

Walkerana, 1993, 7(17/18): 265-273

ANODONTA HEARDI, A NEW SPECIES OF FRESHWATER
MUSSEL (BIVALVIA: UNIONIDAE) FROM THE
APALACHICOLA RIVER SYSTEM OF THE SOUTHEASTERN
UNITED STATES

Mark E. Gordon¹ and Walter R. Hoeh²

ABSTRACT - *Anodonta heardi* n. sp., is described from the Apalachicola River. Previously considered to be a disjunct population of *A. couperiana* Lea 1840, it is specifically distinct on the basis of morphological and allozymic comparisons with other regional species. Its closest faunal affinities appear to be with *A. couperiana* and *A. suborbiculata* Say 1831.

Key words: *Anodonta heardi*, Unionidae, Apalachicola River system.

INTRODUCTION

Distributions of anodontine species within coastal drainages of the southeastern United States have been surveyed by Clench & Turner (1956), Johnson (1965, 1969, 1970, 1972), and Heard (1979). Heard (1975) examined the reproductive biology of several of these species. In particular, he noted that a disjunct population of *Anodonta couperiana* Lea 1840³, from the Apalachicola River (see Johnson, 1969) contained only females and hermaphrodites, whereas, a population from peninsular Florida was found to be gonochoric. This difference in visceral sex together with subsequent morphological comparisons and allozyme analyses (Hoeh, 1990) indicate that *Anodonta "couperiana"* in the Apalachicola River represents a distinct, previously undescribed species.

Family Unionidae, Subfamily Anodontinae, Tribe Anodontini
Genus *Anodonta* Lamarck 1799

Anodonta heardi n. sp.

Figs. 1, 6.

Anodonta gibbosa Say, Clench & Turner 1956, p. 186, in part; Tanvat Pond, 3 miles north of Sneads, Jackson Co., Florida.

¹Zoology Section, Campus Box 315, University of Colorado Museum, Boulder, Colorado 80309, U.S.A.

²Center for Theoretical and Applied Genetics, Cook College, Rutgers University, P.O. Box 231, New Brunswick, N.J. 08903-0231, U.S.A. Current address: Department of Biology, Dalhousie University, Halifax, Nova Scotia B3H 4J1, Canada.

³The publication date for *Anodonta couperiana* generally has been given as Lea (1842) (e.g., Johnson, 1970, 1972; Burch, 1975). However, Clench & Turner (1956) and Haas (1969) noted that this species originally was described by Lea (1840) as *A. cowperiana*. This mussel was named for J.H. Couper and the incorrect original spelling was corrected to *A. couperiana* in Lea (1842). In accordance with the International Code of Zoological Nomenclature (Ride *et al.*, 1985: Articles 19a, 32c-d), the correct citation for this species should be *A. couperiana* Lea 1840, as referenced by Frierson (1927) and Turgeon *et al.*, (1988).

Anodonta couperiana Lea, Johnson, 1969, p. 34, in part; Apalachicola River at Ocheese Landing, 6 miles North of Blountstown, Calhoun Co., Florida.
Anodonta couperiana Lea, Heard, 1975, p. 84, in part; Apalachicola River at Ocheese Landing, about 6 miles north of Blountstown, Calhoun Co., Florida.
Anodonta "couperiana," Hoeh, 1990, p. 65, fig. 1b; Apalachicola River, Chattahoochee, Gadsden Co., Florida.

Diagnosis: *Anodonta heardi* has a relatively heavier shell, a more ovate lateral aspect, and a lesser tendency towards periostracal raying than *A. couperiana* (cf. Figs. 1, 2 and 6). The posterior slope of *A. couperiana* also is relatively more compressed, exhibiting a greater degree of wing development. Contrasted to *A. suborbiculata* Say 1831, *A. heardi* does not grow as large or as circular in shape, although their periostraca and shell thickness can be similar (cf. Figs. 1, 3 and 6). *Anodonta heardi* has a relatively heavier shell and develops a greater degree of ventral convexity than does *Utterbackia imbecillis* (Say 1829) or *U. peggyae* (Johnson 1965) and lacks the oblique orientation of the ventral convexity exhibited by the latter species (cf. Figs. 1, 4, 5 and 6).

Holotype: University of Michigan Museum of Zoology (UMMZ) no. 253324, collected 4 August 1968 by W.H. Heard and R.H. Guckert. Paratypes: three specimens from UMMZ no. 250516 and three specimens from UMMZ no. 250517, collected 2 August, 1968, at type locality by C.C. Swift and J.C. Wolfe.

Type locality: Apalachicola River, Florida, Calhoun County, approximately 9.7 km north of Blountstown at Ocheese Landing.

Etymology: This species is named for Dr. William H. Heard, Department of Biological Science, Florida State University, in recognition of his significant contributions to malacology.

Description: Shell medium-sized (see Table 1), broadly elliptical, sub-ovate, thin and translucent but relatively solid for *Anodonta*, quite inflated; anterior margin rounded and merging evenly into the slightly convex dorsal and deeply convex ventral margins, posterior margin bluntly pointed, postero-dorsal junction distinctly angular; posterior ridge broadly rounded, concave, somewhat double; posterior slope flattened but with a slight longitudinal furrow; ligament low and relatively long, extending from the postero-dorsal angle to the umbo; umbo positioned at 0.36 of shell length from anterior margin; umbonal region swollen but dorsally flattened, only slightly elevated above dorsal margin; umbonal sculpture of three double-looped and several subsequent concentric ridges; periostracum shiny, grayish-green, lightening to yellowish-green peripherally, obscurely rayed

34, in part; Apalachicola River at
 stown, Calhoun Co., Florida.
 84, in part; Apalachicola River at
 Mountstown, Calhoun Co., Florida.
 65, fig. 1b; Apalachicola River,

relatively heavier shell, a more
 tendency towards periostracal raying
 . The posterior slope of *A. cou-*
sed, exhibiting a greater degree
 of *A. suborbiculata* Say 1831, *A.*
 orbicular in shape, although their
 are similar (cf. Figs. 1, 3 and 6).
 The shell and develops a greater
 than *Utterbackia imbecillis* (Say 1829)
 because of the oblique orientation of the
 in this species (cf. Figs. 1, 4, 5 and 6).
 Museum of Zoology (UMMZ)
 N.H. Heard and R.H. Guckert.
 (Z no. 250516 and three speci-
 mens) 12 August, 1968, at type locali-

Florida, Calhoun County,
 town at Ocheese Landing.

for Dr. William H. Heard,
 Florida State University, in recogni-
 talacology.

(see Table 1), broadly elliptical,
 relatively solid for *Anodonta*, quite
 merging evenly into the slight-
 ventral margins, posterior
 junction distinctly angular;
 are, somewhat double; posteri-
 tudinal furrow; ligament low
 postero-dorsal angle to the
 length from anterior margin;
 thickened, only slightly elevated
 of three double-looped and
 periostracum shiny, grayish-
 peripherally, obscurely rayed

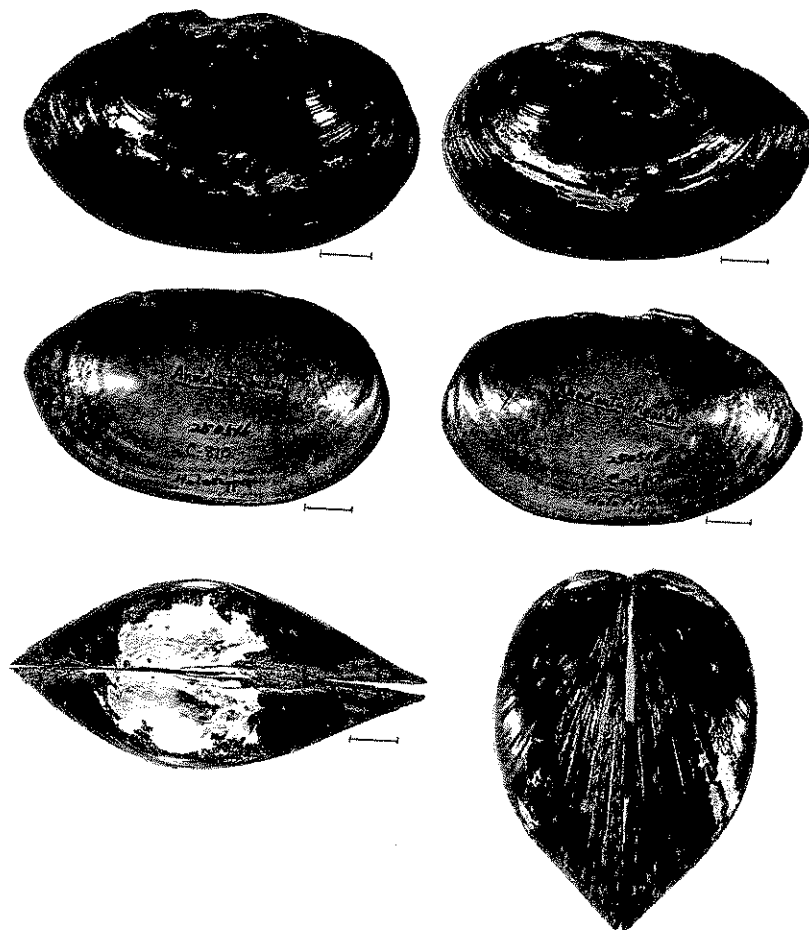


FIG. 1. Holotype of *Anodonta heardi* n.sp., UMMZ 253324: external (top row) and internal (middle row) views of right and left valves, and top and anterior end views (bottom row). Scale lines = 1 cm.

with dark-green capillary-like lines, prevalence for such raying on the posterior slope.

Hinge edentulous, not thickened, with a notch at the posterior terminus of the ligament; anterior muscle scars confluent, posterior muscle scars confluent; dorsal muscle scars small, irregular, positioned anterior to umbo and subparallel to dorsal margin; pallial line lightly impressed; umbonal cavity present but very shallow; nacre

TABLE 1. Shell dimensions of type specimens of *Anodonta heardi* new species (measurements in mm; L = length, H = height, W = width, U = distance of umbo from anterior margin parallel to the longitudinal axis).

Specimen	L	H	W	U	H/L	W/H	U/L	UMMZ cat. no.
Holotype	81.4	47.9	35.9	29.3	0.59	0.75	0.36	253324
Paratype	95.0	54.6	45.5	32.2	0.58	0.83	0.34	250516
Paratype	82.5	47.2	36.2	28.7	0.57	0.77	0.35	250516
Paratype	71.7	40.8	31.4	22.6	0.57	0.77	0.32	250516
Paratype	88.5	52.0	43.4	31.8	0.59	0.83	0.36	250517
Paratype	84.0	48.5	39.5	31.4	0.58	0.81	0.37	250517
Paratype	80.2	47.6	37.7	27.9	0.59	0.79	0.35	250517

white, iridescent, appears somewhat bluish and blotched due to external erosion and staining showing through the thin shell.

Shell dimensions of paratypes are presented in Table 1. With respect to shell length, the lateral aspect (H/L) and position of umbos (U/L) remained relatively constant. However, there may be a slight trend toward increased shell inflation (W/H) with increased shell length. With increasing size, the convexity of the ventral margin becomes quite pronounced and the posterior margin may vary from bluntly pointed to rounded (Fig. 6). Therefore, the outline of the ventral region may appear somewhat subcircular. In smaller specimens, the umbo essentially is flush with the dorsal margin but may be swollen slightly above this margin in larger shells. Periostracum varies from grayish or yellowish-green to dark brown. Although faint narrow rays may be present on any portion of the shell exterior, they tend to occur most frequently on the posterior slope.

Distribution: Presently known only from the lower Apalachicola River system. This species appears to be quite rare. In addition to the type material, one specimen of *Anodonta heardi* (UMMZ no. 250708) was collected 17 July 1986 from the Apalachicola River at Chattahoochee, Gadsen County, Florida (Hoeh, 1990; electrophoretic specimen). An additional specimen of *A. heardi* was located in the Florida State Museum (no. 1915: labeled as *A. gibbosa* Say 1824) from Tanvat Pond, 4.8 km north of Sneads, Jackson County, Florida (evidently a voucher specimen from Clench & Turner, 1956: p. 186). This last record indicates that *A. heardi* historically was distributed in the Apalachicola River basin above Chattahoochee, Florida. However, the extent of its current upstream distribution and the effects of inundation by Seminole Reservoir on former habitats are not known.

Habitat: At the type locality, *Anodonta heardi* was found in a back-

specimens of *Anodonta heardi* new species (height, W = width, U = distance of umbo to ventral axis).

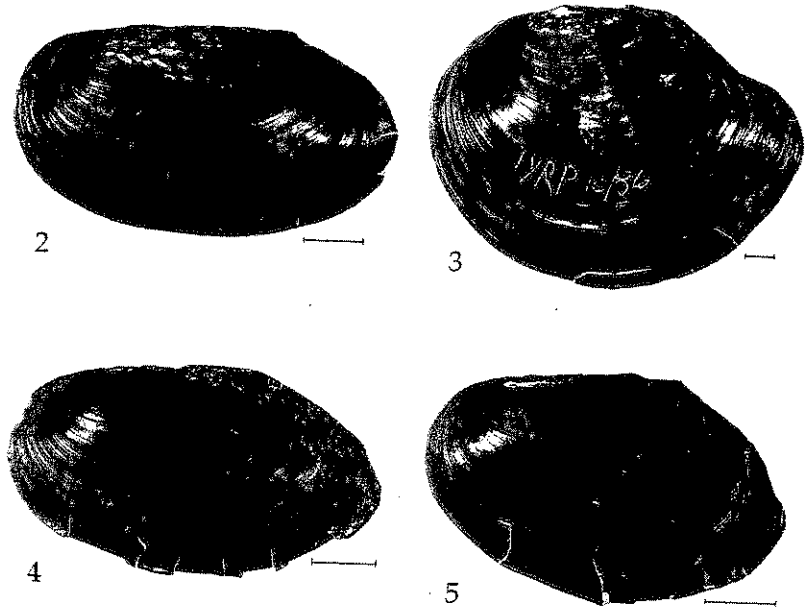
U	H/L	W/H	U/L	UMMZ cat. no.
2.3	0.59	0.75	0.36	253324
2.2	0.58	0.83	0.34	250516
3.7	0.57	0.77	0.35	250516
2.6	0.57	0.77	0.32	250516
1.8	0.59	0.83	0.36	250517
1.4	0.58	0.81	0.37	250517
2.9	0.59	0.79	0.35	250517

at bluish and blotched due to exposure through the thin shell.

are presented in Table 1. With respect (H/L) and position of umbos. However, there may be a slight variation (W/H) with increased shell convexity of the ventral margin. The posterior margin may vary from subcircular. In smaller specimens with the dorsal margin but may vary in larger shells. Periostracum green to dark brown. Although in any portion of the shell exterior, in the posterior slope.

only from the lower Apalachicola to be quite rare. In addition to the *Anodonta heardi* (UMMZ no. 250708) in the Apalachicola River at Chattahoochee, 1990; electrophoretic specimens of *Anodonta heardi* was located in the Florida Apalachicola River (evidently a Turner, 1956: p. 186). This last historically was distributed in the Chattahoochee, Florida. However, distribution and the effects of inrunner habitats are not known.

Anodonta heardi was found in a back-



FIGS. 2-5. Left valves of other species of pertinent Anodontinae. FIG. 2. *Anodonta couperiana* Lea 1840, St. Johns River, Florida Hwy 192 bridge, Brevard County, Florida (UMMZ 250706); FIG. 3. *Anodonta suborbiculata* Say 1831, ponds off the Yazoo River, Yazoo County, Mississippi (UMMZ 250703); FIG. 4. *Utterbackia imbecillis* (Say 1829), Coe's Landing, Lake Talquin, Leon County, Florida (UMMZ 250702); FIG. 5. *Utterbackia peggyae* (Johnson 1965), Coe's Landing, Lake Talquin, Leon County, Florida (UMMZ 250705). Scale lines = 1 cm.

water area with a substrate composed of muddy, medium packed sand. Although collected during a period of very low water levels (0.55 m at Bristol-Blountstown gaging station, 4 August, 1968), depths at that site may exceed 6 m. *Anodonta heardi* may typically occur in relatively deep water. The type specimens were found associated with *Glebula rotundata* (Lamarck 1819).

Discussion: Species of eastern North American mussels that have been classified as *Anodonta* express two general shell morphologies distinguished primarily by umbonal development. The umbo may be well-developed and distinctly elevated above the dorsal margin (*Pyganodon* Crosse & Fischer 1894) or, alternatively, the umbo may be essentially flush with the dorsum (*Anodonta* Lamarck 1799 [except for *A. implicata* Say 1829], and *Utterbackia* Baker 1927; see Hoeh [1990] for revised generic classifications). Within the Apalachicola River sys-

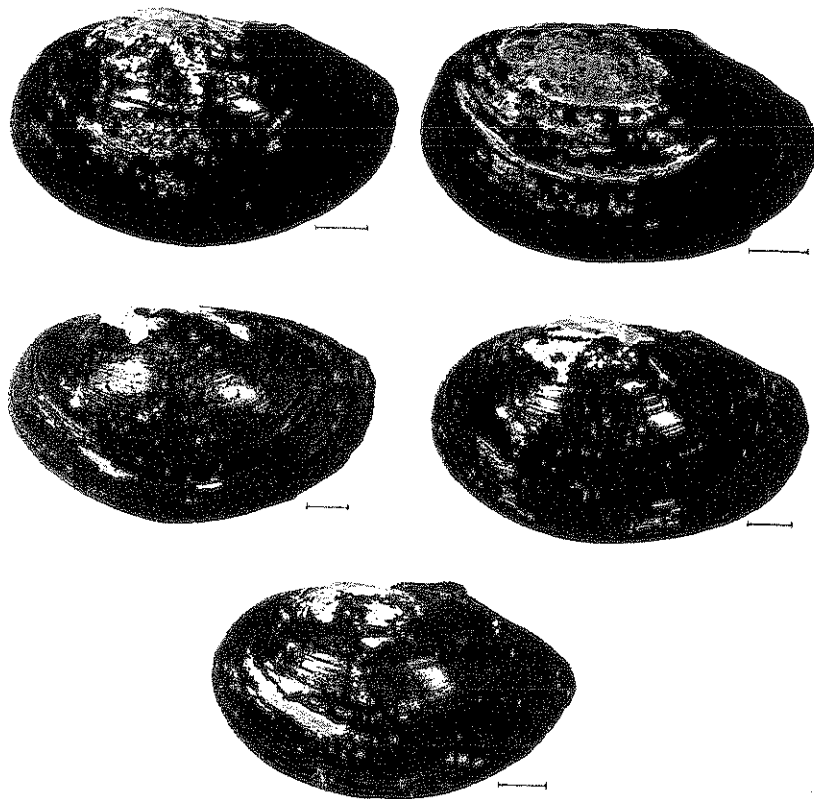


FIG. 6. Left valves of five paratypes of *Anodonta heardi*, n.sp. UMMZ 250516 and UMMZ 250517. Scale lines = 1 cm.

tem, three species exhibit the latter characteristic: *U. imbecillis*⁴ (Fig. 4); *U. peggyae* (Fig. 5); and *A. heardi* (Figs. 1 & 6). Phylogenetic analyses (Hoeh, 1990) suggest that the former two species are members of a distinct clade and that *A. heardi* is not related closely to either (e.g., Nei's [1978] genetic distance estimate between *U. peggyae* and *A. heardi* is 1.21, the distance estimate between *U. imbecillis* and *A. heardi* is 0.96; based on 24 loci [Hoeh 1990]). The phylogenetic hypothesis

⁴In recent publications, this species variously has been spelled *imbecilis* (e.g., Johnson, 1970; Burch, 1975; Hoeh, 1990) or *imbecillis* (e.g., Parmaleo, 1967; Davis & Fuller, 1981; Turgeon *et al.*, 1988). The use of *imbecilis* appears to have resulted from a typographical error in the reprint of Say's (1829) description in Binney (1858: p. 140), although it subsequently was spelled *imbecillis* in the reprint of Say (1831) (Binney, 1858: p. 235). Say's (1829: p. 355) original spelling is *imbecillis*, thus validating the use of a double "l."

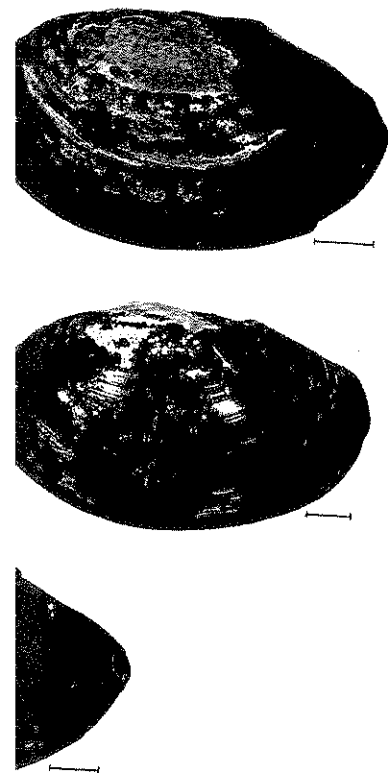
presented by Hoeh (1990, Fig. 4) suggests that the umbonal similarities shared by *U. peggyae*, *U. imbecillis*, and *A. heardi* are plesiomorphic in nature and, therefore, not indicative of a relatively close evolutionary relationship. It also suggests that *Anodonta heardi* is most closely related to *A. couperiana* (as which it previously had been classified by Johnson, 1969) and *A. suborbiculata* Say. Based on allozymes, the conclusion is that *A. heardi* is as distant from *A. couperiana* as the latter species is from *A. suborbiculata* (Nei's $D = 0.136$, 24 loci; Hoeh, 1990). This level of differentiation suggests a relatively recent origin for these three species.

In terms of overall shell morphology, *Anodonta heardi* can be viewed as intermediate between *A. couperiana* and *A. suborbiculata*. The geographic distributions of these three species exhibit a similar relationship. *Anodonta suborbiculata* generally occurs within the Interior Basin but also inhabits Gulf drainages from the Brazos River, Texas, to the Escambia River system of Florida and Alabama (Johnson, 1969, 1980; Neck, 1982; Gordon, 1984). *Anodonta couperiana* is found in drainages of the southern Atlantic slope and peninsular Florida (and possibly the Florida panhandle; Johnson, 1965, 1970, 1972)⁵. With its distribution apparently restricted to the Apalachicola River system, *A. heardi* inhabits the region between the ranges of its two closest relatives. The highly variable shell morphology (e.g., cf. figures in Clench & Turner, 1956; Johnson, 1970, 1972; Burch, 1975; Hoeh, 1990) and relatively large geographic range of *A. couperiana* are consistent with the hypothesis that it remains a species complex despite the specific-level recognition of *A. heardi*. The same may be true for *A. suborbiculata* (P.D. Hartfield, personal communication). Only a thorough examination of the *A. couperiana* - *A. heardi* - *A. suborbiculata* clade, based on comprehensive geographic sampling and the evaluation of conchological, anatomical and molecular characteristics, will enable a test of this hypothesis.

ACKNOWLEDGMENTS

We thank A.G. Gerberich, P.D. Hartfield, W.H. Heard, E.A. Hoeh and R.J. Trdan for assistance in procuring specimens, and A.E. Bogan, J.B. Burch, W.H. Heard and an anonymous reviewer for valuable comments on earlier versions of the manuscript. This work was supported in part by NSF grant BSR-88-15442 (to W.R.H. and D.J. Eernisse); Grant-in-Aid of Research from Sigma Xi, The Scientific Research Society; a

⁵Johnson's (1969) record for *Anodonta couperiana* and at least one of the records for *Pyganodon gibbosa* in Clench & Turner (1956: Tanvat Pond, see above) from the Apalachicola River were specimens of *A. heardi*.



Anodonta heardi, n.sp., UMMZ

characteristic: *U. imbecillis*⁴ (Fig. 4); & 6). Phylogenetic analyses of these two species are members of a clade related closely to either (e.g., between *U. peggyae* and *A. heardi* and *U. imbecillis* and *A. heardi*) the phylogenetic hypothesis

⁴replaced *imbecillis* (e.g., Johnson, 1970; 1967; Davis & Fuller, 1981; Turgeon et al. 1981) from a typographical error in the original (p. 140), although it subsequently was corrected (p. 1858; p. 235). Say's (1829: p. 355) original description of "l."

National Capital Shell Club Scholarship; an Anthony D'Attilio Student Research Grant; Block Grants from the Department of Biology, and Hinsdale-Walker Scholarships from the Museum of Zoology, University of Michigan.

LITERATURE CITED

- BINNEY, W.G., (ed.) 1858. *The complete writings of Thomas Say of the conchology of the United States*. H. Bailliere Co., New York. 252 pp.
- BURCH, J.B. 1975. *Freshwater unionacean clams (Mollusca: Pelecypoda) of North America*. Malacological Publications, Hamburg, Michigan. 204 pp.
- CLENCH, W.J. & TURNER, R.D. 1956. Freshwater mollusks of Alabama, Georgia, and Florida from the Escambia to the Suwannee River. *Bulletin of the Florida State Museum*, 1: 97-239.
- DAVIS, G.M. & FULLER, S.L.H. 1981. Genetic relationships among recent Unionacea (Bivalvia) of North America. *Malacologia*, 20: 217-253.
- FRIERSON, L.S. 1927. *A classified and annotated check list of the North American naiads*. Baylor University Press, Waco. 111 pp.
- GORDON, M.E. 1984. First record for *Anodonta suborbiculata* Say (Unionidae: Anodontinae) in Oklahoma. *Southwestern Naturalist*, 27: 233-234.
- HAAS, F. 1969. *Das Tierreich, Lieferung 88: Superfamilia Unionacea*. Walter de Gruyter & Co., Berlin. 663 pp.
- HEARD, W.H. 1975. Sexuality and other aspects of reproduction in *Anodonta* (Pelecypoda: Unionidae). *Malacologia*, 15: 81-103.
- HEARD, W.H. 1979. Identification manual of the freshwater clams of Florida. *Florida Department of Environmental Regulation Technical Series*, 4: 1-83.
- HOEH, W.R. 1990. Phylogenetic relationships among eastern North American *Anodonta* (Bivalvia: Unionidae). *Malacological Review*, 23: 63-82.
- JOHNSON, R.I. 1965. A hitherto overlooked *Anodonta* (Mollusca: Unionidae) from the Gulf drainage of Florida. *Brevoria*, 213: 1-7.
- JOHNSON, R.I. 1969. Further additions to the unionid fauna of the Gulf drainage of Alabama, Georgia and Florida. *The Nautilus*, 83: 34-35.
- JOHNSON, R.I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic slope region. *Bulletin of the Museum of Comparative Zoology*, 140: 263-450.
- JOHNSON, R.I. 1972. The Unionidae (Mollusca: Bivalvia) of peninsular Florida. *Bulletin of the Florida State Museum*, 4: 181-249.
- JOHNSON, R.I. 1980. Zoogeography of the North American Unionacea (Mollusca: Bivalvia) north of the maximum Pleistocene glaciation. *Bulletin of the Museum of Comparative Zoology*, 149: 77-189.
- LEA, I. 1840. Descriptions of new fresh-water and land shells. *Proceedings of the American Philosophical Society*, 1: 284-289.
- LEA, I. 1842. Descriptions of new fresh-water and land shells. *Transactions of the American Philosophical Society*, 8: 163-252.
- NECK, R.W. 1982. Significant Texas naiad records. *Texas Conchologist*, 19: 1-3.
- NEI, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. *Genetics*, 89: 583-590.
- PARMALEE, P.W. 1967. The fresh-water mussels of Illinois. *Illinois State Museum Popular Science Series*, 8: 1-108.
- RIDE, W.D.L., SABROSKY, G., BERNARDI, G. & MELVILLE, R.V., (eds.) 1985. *International code of zoological nomenclature, third edition*. International Trust for Zoological Nomenclature, British Museum (Natural History), London. 338 pp.
- SAY, T. 1829. Description of some terrestrial and fluviatile shells of North America (concluded). *The Disseminator of Useful Knowledge, containing hints to the youth of the United States, from the "School of Industry"*, 2(23): 355-356.

rony D'Attilio Student Research Grant;
nd Hinsdale-Walker Scholarships from

TURGEON, D.D., BOGAN, A.E., COAN, E.V., EMERSON, W.K., LYONS, W.G.,
PRATT, W.L., ROPER, C.F.E., SCHELTEMA, A., THOMPSON, F.G. & WILLIAMS,
J.D. 1988. Common and scientific names of aquatic invertebrates from the United
States and Canada. *American Fisheries Society Special Publication*, 16: 1-277.

CITED

s of Thomas Say of the conchology of the
2 pp.
(Mollusca: Pelecypoda) of North America.
in. 204 pp.
ter mollusks of Alabama, Georgia, and
e River. *Bulletin of the Florida State*
relationships among recent Unionacea
17-253.
check list of the North American naiads.
odonta suborbiculata Say (Unionidae:
ralist, 27: 233-234.
imilia Unionacea. Walter de Gruyter &
ts of reproduction in Anodonta (Pele-
e freshwater clams of Florida. *Florida*
Series, 4: 1-83.
ps among eastern North American
view, 23: 63-82.
donta (Mollusca: Unionidae) from the
nionid fauna of the Gulf drainage of
: 34-35.
ography of the Unionidae (Mollusca:
Bulletin of the Museum of Comparative
ca: Bivalvia) of peninsular Florida.
rth American Unionacea (Mollusca:
aciation. *Bulletin of the Museum of*
and land shells. *Proceedings of the*
and land shells. *Transactions of the*
. *Texas Conchologist*, 19: 1-3.
ty and genetic distance from a small
is of Illinois. *Illinois State Museum*
MELVILLE, R.V., (eds.) 1985. *Inter-
n. International Trust for Zoological*
, London. 338 pp.
d fluviatile shells of North America
ge, containing hints to the youth of the
55-356.

Walkerana, P. O. Box 2701, Ann Arbor, Michigan 48106, U.S.A.
©Society for Experimental and Descriptive Malacology, 1995.

