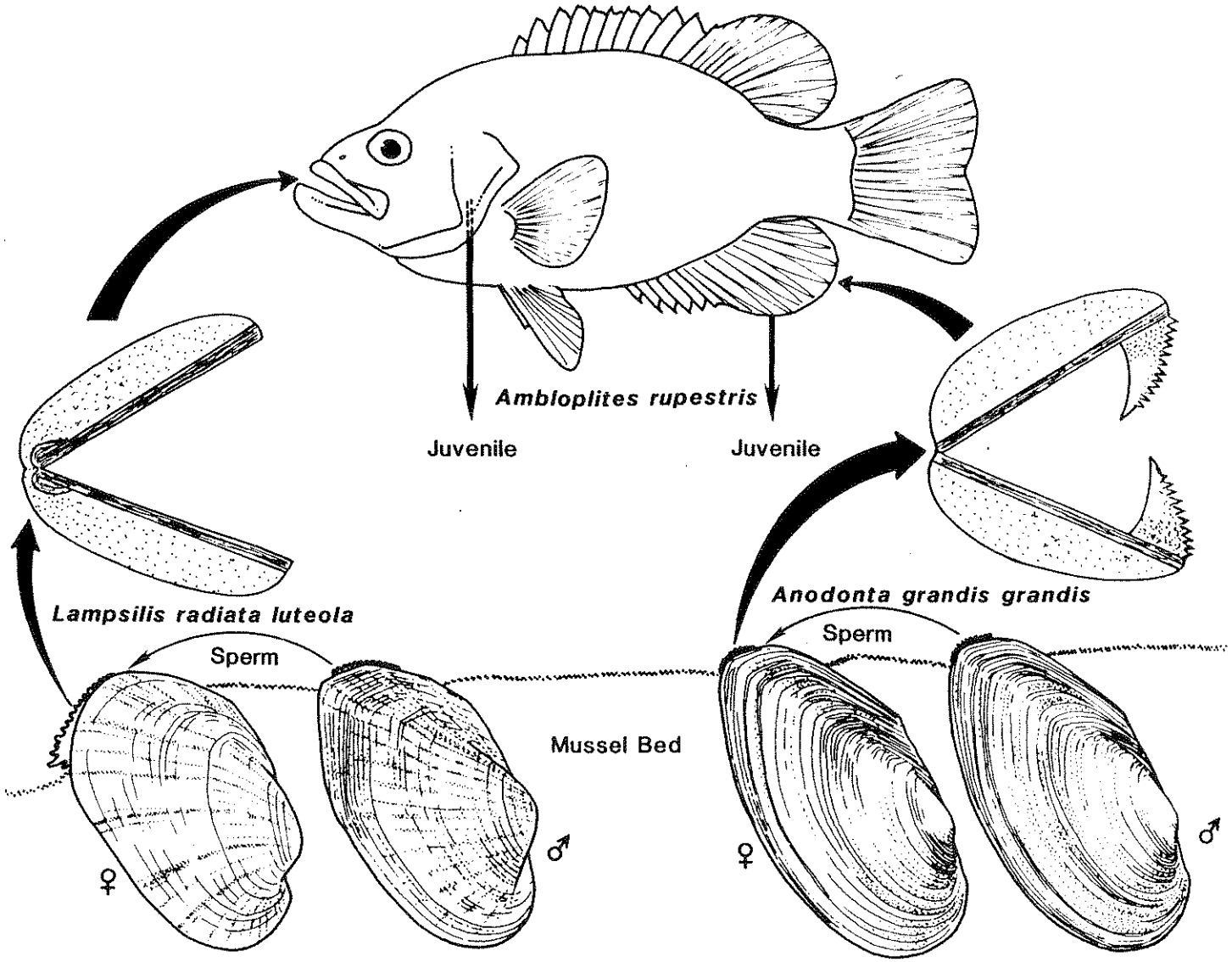
A KEY TO THE GLOCHIDIA OF THE UNIONIDAE OF TEXAS



Typical unionid life history. Drawings of *Ambloplites rupestris* after Trautman (1981) and of adult *Anodonta grandis grandis* and *Lampsilis radiata luteola* after Burch (1975).

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Abstract

The Unionidae possess a parasitic larval stage known as a glochidium. During this short parasitic period, the larvae transform into juveniles and then drop from their host to begin a much more lengthy independent stage in their life cycle. Glochidia differ from their adult progenitors both anatomically and conchologically. Many current keys to the adults are available but keys to the glochidia are rare, mostly outdated, and where available are based solely on the light microscope level of study. The present key is a result of the examination of numerous species of unionid glochidia by using Scanning Electron Microscopy (SEM), supplemented by glochidial descriptions at the light microscope level of study. It was constructed to distinguish the Texas fauna but may be of value in some neighboring states as well. Glochidia of most genera of Texas Unionidae are presented at the SEM level of study. A large percentage of the glochidia of Texas species are included also. Although genera may be distinguished at the light microscope level, most positive identifications of glochidia can only be made at the SEM level, if at all.

Introduction

This key is intended for use at the light microscope level of study although some characters can only be seen when viewed with a scanning electron microscope. Those characters are specifically identified as high magnification characters (sem). It includes a key to the genera and extant species of Unionidae or pearly freshwater mussels of Texas. The couplets draw heavily on glochidial descriptions prepared from scanning electron microscopy (Clarke 1981, 1985; Hoggarth, 1988; and others) but also incorporates as much of the light microscope level of descriptive information as appropriate (Lefevre & Curtis, 1910, 1912; Ortmann, 1911, 1912, 1919; Surber, 1912, 1915, and others). It will be less useful outside of the state at the species level, but will be fairly reliable at the generic level for most of the southwestern United States. The species level nomenclature follows Turgeon et al. (1988) although the generic level nomenclature is sometimes different. Footnotes describing those differences are included.

The glochidium is the parasitic larval stage of the superfamily Unionacea. This larval stage is not restricted to the family Unionidae but only occurs in molluscs generally known as freshwater mussels (Unionidae, Margaritiferidae, Hyriidae). The glochidium is only a part of the fascinating life history of these animals (typical life histories are figured on the cover page).

Leeuwenhoek (1722) made the first substantial observations of the glochidium. He concluded, after observing their development, that the tiny bivalve molluscs enclosed within the gills of the female, must be her young. This same reasoning was not followed by subsequent observers of glochidia and in 1797 Rathke concluded that the smaller molluscs, which filled the outer gills of the freshwater mussel to the point of bursting, were in fact parasites of the larger mollusc. These tiny parasites were given the scientific name *Glochidium parasiticum* Rathke, 1797. Thirty five years later, Carus (1832) observed the brightly colored ova of a female mussel pass from the oviduct to the outer gill. More than thirty years later, Leydig (1866) discovered glochidia embedded in the fins of a fish. Since

then a great deal of work has been done to determine specific hosts for specific species of mussels. Hoggarth (1992) reviewed the host-glochidium data available for North American species of Unionacea.

The successful glochidium, upon release from the female, comes in contact with the tissues of a host, clamps down on this tissue, and becomes encapsulated by the host. Some species of glochidia are more often encountered attached to the fins and epidermis (the stout, triangular glochidia of the Anodontinae) while others are more often found attached to the gills (the smaller, fragile glochidia of the Ambleminae and Lampsilinae). Transformation from glochidium to juvenile mussel occurs while encapsulated. This parasitic period is an obligate part of the life cycle for most species, although in a few species the larvae have been shown to transform without first having attached to a host. Even for these species, the glochidium has been shown to attach to a host if it is provided with one.

Glochidial valve orientation

Orientation of the diagrams and electron micrographs of the glochidial valves will follow Hoggarth (1987). As such all glochidial valves pictured in this key will have the dorsal aspect of the valve toward the top of the page, the ventral aspect toward the bottom, the posterior margin to the left, and the anterior margin to the right. The anterior margin (margin A-E in Figure 1) is the long margin of the valve while the posterior margin (margin C-E) is the short side. Glochidia are not symmetrical about the dorso-ventral axis of the valve. Hooks and other structures involved in piercing the tissues of the host are located on the ventral margin while the hinge and hinge ligaments are located at the dorsal margin.

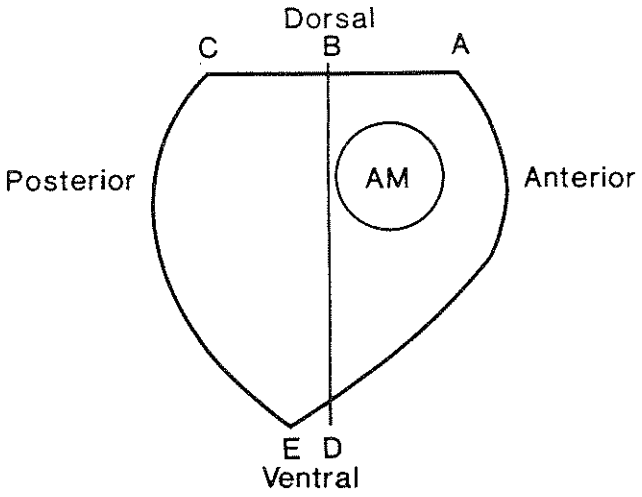

Figure 1. The subtriangular glochidium of the Anodontinae showing the orientation of glochidial valve. AM = adductor muscle.

Key to the glochidia of Texas Unionidae

1) Glochidium subtriangular with a stout hook on the ventral margin of each valve. Figure 2a - Anodontinae. (2)

   Glochidium subelliptical to ligulate, without a single stout ventral hook at the margin of each valve. Figures 3-5 - Ambleminae and Lampsilinae. (8)

2) Anterior and posterior margins almost equal giving the valve a symmetrical appearance about the dorso-ventral axis. Hook with a single row of large stylets (microstylets) toward its distal end (sem). Figures 2a-d, n. Genus *Anodonta.* (3)

Anterior and posterior margins unequal, valve high pear-shaped (pyriform) to depressed (depressed pyriform). Hook with two to four rows of microstylets toward its distal end (sem). Figures 2e-h, o, p. (5)

3) Tight looped valve sculpture covers the exterior surface of the valve (sem). Glochidium 0.30 mm in length and height. Dorsal margin 0.25 mm in length. *Anodonta imbecillis* (Figures 2c, i).

Exterior valve sculpture loose looped or vermiculate (sem). Figures 2j, k. (4)

4) Exterior valve sculpture loose looped (sem). Glochidium 0.36 mm in length and height. Dorsal margin 0.25 mm in length. *Anodonta grandis grandis* (Figures 2a, b, j, n).

Exterior valve sculpture vermiculate (sem). Glochidium 0.32 mm in length and height. Dorsal margin 0.23 mm in length. *Anodonta suborbiculata* (Figures 2d, k).

5) Glochidial valve depressed pyriform (height less than length). Hook with two rows of microstylets distally (sem). Figures 2e, f, o. Genus *Strophitus.* (6)

Glochidial valve pyriform (height greater than or equal to length).* Hook with four rows of microstylets distally (sem). Figures 2g, h, p. (7)

6) Loose looped sculpture very coarse, ridges pronounced; ventral terminus located 45% from the posterior margin of the valve (sem). Glochidium 0.36 mm in length and 0.29 mm in height. Dorsal margin 0.28 mm in length. *Strophitus undulatus undulatus* (Figures 2e, o).

Loose looped sculpture less coarse, ventral terminus located 50% from the posterior margin of the valve (sem). Glochidium 0.35 mm in length and 0.29 mm in height. Dorsal margin 0.27 mm in length. *Strophitus subvexus* (Figure 2f).

7) Height equal to length. Exterior valve sculpturing rosette (sem). Glochidium 0.35 mm in length and height. Dorsal margin 0.25 mm in length. Genus *Arcidens, Arcidens confragosus* (Figures 2g, l, p).

Height greater than length. Exterior valve sculpture pustulate (sem). Glochidium 0.29 mm in length and 0.30 mm in height. Dorsal margin 0.20 mm in length. *Lasmigona complanata complanata* (Figure 2h, m).

* The glochidium of *Arkansia wheeleri* is unknown but probably is in this group.

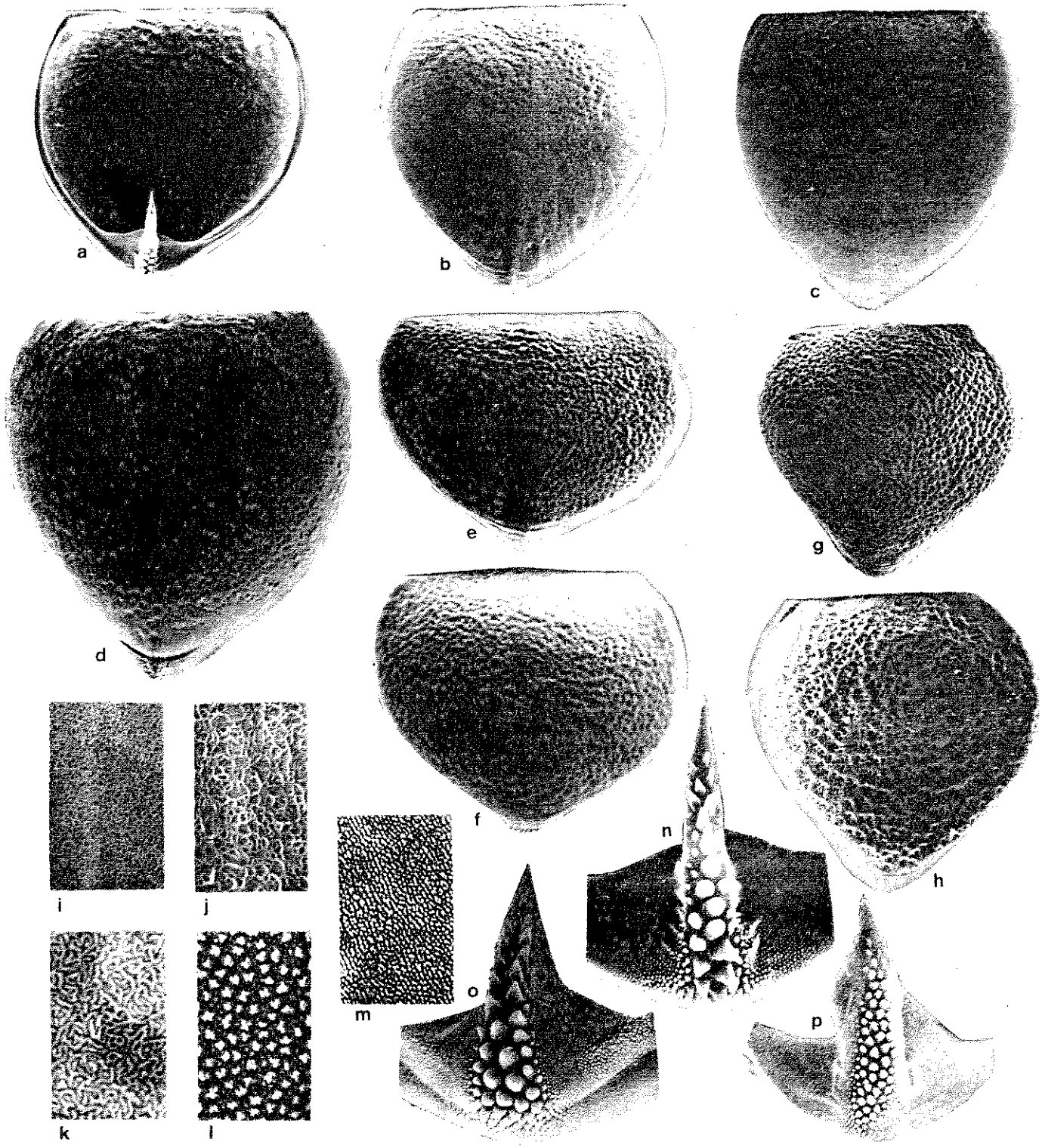

Figure 2. Glochidia of the subfamily Anodontinae. *Anodonta grandis grandis* (a, b), *Anodonta imbecillis* (c), *Anodonta suborbiculata* (d), *Strophitus undulatus undulatus* (e), *Strophitus subvexus* (f), *Arcidens confragosus* (g), *Lasmigona complanata complanata* (h). Tight looped valve sculpture (i), loose looped valve sculpture (j), vermiculate valve sculpture (k), rosette valve sculpture (l), pustulate valve sculpture (m). Hook of *Anodonta grandis grandis* (n), hook of *Strophitus undulatus undulatus* (o), hook of *Arcidens confragosus* (p).

8) Glochidium with lateral valve gape when valves adducted (Figures 3c, g). Dorsal alae short and directed at a 45° angle to the hinge (sem) (Figures 3a, b, d, e, g). Lampsilinae in part. (9)

Valves when adducted come together along their entire length; gape absent (Figure 5j). Dorsal alae not directed at a 45° angle to the hinge or absent (sem). (12)

9) Glochidium small; less than 0.30 mm in height. Micropoints lamellate, exterior valve sculpture pustulate, lanceolate hooks absent (sem) (Figures 3a - d, i, j). (10)

Glochidium larger; greater than 0.30 mm in height. Micropoints lanceolate in complete rows on the ventral margin, lanceolate hooks pronounced. Glochidium 0.22 mm in length, 0.38 mm in height. Dorsal margin 0.10 mm in length. Genus *Potamilus*,* *Potamilus purpuratus* (Figures 3e - h, k).

10) Glochidium very small. Lateral gape not pronounced. Glochidium 0.07 mm in length and 0.08 mm in height. Dorsal margin 0.03 mm in length. Genus *Leptodea*, *Leptodea fragilis* (Figures 3a, i).

Glochidium larger. Lateral gape pronounced. Genus *Lastena*.** (11)

11) Glochidium 0.12 mm in length and 0.18 mm in height. Dorsal margin 0.05 mm in length. *Lastena ohiensis* (Figures 3b, c).

Glochidium 0.11 mm in length and 0.17 mm in height. Dorsal margin 0.04 mm in length. *Lastena amphichaenus* (Figures 3d, j).

12) Dorsal alae absent (Figure 4) (sem). Ambleminae and Lampsilinae in part. (13)

Dorsal alae present (Figure 5) (sem). Lampsilinae in part. (23)

13) Glochidium subelliptical, very large (approaching the size of the anodontine glochidia). Glochidium 0.26 mm in length, 0.35 mm in height. Dorsal margin 0.15 mm in length. Genus *Megalonaias*, *Megalonaias nervosa* (Figure 4a).

Glochidium not as large. (14)

14) Glochidium subelliptical, very small (approaching the size of *Leptodea fragilis*). Glochidium 0.09 mm in length, 0.10 mm in height. Dorsal margin 0.04 mm in length. Genus *Tritogonia*, *Tritogonia verrucosa* (Figure 4b).

Glochidium larger, subelliptical or depressed subelliptical. (15)

* The glochidium of *Potamilus saliasensis* is unknown but probably belongs to this group.
**The genus *Lastena* contains species formerly in *Potamilus* (having ligulate glochidia), but the glochidia in this genus lack lanceolate hooks and have lamellate micropoints.

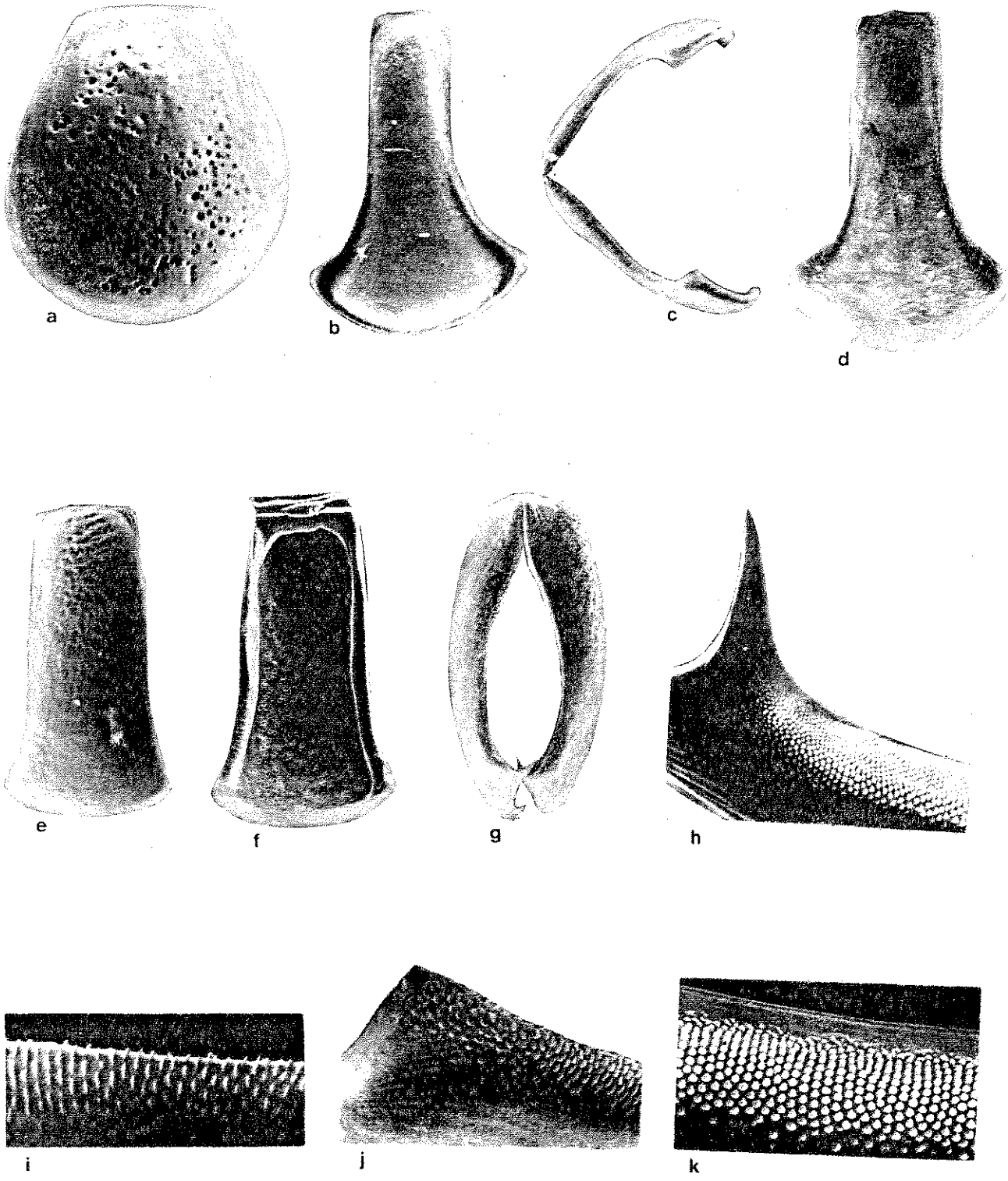

Figure 3. Glochidia of the subfamily Lampsilinae, tribe Potamilini. *Leptodea fragilis* (a), *Lastena ohiensis* (b, c), *Lastena amphichaenus* (d), *Potamilus purpuratus* (e - h). Micropoint structure of *Leptodea fragilis* (i), micropoint structure of *Lastena amphichaenus* (j), micropoint structure of *Potamilus purpuratus* (k).

15) Glochidium depressed subelliptical (length ≥ height). (16)

Glochidium subelliptical (length < height). (18)

16) Many of the glochidia of Texas species of Ambleminae were not available for scanning electron microscopy but have been described in the literature. One depressed subelliptical glochidia is *Fusconaia flava*, 0.17 mm in length and height.

Glochidium with dimensions other than above. (17)

17) Glochidium 0.22 mm in length and height. Dorsal margin 0.14 mm in length. *Elliptio dilatata* (Figure 4c).

Glochidium 0.22 mm in length and height. Dorsal margin 0.12 mm in length. *Obliquaria reflexa* (Figure 4i).

18) Five elliptical glochidia of Texas species of Ambleminae not available for scanning electron microscopy are *Quadrula quadrula*, 0.28 mm in length, 0.29 mm in height, *Quadrula metanevra*, 0.18 mm in length, 0.19 mm in height, *Quadrula nodulata*, 0.20 mm in length, 0.25 mm in height, *Amblema plicata plicata*, 0.21 mm in length, 0.22 mm in height, and *Uniomerus tetralasmus*, 0.16 mm in length, 0.21 mm in height.

Glochidium with dimensions other than above. (19)

19) Glochidium with coronal micropoints (sem) (Figure 4h). (20)

Micropoints lanceolate (sem) (Figure 3k). (21)

20) Glochidium 0.24 mm in length, 0.28 mm in height. Dorsal margin 0.10 mm in length. *Quincuncina infucata* (Figures 4g, h).

Glochidium 0.24 mm in length, 0.29 mm in height. Dorsal margin 0.13 mm in length. *Quadrula petrina* (Figure 4e).

21) Glochidium 0.11 mm in length, 0.18 mm in height. Dorsal margin 0.06 mm in length. *Uniomerus declivis* (Figure 4f).

Glochidium larger. (22)

* Texas species of Ambleminae of which the glochidium is unknown are: *Fusconaia askewi, Fusconaia lananensis, Pleurobema rudelli, Popenaias popei, Quadrula apiculata, Quadrula aurea, Quadrula couchiana, Quadrula houstonensis, Quadrula mortoni,* and *Quincuncina mitchelli* (see *Quincuncina infucata* above).

Figure 4. Glochidia of the subfamily Ambleminae and Lampsilinae. *Megalonaias nervosa* (a), *Tritogonia verrucosa* (b), *Elliptio dilatata* (c), *Plectomerus dombeyanus* (d), *Quadrula petrina* (e), *Uniomerus declivis* (f), *Quincuncina infucata* (g, h)*, *Obliquaria reflexa* (i), and *Toxolasma texasensis* (j).

* Not a Texas species, but it is the only member of the genus examined with SEM.

22) Glochidium 0.17 mm in length, 0.19 mm in height. Dorsal margin 0.10 mm in length. *Toxolasma texasensis* (Figure 4j).

Glochidium 0.23 mm in length, 0.25 mm in height. Dorsal margin 0.13 mm in length. *Plectomerus dombeyanus* (Figure 4d).

23) Dorsal alae equal to one sixth the height of the valve (sem). Glochidium 0.18 mm in length, 0.20 mm in height. Dorsal margin 0.09 mm in length. *Genus Obovaria, Obovaria jacksonaina* (Figure 5a).

Dorsal alae equal to one quarter the height of the valve (sem). Genera *Ligumia, Villosa* and *Lampsilis* (Figures 5b-j). (24)

24) Glochidium 0.19 mm in length, 0.24 mm in height. Dorsal margin 0.11 mm in length. *Lampsilis bracteata* (Figure 5f).

Glochidium larger. (25)

25) Glochidium 0.20 mm in length, 0.25 mm in height. Dorsal margin 0.11 mm in length. *Lampsilis teres* (Figure 5d).

Glochidium larger. (26)

26) Glochidium 0.21 mm in length, 0.26 mm in height. Dorsal margin 0.11 mm in length. *Ligumia recta* (Figure 5b).

Glochidium larger. (27)

27) Glochidium 0.22 mm in length, 0.27 mm in height. Dorsal margin 0.12 mm in length. *Lampsilis satura* (Figure 5j).

Glochidium larger. (28)

28) Glochidium 0.23 mm in length, 0.29 mm in height. Dorsal margin 0.12 mm in length. *Lampsilis radiata hydiana* (Figure 5e).

Glochidium larger. (29)

29) Glochidium 0.23 mm in length, 0.30 mm in height. Dorsal margin 0.11 mm in length. *Villosa iris iris* (Figure 5c)

Glochidium 0.25 mm in length, 0.28 mm in height. Dorsal margin 0.11 mm in length. *Lampsilis cardium* (Figures 5g - i).

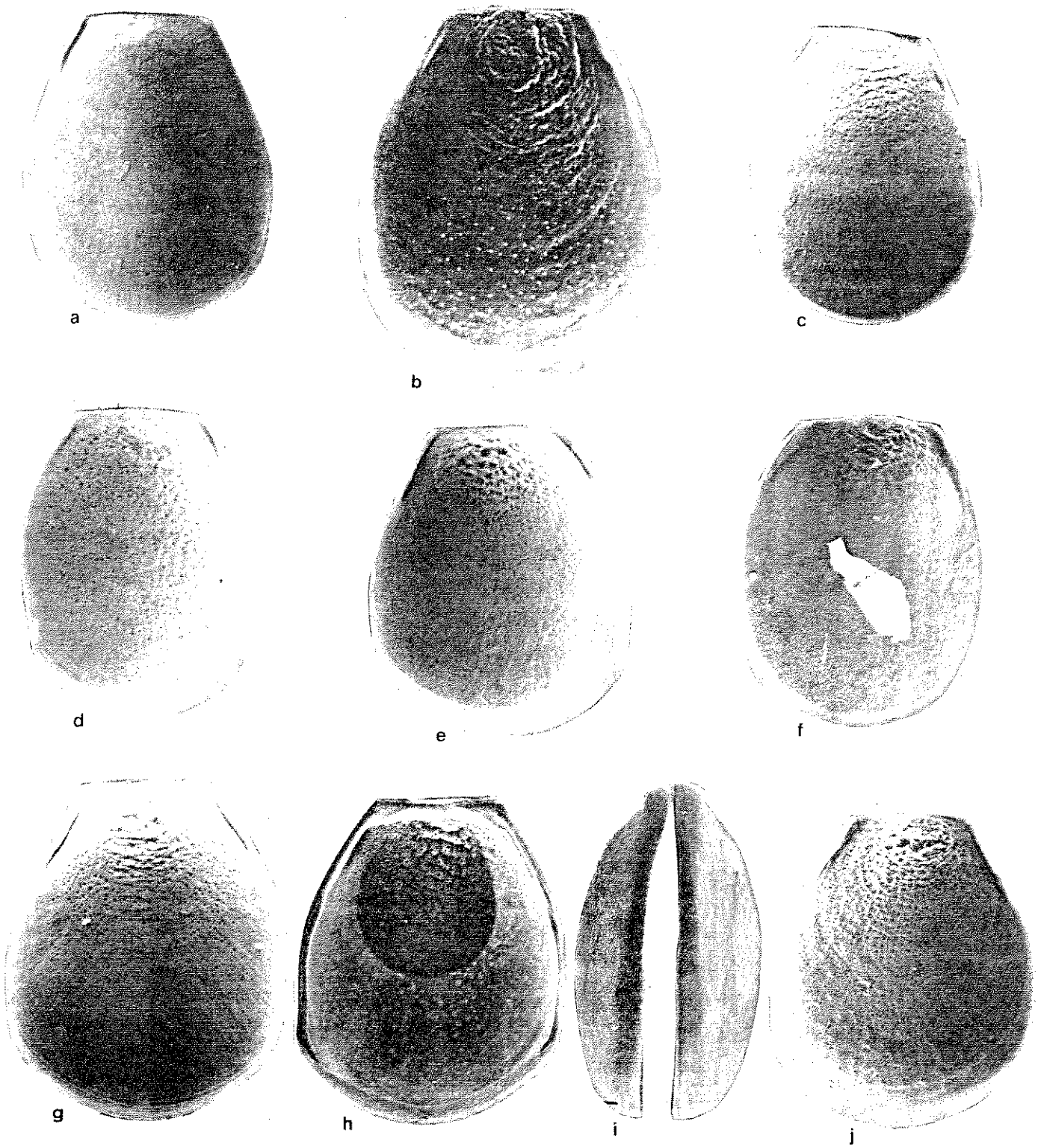

Figure 5. Glochidia of the subfamily Lampsilinae. *Obovaria jacksoniana* (a), *Ligumia recta* (b)*, *Villosa iris iris* (c)*, *Lampsilis teres* (d), *Lampsilis radiata hydiana* (e), *Lampsilis bracteata* (f), *Lampsilis cardium* (g - i)**, *Lampsilis satura* (j).

* Not a Texas species, but it is the only member of the genus examined with SEM.

Many of the glochidia of Texas species of Lampsilinae were not available for scanning electron microscopy but have been described in the literature. *Truncilla donaciformis*, 0.05 mm in length, 0.06 mm in height, *Truncilla truncata*, 0.08 mm in length, 0.09 mm in height, *Toxolasma parvus*, 0.17 mm in length, 0.20 mm in height, *Ligumia subrostrata*, 0.25 mm in length, 0.29 mm in height (see *Ligumia recta* above), and *Villosa lienosa*, 0.20 mm in length, 0.27 mm in height (see *Villosa iris iris* above).

Texas species of Lampsilinae of which the glochidium is unknown are: *Cyrtonaias tampicoensis, Glebula rotundata, Truncilla cognata*, and *Truncilla macrodon*.

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