# Notes of the Ecology of the Fresh-Water Mussels of Dallas County[1]

*Louis B. Read & Kelly H. Oliver*

The late John K. Strecker of the Baylor University Museum catalogued the Naiades of Texas in 1931. Since then, but little has been added to our knowledge of these mollusks in Texas. We need now, especially, studies on the general ecology of Texan species, with a modern revision of names, careful comparison of the synonymy, and close identification of Texas specimens in the museums.

Last summer (1951) we made an ecological study of Parson's Slough in the southeastern part of Dallas County. In our work we gathered much information on the bivalve mollusks. Other data later gathered from this locality and other parts of the county, have been incorporated in this report.

## Drainage and Rainfall

Three major drainage areas exist in Dallas County: the overflow drainage of the southeastern section of the county; Elm Fork of the Trinity River in the northwestern part of the county; and White Rock creek, which, with White Rock lake, drains much of the northern and eastern part of the county.

Although our total annual rainfall averages some 38 inches, two years of drouth in the upper watershed of the Trinity River immediately preceded this study. All of the consequential streams of Dallas County are normally of sluggish flow, hence many of the shallower portions have been completely dry during the past summer. Many small creeks have dried up altogether, and normal spring- and fall floods have been almost entirely lacking. These factors have produced a somewhat abnormal picture of the ecology of clam communities.

*Glochidial Stage and Parasitism.*—Although many species of fish have been examined for glochidial infection throughout the summer of 1951, few species have shown any gill infection. Certain cyprinid minnows (notably *Notemigonus chrysoleucus* Raf. and *Notropis* sp.) have, however, been

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FAMILY UNIONIDAE

List of Species collected by us, and by Strecker (1931), with Localities

*Actinonaias carinata* (Barnes) B
*Amblema costata* Raf. A, B, 2
*A. perplicata* (Conrad) A, B, 1
*Anodonta corpulenta* Cooper A, B, C, 1
*A. imbecillis* Say A, B, C, 1
*Arcidens confragosus* (Say) A, 1
*Carunculina parva texasensis* (Lea) A, B, C, 1
*Fusconaia undata* (Barnes) A, 1
*Lampsilis anodontoides* (Lea) A, B, 1
*L. hydiana* (Lea) B, 1
*L. tampicoensis* (Lea) B, C
*L. ventricosa* (Barnes) A
*Leptodea fragilis* (Raf.) A, B, C, 1
*L. laevissima* (Lea) A
*Lasmigona costata* (Raf.) B
*Obliquaria reflexa* Raf. B, 1
*Obovaria subrotunda* (Raf.) B
*Pleurobema cordatum* (Raf.) B
*Proptera purpurata* (Lam.) A, B, 1
*Quadrula houstonensis* (Lea) B, 2
*Q. metanevra* Raf. B
*Q. pustulosa* (Lea) B, 1
*Q. quadrula forsheyi* (Lea) A, B, 1
*Q. quadrula speciosa* (Lea) A, B, C
*Tritogonia verrucosa* (Say) A, B, 1
*Truncilla donaciformia* (Lea) B, 2
*T. truncata* Raf. A, B, 1
*Uniomerus tetralasmus* (Say) A, C, 2

NOTE: A = Parson's slough in southeastern part of county.
B = Elm Fork of the Trinity or some of its tributaries.
C = White Rock Creek or White Rock Lake.
1 = Reported for Dallas County by Strecker.
2 = Reported for Trinity drainage below Dallas County by Strecker.

found literally covered with encysted glochidia. Glochidia were found not only on the fins, but also on the body of the fish, many being encysted beneath the scales. Lefevre & Curtis (1912) noted that the hooked glochidia of *Anodonta* fasten on the edges of fins, while the hookless glochidia of most other species encysted only on the gills. Their investigations did not note any glochidial encystment under the scales on the body of the fish.

All glochidia which we found on the fins were readily identified as those of *Anodonta corpulenta* from Surber's (1912) key. We did not identify with certainty glochidia under the scales; some appeared to be hookless, very similar to Surber's diagrams for the glochidia of *Amblema* and *Quadrula*. Gills of these cyprinid-minnow hosts were not infected. We saw numerous scars on the fish, apparently places whence encysted glochidia had fallen. From the appearance of glochidia encysted under the scales, we had no reason to doubt that they would successfully complete their metamorphosis.

*Ecology of the early Juvenile Clams.*—Our ignorance of the ecology of early juvenile naiades (under 17 mm. in length) was noted by F. B. Isely (1911). He collected 32 individuals of several species, ten of these less than nine millimeters in length. Isely noted that all of these, regardless of species, were attached to rocks and pebbles by a functional byssus. We have found a number of early juveniles (5-17 mm.) in Dallas County. These (of several species) were found only on gravel shoals. They were sometimes attached to large rocks by a byssal thread, or had the shell clamped to an algal filament. As Isely reported, two conditions have been evident wherever early juveniles have been found; (1) rocks or coarse gravel were available, and (2) there was a fairly swift current, with water-depth usually somewhat more than twelve inches. These conditions do not hold in Dallas County for the fragile clams *Anodonta* and *Leptodea,* nor for *Carunculina;* for all of these are found abundantly away from gravel and out of swift currents. We sometimes found early juveniles of the heavy shelled clams in sand banks, but this seems to be accidental. These very young clams require for normal development maximum food without effort, abundant oxygen, and freedom from their principal enemy, silt.

*Late Juvenile Stage of Development.*—This extends from the time a clam has reached the length of *ca.* 17 mm. until it has attained sexual maturity. For many species in Dallas County, this stage appears to begin with about the second year of independent existence. The clam no longer attaches to rocks by a byssus; but, if it is a heavy shelled clam, may be found lying among the gravel particles on shoals, or in abundance in sand banks or in sandy bottoms of shallow areas. We found large numbers of the fragile clams *Anodonta* and *Leptodea* in the late juvenile stage of development in the mud bottoms that are normal for the adults. This is the period of maximum growth-rate in the clam. Growth is variable according to species, but some of the large species multiply their size several times during the late juvenile stage.

*Ecology of the Adult Clams.*—Most species of clams show a decided preference for a given type of substrate. Thus fragile forms, rare on gravel shoals, are usually found in clay muck, and sometimes in soft sand. Small clams like *Anodonta imbecillis* and *Carunculina* usually bury themselves in shallow bank areas or in shallow inlets and coves. In Parson's Slough, where nearly every conceivable combination of substrate-type is available, most species of clams live in soft bottom-ooze with a high proportion of sand. Specimens of *Anodonta* are found far more abundantly there, however, than any other group. After a spring rain and slight flooding of the slough, many very large heavy-shelled clams were found lying on a moderately hard bottom in water from three to four feet deep. Here the current was not swift, and apparently the clams found those conditions favorable while the water level was high. As the water level receded to normal, the heavy clams migrated to a shallow constriction of the stream where there was still a current and a good oxygen level. The water here was only about eight inches deep and the clams were about half buried in the sandy substrate. With increasing summer heat (August), and air temperatures above 100° F., the heavy clams vacated the shallow areas, and only dead shells were to be found. In the much cooler depths of depressions nearby, these clams could then be found in abundance. On the other hand, thin-shelled species of *Anodonta* migrated hardly at all in a horizontal direction, but rather vertically, to meet changing conditions. They were found usually in water about 18 inches deep at normal level. Spring and early summer saw *Anodonta corpulenta* in the upper six inches of bottom muck twice as abundant as all other species collectively. When the water level of the stream was below normal (late August), the same species was found in the upper six inches of muck in a ratio of 9:1 to all other species, although the abundance of these other species was about the same per unit-area as before.

When a mussel has selected a position and has dug in with siphons exposed, and conditions of current, temperature, and oxygen remain fairly uniform, the only thing apparently that will cause it to move is a lack of food. This food consists, for the freshwater mussels of this area, overwhelmingly of zoöplankters as compared to phytoplankters and detritus. Selectivity on the animal's part is evidenced by the finding of entirely undigested diatoms and algae in the lower intestine. At the same time very few living zoöplankters were found beyond the stomach; usually only chitinous parts of minute crustacea were found. No doubt these mussels feed on algae when zoöplankters are not available, but their preference seems clearly indicated. All forms of plankton are taken into the siphons but the animal seems to exercise selectivity in various ways, from that point. This corroborates the report of W. R. Allen (1914), which gave detailed feeding-data for mussels. In this connection it is interesting to note that in Parson's Slough in June, 1952, the ratio of zoöplankters to phytoplankters was 7:1. Parson's Slough has been long known locally for the diversity and abundance of its clam population. Seventeen of the species listed for Dallas County occur within a very limited area in this stream.

Reproduction among the naiades here conforms very closely to the "long period" and "short period" breeding groups of Lefevre & Curtis (1912), and of T. Surber (1912). During this study we have found embryonated eggs, and glochidia at the times set forth by those authors, and in many of their species. We have also noted the lapse-period, during which embryos of glochidia are absent from "long period" breeders, to be the same for Texas species as for the northern species. (To their 1912 records we may add that *Carunculina parva texasensis* is apparently a "long term" breeder, with lapse-period during July and August.) Sexual dimorphism has been noted in several of our Dallas County species. This dimorphism is most pronounced in *Tritogonia verrucosa, Lampsilis anodontoides,* and *Carunculina.* One instance of apparent hermaphroditism was noted in *Carunculina;* the animal, although having the male shell outline, and male-type gills, nevertheless possessed a marsupium which was filled with glochidia. This animal possessed no caruncles (fairly large gland-like structures varying in color from red to white found on the edge of the mantle posteriorly, in an opposing pair) which are common to the female *Carunculina* and may have a physiological function in connection with breeding.

Survival-ability under adverse conditions is noteworthy among many species of clams. Strecker, 1931, reported that *Uniomerus tetralasmus* and *Glebula* could live for months on dry land. On the other hand, individuals of *Lampsilis fragilis* died if the water became less than six inches deep. These are interesting extremes. Most of the heavy-shelled clams, we have found, survive long periods of drying. The clams apparently remained bathed in the water which filled the mantle cavity, sealed from evaporation. Large amounts of water are not necessary, however; we found a large number of *Carunculina* lying on the dry bed of a creek that, to our knowledge, had been dry for two months. The Carunculinas were alive, but when opened slightly were found to contain no water in the mantle cavity. The marsupia of the females were distended slightly with ova. Several of these clams were placed in water, and soon became active. We have frequently found living *Anodonta* buried in damp mud where ponds have dried up. These had fairly heavy shells for *Anodonta,* however, while there were many dead thin-shelled *Anodonta* about. Thickness of shell and close alignment of the shells seem to be necessary to survival under conditions of drying. We have never found a deformed clam alive under waterless conditions. The two things that clams apparently cannot stand are extensive organic pollution of the stream, and increasing acidity. The main Trinity River was, at one time (Strecker, 1931) a good clam habitat. Strecker emphasized the fact, 21 years ago, that pollution was ruining the clam population of the Trinity around Dallas, and this pollution has greatly increased up to the present time. Several attempts at collecting in the Trinity River have been made in the course of this study, and not a live clam has been found, although ancient eroded shells attest to the former abundance of these animals.

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# Synopsis of the United States Species of Lythrum (Lythraceae)

*Lloyd H. Shinners*

Considerable difficulty was encountered in distinguishing the species of *Lythrum* found in north central Texas, and in deciding on the correct names for them. To dispose of a relatively small problem (only two species were involved), it has been necessary to undertake a study of the genus in the entire United States and Mexico. Because of lack of adequate collections, and lack of field acquaintance with any of them, those of the latter region have been omitted. Only two proved of any concern in treating those of the United States; they are noted briefly under *L. californicum* and *L. alatum.* Introgression between species where the ranges meet, the occurrence of endemic minor variants (especially in *L. californicum*), and the considerable superficial simi-