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Contents

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ANNOUNCEMENT

Malacology Data Net (Ecosearch Series) is a new and unique journal devoted to the prompt dissemination of scholarly, innovative, and timely information in malacology. Subscriptions are now being offered and manuscripts are solicited.

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Naiad Distribution in the Mud River Drainage, Southwestern West Virginia

by

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ABSTRACT

A preliminary survey of the freshwater mussels (naiads) of the Mud River was conducted by the West Virginia Department of Natural Resources, Division of Water Resources personnel in June 1984. During

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this preliminary survey, 34 sites in the Mud River watershed were investigated for water quality and benthic macroinvertebrate data in conjunction with the division's basin planning. Twelve of these sites were further surveyed in August 1984 as part of the division's statewide inventory of naiad populations. The survey yielded a total of thirteen naiad species in the Mud River and/or its tributaries. The most common species collected were Lampsilis radiata luteola and Fusconia flava. Species of least occurrence were Toxolasma parvus, Anodonta imbecillis, and Obovaria subrotunda, and Lasmigona costata.

INTRODUCTION

This study was performed as part of the statewide inventory of naiad populations currently being conducted by the West Virginia Department of Natural Resources, Division of Water Resources. In addition to the work of Morris and Taylor (1978), Taylor (1980), and Taylor and Hughart (1981), the statewide inventory (approximately sixty percent complete) as served to fill an informational void regarding West Virginia's naiad population (Schmidt et. al. 1983, Schmidt and Zeto 1984, Zeto 1982, and Zeto and Schmidt 1984). Ortmann (1919) lists 3 naiad species from the Mud River at Milton in Cabell County. Bates (1971) did not investigate the Mud River during his statewide survey, however he reported finding no naiads in the Guyandotte River, the receiving stream of the Mud River. This study was conducted to update the naiad fauna of the Mud River drainage.

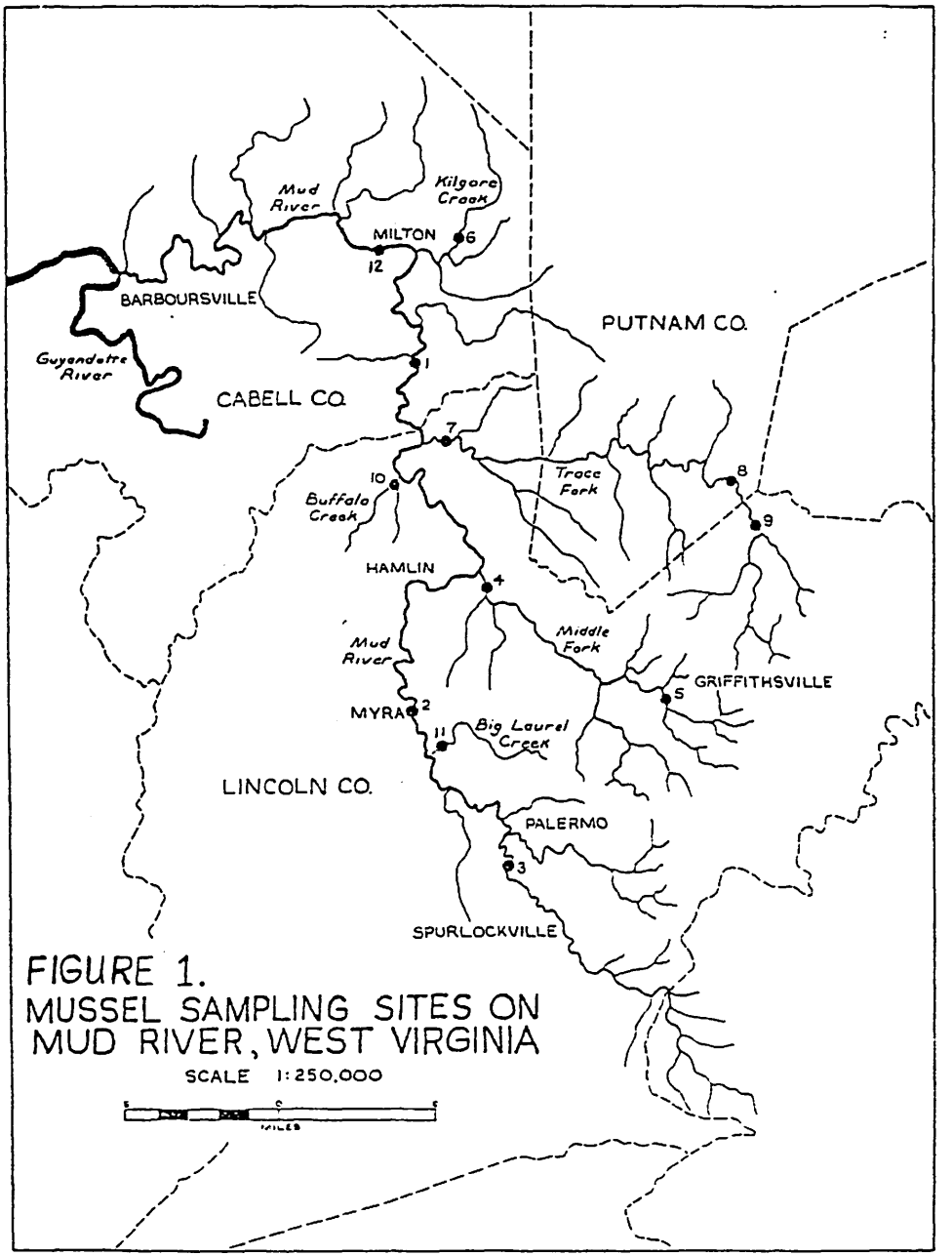

FIGURE 1.
MUSSEL SAMPLING SITES ON MUD RIVER, WEST VIRGINIA

STUDY AREA

The Mud River, which is a major tributary of the Guyandotte River, is located in southwestern West Virginia. The Mud River and its tributaries drain 358 square miles in Cabell, Putnam, Kanawha, Lincoln, and Boone Counties (WVDNR-DWR 1980). Table 1 lists the stream, location description, latitude and longitude for each station where naiads where collected. Figure 1 illustrates the location of each sampling station.

METHODS

A preliminary survey of 34 sites was conducted in June 1984 in conjunction with water quality and benthic macroinvertebrate assessments as part of planning efforts for the Mud River subbasin. Twelve sites were further studied in August 1984 as part of the statewide naiad population inventory.

Fieldwork was conducted during normal flow conditions. Each site was approximately 100 meters long and consisted of at least one riffle and one pool. Initially, sites were sampled by walking the banks and shoals searching for shell material. Waterscopes were utilized to locate live naiads in shallow water.

As shell material and live naiads were collected in the field, a preliminary species list was compiled on site and was later confirmed in the laboratory. Representatives of each species were kept, bagged,

Table 1. Selected collection sites for naiads in the Mud River basin

Site	Stream	Location Description	Latitude	Longitude
1	Mud River	at mouth of Big Two-Mile Creek, 3.6 miles S of Milton	38 23'00" N	82 07'19" W
2	Mud River	at Myra, 3.8 miles S of Hamlin	38 13'22" N	82 06'48" W
3	Mud River	at Route 46 bridge at Palermo	38 08'57" N	82 03'38" W
4	Middle Fork of Mud River	at bridge, 1.8 miles E of Hamlin	38 16'31" N	82 04'17" W
5	Middle Fork of Mud River	at bridge, 0.1 mile above mouth of Billy Creek,	38 14'29" N	82 00'51" W
6	Kilgore Creek	2.3 miles NW of Culloden	38 26'20" N	82 05'48" W
7	Trace Fork of Mud River	5.0 miles N of Hamlin	38 20'39" N	82 05'49" W
8	Trace Fork of Mud River	at mouth of Raccoon Hollow, 1.8 miles NNW of Garretts Bend	38 19'49" N	81 55'57" W
9	Trace Fork of Mud River	at Garretts Bend	38 18'21" N	81 54'40" W
10	Buffalo Creek	1.0 mile S of Portersville	38 19'26" N	82 07'37" W
11	Big Laurel Creek	at Jenks, 5.3 miles S of Hamlin	38 12'00" N	82 06'09" W
12	Mud River	1.0 mile W of Ona	38 24'55" N	82 14'10" W

and labeled for each site. Live naiads were sacrificed only if suitable dead material was not collected.

Dr. David H. Stansbery, the Ohio State University, aided in the identification of difficult specimens and confirmed all others. Voucher specimens have been deposited at the Museum of Zoology, the Ohio State University.

RESULTS AND DISCUSSION

A total of 13 naiad species and the asiatic clam Corbicula sp. were collected from the Mud River drainage (Table 2). The asiatic clam, Corbicula sp. was present at all sites. Station 1, on the lower Mud River, supported the most diverse naiad population (9 naiad species). Trace Fork near Garretts Bend (Site 8), Trace Fork near Portersville (Site 7), and Middle Fork near Griffithville (Site 5) followed in diversity with 6, 5 and 5 naiad species, respectively. Typically, downstream stations support more diverse naiad populations due to their higher stream order (Harman 1974, Schmidt 1982). Many tributary sites had only 1 or 2 species. However, this is significant since these streams were second and third order streams which typically do not support naiad populations.

The most abundant species collected was Lampsilis radiata luteola. It occurred at 9 of 12 sites surveyed. Following in abundance were Fusconaia flava, Strophitus u. undulatus, Anodonta g. grandis, Anodontoides ferussacianus and Lampsilis ventricosa which were collected at 6, 3, 3, 3, and 3 locations, respectively. Of note, Anodonta

Table 2. Naiad species collected from selected sites in the Mud River drainage basin, southwestern West Virginia

Species	1	2	3	4	5	6	7	8	9	10	11	12
Anodonta imbecillis								X				
Anodonta g. grandis	X						X	X				
Anodontoides ferussacianus					X	X					X	
Strophitus u. undulatus	X						X	X		X		
Lasmigona costata	X											
Tritogonia verrucosa	X											X
Amblema p. plicata	X											X
Fusconaia flava	X	X	X				X	X				X
Obovaria subrotunda	X											
Toxolasma parvus					X							
Villosa lienosa					X			X				
Lampsilis radiata luteola	X	X	X	X	X	X	X	X	X			X
Lampsilis ventricosa	X				X		X					
TOTALS	9	2	2	1	5	2	5	6	1	1	1	4

imbecillis, Villosa lienosa, Toxolasma parvus, and Anodontoides ferussacianus were collected. These species are rarely collected in West Virginia.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to Dr. David Stansbery, Ohio State University Museum of Zoology for his assistance in identifying difficult specimens and verifying all others.

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Elliptio judithae, New Species (Bivalvia, Unionidae), From the Neuse River, North Carolina

by Arthur H. Clarke

ABSTRACT

Elliptio judithae, n.sp., may be distinguished from other southern Atlantic Drainage unionids by its delicate, centrally plicate shell, coronate incurrent papillae, and irregularly developed branchial septa. It is believed to be a primitive species of Elliptio not closely related to any other species which is anatomically known. It is rare and its survival is believed to be in jeopardy, partly because of competition from recently introduced and now dominant Corbicula fluminea (Muller).

INTRODUCTION

Several recent anatomical and allozyme studies of Unionidae in our southern Atlantic Coastal Drainage have demonstrated that an unknown number of cryptic species and previously misunderstood species complexes occur there. In North Carolina alone 3 new cryptic species have recently been defined, viz. Elliptio marsupiobesa Fuller (1972), Lampsilis fullerkati Johnson (1984), and Elliptio judithae, here described. Each of these have distinct, anatomical characteristics but their shells exhibit broad morphological overlap with those of other well-known species of Elliptio. Previously unresolved species complexes in the region have also been elaborated by use of molecular genetic analyses, studies of glochidial morphologies and adult anatomies, and other methods by Clarke (1981), Coney et al (1983), Davis (1984), and Kool et al (1981).

Elliptio judithae is noteworthy not only because it represents another (partially) cryptic species, but also because it is an apparently primitive taxon. E. judithae appears to be rare and it may now be endangered. Several careful surveys were made in the Neuse River from bridge access points by my wife Judith and me in 1983, and by Mr. Andrew Gerberich in 1982, but only 3 living specimens were found. Further, Corbicula fluminea, although absent from the Neuse River in 1977 (Shelley in Fuller, 1977), was abundant (about 1000/M) in broad areas of the lower Neuse at the type locality of E. judithae in 1983. It also occurred in lesser numbers, except where pollution excluded it, all the way to the vicinity of

Raleigh[1]. Fuller (1977) has provided general evidence, and has also cited the opinions of other workers, that Corbicula is a menace to some freshwater mussel populations. Clarke (1986) provided specific data that indicated a cause and effect relationship between proliferation of Corbicula and both the extirpation of Canthyria collina[2] and the rarification of all

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[1] Specifically, 4 mi SW of Knightdale, Wake Co., N.C. Corbicula density there was 5-10 /m . No sites farther upstream were visited.

[2] The taxonomy of this species and of Canthyria steinstansana (Johnson & Clarke, 1983) was altered by Clarke (1986) without sufficient clarification. Although most character-states in the 3 species originally described as Unio collinus Conrad, Unio spinosus Lea, and Elliptio (Canthyria steinstansana Johnson & Clarke are in concordance with those of Elliptio Rafinesque (1819), some character states shared by those 3 species are not found in Elliptio, (s. str.). These relate to shell sculpturing (the possession of conspicuous spines, a unique feature among Unionidae), soft part pigmentation (pale orange), and distribution (all in southern Atlantic Drainage). These features indicate that the 3 species, which are also similar ecologically, comprise a monophyletic group. Further, their presently disjunct distributions (James River, Tar River, and Altamaha River Systems) indicate a group of significant antiquity. Use of Canthyria Swainson (1840) for these species at the generic level, is therefore considered correct.

other unionid species, except Elliptio complanata, in most of the James River System in Virginia and West Virginia. Since Corbicula is a menace to the survival of most unionids in the region, even though only a few specimens of E. judithae were available it was deemed advisable to describe it without further delay. In view of its probable jeopardy, I also urge that a thorough status survey of E. judithae be carried out soon by the U. S. Fish and Wildlife Service so as to determine precisely its status of endangerment.

ACKNOWLEDGEMENTS: I wish to thank my wife Judith, who with me collected the holotype of E. judithae, for her continuous and valuable assistance in the field. I also thank Mr. Andrew Gerberich of the Smithsonian Institution for the donation of specimens and Dr. Arthur Bogan, Dr. George M. Davis, Mr. Richard I. Johnson and Dr. Richard J. Neves for the loan of material. The dedicated efforts of Mr. Gerberich to locate more specimens of E. judithae are also sincerely appreciated. Gratitude is also expressed to Dr. Davis and Ms. Jane E. Deisler for reviewing the manuscript and to Dr. Joe Lewis and his staff at Spohn Memorial Hospital, Corpus Christi, for preparing histological sections. Dr. Kenneth J. Boss, Mr. Richard I. Johnson, and the late Dr. Joseph Rosewater also kindly facilitated access to collections and Mrs. Frances Trevino of Corpus Christi State University typed the manuscript. The Neuse River mussel survey was funded by the U.S. Fish and Wildlife Service (Contract No. 14-16-0004-82-014). Preparation of this paper was supported by ECOSEARCH, Inc.

Elliptio judithae, New Species

(Plate 3)

DESCRIPTION

Shell elliptical, up to about 85 mm long in available material, height about 48% of length, width with valves appressed about 23% of length and shell wall thin (up to about 1.6 mm anteriorly and 0.8 mm posteriorly) but not fragile, and with low centrally located plications. Anterior margin semicircular, ventral margin flatly curved, posterior margin roundly pointed a little below the center, a dorsal margin almost straight. Shell a little higher posteriorly than anteriorly. Maximum inflation near center of shell above midline. Beaks barely inflated, very low, not projecting above hinge line, corroded, and located about 1/4 the distance from anterior to posterior. Posterior ridge subangular, low, moderately prominent, and extending to the posterior extremity. Posterior slope of medium width and flattened or slightly concave. Nepionic sculpture corroded away in available material. As in most amblemines the mesoconch is not immediately apparent. Annual growth rests marked by a few concentric, incised, narrow grooves which, by transmitted light, appear as dark bands 1 to 2 mm wide. There are 2 such annulae in the holotype and 3 in each paratype. Major sculpturing consists of about 10 to 16 low, rounded ridges, oriented approximately perpendicularly to the ventral margin, each about 1.5 to 3.0 mm wide, located on the disc in front of the posterior ridge and occupying from about 1/4 of the shell area (in the holotype and first paratype) to about 1/16 of the shell area (in the second paratype). Other postjuvenile sculpturing consists of numerous concentric threads, some low radial lines, and occasional growth irregularities. Petiostracum glossy on the disc and concentrically

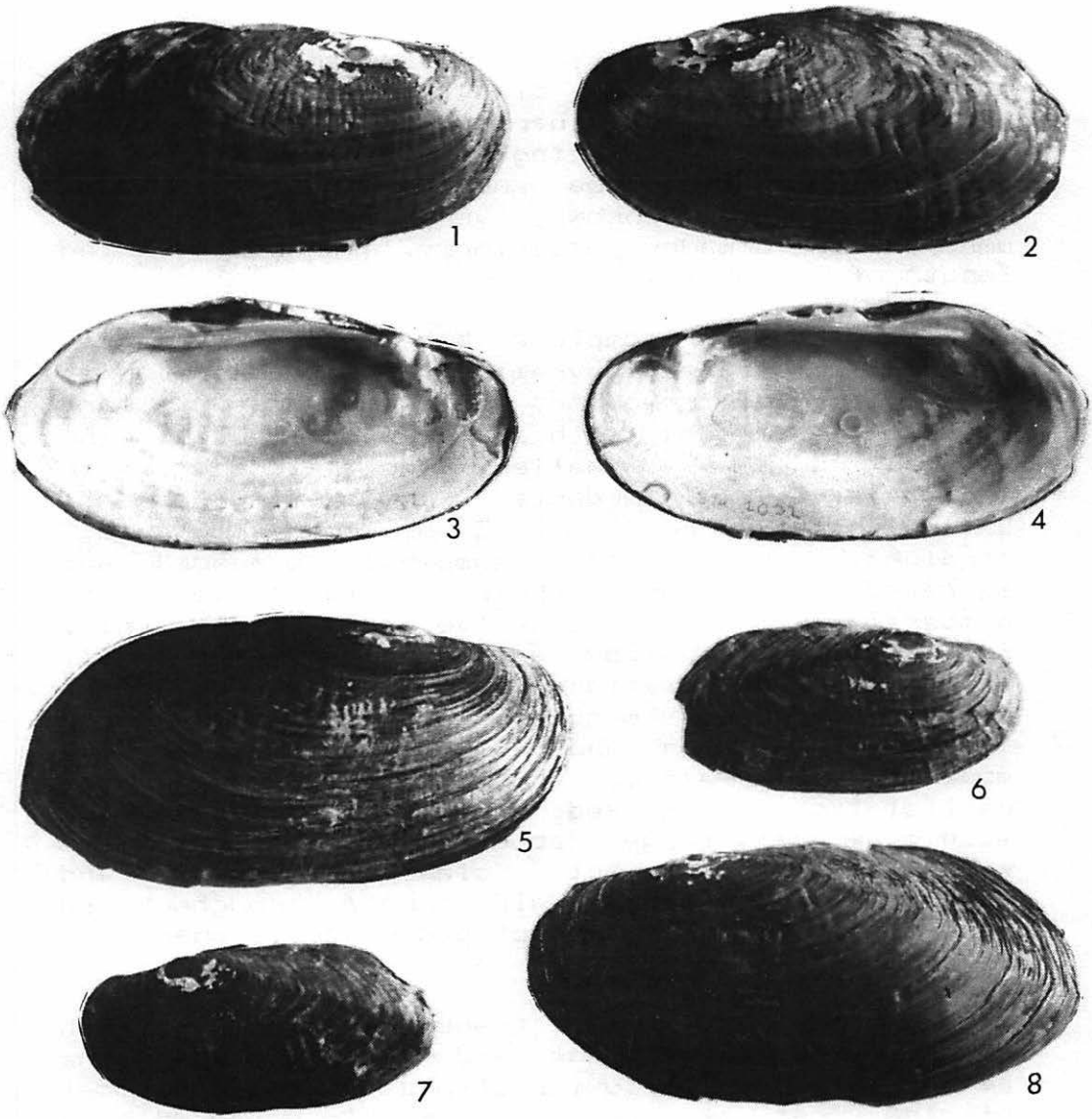

Plate 3. Elliptio judithae, new species. 1 - 4 holotype; 5, 8, paratype #1; 6, 7, paratype #3. All figures about 0.9X.

roughened posteriorly; yellowish centrally, brownish ventrally, and blackish posteriorly; and with narrow to very narrow green rays, some of which are broken, covering the whole shell except for the corrugated area and the posterior ridge. Ligament reddish brown, very narrow near the umbones and broader posteriorly, and about 40% the length of the shell.

Hinge teeth complete but rather delicate. Pseudocardinal teeth pyramidal, erect, serrated at their margins, irregular, and numbering 2 in each valve. The largest teeth are about 4 mm high. The anterior tooth is smaller than the posterior in each valve. Interdental projection absent. Lateral teeth long (about 25 mm in the holotype), straight, narrow, each somewhat expanded and serrated throughout their distal halves, and numbering 1 in the right valve and 2 in the left. Beak cavities shallow and with a few small, irregular, and distinct muscle scars in each. Anterior adductor muscle scars moderately large (about 5 mm high and 10 mm wide in holotype), moderately impressed, and irregularly subovate; pallial line well marked; and posterior muscle scar also moderately large (about 10 mm high and 10 mm wide), shallow but clearly etched, and subtriangular. Nacre pale purple throughout and only slightly glossy except posteriorly, where it is distinctly glossy.

Mantle very thin, transparent and whitish dorsally, semitransparent and filled with a fine network of pale yellowish strands throughout most of the rest of its area. Mantle bordered by a thin, translucent band, in the holotype about 3 mm wide anteriorly and ventrally and 5 mm wide posteriorly this band is generally whitish but with narrower yellowish band on its innner surface

1.0 - 1.5 mm from its distal margin, beginning as a narrow strip anterioventrally, extending and broadening posteriorly, and becoming extensive near the mantle aperatures. Mantle edge closely adherent to margin of shell and when soft parts are removed from shell a strip of shell and periostracum invariably breaks away also. Mantle margins convex at incurrent opening, incurrent opening in holotype with ends 10.0 mm apart, whitish and only faintly pigmented in the holotype (but more strongly pigmented in the paratypes), and bordered on each side by 2 rows of papillae, the outer row marginal and the inner row originating in the inner surface. In the holotype each marginal row has 18-20 narrow, pyramidal papillae of unequal length between 0.1 and 1.0 mm and each submarginal row has 5 large papillae, each about 3 mm long, and 4 of which are coronate (i.e. distally divided into small papillae); on each large coronte papilla the tiny papillae are 4 or 5 in number and 0.2 - 0.3 mm in length. Mantle edges between incurrent and anal openings 3.0 mm long and thickened centrally. Anal opening with slightly curved margins, unpigmented, about 6.5 mm long, and margined on each side by a single row of about 18 tiny, pyramidal papillae, each about 0.2 - 0.3 mm high. Mantle connection between anal and supra-anal opening 3.0 mm long. Supra-anal opening almost straight, unpigmented, slit-like, without papillae or crenulations, and 14.0 mm long.

Demibranch pale brownish in preserved specimens and vertically wrinkled. Outer demibranch in holotype 42.0 mm long, 14.0 mm high at the center, with margin broadly curved and narrowing to a rounded point anteriorly and posteriorly, and apparently with about 1.4 poorly defined and irregularly developed water tubes, 20 dorso-ventral surface filaments, and 12 surficial cross filaments

per mm. Inner demibranch similarly shaped but extending 5.0 mm beyond outer demibranch anteriorily, 2.7 mm beyond it ventrally, and flush with it posteriorly. Water tubes in inner demibranch also not well defined but apparently also numbering about 1.4 per mm; surficial dorso-ventral and cross filaments as in outer demibranch. Distinct septa are not uniformly developed but are missing at about 1/3 to 1/4 of their "expected" positions. The inner laminae of inner demibranchs are attached to each other but not to the visceral mass.

Labial palps thin, fragile, and translucent, with margins roundly curved anterioventrally, slightly concave posterioventrally, irregularly truncated anteriorly, and slightly overlapping the inner demibranch. The outer surfaces are smooth and the inner opposing surfaces of each member are radially furrowed (about 7 furrows per mm at the margin). The outer palpus of each pair is fused to the mantle anteriorly and ventrally and to the inner palpus along its entire dorsal margin.

VARIATION

Data in Table 1 illustrate much of the variation within the type material. The holotype is somewhat more prominently sculptured on the disc than the paratypes. Paratype number 2 has broader rays in the posterior region than other specimens. The most variable topographic anatomical features are mantle pigmentation (weak to moderate), shape of the supra-anal opening (in paratype number 2 it is divided into 2 openings by a short mantle connection (2.5 mm long) located about 40% of the distance from posterior to anterior but in other specimens it is undivided), and in the relative development of the branchial septa, all of which

are rather obscure when viewed by transmitted light. In sectioned material the septae, although short and irregularly developed, are clearly visible. In the presumed sterile female paratype, the outer demibranch septa are somewhat longer (i.e. the lamellae are further apart) than those of the inner but in the presumed male paratype the septal length is similar in each demibranch.

Additional specimens, presumed to be E. judithae but represented by shells only, have also been collected by R.J. Neves in the Tar River, below Rocky Mount, Edgecombe County, North Carolina, along with an unusually diverse assemblage of morphotypes conchologically referable to Elliptio complanata in its broadest sense. Anatomical and allozyme data about these morphs[3] are much to be desired. The presumed E. judithae specimens include both plicate and non-plicate individuals and some of the non-plicate specimens closely approach some of the compressed morphs of E. complanata seen from other localities. Further studies may show that E. judithae is not entirely separable from E. complanata on the basis of shell characters alone. A similar case involving a distinct species from the Savannah River System, conchologically referable to E. complanata, has been described by Davis (1984).

TYPES

The holotype was collected alive from the middle of the Neuse River at Seven Springs, Wayne

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[3] As used here and elsewhere the term "morph", in combination with an appropriate adjective, simply identifies one group of variants within a morphologically variable species without regard for the possible generative causes (genetic and/or ecological) of that variant group.

TABLE 1

Character Measurements and Some Morphological Attributes of *Elliptio judithae*.

	Holotype	Paratype 1	Paratype 2	Paratype 3
Shell features:				
Shell length (mm)(L)	75.0	84.8	84.2	53.5
Relative height:H/L	.468	.468	.470	.488
Relative width:W/L	.228	.232	.240	.204
Relative hinge plate thickness:Hp/L	.060	.061	.057	.050
Mantle pigmentation:				
Extent	AV	A	AV	-
Strength	weak	moderate	moderate	-
Length of mantle features (as% of L):				
Incurrent aperture	13	10	12	-
Anal aperture	9.1	8.3	8.3	-
Anal-supra-anal mantle connection	2.7	3.2	2.4	-
Supra-anal aperture	15	18	18	-
Incurrent papillae:				
No. of ranks	2	2	2	-
Shape	S,AR	S,AR	S,AR	-
Max. height (mm)	3.0	2.8	2.9	-

TABLE 1 (continued)

	Holotype	Paratype 1	Paratype 2	Paratype 3
Labial palps:				
Position	O	?(folded)	T	-
Grooves per mm	7	7	6	-
Water tubes: (N/mm)				
Outer demibranchs	NS	1.2	1.4	-
Inner demibranchs	NS	1.5	1.4	-
Inferred sex	?	F	M	-
Pre-preservation treatment:	Relaxed with nembutal	Frozen in river water		-

Abbreviations: A, anterior; AV, anterioventral; C. coronate; F, female; H, height; Hp, maximum hinge plate thickness measured at largest pseudocardinal tooth, right valve; M, male; NS, not sectioned; O, overlapping inner demibranch; T, touching inner demibranch; W, width with both valves appressed.

Co., N.C. (35 12' 44"N, 77 50'48"W) on July 14, 1983 by me and Judith J. Clarke, in honor of whom the species is named. It is now in the Division of Malacology Department, Academy of Natural Sciences of Philadelphia, (ANSP) and bears catalogue numbers 36332 (shell) and A11756 (alcohol-preserved soft parts). The first two paratypes were collected alive in the Neuse River about 100 M upstream from the U.S. Route 301 bridge, 2 mi S of Smithfield, Johnston Co., N.C. (35 27' 16"N, 78 36' 49" W) on September 20, 1982 by Andrew Gerberich, Warren Steiner, and W. Rowe. They are also in the ANSP Collection (Nos: 2363334 and 363333, respectively for the shells). The third paratype was collected in the Neuse River at Milburnie, 7 mi E of Raleigh, in Wake Co., N.C. by Richard I. Johnson in July, 1964. It is subadult and lacks soft parts but it appears to have been collected alive. It is in the Museum of Comparative Zoology and bears catalog number 250582. Measurements of these specimens are given in Table 1.

ECOLOGY

The holotype was collected in about 6 inches (0.15M) depth on a sand bottom near the middle of the Neuse River, which was about 100 M wide at that point. That specimen, and 2 large, compressed, moderately heavy, typical specimens of Elliptio complanata which were nearby, were the only mussels found in mid-river but other smaller and more inflated specimens of Elliptio were seen to be common near the river bank where the water was deeper (ca 1.0M) and the bottom was of mud and fine sand. Corbicula fluminea was also abundant near the banks with densities of up to about 1000/M^2. Water was low when the area was visited and we searched there for about 1 hour.

The first 2 paratypes were found together with a small (39 mm) typical specimen of Elliptio complanata but no habitat data are available for them or for paratype no. 3.

DISTRIBUTION

Elliptio judithae is known with certainly only from the Neuse River of North Carolina. Concholo-gically similar specimens without soft parts have also been collected in the lower Tar River of North Carolina but their identity should be evaluated by examination of the anatomies of other specimens from the same population.

COMPARISONS

Elliptio judithae differs from *E. complanata* (Lightfoot) by having low but conspicuous plications on their discs, by the possession of coronate branchial papillae (i.e. papillae which are subdivided distally into micropapillae), and by having inconsistently developed branchial septa. The 2 latter character-states also distinguish *E. judithae* from all other species of *Elliptio* in which anatomies are known. *E. judithae* also differs from Neuse River specimens of *E. complanata* by having much more compressed shells which are of much thinner substance (i.e. are more fragile), but at some localities elsewhere within its broad range *E. complanata* also exhibits compressed and fragile (but not plicate) shells. *E. judithae* may also be differentiated from *Elliptoideus sloatianus* (Lea), to which it bears some resemblance, by the fact that *E. sloatianus* has a much heavier shell, is conspicuously sculptured on the posterior slope as well as on the disc, and has truly arborescent incurrent papillae (i.e. with tertiary branching papillae) and other distinct attributes.

SYSTEMATIC RELATIONSHIPS

It is helpful to compare the character states of *E. judithae* with those given by Davis & Fuller

(1981:240) for 12 genera of the tribes Amblemini and Pleurobemini. Character-states for E. judithae are as follows: 1, incurrent papillae coronate (score 2 is the most applicable); 2, excurrent papillae well developed (score 1); 3, digenous (0); 4, supra-anal opening present (1); 5, septa weak (1); 6, tissue not brightly colored (0); 7, sculpture plicate (1); 8, shell not pustulate (0). Among the genera tabulated by Davis & Fuller, the greatest number of character states which are shared with E. judithae are found in the genera Amblema, Megalonaias, Plectomerus, Elliptio, Pleurobema, and Uniomerus, each with 5, followed by all the rest with 3 or 2.

Of course other considerations also apply. All species assigned to Megalonaias and Amblema have large, massive, subquadrate shells and they bear no resemblance to the comparative delicate and elongate shells of E. judithae. The same incongruities also apply, in reduced degree, to Plectomerus and Pleurobema. Further, in E. judithae there is no trace of the conspicuous, concentric nepionic sculpturing ("beak sculpturing"), the sine qua non for Uniomerus. On the other hand 2 unusual species traditionally assigned to Elliptio, E. macmichaeli[4] Clench & Turner (1956) and E. fraterna (Lea, 1852), have well-developed plicae on their posterior slopes. Even Elliptio crassidens (Lamarck, 1818), the type species of Elliptio, has posterior slope plications in some specimens.

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[4] ICZN Rules require that Elliptio mcmichaeli, as originally proposed, should be emended to Elliptio macmichaeli.

Further, Fuller & Bereza (1973) have stated that E. macmichaeli has arborescent incurrent papillae. The character states tabulated by Davis & Fuller for Elliptio, as presently constituted, should therefore be revised to include plicate sculpturing and arborescent incurrent papillae. See also Davis, 1984. The number of character states shared by E. judithae and Elliptio then rises to 7.

The Neuse River, located in the southern Atlantic Coastal Drainage, is in a region containing a species flock of Elliptio but containing no representatives of Amblema, Megalonaias, Plectomerus or Pleurobema. On zoogeographic grounds, therefore, it is more likely that E. judithae is an Elliptio or an Uniomerus than a member of any of the other genera and Uniomerus has been ruled out on essential morphological grounds. Elliptio judithae exhibits distinctive character-states unknown in other species of Elliptio, however. These are coronate incurrent papillae, irregularly-developed branchial septa, and centrally plicate shells. The latter 2 states also occur in the primitive subfamily Margaritiferinae and are presumed to be plesiomorphic. E. judithae is therefore believed to be a primitive Elliptio not closely related to any other species in which the anatomy has been described.

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