A Preliminary Study of Aquatic Macroinvertebrates From Two Springs in the Pontotoc Ridge Nature Preserve, Oklahoma

David Bass
Biology Department, University of Central Oklahoma, Edmond, Oklahoma 73034

The Pontotoc Ridge Nature Preserve is located in southeastern Pontotoc County, Oklahoma and is currently managed by The Nature Conservancy. It consists of 2000 acres of woodland and prairie vegetation. Several small springs are located on the property and these serve as headwaters for the Blue River and several of its tributaries. Very little is known regarding the spring invertebrate fauna in Oklahoma *(1)*. The purpose of this investigation was to collect baseline data concerning the physicochemical conditions of the water and to determine distributions of macroinvertebrates in springbrooks resulting from two springs emerging on the property. Pot Spring and Coal Creek Cave Spring were selected for this study. Pot Spring (34.4973ºN, 96.6022ºW) emerges from a forested rocky slope and maintains perennial flow. Coal Creek Cave Spring (34.5247ºN, 96.6014ºW), as its name implies, emerges from the opening of a small cave in a wooded area and flows intermittently (N. Jones, personal communication). Both springbrooks had depths of less than 0.1 m and widths of less than 1 m. The substrate at Pot Spring was primarily limestone cobble while the substrate at Coal Creek Cave Spring was mostly sand with a small amount of cobble present.

Water quality measurements conducted in the field included water temperature and dissolved oxygen concentration using a YSI Model 57 meter that was air calibrated at each site. Alkalinity was determined in the field using the sulfuric acid method *(2)*. Water samples were transported to the laboratory to determine the amounts of ammonia, nitrates, nitrites, orthophosphates, and turbidity using methods described by Hach Chemical Company *(3)*. Specific conductance was determined by using an Oakton conductivity meter. Due to the shallow depth of the water at both sites, flow was unable to be measured.

Benthic macroinvertebrates were collected at sites established 0, 50, and 100 m downstream from the emergence source for both springs. Each site was quantitatively sampled by taking replicate Surber net samples. All material collected in the Surber net was preserved in the field with a mixture of formalin and rose-bengal dye and returned to the laboratory where it was sorted using a 500 μm sieve, identified, and counted. In addition, qualitative samples

TABLE 1. Physicochemical conditions of springs at Pontotoc Ridge, 11 February 1995.

	Pot Spring			Coal Creek Cave Spring		
	Downstream Distance (m)					
	0	50	100	0	50	100
Water Temperature (°C)	16	15	14	15	12	10
Dissolved Oxygen (mg/L)	5.5	5.7	5.6	7.6	9.6	9.6
Oxygen Saturation (%)	54	56	53	74	88	86
Alkalinity (mg/L)	286			358		
Turbidity (JTU)	0			0		
Specific Conductance (μmhos/cm)	500			625		
Ammonia (mg/L)	0.83			0.83		
Nitrite Nitrogen (mg/L)	0.23			0		
Nitrate Nitrogen (mg/L)	0.70			0.62		
Orthophosphates (mg/L)	0.21			0.10		

were collected by the examination of as many microhabitats as could be determined to identify taxa missed in the Surber net samples. However, only Surber net samples were used in the statistical analysis.

Results of the physicochemical analysis are in Table 1. These results fall within the ranges expected of streams possessing high water quality in southern Oklahoma *(4)*. Dissolved oxygen concentrations in Pot Spring were lower than those in Coal Creek Cave Spring. Possibly the water from Coal Creek Cave Spring emerges far back in the cave, exposing that water to atmospheric oxygen much longer than the water emerging from Pot Spring. Alkalinity measurements indicate both springs should be capable of maintaining substantial primary production levels. It is possible the low level of nutrients in the water may inhibit further development of aquatic plant communities.

A total of 39 taxa were collected from the two springs (Table 2). Only two of those taxa were not collected in the Surber net samples. Twenty-five taxa were captured in the Surber net at Pot Spring, whereas 22 taxa were found in the Surber net samples from Coal Creek Cave Spring. The number of individuals was much higher in Pot Spring than in Coal Creek Cave Spring, probably because of the more permanent nature of the water. This observation was accentuated by the high population of the caddisfly larvae, *Helicopsyche borealis*. Generally, populations in the two springs increased as the distance downstream increased, probably as a result of greater food availability. This increase in population size is particularly evident when *H. borealis* is omitted from the analysis.

Shannon's species diversity values *(5)* increased as distance downstream increased. Although Coal Creek Cave Spring had a higher species diversity value than Pot Spring, this is an artifact of the high population of *Helicopsyche borealis* in Pot Spring. If this species is not included in the diversity calculations, then the Shannon's diversity value at Pot Spring is higher.

Sorenson's index of similarity *(6)* was 0.47, indicating a small amount of faunal similarity between the two springbrooks. This somewhat low value may be attributed to differences in substrate and dissoved oxygen concentrations in the two springbrooks, as different species often have different requirements *(7)*.

Dominant taxa in these springs included the caddisfly larvae, *Helicopsyche borealis*; the pulmonate snail, *Physa* sp.; the flatworm, *Dugesia* sp.; and several dipterans (especially chironomid larvae). *H. borealis* has a widespread distribution and seems to prefer hard substrates where it feeds by scraping algae and other food particles from the substrate *(7)*. *Physa* has an omnivorous diet and is tolerent of very low dissolved oxygen conditions *(8)*. *Dugesia*, like many flatworms, is common in springs and may feed on living or dead animals *(8)*. All of these taxa have been previously reported from Oklahoma and are well adapted to these spring environments.

Matthews and coworkers *(1)* collected several taxa from other nearby springs that were also encountered in these Pontotoc Ridge springs. Vaughn *(9)* reported the amphipod *Allocrangonyx pellucidus* to be present in springs from this area, but no specimens of this species were found in these samples during this sampling period.

Most of the taxa collected in this study are typical of small, lotic environments *(7)* and are not limited in distribution to springs. Many have been reported by previous investigators from south-central Oklahoma streams *(9-12)*. Further studies involving invertebrate collections from these sites on a year-round basis or over a period of several years would probably yield additional species not reported in this 1995 investigation.

ACKNOWLEDGMENTS

This study was conducted with the cooperation of the Oklahoma Field Office of The Nature Conservancy and funded by the University of Central Oklahoma. The following graduate students assisted in the field and the laboratory: C. Clarke, J. Cunningham, C. Potts, and L. Samanie.

REFERENCES

1. Matthews WJ, Hoover JJ, Milstead WB. The biota of Oklahoma springs: natural biolog-ical monitoring of ground water quality. Final Report. Stillwater (OK): Oklahoma Water Resources Research Institute; 1983. 64 p.
2. Lind O. Handbook of common methods in limnology. 2nd. ed. St. Louis (MO): CV Mosby; 1979. 199 p.
3. Hach Chemical Company. Procedures for water and wastewater analysis. 2nd ed. Loveland (CO): Hach Chemical Co.; 1987. 119 p.
4. Blazs RL, Walters DM, Coffey TE, White DK, Boyle DL. Water resources data: Oklahoma. United States Geological Survey Water-Data Report OK-90-1; 1990.
5. Shannon CE. A mathematical theory of communication. Bell Syst Tech J 1948;27:379-423, 623-656.
6. Sorenson T. A method of establishing groups of equal amplitude in a plant society based on similarity of species content and its application to analysis of the vegetation on Danish commons. Biol Skr 1948;5:1-34.
7. Merritt RW, Cummins KW, editors. The aquatic insects of North America. 3rd ed. Dubuque (IA): Kendall/Hunt Publishing; 1996. 862 p.
8. Pennak RW. Fresh-water invertebrates of the United States. 3rd ed. New York: John Wiley & Sons; 1989. 628 p.
9. Vaughn, CC. Status survey for three candidate stream-dwelling invertebrates in the Arbuckle Mountains. Final Report. Oklahoma City, OK: Oklahoma D e - partment of Wildlife Conservation; 1996. 36 p.
10. McKinley RE, Prins R, Jech LE. Occurrence and distribution of arthropods in Travertine Creek, Platt National Park, Murray County, Oklahoma. Proc Okla Acad Sci 1972;52:49-52.
11. Reisen WK. The ecology of Honey Creek, Oklahoma: spatial and temporal distributions of the macroinvertebrates. Proc Okla Acad Sci 1975;55:25-31.
12. Cheper NJ. Survey of aquatic invertebrates of south-central Oklahoma I. Lotic animals. Proc Okla Acad Sci 1985;65:35-37.

Received: September 15, 1999 ; Accepted: August 18, 2000

TABLE 2. Macroinvertebrates collected from Pot Spring and Coal Creek Cave Spring at Pontotoc Ridge 11 February 1995.

	Pot Spring							Coal Creek Cave Spring						
Surber Net Sample Number	1A	1B	2A	2B	3A	3B		4A	4B	5A	5B	6A	6B	
Distance Downstream (m)	0	0	50	50	100	100	Total	0	0	50	50	100	100	Total
Platyhelminthes														
Dugesia sp.	1*		12*	11	11*	25	60	1						1
Nematoda							0					3	1	4
Oligochaeta														
Dero sp.	2		2		2	1	5							0
Limnodrilus sp.	4		1		1	1	8	1	1	1		8	1	12
Lumbriculus sp.			1		*		1			3	15	9*	7	34
Pristina longiseta					4	13	18							0
Nematomorpha							0						1	1
Gastropoda														
Physa sp.	*				6	2	8	*		15*	15	39*	6	75
Crustacea														
Decapoda		1					1	*		*		*		0
Hydrocarina			*				0							0
Ephemeroptera														
Baetis sp.	1	4	1*	2	13*	4	25				1	2	2	5
Paraleptophiebia sp.							0			*		4	6	10
Stenonema sp.							0				1			1
Odonata														
Argia sp.	25*	1	6*		1		33							0
Cordulegaster sp.	*		1				1							0
Hetaerina sp.		1	2				3							0
Lestes sp.					*		0							0
Plecoptera														
Perlinella drymo							0			9	2	13*	1	25

TABLE 2. (contd.) Macroinvertebrates collected from Pot Spring and Coal Creek Cave Spring at Pontotoc Ridge 11 February 1995.

	Pot Spring							Coal Creek Cave Spring						
Surber Net Sample Number	1A	1B	2A	2B	3A	3B		4A	4B	5A	5B	6A	6B	
Distance Downstream (m)	0	0	50	50	100	100	Total	0	0	50	50	100	100	Total
Hemiptera														
Gerris sp.		1	*		*		1			*				0
Trepobates sp.					2		2					*		0
Trichoptera														
Helicopsyche borealis	168	58*	122	27*	8	6*	387							0
Ochrotrichia sp.						3	3			2	2			4
Parapsyche sp.			1				1					1		1
Coleoptera														
Derovatellus sp.	*						0			1				1
Helichus sp.							0			1	1			2
Hydrochus sp.							0			1	2	2	7	12
Peltodytes sp.					*		0							0
Diptera														
Antherix sp.	1		11*	7	11*	2	32							0
Bezzia sp.					6	12	18							0
Cricotopus sp.		8				6	14	2						2
Cryptochironomus sp.							0					1		1
Dicrotendipes sp.							0					5	1	6
Dixa sp.					1		1							0
Larsia sp.					3	1	4					6		6
Odontomyia sp.	*	1	2*	22	*	10	35							0
Paramerina sp.							0					2	1	3
Pseudochironomus sp.	2	5	6	6			19	2						2
Rheotanytarsus sp.			3		1	21	25							0
Stenochironomus sp.					1		1							0
Total Individuals	202	80	171	75	71	107	706	6	1	33	39	104	44	227
Total Species	8	9	14	6	15	14	25	4	1	8	8	14	12	22
Species Diversity							2.69							3.31

* indicates taxon collected in qualitative sample