 0030-0950/82/0005-0242 $2.00/0

CRAYFISH AND BIVALVE DISTRIBUTION IN A VALLEY IN SOUTHWESTERN OHIO[1]

F. LEE ST. JOHN, Department of Zoology, The Ohio State University, Newark, OH 43055

ABSTRACT. The crayfish and bivalve fauna of 2 stream systems in an ancient valley in southwestern Ohio were examined. The distribution of the various species was mapped and the topography and environmental conditions of each collecting site were noted. The greatest diversity of species was usually found at the edge of the valley, while environmentally stressed sites harbored neither decapods nor bivalves. One species of crayfish, *Orconectes sloanii,* was found in the northwestern drainage system of the valley, but not in the southeastern drainage system, even though the 2 stream systems were once connected.

OHIO J. SCI. 82(5): 242, 1982

INTRODUCTION

Two streams flowing in opposite directions from their drainage divide in a valley in parts of Butler and Warren Counties, Ohio, were chosen for investigation. This valley was selected because 2 species of crayfish that are quite limited in distribution (*Orconectes sloanii* and *Cambarus ortmanni*) are known from this area of Ohio. In addition, portions of the valley have been disturbed ecologically, while other portions are, as yet, relatively undisturbed. Finally, comparison of the species found in the 2 drainage systems in the valley would be of interest, especially since they were connected at their headwaters by a swamp at one time. The crayfish and bivalve fauna of the stream systems were sampled and compared.

METHODS AND MATERIALS

Specimens were collected from the 16 locations (fig. 1) during August, October, and November 1975; March and April 1976; March 1977; and March, April, and October 1978. Live bivalves and bivalve shells were collected by hand. Crayfish were occasionally collected by hand or with a metal strainer, but usually with a 1.2 × 1.8 m minnow seine with .64 cm mesh. The crayfish and live bivalves were fixed and preserved in the field in a mixture of 70% ethyl alcohol, 2% glycerine and 28% water (AGW).

The location of this study is a broad, nearly level valley which passes southeast from Middletown in Butler County toward South Lebanon in Warren County. About 11.2 km southeast of Middletown the valley narrows and ends in an area of kames. The valley area is about 27 km^2 and is of glacial origin with lacustrine deposits (Goldthwait et al. 1961). Prior to glaciation the valley was occupied by Monroe Creek which was part of the Teays River system and later during the Deep Stage, the valley was occupied by South Lebanon Creek (Stout et al. 1943). This paper will refer to the study area as "Monroe Valley."

Figure 1 shows the 2 small stream systems which presently occupy Monroe Valley. Shaker Creek and Millers Creek both drain to the northwest and join near their confluence with Dicks Creek which then flows into the Great Miami River. Little Muddy Creek and its tributaries, including Swamp Run, drain to the southeast and join Turtle Creek which then empties into the Little Miami River. Both the Great Miami and the Little Miami Rivers join the Ohio River near Cincinnati.

The headwaters of all the streams in Monroe Valley, except Swamp Run, originate as intermittent streams beginning at elevations of 229–244 m on the ground moraine which boarders the valley. Swamp Run is formed by 2 unnamed intermittent tributaries, one of which arises at 229 m elevation on the adjacent ground moraine. The other begins in the flat, agricultural land of the valley floor, which is chiefly at 204 m elevation throughout. This latter tributary has apparently been channelized and dredged periodically.

[1]Manuscript received 13 January 1981 and in revised form 23 February 1982 (#81–2).

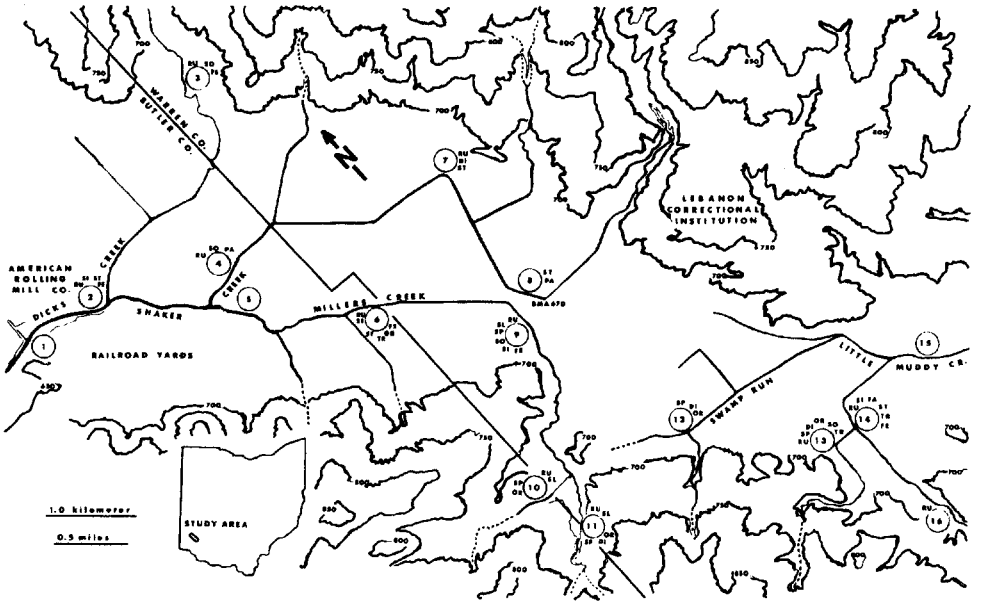

FIGURE 1. Topographic map of Monroe Valley (elevations are in feet). Numbers within circles are the collecting sites referred to in the text. Abbreviations of the species collected at each site: RU = *Orconectes rusticus*, SL = O. *sloanii*, DI = *Cambarus d. diogenes*, SP = *C.* sp., OR = *C. ortmanni*, SO = *Sphaerium solidulum*, SI = *S. simile*, FA = *S. fabale*, ST = *S. striatinum*, TR = *Musculium transversum*, PA = *Toxolasma parvus*, GR = *Anodonta grandis*, FE = *Anodontoides ferussacianus*.

RESULTS

Figure 1 shows the distribution of the 5 species of crayfish that were found in the valley: *Orconectes rusticus, Orconectes sloanii, Cambarus diogenes diogenes, Cambarus* (C.) *ortmanni,* and an additional, uncertain species of *Cambarus,* referred to in this paper as *Cambarus* sp. At 4 of the collecting sites (1, 5, 8, 15) no crayfish were taken. At 6 of the sites (2, 3, 4, 6, 14, 16) only *O. rusticus* was found. At the remaining 6 sites (7, 9, 10, 11, 12, 13) 2 or more species were found (fig. 1).

The freshwater mussels of Monroe Valley included 3 species of family Unionidae, *Toxolasma parvus, Anodonta grandis* and *Anodontoides ferussacianus,* as well as 5 species of family Sphaeriidae (the "fingernail clams"), *Musculium transversum, Sphaerium solidulum, S. simile, S. fabale* and *S. striatinum,* the latter a complex of species (K. G. Borror, pers. comm.) (fig. 1).

T. parvus was found at sites 4 and 8. *A. grandis* was found only at site 6. *A. ferussacianus,* the most abundant Unionid in the valley, was found at sites 2, 3, 6, 9, and 14.

M. transversum was found at sites 6, 13, and 14. *S. solidulum* was found at sites 3, 4, 9, and 13. *S. simile* was found at sites 2, 6, 9, and 14. *S. fabale* was found only at site 14. Members of the *S. striatinum* complex were found at sites 2, 6, 7, 8, and 14.

DISCUSSION

No crayfish were found at collecting sites 1, 5, 8, and 15. Site 1 is just south of the Middletown Works of the American Rolling Mill Company and receives a tributary draining part of the grounds of this facility. In addition, the stream bed in the area has been channelized. Site 5 had been recently dredged when visited in

1975 and when revisited in 1978 a bridge relocation project had included channelization of this portion of the stream. Likewise, recent dredging activity was evident just downstream from site 15. In fact, channelization was evident throughout the flood plain area of Little Muddy Creek at the southern end of Monroe Valley. This is apparently to drain the flat agricultural fields. The detrimental effects of channelization on crayfish are cited below.

At site 8 Shaker Creek occupies part of an old canal bed (Richardson 1968) and the bottom lacks rocks, precluding the refugia usually preferred by crayfish. The absence of crayfish here is not surprising.

Only *O. rusticus* was found at sites 2, 3, 4, 6, 14, and 16. All of these sites, except 16, were obviously environmentally stressed. Site 2 has been channelized, although not recently. Moreover, the surrounding area is becoming increasingly industrialized and is near the site of a newly constructed railroad yard. Site 3 had been channelized at some time in the past just downstream, and upstream was a new housing development. Sites 4 and 6 showed increased urbanization and industrial development nearby. In addition, site 6 had been channelized just downstream from the collecting site. Site 14, likewise had been channelized in the immediate vicinity of the collecting site, which was in the agricultural valley floor. Hobbs and Hall (1974) state that channelization removes much of the immediate crayfish population by eliminating undercut banks and accumulations of debris necessary for survival. These sites may once have harbored a greater diversity of crayfish species, but now only *O. rusticus,* a hardier species (D. H. Stansbery, pers. comm.), remains. Site 16, unlike the others where only *O. rusticus* was found, was not in an area of urbanization or industrialization, but rather, at the edge of the valley where the stream descends from the glacial moraine near the edge of the valley to the valley floor. It was, in fact, similar to the remaining sites at which 2 or more species were found. That only *O. rusticus* was found at site 16 was, therefore, surprising.

The remaining sites (7, 9, 10, 11, 12, 13) are at the perimeter of the valley where the broad, flat flood plain abuts the rolling topography of the ground moraine. Here rocks of various sizes from the glacial till are evident in the creek beds and at or near the collecting sites the creeks are fed by streams (usually intermittent) which flow from approximately 30.5 m greater elevation off the ground moraine to the main channel in the flood plain of the valley. This type of habitat at the margin of 2 environments, an "edge effect" (Barrick 1954), is probably responsible for the greater species diversity of crayfish at these collecting sites.

Rhoades (1941) reported collecting *Cambarus (=Orconectes) sloani,* "... in Shakers (sic) Creek, Warren County, a locality near the old Lebanon Canal bed." His map, however, is unclear, and the collection site could correspond to this study's site 7, 8, or even 9. Nevertheless, this species is found only in the Great Miami River drainage and not in the Little Miami. Rhoades suggested that since the 2 drainages of Monroe Valley were connected from 1835 to 1865 by "Old Shakers Pond" that Little Muddy Creek would seem a probable locality for the occurrence of *sloanii,* but he did not find it there. The present study also did not find the species in the Little Miami drainage and, in fact, a paper in preparation by the author will suggest that the species occurs nowhere east of the Great Miami River system.

No freshwater bivalves were found at sites 1, 5, and 15. *T. parvus* was found at only 2 collecting sites in Monroe Valley, 4 and 8, both of which are on Shaker Creek. Site 8 is a portion of Shaker Creek which was once a part of the Warren County canal. This part of the creek is straight with grassy, treeless embankments on both sides (no doubt maintained this way as it marks the outer perimeter of the Lebanon Correctional Institution). Ortmann (1919) described this species in

Pennsylvania as living, ". . . buried in the mud, in sluggish streams, canals, etc."

A. grandis was collected at only one site in Monroe Valley, number 6. Ortmann (1919) described this species as an inhabitant of smaller creeks, especially of quiet pools, ". . . in fine sand and mud." Site 6 was such a location. *A. ferussacianus,* as well as 3 species of Sphaeriidae were also collected here. A collecting trip to this site in spring 1977 revealed a recent dredging project. Bottom mud had been scooped up and piled on the banks, the pool with *Typha* sp. where the 1975 specimens had been collected was gone. The habitat appeared to have been destroyed. Surprisingly, in 1978, both Unionidae and Spaeriidae were again collected here; however, *A. grandis* was not found. Inasmuch as site 6 was the only location where *A. grandis* was found it may be that the species was once more widespread. Other sites in the broad, central area of the valley are, or may have been similar habitats. In any case, *A. grandis* occurred at only one site in 1975, and by 1978 had been extirpated from Monroe Valley.

A. ferussacianus was found at sites 2, 3, 6, 9, and 14. Number 3 had cobbles and boulders on the bottom as a result of its location in an area of glacial till. The other 4 sites were habitats with areas of sandy and/or silty bottoms. Baker (1928) described this species, in Wisconsin, as occupying, ". . . small, quiet creeks where it lives on a sandy bottom in shallow water," and Ortmann (1919) reported the species' Pennsylvania habitat as, ". . . sandy-gravelly bottoms, with some admixture of mud." *A. ferussacianus* was the most common unionid in the valley, being the most widely distributed and the most numerous in the collections.

That some sites would be the habitat of no Unionidae is not surprising, inasmuch as these bivalves depend on host fish for the development and distribution of their glochidia (Pennak 1953). Sites elevated above the valley floor (to which host fish might not have access) and intermittent portions of streams (often dry during the summer months) were not found to contain a unionid fauna.

No clearcut distribution pattern emerged for the fingernail clams (Sphaeriidae) (fig. 1). *S. solidulum, S. simile, S. striatinum,* and *Musculium transversum* were found in both the northwest and southeast drainages of Monroe Valley. Only *S. fabale* was confined to a single drainage, being found only at site 14, on Little Muddy Creek. Baker (1928) stated that ". . . wherever fresh water is found, unless the conditions are unusually unfavorable, Sphaeriidae of one form or another are sure to be found." Some sites which harbored one or more species of crayfish were devoid of Sphaeriidae. These were sites at elevations above the valley floor where stream gradient may have prevented access by Sphaeriidae larvae, or sites on intermittent streams which were found to have dry beds during part of each year.

Generally, at those collecting sites which were at the edge of the valley and which were relatively undisturbed, the diversity of crayfish species was greatest. Toward the center of Monroe Valley, and in areas where urbanization and industrialization appeared to be damaging the environment, only *O. rusticus* was found. Those sites which had neither decapod nor sphaeriid fauna can be assumed to have suffered the greatest environmental stress.

ACKNOWLEDGMENTS. I would like to express my appreciation to James and David St. John for their assistance in collecting specimens. K. G. Borror and D. H. Stansbery, both of The Ohio State University Museum of Zoology, kindly assisted in the identification of bivalve specimens, and provided information. Shirley Justice typed the manuscript. This study was supported by funds provided by The Ohio Biological Survey, Columbus, OH and the College of Biological Sciences, The Ohio State University, Columbus, OH.

LITERATURE CITED

Baker, F. C. 1928 The fresh water Mollusca of Wisconsin Part II. Pelecypoda. Bull. Univ. of Wis. 495 p.

Barick, F. B. 1950 The edge effect of the lesser vegetation of certain Adirondacks forest types

with particular references to deer and grouse. Roosevelt Wildlife Bull. 9: 1–146.

Goldthwait, R. P., G. W. White and J. L. Forsyth 1961 Glacial map of Ohio, U. S. Geol. Surv. Misc. Geol. Invest. Map 1–316.

Hobbs, H. H., Jr. and E. T. Hall, Jr. 1974 Crayfishes (Decapoda: Astacidae). Chapter 7 *In*: C. W. Hart and S. L. H. Fuller (eds.). Pollution ecology of freshwater invertebrates. Academic Press, Inc., NY.

Ortmann, A. E. 1919 A monograph of the naiades of Pennsylvania. Part III Systematic account of the genera and species. Mem. of the Carnegie Mus. VIII. 385 p.

Pennak, R. W. 1953 Fresh-water invertebrates of the United States. Ronald Press. NY. 769 p.

Richardson, L. W. 1968 The Warren County canal. Towpaths. 6: 13–19.

Rhoades, R. 1941 The distribution of *Cambarus sloani* Bundy, in Ohio. Ohio J. Sci. 44: 93–98.

Stout, W. E., Ver Steeg and G. F. Lamb 1943 Geology of water in Ohio. Geol. Surv. Bull. 44: 672 p.