidoptera, unidentified	1
Plecoptera	
Capniidae, unidentified*	35
Chloroperlidae	
*Sweltsa**	32
Nemouridae, unidentified	54
Malenka	134
Zapada	260
Perlidae	
Hesperoperla pacifica	34
Perlodidae	215
Isoperla	761
Trichoptera	192
Hydroptilidae, unidentified	13
Limnephilidae, unidentified	12
Dicosmoecus	1
Hesperophylax	480
Psychoglypha	48
Rhyacophilidae	
Rhyacophila	5
Uenoidae	
Neophylax	8
Neothremma	296
Oligophlebodes	1
Malacostraca	
Amphipoda	
Crangonyctidae	
Stygobromus hubbsi group*	52
Mollusca	
Bivalvia	
Veneroida	
Pisidiidae	
Pisidium	3
Gastropoda	
Basommatophora	
Lymnaeidae, unidentified	9
Planorbidae, unidentified	8
Neotaenioglossa	
Hydrobiidae, unidentified	18
Platyhelminthes	
Turbellaria	331

this study was performed, we also have collected *Stygobromus* in southern Utah (Alvey Wash, Garfield County). These discoveries were predicted by Holsinger (1974) and echoed by Ward (1977) and Canton and Chadwick (2000). The occurrence and discovery of additional species of *Stygobromus* in other areas of the western United States are likely as these areas are sampled in the future.

We thank Dr. John Holsinger for examination of the *Stygobromus* specimens. Charles Hawkins offered valuable suggestions regarding the study and the manuscript. We also thank B.C. Kondratieff for reviewing the manuscript. Financial support was provided by Utah State University.

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Received 22 January 2002
Accepted 28 March 2003