Walters 1995

Errata for Unionoidea Bibliography

p.12 Simpson's Catalogue was published in 1914, not 1900. Simpson (1900) was his Synopsis, included below.
p. 77 1988 Bruno et al. Journal should read *Fish Pathologists*, not *Fish Pathology.*
p. 87 top. Number should be 38,100,000,000,000, not 38,100,000,000.
p. 111 Under *Potamilus capax.* Author should be Cummings, not Cumming.

Dr. G. Bauer, Universität Bayreuth, (in litt., 10 October 1994) comments that margaritiferids only use salmonids as hosts, and that reports of other hosts are in error. He also notes that the species used in the studies by Meyers, Fustish, and Karna are *Margaritifera falcata*, not *Margaritifera margaritifera* as stated by the authors.

Dr. Bogan has pointed out that Coker et al, 1921, also gives tadpole madtom and American eel as hosts for *Actinonaias ligamentina.*

Addenda for Unionoidea Bibliography

The following entries are mostly papers that have appeared since the publication of the Bibliography, or were not available at that time.

1900 Simpson, Charles T. Synopsis of the naiades, or pearly fresh-water mussels. *Proceedings of the U. S. National Museum* **22**: 501-1075.

This work, greatly expanded in Simpson (1914), was one of the most important and influential works on the unionaceans ever written. Although the marsupia and other parts of the anatomy were described for many groups, this is mainly a systematic work.

1925 Walker, Bryant. A new species of *Micromya. Occasional papers of the Museum of Zoology, University of Michigan* (163): 1-6, pl. 1.

The newly described *Villosa ortmanni* was reported to have a marsupium "of the usual shape, with 8-20 ovisacs, the edge is pigmented grayish-black... glochidia subspatulate, of the general shape of those of" *Villosa lienosa* and *V. vanuxemi.*

1952 Jaeckel, Sigfried H. *Unsere Süsswassermuscheln.* Akademische Verlagsgesellschaft Geest & Portig K.-G., Leipzig. 40 pp.

A highly stylized illustration of a *Unio* species glochidium was given on p. 34.

1962 Bonetto, Argentino A. & Inés D. Ezcurra. El desarrollo del lasidium de *Anodontites trapesialis forbesianus* (Lea) (Moll. Lamell.). *Physis* **23**: 195-203.

The lasidium of *Anodontites trapezeus* was described and illustrated in detail. Larvae occurred in the inner demibranchs, and numbered 3,500,000 in one individual. Seven hosts were identified: *Corydoras paleatus, Geophagus brasiliensis, Astyanax fasciatus, Pimelodella gracilis, Pimelodus*

clarias, Prochilodus platensis, and *Hoplias malabaricus.* Parasitic durations ranged from 4 to 20 days.

1962 Bykhovskaya-Pavlovskaya, I. E., Gusev, A. V., Dubinina, M. N., Izyumova, N. A., Smirnova, T. S., Sokolovskaya, I. L., Shtein, G. A., Shul'man, S. S. & V. M. Epshtein. Opredelitel' parazitov presnovodnykh ryb SSSR. [Key to parasites of freshwater fish of the U.S.S.R. *Keys to Fauna of the U.S.S.R.* (80). Reprinted in English, 1964, Israel Program for Scientific Translations. 919 pp.]

Keys and illustrations were given for glochidia of *Cristaria plicata, Anodonta cygnea, A. woodiana, A. arcaeformis, Pseudanodonta complanata, Unio pictorum, U. tumidus, U. crassus, U. douglasiae, U. sieversi,* and *Margaritifera margaritifera.* The glochidial filament, termed here the provisional filament, was absent in *A. arcaeformis* and *Pseudanodonta complanata,* but present in other species. *Unio pictorum* was said to parasitize *Perca fluviatilis,* silver bream, and roach.

1963 Bonetto, Argentino A. Contribución al conocimiento de *Leila blanvilleana* (Lea) (Mollusca: Pelecypoda). *Physis* **24**: 11-16.

The lasidium of *Leila blainvilleana* was illustrated and described. It was shown to have greater affinities with the mutelid haustorial larvae than with the mycetopodid lasidium. The 280μ larva lacks the large wing-like projections of the lasidium, but has a long larval thread. These differences, plus the presence of true siphons and other morphological characteristics, set this genus apart from other unionaceans. The author advocated placing *Leila* in its own subfamily, Leilinae in the Mycetopodidae.

1963 Bonetto, Argentino A. & Inés D. Ezcurra. Notas malacologicas. I. *Physis* **24**: 17-22.

Diplodon delodontus delodontus successfully metamorphosed on all seven fishes that were tested, suggesting that this species may lack host specificity. Hosts were identified as: *Prochilodus platensis, Serrasalmus sp., Astyanax fasciatus, Geophagus sp., Aequidens sp., Schizodon fasciatum,* and *Asiphonichthys stenopterus.* Females spawned in June. Attached glochidia began forming cysts on the 3rd day, and cysts were complete on day 6. Metamorphosis commenced after 25 days infestation. The glochidial valve of *Prisodon corrugatus* had a hook that ended in two or three strong spikes. The hooks were basally expanded and merged with the valve edge. The lasidium of *Monocondylaea paraguayana* was described and illustrated. The larval shell was non-calcareous. The adhesive organ was a long ribbon-like structure. For a 115μ larva, the ribbon was 1 mm. The larvae attached to the gills of an unspecified host from October through January.

1965 Bonetto, Argentino A. Las almejas sudamericanas de la tribu Castaliini. *Physis* **25**: 187-196.

The glochidial valve of this hyriid group was described as subtriangular, with a strong, curved, medial tooth.

1965 Bonetto, Argentino A. & Inés D. Ezcurra. Notas malacologicas. III. *Physis* **25**: 197-204 .

The lasidia of *Anodontites trapezeus* and *Mycetopoda siliquosa* were illustrated and described. These larvae were found to be very similar, suggesting a close phylogenetic relationship between the two species.

1972 Fuller, Samuel L. H. An undescribed structural feature in the marsupium of *Elliptio lanceolata* (Lea 1828) (Unionidae). *Nautilus* **86**: 85-86.

Some populations of this species have a septal rib on the intralamellar septa that may help support the marsupium.

1973 Fuller, Samuel L. H. & Daniel J. Bereza. Recent additions to the naiad fauna of the eastern Gulf drainage (Bivalvia: Unionoida: Unionidae). *Association of Southeastern Biologists Bulletin* **20**: 53 [abstract].

Elliptoideus sloatianus had poorly differentiated marsupial features and was considered a very primitive amblemine. *"Lampsilis" jonesi* was transferred to *Ptychobranchus* based on the folded, distal marsupia in the outer gills. *"Lampsilis" australis* otherwise resembled *jonesi* but lacked the folded marsupia

1975 Fuller, Samuel L. H. The systematic position of *Crytonaias* (Bivalvia: Unionidae). *Malacological Review* **8**: 81-89.

This problematic monotypic genus was shown to be lampsiline. The marsupia occupied the entire outer gill.

1975 Habe, Tadashige. *Shells of the Pacific.* 3rd ed. Hoikusha Publishing Co., Osaka.

The cyprinid *Acheilganthus moriokae* was listed as a host for *Anodonta woodiana.* In turn, the fish lays its eggs in the mantle of the mussel.

1978 Veitenheimer, Inga L. & Maria C. D. Mansur. Morfologia, histologia e ecologia de *Mycetopoda legumen* (MARTENS, 1888) - (Bivalvia, Mycetopodidae). *Iheringia* (52): 33-71.

The marsupium of this South American mycetopodid occurred in the anterior portion of the interior demibranch. Lasidial larvae were found, but not described in detail or illustrated. The body of the larva was 160µ in length.

1980 Kenmuir, D. H. S. Seasonal breeding activity in freshwater mussels (Lamellibranchiata: Unionacea) in Lake Kariba and Lake McIlwaine, Zimbabwe. *Transactions of the Zimbabwe Scientific Association* **60**: 18-23.

The gravid periods of three mutelids were reported. *Caelatura mossambicensis* and *Mutela dubia* were gravid year round in Lake Kariba, but the latter species was not gravid in May in Lake McIlwaine. *Aspatharia wahlbergi* was gravid from September to March (summer).

1982 Djajasasmita, Machfudz. The occurrence of *Anodonta woodiana* Lea, 1837 in Indonesia (Pelecypoda: Unionidae). *Veliger* **25**: 175.

The southeast Asian *Anodonta woodiana* was reported as an exotic in Java and other islands. It was introduced as the result of stocking the silver carp and Nile tilapia as food fishes. The mussel has since spread from the original hatcheries and was using unspecified native fishes as hosts.

1983 Martínez E., Rafael. Contribucion al conocimiento de la gloquidia de *Castalia ambigua multisulcata* Hupé, 1857, "Guacuco de Rio" (Mollusca: Lamellibranchia: Hyriidae). *Acta Biologica Venezuelica* **11**: 197-213.

The glochidium of this South American hyriid was described and illustrated with SEM photography. The surface of the glochidial valves were pitted and corrugated. Each valve had a single, short, curved spine. No other microspines or points were present, in contrast to that of most glochidia examined. Glochidia were up to 240μ in width.

1984 Petró, Ede. Az *Anodonta woodiana woodiana* (Lea, 1834) kagyló megjelenése Magyarországon. *Allattani Közlemények* **71**: 189-191.

This Asian species was introduced into Hungary on foraging fishes from 1963 - 1965. Suspected hosts were grass, silver, bighead, and black carp, and *Pseudorasbora parva.*

1984 Baer, Otto. Das östlichste Vorkommen der Flußperlmuschel im Stromsystem der Oder und seine Beziehungen zu den sich westlich anschließenden Verbreitungsgebiten (Eulamellibranchiata, Margaritiferidae). *Malakologische Abhandlungen* **10**: 53-68.

The eastern-most population of *Margaritifera margaritifera* in the Oder River was found in what is now the Czech Republic near Vidnava. Sewage may be having a negative effect on the mussels by changing the local fish fauna.

1985 Villalobos, Carlos R., Cruz, Rafael A. & Roberto Ruiz. *Anodontites trapezialis glaucus* Lamarck, 1819 y *Anodontites patagonicus* Lamarck, 1819 en Costa Rica (Mycetopodidae: Bivalvia). *Brenesia* **23**: 301-308.

Anodontites trapezialis glaucus was found gravid in September.

1986 Sárkány-Kiss, Andrei. *Anodonta woodiana* (Lea, 1834) a new species in Romania (Bivalvia, Unionacea). *Travaux du Muséum d'Histoire Naturelle "Grigore Antipa"* **28**: 15-17.

This Asian species was introduced into Cefa, Romania, on one or more species of foraging fishes imported from Moscow and the Yangtze River basin. These fishes were silver carp, grass, and bighead carp.

1989 Girardi, Henri & Jean-Claude Ledoux. Présence d'*Anodonta woodiana* (Lea) en France (Mollusques, Lamellibranches, Unionidae). *Bulletin Mensuel de la Société Linnéenne de Lyon* **58**: 286-290.

The southeast Asian *Anodonta woodiana* was reported as an exotic in a hatchery in Bouches-du-Rhône, France. It was believed to have been introduced on either or both of two fishes stocked from hatcheries in Hungary: common carp, and grass carp. One of the Hungarian

hatcheries, at Szarvas, had been colonized by *Anodonta woodiana* imported on unspecified fishes from China and/or Russia. The French population was described as being abundant and of all sizes.

1990 Mansur, Maria C. D. & Nádia M. R. de Campos-Velho. Técnicas para o estudo dos gloquídos de Hyriidae (Mollusca, Bivalvia, Unionoida). *Acta Biologica Leopoldensia* **12**: 5-18.

Alas, I am still having this one translated.

1990 Schmidt, Hans. Entwicklung eines Artenhilfsprogramms für die beiden Großmuschelarten Flußperlmuschel (*Margaritifera margaritifera* L. 1758) und Bachmuschel (*Unio crassus* PHIL. 1788). *Schriftenreihe Bayer, Landesamt für Umweltschutz* **97**: 5-13.

This was a description of a conservation effort to save seven Bavarian mussels. A concise review of their biology was given, including reproductive seasons and hosts, summarized here. *Margaritifera margaritifera* - can live over 100 years, expels glochidia in July and August, glochidia overwinter on host, metamorphosis occurs from April through June, juveniles remain in sediment for five years, become reproductive after 15 years, and are tachytictic. *Unio crassus* - lives to 25 years, expels glochidia from March through July, metamorphosis occurs after 45 weeks [error for days?], becomes reproductive after 3-4 years, and is tachytictic. *Unio tumidus* - lives to 15 years, expels glochidia from May through July, metamorphosis occurs after 21 days, and is tachytictic. *Unio pictorum* - lives to 15 years, expels glochidia in June and July, metamorphosis occurs after 21 days, and is tachytictic. *Anodonta cygnea* - lives to 15 years, expels glochidia from February through March, metamorphosis occurs after 10 days, and is bradytictic. *Anodonta anatina* - lives to 15 years, expels glochidia from January through April, and is bradytictic. *Pseudanodonta complanata* - lives to 15 years, expels glochidia from January through April, metamorphosis occurs after 10 days, and is bradytictic. Hosts were identified for six of the species: *Margaritifera margaritifera* - brook trout; *Unio crassus* - rudd, ruffe, dobel, *Phoxinus phoxinus*, muhlkoppe, stickleback; *Unio tumidus* - river ruffe, *Rutilus rubilio*, rudd; *Unio pictorum* - river ruffe, *Rutilus rubilio*, rudd; *Anodonta cygnea* - river ruffe, brook trout, *Stizostedion lucioperca*, nine-spine stickleback; *Pseudanodonta complanata* - river ruffe, brook trout, *Stizostedion lucioperca*, nine-spine stickleback.

1991 Silkenat, Wolfgang, Silkenat, Michaela, Klupp, Robert, Schmidt, Stephan, Wenz, Gabriele, Eicke, Lebrecht & Gerhard Bauer. Errichtung und Sicherung schutzwürdiger Teile von Natur und Landschaft mit gesamtstaatlich repräsentativer Bedeutung. Erfahrungen mit einem Projekt zur Rettung der Flußperlmuschel. *Natur und Landschaft* **66**: 63-67.

This contained a summary of the reproduction of *Margaritifera margaritifera* in central Europe. Females produced about ten million larvae, each 0.07 mm in width. These were shed in August or September. They parasitized the brook trout and remained encysted until the following June. Metamorphosed juveniles were 0.4 mm when they dropped off the host. They lived in the substrate for 3-5 years.

1991 Amyot, Jean-Pierre & John A. Downing. Endo- and epibenthic distribution of the unionid mollusc *Elliptio complanata*. *Journal of the North American Benthological Society* **10**: 280-285.

Individuals buried into the substrate with approaching winter. In mid-summer, 18% were epibenthic, and in late autumn over 60% were epibenthic. Most of the epibenthic individuals found in mid-summer were juveniles.

1991 Nagel, Karl-Otto & L. Castagnolo. Fish hosts for the glochidium of *Unio mancus*. *Rivista di Idrobiologia* **30**: 339-346.

Hosts were identified by field and laboratory investigations for this Italian species. Glochidia attached to the gills of eight species: *Rutilus erythrophthalmus, Leuciscus cephalus, L. souffia, Barbus barbus plebejus, Padogobius martensis,* pumpkinseed, rudd, and tench. Infestations were unsuccessful on salmonids, cobitids, and *Carassius carassius.*

1992 Altaba, Cristian R. Les nàiades (Mollusca: Bivalvia: Unionoida) dels Països Catalans. *Butlletí de la Institució Catalana d'Història Natural, Secció de Zoologia* **60**: 23-44.

The Catalan Countries were shown to have four unionoidean species: *Anodonta cygnea, Psilunio littoralis, Unio elongatulus,* and *Margaritifera auricularia.* The last species now occurs only in this region. Glochidia were described and illustrated for each of the four species.

1992 Dharma, Bunjamin. *Siput dan Kerang Indonesia* **2** [*Indonesian Shells* **2**]. Verlag Christa Hemmen, Wiesbaden. 135 pp.

Based on the report of Djajasasmita (1982), the southeast Asian *Anodonta woodiana* was reported as an exotic in Indonesia. It originally was introduced from Taiwan in 1969.

1992 Kiss, Árpád & Ede Petro. Distribution and biomass of some Chinese mussel (*Anodonta woodiana woodiana* Lea, 1834) (Bivalvia: Unionacea) population in Hungary. *Abstracts of the 11th International Malacological Congress, Sienna 1992*: 31-33.

In 1984 the Asian *Anodonta woodiana* was reported from Hungary at Szarvas, from where it had spread into the Tisza, Danube, and other areas. It presumably was introduced on unspecified fishes imported from China in 1962. Individuals reached a density of 70/m^2, and accounted for 75% of the biomass in Szarvas. Sexes ratios were 45.6% male and 54.4% female, with no hermaphrodites.

1992 Ross, Helena C. G. The reproductive biology of the freshwater pearl mussel *Margaritifera margaritifera* (L.) in Co Donegal. *Irish Naturalist's Journal* **24**: 43-50.

Spawning took place over a two week period at the end of July. Fertilized eggs filled the marsupia two weeks later, and glochidia were expelled by the second week of October. Water temperature controlled the timing and duration of the reproductive cycle. Of 168 individuals, 72 were males, 95 were females, with a single hermaphrodite. Despite up to 58% of the population bearing glochidia, no juvenile mussels were found.

1993 Park, G. M. & O. K. Kwon. A comparative study of morphology of the freshwater Unionidae glochidia (Bivalvia: Palaeoheterodonta) in Korea. *Korean Journal of Malacology* **9**: 46-62 [in Korean with English abstract].

The glochidia and marsupia were examined in *Anodonta arcaeformis flavotincta, A. woodiana, Unio douglasiae, U. douglasiae sinuolatus, Lamprotula gottschei,* and *Lanceolaria acrorhyncha.* SEM photomicrographs were presented for the glochidia, and glochidial taxonomic characteristics were suggested. *Unio douglasiae, U. douglasiae sinuolatus,* and *Lanceolaria acrorhyncha* formed conglutinates, the other species released glochidia individually. All four demibranchs formed the marsupia in *Lamprotula gottschei,* while only the outer ones were used in the other five species.

1993 Jungbluth, Jürgen H. Beiträge zur Najadenfauna in Mitteleuropa. *Archiv für Molluskenkunde* **122**: 155-170.

Although primarily a review of European mussels, the chronology of development in *Margaritifera margaritifera* was given. June - July: eggs arrive in marsupia and are fertilized; July - August: glochidia expelled over 4-6 days; encystment lasts 4-6 hours; September - March: parasitic on brook trout; April - May: metamorphose; June: metamorphosed glochidia released over perhaps four weeks; juveniles live buried in substrate for 3-4 years; reach sexual maturity at approximately 20 years.

1993 Anders, K. & V. Wiese. Glochidia of the freshwater mussel, *Anodonta anatina,* affecting the anadromous European smelt (*Osmerus eperlanus*) from the Eider estuary, Germany. *Journal of Fish Biology* **42**: 411-419.

Glochidia of *Anodonta anatina* were found on 0.2% of 40,011 smelt examined over two years. However, during that time glochidia were only found during March and April of a single year, when up to 37% of the smelt were infested. Glochidia were most numerous on temporarily resident spawning fish rather than on resident juveniles. It was suggested that the behavior of spawning smelt brought them into contact with glochidia, accounting for the lessened infestation seen in juvenile smelt. The glochidia would be killed when the smelt returned to the sea. Glochidia attached to both fins and gill filaments. Prevalence of infestation decreased with increasing salinity in the estuary.

1994 Nezlin, L. P., Cunjak, R. A., Zotin, A. A. & V. V. Ziuganov. Glochidium morphology of the freshwater pearl mussel (*Margaritifera margaritifera*) and glochidiosis of Atlantic salmon (*Salmo salar*): a study by scanning electron microscopy. *Canadian Journal of Zoology* **72**: 15-21.

Glochidia encysted on Atlantic salmon gills were studied with SEM. Cyst formation was the result of the movement and morphological change in gill epithelial cells. Cysts formed in 9 to 12 hours, and metamorphosed after 40 days at 14°C. Glochidia increased in size within the cyst after 20 days. The inner epitheliium was covered with dense microvilli, and five ciliary tufts were present. A marginal band of cilia may direct water currents for respiration and feeding. No larval threads or shell pores were found.

1994 Sogamoso, Edgar. A. El lasidium de *Acostaea rivoli* Deshayes, 1827 (Mollusca: Bivalvia: Etheriidae) y su importancia para la ubicacion taxonomica de este especie. *Boletin Ecotropica: Ecosistemas Tropicales* **27**: 1-9.

This aberrant, attached freshwater "oyster" was shown to possess a lasidium larva, allying this species with the Mycetopodidae. The larva had three body regions: an anterior region of two cilated lobes and an excretory organ; a mid region with a single shell bearing both lateral and

medial indentations; and a posterior region with two hooked lobes. A large adhesive organ was present on the mid and anterior region that extends into three distal branches. No hosts were identified.

1994 Gordon, M. E., Layzer, J. B. & L. M. Madison. Glochidial host of *Villosa taeniata* (Mollusca: Unionoidea). *Malacological Review* **27**: 113-114.

Rock bass was identified from artificial infestations as the host for the painted creekshell. Glochidia did not metamorphose simultaneously, but continued to excyst for 11 days after the first transformation.

1994a Howells, Robert G. Mussel fecundity. *Info-Mussel Newsletter* **2** (2): 2.

A 74 mm specimen of *Lampsilis hydiana* had approximately 374,000 glochidia, while an 88 mm *Leptodea fragilis* had 18,936,000. The latter figure is substantially greater than other estimates for that species.

1994b Howells, Robert G. Exotic fishes and freshwater mussels. *Info-Mussel Newsletter* **2** (2): 2.

It was suggested that exotic fishes, such as goldfishes, common carp, guppies, and blue tilapia, are usually not suitable hosts for native unionids. The presence of numerous exotics may therefore decrease the survivorship of unionids by monopolizing their glochidia.

1994c Howells, Robert G. Host fish determination. *Info-Mussel Newsletter* **2** (2): 3-4.

Lampsilis hydiana metamorphosed on green sunfish after 37 days. *Anodonta suborbiculata* transformed on longear sunfish, green sunfish, and channel catfish after 31 days. *Arcidens confragosus* transformed on channel catfish after 36 days. All transformations occurred a 18°C.

1994d Howells, Robert G. Mussel fecundity. *Info-Mussel Newsletter* **2** (3): 3-4.

Numbers of eggs and glochidia were related to shell length in *Lampsilis hydiana* and *L. teres.* Eggs and glochidia may occur simultaneously in the marsupia.

1994 Prentice, Janelle [in] Howells, Robert G. Student wins science fair with mussel project. *Info-Mussel Newsletter* **2** (3): 5-6.

Glochidia of *Lampsilis teres* encysted on four fish species: redbreast sunfish; bluegill; redear x green sunfish; and greenthroat darter. Although the experiment did not follow development to metamorphosis, the glochidia were still encysted after seven days.

1994e Howells, Robert G. Mussel fecundity. *Info-Mussel Newsletter* **2** (4): 3.

80-85 mm specimens of *Crytonaias tampicoensis* had 309,000 to 964,000 eggs/female.

1994 Hove, Mark C. & Richard J. Neves. Life history of the endangered James spinymussel *Pleurobema collina* (Conrad, 1837) (Mollusca:Unionidae). *American Malacological Bulletin* **11**: 29-40.

This species was gravid from late May through August. 13,000 brooded eggs were found per female, and glochidia were released as conglutinates. Seven hosts were identified through artificial infestations: bluehead chub, rosyside dace, satinfin shiner, rosefin shiner, central stoneroller, blacknose dace, and mountain redbelly dace. Days to metamorphosis varied with hosts and water temperature from 7 to 50 days. Suckers were found to ingest free glochidia. The adult mortality rate was approximately 15.6%.

1994 White, Laura R., McPherson, B. A. & J. R. Stauffer. Identification of freshwater mussel glochidia on host fishes using restriction fragment length polymorphisms. *Molecular Ecology* **3**: 183-185.

Preliminary results and procedures were given for identifying hosts based on matches between encysted glochidial DNA and adult mussel DNA. The ITS-1 region of nuclear ribosomal DNA was shown to differ between fishes and mussels, allowing separation of these DNA in encysted glochidia. This region also was suitable for separating mussels at least to tribe, and to species in many cases, by using different restriction enzymes.

1994 Bauer, Gerhard. The adaptive value of offspring size among freshwater mussels (Bivalvia; Unionoidea). *Journal of Animal Ecology* **63**: 933-944.

Small glochidia were associated with high fecundity, long parasitic stage, and a long period of growth on the host, while larger glochidia are associated with low fecundity, short parasitic stage, and no growth on host. The number and placement of glochidia, breeding type, and habitat were unrelated to glochidial size. Hooked glochidia were larger than nonhooked ones, perhaps to increase strength of the glochidial grip. Mussels with large glochidia also tend to parasitize a wider range of hosts than do those with smaller glochidia.

1995 Yeager, Bruce L. & Charles F. Saylor. Fish hosts for four species of freshwater mussels (Pelecypoda: Unionidae) in the upper Tennessee River drainage. *American Midland Naturalist* **133**: 1-6.

Hosts were determined by artificial infestations for *Epioblasma brevidens, E. capsaeformis, E. triquetra,* and the endangered *Quadrula intermedia. Epioblasma* species were gravid in May and June. *Epioblasma brevidens* parasitized greenside, redline, snubnose, and wounded darters, logperch, and banded sculpin. *Epioblasma capsaeformis* parasitized redline, wounded, and dusky darters, and banded sculpin. *Epioblasma triquetra* parasitized logperch and banded sculpin. *Quadrula intermedia* was gravid from April to June and metamorphosed on streamline chub and blotched chub. All hosts occurred in the same habitat as the mussel.

1995a Howells, Robert G. Mussel fecundity. *Info-Mussel Newsletter* **2** (12): 4.

Fecundity estimates were given for *Potamilus purpuratus, Crytonaias tampicoensis, Lampsilis teres,* and *Leptodea fragilis.* Several individuals possessed both eggs and glochidia simultaneousl;y.

1995b Howells, Robert G. Rio Grande bleuffer. *Info-Mussel Newsletter* **3** (1): 1.

Glochidia of the Rio Grande bleuffer, *Potamilus sp.*, attached to the gills of redear sunfish, redbreast sunfish, warmouth, and golden shiner.

1995 Henley, William F. & Richard J. Neves. Chemosensory abilities of gravid freshwater mussels and glochidia. *Triannual Unionid Report* (6): 1 pp.

Glochidia of *Villosa iris* and *Lampsilis fasciola* responded more quickly to non-host mucus than to host mucus, yet adult behavioral activity was greater towards host species than non-host ones. *Villosa iris, V. taeniata,* and *V. vanuxemensis* had rhythmic movements of mantle appendages. Smallmouth bass were identified as hosts for *Lexingtonia dolabelloides.*

1995a Hove, Mark C., Engelking, Robin A., Peteler, Margaret E. & Eric M. Peterson. Life history research on the creek heelsplitter, *Lasmigona compressa. Triannual Unionid Report* (6): 1 pp.

Black crappie, slimy sculpin, spotfin shiner, and yellow perch were identified as hosts for this species. Most glochidia were released in conglutinates, which also contained apparently unfertilized ova.

1995b Hove, Mark C., Engelking, Robin A., Peteler, Margaret E. & Eric M. Peterson. *Anodontoides ferussacianus* and *Anodonta imbecillis* host suitability tests. *Triannual Unionid Report* (6): 1 pp.

Black crappie and spotfin shiner were identified as hosts for these species. Most glochidia were not released in conglutinates. Some *Anodontoides ferussacianus* released transparent mucus strands containing 5-20 glochidia.

1995 Lucey, J. The distribution of *Anodonta cygnea* (L.) and *Anodonta anatina* (L.) (Mollusca: Bivalvia) in southern Irish rivers and streams with records from other areas. *Irish Naturalists' Journal* **25**: 1-8.

Although salmonids were thought to be hosts for these species, the author believed that other hosts occurred in Ireland. The mussels lived in areas were salmonids were absent, or the fish fauna was dominated by cyprinids. Gravid female mussels were found in late September.

1995 Haggerty, Thomas M., Garner, Jeffrey T., Patterson, George H. & Lannis C. Jones. A quantitative assessment of the reproductive biology of *Cyclonaias tuberculata* (Bivalvia: Unionidae). *Canadian Journal of Zoology* **73**: 83-88.

Spermatogenesis was found in this species mainly between May and July. Embryos were brooded in the outer demibranchs between early April and late August, with glochidia formed by early July and late August of the same year. Sexes ratios were approximately equal.

1995 Buddensiek, Volker. The culture of juvenile freshwater pearl mussels *Margaritifera margaritifera* L. in cages: a contribution to conservation programmes and their knowledge of habitat requirements. *Biological Conservation* **74**: 33-40.

Metamorphosed glochidia were collected from artificially infected brown trout. These were placed in plastic cages in which juveniles were enclosed between 200 µ plastic gauze sheets. Each cage held 460 juveniles. These were transfered to four German rivers and fastened to the river bottom. At the time the paper was written, juveniles had been kept alive up to 52 months. Mortality was greatest during the first seven months. Growth essentially ceased during the winter, and winter mortality was greatest among small individuals. Cages colonized by chironomids had decreased mussel survival. Survival and growth were comparable to free-living individuals. Mortality increased in eutrophied rivers.

1995 Michaelson, David L. & Richard J. Neves. Life history of the endangered dwarf wedgemussel *Alasmidonta heterodon* (Bivalvia: Unionidae). *Journal of the North American Benthological Society* **14**: 324-340.

This species was bradytictic, spawning in late summer and becoming gravid in fall. Of 15 fishes species tested for host suitability, three resulted in metamorphosis: tessellated and Johnny darters, and mottled sculpin. Glochidia initially attached to hosts in greater numbers than to non-hosts, suggesting that glochidia may be able to distinguish host species.

1995 Fichtel, Christopher & Douglas G. Smith. The freshwater mussels of Vermont. *Nongame & Natural Heritage Program, Vermont Fish & Wildlife Department Technical Report* (18): 1-54.

While primarily a faunal survey, hosts are reported for several species based on the unpublished studies of B. Wicklow. Slimy sculpin, pumpkinseed, and blacknose dace were identified as hosts for *Alasmidonta varicosa.* Blacknose dace was identified as a host for *Alasmidonta undulata.*

1995 O'Brien, Christine & Jayne Brim-Box. Shinyrayed pocketbook (*Lampsilis subangulata*) confirmed as superconglutinate producer. *Triannual Unionid Report* (7): 3-4.

This species was shown to produce a superconglutinate, a double row of conglutinates from both marsupia, 4-5 cm in length. It is expelled through the excurrent siphon on a mucous strand and may remain attached to the female or become entangled on other objects. The mucous cord may reach 2.5 m in length. Its fish-like shape presumably attracts host fishes.

1995a Watters, G. Thomas. New hosts for *Anodontoides ferussacianus* (Lea, 1834). *Triannual Unionid Report* (7): 7.

Largemouth bass and bluegill were shown to be hosts based on laboratory infestations. Transformation occurred from 21-25 days post infestation at 15°C

1995 Burress, Jonathan W. & Richard Neves. Use of ponds as a refugia for adult freshwater mussels. *Triannual Unionid Report* (7): 20.

Fifteen mussel species were held in four ponds. Species kept in suspended cages had 70 to 100% survival, while those in cages on a raceway bottom had 5 to 30% survival. Survival varied with species.

1995 Beaty, Braven & Richard Neves. Attempts to culture juvenile mussels at the Clinch River Steam Plant, Carbo, VA. *Triannual Unionid Report* (7): 21.

Juvenile mussels raised in an artficial stream channel experienced low survivorship (maximum 17%). Those placed in the channels in June had greater survivorship than those placed in September. Mussels did not grow appreciably after September.

1995 Barnhart, M. Christopher, Roberts, Andrew D. & Ashley P. Farnsworth. Fish hosts of four unionids from Missouri and Kansas. *Triannual Unionid Report* (7): 22.

Host-mussels identifications were made from laboratory infestations for four unionids. *Ptychobranchus occidentalis* released larval fish-like conglutinates, and glochidia metamorphosed from 26-31 days at 21°C on greenside, yoke, and rainbow darters. *Lampsilis reeviana brevicula* had a mantle lure, and glochidia metamorphosed from 22-34 days at 21°C on smallmouth bass, green sunfish, and banded sculpin. *Lampsilis rafinesqueana* had a mantle lure, and glochidia metamorphosed at 27 days at 21°C on largemouth and smallmouth bass. *Anodonta suborbiculata* released glochidia that metamorphosed from 51-63 days at 10°C on golden shiner, warmouth, white crappie, and largemouth bass.

1995 Kirk, Sheila G. Immunosuppression of nonhost fish species and its effect on glochidial metamorphosis. *Triannual Unionid Report* (7): 24.

Cortisol was implanted in nonhost fish species to determine if immunosupression would enable nonhosts to function as hosts. The results suggested that this method could work on some species, but not on others. A seasonal effect was noted in which this procedure was successful only during certain seasons.

1995a Hove, Mark C. Early life history reserarch on the squawfoot, *Strophitus undulatus*. *Triannual Unionid Report* (7): 28-29.

Strophitus undulatus released tube-shaped, 5-10 mm long conglutinates. Of 11 fishes tested, seven acted as hosts. Days to metamorphosis ranged from 10 to 29 at 19°C. Hosts were spotfin shiner, fathead minnow, yellow bullhead, black bullhead, bluegill, largemouth bass, and walleye.

1995 Neves, Richard, Gatenby, Catherine & Bruce Parker. A diet for rearing juvenile freshwater mussels. *NBS Information Bulletin* (17): 3 pp.

Juvenile mussels pedal feed for approximately four months after metamorphosing, and require a fine substrate of organic and inorganic material. Algae were suitable for juvenile, in particular a tri-algal mix of *Neochloris oleoabundans, Bracteacoccus grandis,* and *Phaeodactylum tricornutum.* Bacteria did not enhance growth..

1995 Naimo, Teresa, Thiel, Pamella & Kurt Welke. An evaluation of relocation and holding of unionid mussels in an artificial pond. *Triannual Unionid Report* (8): 7.

Five species of 1392 mussel individuals were relocated to either a 1.2 acre pond or the upper Mississippi River. Four months later, survival in ponds was 71%, and 95% in the river. Survivorship was higher in suspended trays than in buried trays. Species differed in mortality as well.

1995b Hove, Mark C. Host research on round pigtoe glochidia. *Triannual Unionid Report* (8): 8.

Pleurobema sintoxia metamorphosed on three of seven fish species artificially infested. Days to metamorphosis ranged from 25-33 days at 19°C. Hosts were identified as spotfin shiner, bluntnose minnow, amd northern redbelly dace. Female mussels released white, 10-15 mm long conglutinates.

1995c Hove, Mark C. Suitable fish hosts of the lilliput, *Toxolasma parvus. Triannual Unionid Report* (8): 9.

Toxolasma parvus metamorphosed on one of three fish species artificially infested. Days to metamorphosis ranged from 30-35 days at 19°C. A host was identified as green sunfish.

1995 Watters, G. Thomas & Scott H. O'Dee. Towards "natural" reproduction of freshwater mussels in enclosures - preliminary results. *Triannual Unionid Report* (8): 13.

Twenty *Lampsilis radiata luteola* were kept in outdoor 3028 liter enclosures with 20 hatchery-raised largemouth bass. Glochidial samplers were inspected every other day. Glochidial release declined with falling water temperature. Bass have become infested but appear to be carrying the glochidia overwinter. This was the first report of a natural infestation in captivity.