ANALYSIS OF AN ENVIRONMENT AS SUGGESTED BY SHELLS OF FRESH-WATER MUSSELS DISCARDED BY INDIANS OF ILLINOIS

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Introduction

During the past few decades an ever-increasing amount of knowledge has been accumulated concerning the former distribution of freshwater mussels and, to a certain extent, of terrestrial and aquatic gastropods. Information has been derived primarily from two sources. Gastropods and occasionally sphaerids have been found in various geological formations; usually, unionids have been lacking. For the majority of our collections of past populations of freshwater mussels, we must thank the diet of some of the early American Indians.

Along certain rivers, usually part of the Mississippi River basin, these Indians left large refuse piles that were often composed entirely of mussel shells. These middens offer evidence that, at least with some groups of Indians, the clam constituted a chief item of diet. Knowledge of the existence of the middens is usually supplied by anthropologists.

Reconstruction of the physical aspects of a stream environment, as it formerly existed, through an analysis of the habitat-demands of the mussels which were once removed from it is a relatively new field of endeavor. An example of this procedure is a study made of shells taken from a midden on McGee's Creek (Poole site; Matteson, 1953). A report in which past populations of mussels from streams in southern Illinois are compared with mussels now existing nearby has been recently published by Parmalee (1956); however, no attempt is made to reconstruct the nature of the environment as occupied by the original mussels. Changes in the bed of the Tennessee River have been demonstrated through a study of its former unionid fauna by Morrison (1942).

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Description of Site

The midden from which these shells were obtained was located several hundred feet from the present west bank of McGee's Creek. The location, known as the Irvin site, is one mile below the midden of the Poole site mentioned previously. It is situated in Pike County, Illinois, and is about one mile north of Chambersburg. The shells were discarded by Indians of the late Middle Wood-

land culture living in a village which existed about 776 A. D. Approximately one thousand years separate the shells of this midden from those of the midden located at the earlier Poole site. Both dates were ascertained by carbon[14] determination through the efforts of Dr. McGregor.

There is little doubt that the collecting areas of both villages overlapped, although separated by a thousand years. The Irvin site is roughly seven miles from the Illinois River by water, or five miles by land; however, the Illinois River and the lower portion of McGee's Creek did not necessarily occupy their present beds in 776 A.D.

The shells are well preserved. They were embedded in a soil composed chiefly of clay, which had been deposited by past floods involving the nearby stream.

Results

An inventory of the collection revealed 37 species of 22 genera. Where only one specimen of a thin-shelled mussel, *Strophitus rugosus,* was found in the earlier Poole collection, shells representing several thin-shelled genera were now present. Not listed in the following chart are six shells of the terrestrial snail, *Anguispira alternata* (Say), 1816. This snail is notorious for securing lime from the shells of other snails, both living and dead. Its affinity for the lime of which the mussel shells were composed doubtlessly explains its presence in the collection.

Discussion

The habitat-demands of various species of mussels may coincide to the extent that they tend to occupy a common aquatic environment. They thus constitute a rather constant community. The number of species which occupy a community will vary according to the nature of the environment. When certain members of such a community are found during a survey, one can predict quite accurately which species may yet be found. The accompanying inventory varies little in composition from that of the Poole site, with the exception that several thin-shelled species (*A. grandis, U. tetralasmus, S. rugosus*) are present in the former while only one is found in the latter. It is probable that the thin-shelled forms once existed in the unionid community from which the valves found at the Poole site were secured by the Indians. There are several possible explanations why they were not found in this collection; the most plausible one is that they were subjected to deterioration for an added 1000 years.

With few exceptions, all of the mussels listed here are found in small rivers. There are a few species present whose habitat-demands are such that they can occupy a river of any size. Usually, the size attained by such forms varies directly with that of the river.

A. costata, L. ventricosa, L. Siliquoidea, E. dilatatus, P. c. coccineum, and *A. carinata* are most frequent in this collection; all are typical of unionid communities occupying small or medium-sized rivers. It will be noted that *A. peruviana* and *A. rariplicata* are numerically next most frequent. Both species are found also in larger deeper rivers.

TABLE 1.—Species of Unionids Found at Irvin Site.

	Number identifiable valves	Number for height only	Number complete valves	Mean, for height only, in mm.	Mean height, in mm. (complete valves)	Mean length, in mm.	Percent total population
Amblema costata Rafinesque, 1820	333	67	25	4.67	4.72	6.87	12.93
Lampsilis ventricosa (Barnes), 1823	297	56	24	6.42	6.67	10.12	11.53
Lampsilis siliquoidea (Barnes), 1823	282	91	38	4.02	4.04	6.81	10.94
Elliptio dilatatus (Rafinesque), 1820	273	71	28	3.85	4.00	8.34	10.60
Pleurobema coccineum (Conrad), 1836	250	43	5	3.57	2.80	3.76	9.70
Actinonaias carinata (Barnes), 1823	217	78	31	5.09	4.91	7.82	8.42
Amblema peruviana (Lamark), 1819	175	70	38	4.88	4.67	6.33	6.79
Amblema plicata (Say), 1817	158	58	34	4.91	4.79	6.49	6.13
Fusconaia flava (Rafinesque), 1820	101	28	9	3.18	3.12	4.05	3.92
Fusconaia undata (Barnes), 1823	99	79	15	3.57	3.59	3.92	3.84
Quadrula pustulosa (Lea), 1831	51	43	23	4.05	4.02	4.37	1.97
Proptera alata (Say), 1817	49	4	1	7.35	7.50	11.16	1.90
Lampsilis anodontoides (Lea), 1831	43	2	2	3.50	3.50	7.05	1.67
Actinonaias ellipsiformes (Conrad), 1836	38	9	3	2.04	2.00	3.40	1.48
Lasmigona costata (Rafinesque), 1820	37	4	2	5.45	4.40	8.40	1.44
Fusconaia ebenus (Lea), 1831	29	4	1	4.73	5.00	5.90	1.13
Lasmigona complanata (Barnes), 1823	27	2	1	8.45	8.80	12.10	1.04
Anodonta grandis Say, 1829	21	.....	.....	.....	.....	.....	.82
Uniomerus tetralasmus (Say), 1830	16	.....	.....	.....	.....	.....	.61
Ligumia recta (Lamark), 1819	14	10	4	4.01	3.65	8.75	.54
Pleurobema pyramidatum (Lea), 1831	11	8	1	4.43	4.60	5.50	.43
Strophitus rugosus (Swainson), 1822	11	.....	.....	.....	.....	.....	.43
Elliptio crassidens (Lamark), 1819	9	3	1	6.03	5.90	9.10	.35

	Number identifiable valves	Number for height only	Number complete valves	Mean, for height only, in mm.	Mean height, in mm. (complete valves)	Mean length, in mm.	Percent total population
Cyclonaias tuberculata (Rafinesque), 1820	5	3	1	5.77	5.80	7.00	.19
Quadrula nodulata Rafinesque, 1820	4	3	3	3.80	3.80	4.37	.16
Tritogonia verrucosa (Rafinesque), 1820	4	2	2	3.95	3.95	5.85	.16
Micromya iris (Lea), 1830	3	.....	.....	.....	.....	.....	.12
Micromya lienosa (Conrad), 1834	3	2	.....	3.20	.....	.....	.12
Plagiola lineolata Rafinesque, 1820	3	3	2	3.83	3.85	5.05	.12
Proptera laevissima (Lea), 1834	3	2	2	7.50	7.50	12.25	.12
Plethobasus cyphyus (Rafinesque), 1820	2	2	1	4.65	4.80	6.90	.08
Quadrula metanevra Rafinesque, 1820	2	2	2	4.60	4.60	5.80	.08
Quadrula quadrula Rafinesque, 1820	2	2	.....	4.20	.....	.....	.08
Alasmidonta marginata Say, 1819	1	.....	.....	.....	.....	.....	.04
Arcidens confragosus (Say), 1830	1	.....	.....	.....	.....	.....	.04
Obliquaria reflexa (Rafinesque), 1820	1	1	.....	3.00	.....	.....	.04
Truncilla truncata Rafinesque, 1820	1	1	1	2.90	2.90	4.50	.04
Totals	2576	753	300				100.00

Experience has shown that both may be collected in the lower portions of small tributaries of large rivers, wherever their young have been dropped by fish hosts. The Indians probably gathered them a considerable distance below their village where the creek had entered the flood plain of the Illinois River and had become broader and deeper.

All of the remaining species of unionids which form more than one per cent of the population, with the exception of two, normally occupy rivers of small to medium size. *F. ebenus* and *F. undata* are also found in larger rivers such as the lower portions of the Kaskaskia and Embarrass rivers, or the Illinois.

An analysis of the habitat-demands of those mussels represented by less than one per cent of the total population is of interest. *A. marginata, C. tuberculata, E. crassidens, L. recta, M. lienosa, Q. metanevra, S. rugosus, T. verrucosa,* and *T.*

truncata are seldom found in large concentrations. All are typical of small rivers which flow rather rapidly over a sand-gravel bottom; usually one or both borders will have a narrow band of silty substratum. *A. grandis* is often found in limited numbers along the borders of such a stream, in indentations where the current is slow and considerable silt has gathered.

A. confragosus, O. reflexa, P. Lineolata, P. cyphyus, P. pyramidatum, and *Q. nodulata* occupy the deeper portions of a stream at a point just previous to its flowing onto the flood plain. All prefer deeper water but still demand a firm, somewhat rocky substratum. *P. laevissima* is found almost entirely in deep silt along the edges of slow-moving, rather large streams; it was without doubt gathered from the stream after it had entered the flood plain. *M. iris* typically inhabits headwaters or small rivers where the substratum is of sand-gravel.

Anomalous situations have arisen in regard to several species in this collection. Only two shells of *Q. quadrula* were found. In modern communities composed of the species identified here, this clam is always present in larger numbers. Similarly *Q. pustulosa* should have constituted at least five percent of the total population. Wherever the author has collected *P. laevissima,* he has invariably found *Leptodea fragilis.* None of the latter were present. *U. tetralasmus* is found either in very slowly moving water over a silty substratum or in small muddy sloughs associated with a stream where the water is usually less than two feet in depth. There seems to be no evidence that this condition existed near the midden.

There should have been more than one specimen of *T. truncata.* However, this species is roughly one inch in length and could have been easily overlooked by the Indians or considered not worth taking for its small food content. The presence of large numbers of *E. dilatatus* suggests that an area of shallow, rapidly flowing water must have been present, because this species is found almost exclusively in such a habitat. Usually *L. complanata* exceeds *L. costata* in number, where they occur together; however, the latter possesses a larger soft part and thus might be more desirable as food.

The collection is quite similar in quality and quantity to one that might be removed from a small river today. The mussels appear to be of normal size for the reconstructed habitat from which they were removed; very few immature shells were observed, which would lead one to believe that the Indians selected only adults. With the exception of *L. fragilis* and possibly *Carunculina parva,* all the mussels of a small-river community are present.

An environment which would support the preceding population would consist of a stream which possesses the following characteristics: 1) 40 to 60 feet in width, with a depth ranging from a few inches to about three feet; 2) a decided current; 3) a diverse substratum including areas of sand, sand-gravel, gravel, and silt; 4) a slightly alkaline pH of about 8.1; and 5) little suspended silt.

It is evident that any general col-

lection of mussel shells from the past, which can be accurately dated, will denote quite thoroughly stream conditions which prevailed when they were alive. By continuing to study collections of these old shells it is hoped that eventually a more lucid picture may be formed of the former appearances of some of the rivers of Illinois. As Illinois is known as a land of rivers this revelation will be of value.

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