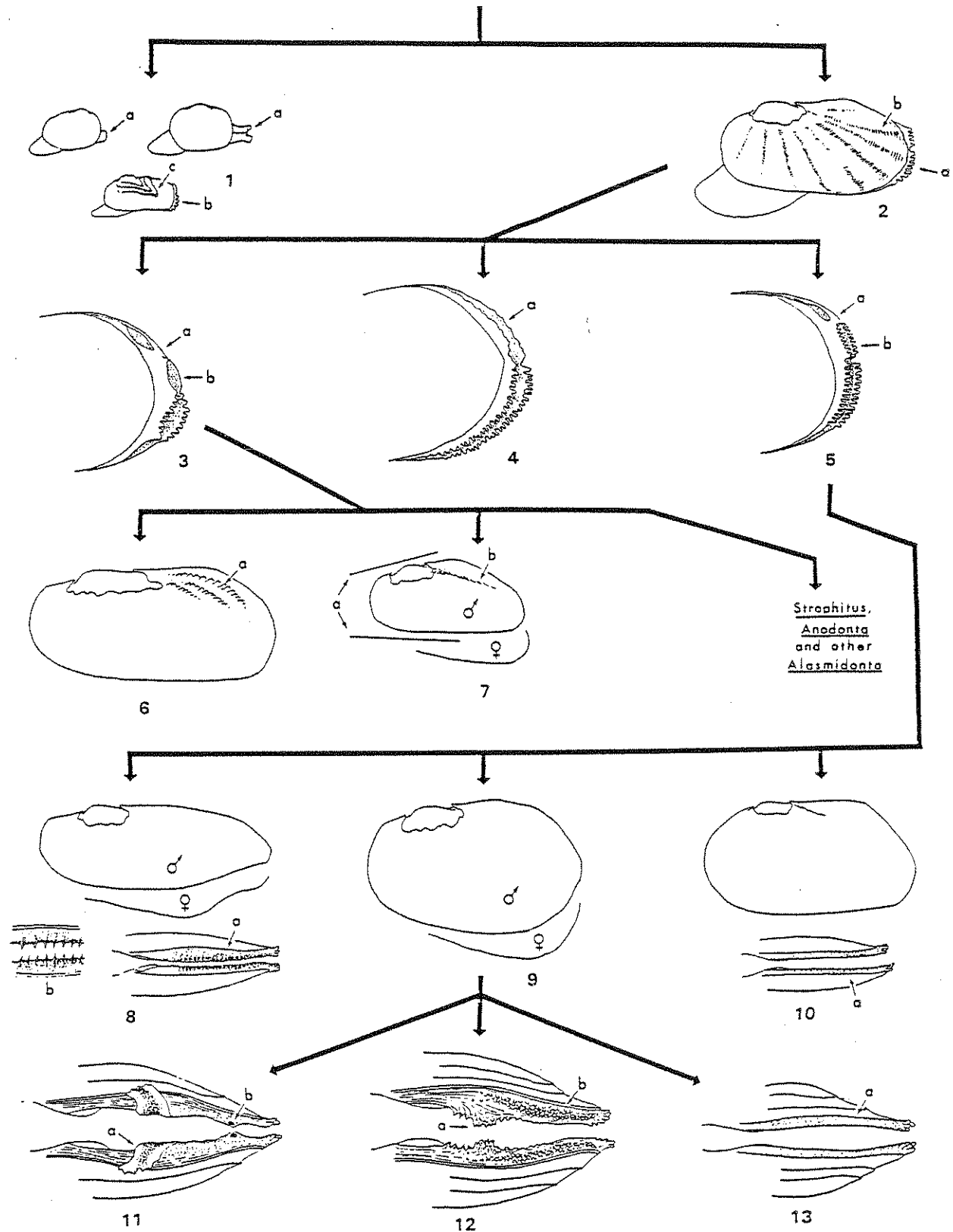


PICTORIAL KEY TO MASSACHUSETTS UNIONACEANS



Legend for pictorial key

(NOTE: Endangered, Threatened, and Special Concern listings refer to Massachusetts only.)

1. Shell less than 25 mm in length, specimens with plain beaks and tubular siphons (a) - (Pisidiidae); or with papillate inhalent aperture (b) and strongly ridged beaks (c) - (immature Unionacea).
2. Shell 25 mm or over in length, inhalent aperture papillate (a), shell with color rays (b) or not - (Unionacea).
3. Mantle edges fused (a) forming separate exhalent openings, exhalent aperture without papillae (b).
4. Mantle edges entire, no fusion forming two openings (a), exhalent aperture margin crenulate, shell brownish to black, rayless - (Margaritifera margaritifera).
5. Mantle edges fused (a) forming separate exhalent openings, lower exhalent aperture with minute but distinct papillae (b), shell rayed or not.
- ★ 6. Dorso-posterior shell surface with series of raised ridges perpendicular to growth lines (a) - (Alasmidonta varicosa, Endangered).
- ★ 7. Shell wedge-shaped in lateral view, particularly in female, and rarely over 40 mm in length, oblique dorso-posterior ridge present (b), shell usually rayless - (Alasmidonta heterodon, Endangered).
8. Shell elongate-rostrate, pointed posteriorly, females with ventral expansion of shell; mantle darkly pigmented (a), mantle edge with digitiform extensions (b) in both sexes, though more obvious in female - (Ligumia nasuta, Special Concern).
9. Shell either rounded, oval or broadly oval, with a rounded ventral expansion. Shell light colored or rayed, valves swollen.
- ★ 10. Shell either trapezoidal or quadrate to elongate-quadrate, with a straight ventral margin. No sexual dimorphism, valves compressed and usually rayed in younger specimens (<50 mm). Mantle margin (a) greyish without pattern or modification - (Elliptio complanata).
- ★ 11. Mantle margin smooth with greyish streaks or dots, and with a well developed and brightly pigmented flap-like extension (a); a dark eyespot present (b). Mantle characters most pronounced in female. Shell yellow to yellowish-brown and without rays on disk - (Lampsilis cariosa, Endangered).
- ★ 12. Mantle margin rough with greyish streaks and a small darkly pigmented flap-like extension (a), and with conspicuous fleshy tubercles (b). No eyespot present. Mantle characters most pronounced in female. Shell yellow, green or brown, often rayed on disk - (Lampsilis r. radiata).
- ★ 13. Mantle margin (a) smooth and greyish, without pattern or modification. Shell copper, pink, or brassy colored, sometimes finely rayed on disk - (Leptodea ochracea, Special Concern).

GENERAL KEY TO THE UNIONACEA AND CORBULACEA OF MASSACHUSETTS

- 1a Shell length less than 25 mm2
- 1b Shell length equal to or greater than 25 mm.....3
- 2a (1) Shell beaks without strong ridges extending out onto shell (Fig. 6); siphons, if visible, tubular (Figs. 6,25); gills unequal in size, outer (posterior) gill smaller or absent (Figs. 2b,21,22,33)CORBULACEA.....14
- 2b Shell beaks with strong, angular ridges extending out onto shell (Fig. 7), inhalent aperture, if visible, with papillae (Fig. 7); outer gill fully overlapping inner gill (Fig. 2a).....juvenile UNIONACEA (note 1)
- 3a (1) Shell with well developed pseudocardinal teeth but without lateral teeth (Fig. 8); inner surface of fresh shells containing several small punctations with trails radiating from beaks (Fig. 8); gills without vertical septa (Fig. 2a), separate from mantle posteriorly (Fig. 9)MARGARITIFERIDAE ..Margaritifera margaritifera (note 2)
- 3b Shell with or without pseudocardinal and lateral teeth, no punctations on inner shell surface; gills with vertical septa (Fig. 2a) and attached to mantle posteriorly (Fig. 10)UNIONIDAE.....4
- 4a (3) Shell hinge straight or gently curved, without any trace of hinge teeth (Figs. 11,12,13a); beak sculpture, if visible, with double looped ridges (Fig. 13b).....5
- 4b Shell hinge uneven, with only a weak or moderate swelling along hinge (Fig. 16a,b) or with well developed hinge teeth (Figs. 13c, e,16c,d); beak sculpture, if visible, consisting of unlooped bars (Fig. 13d).....6
- * 5a (4) Shell of uniform thickness throughout (Fig. 11).....Anodonta c. cataracta
- * 5b Shell with distinct extra-thickening along antero-ventral border (Fig. 12)Anodonta implicata (note 3)
- 6a (4) Shell with distinct pseudocardinal teeth and one (1) lateral tooth in right valve (Figs. 13c,e,14a,15a); ventral mantle margin with patterned pigment and modifications to inner edge (Pictorial key, 8,11,12) or plain (Pictorial key, 10,13); exhalent aperture minutely papillate (Pictorial key, 5b).....7
- 6b Shell with pseudocardinal teeth variously developed and without lateral teeth or with two (2) lateral teeth in right valve (Fig. 16a-d); ventral mantle margin plain; exhalent aperture without papillae (Pictorial key 3b).....11

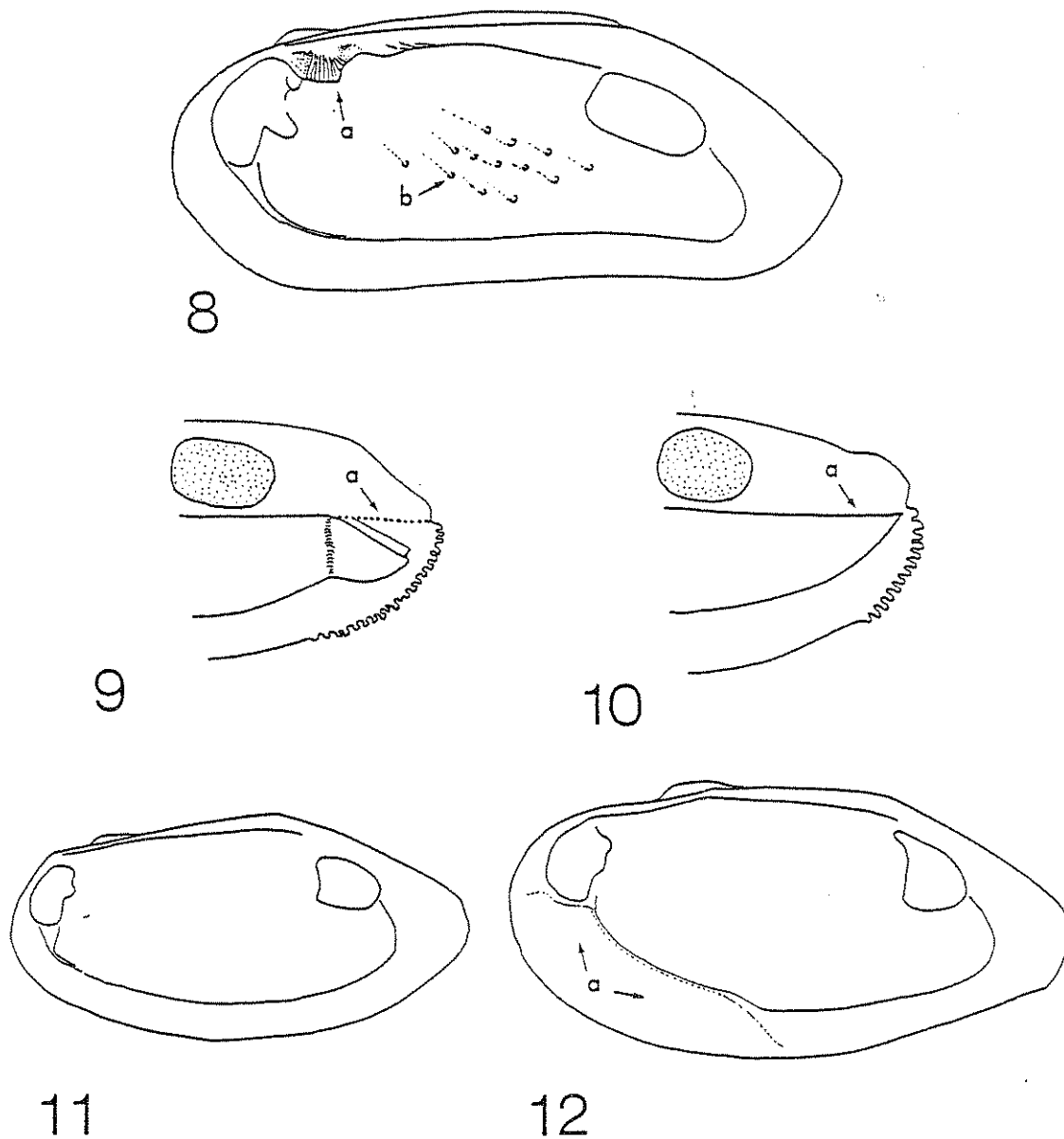


Figure 8. Internal view of shell of Margaritifera margaritifera (actual size) showing pseudocardinal teeth (a) and punctations (b). Figure 9. Posterior gill and mantle morphology of M. margaritifera showing free posterior portion of gills (a) (actual size). Figure 10. Posterior gill and mantle morphology of the Unionidae showing attached posterior portion of gills (a) (actual size). Figure 11. Interior of Anodonta c. cataracta shell (actual size). Figure 12. Interior of Anodonta implicata shell showing area of thickening (a) (actual size).

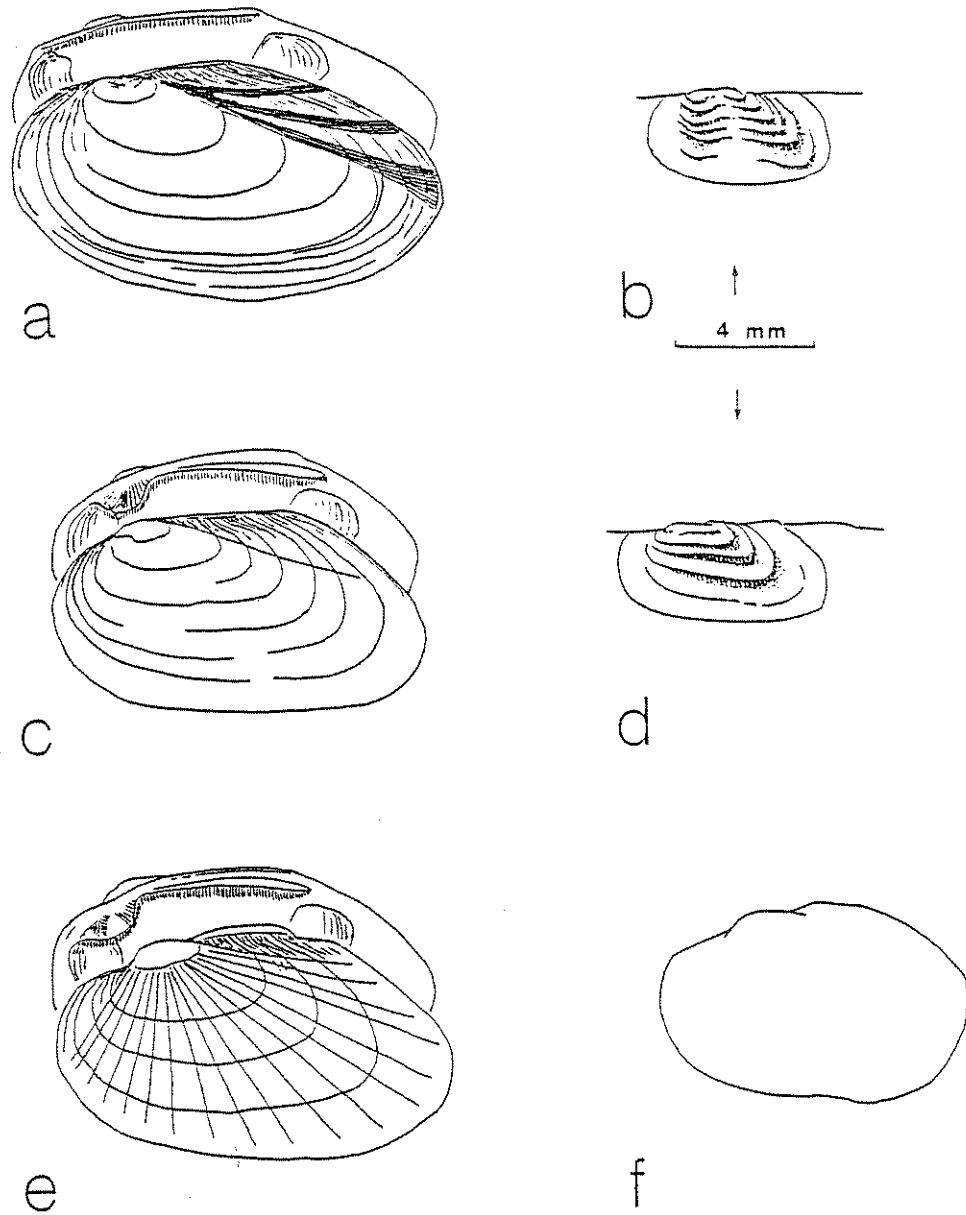


Figure 13. Shells of three of the most common species of Unionidae in Massachusetts: (a), Anodonta c. cataracta; (b), beak sculpture of A. c. cataracta; (c), Elliptio complanata; (d), beak sculpture of E. complanata; (e), male Lampsilis r. radiata; (f), female L. r. radiata. All except b and d are actual size.

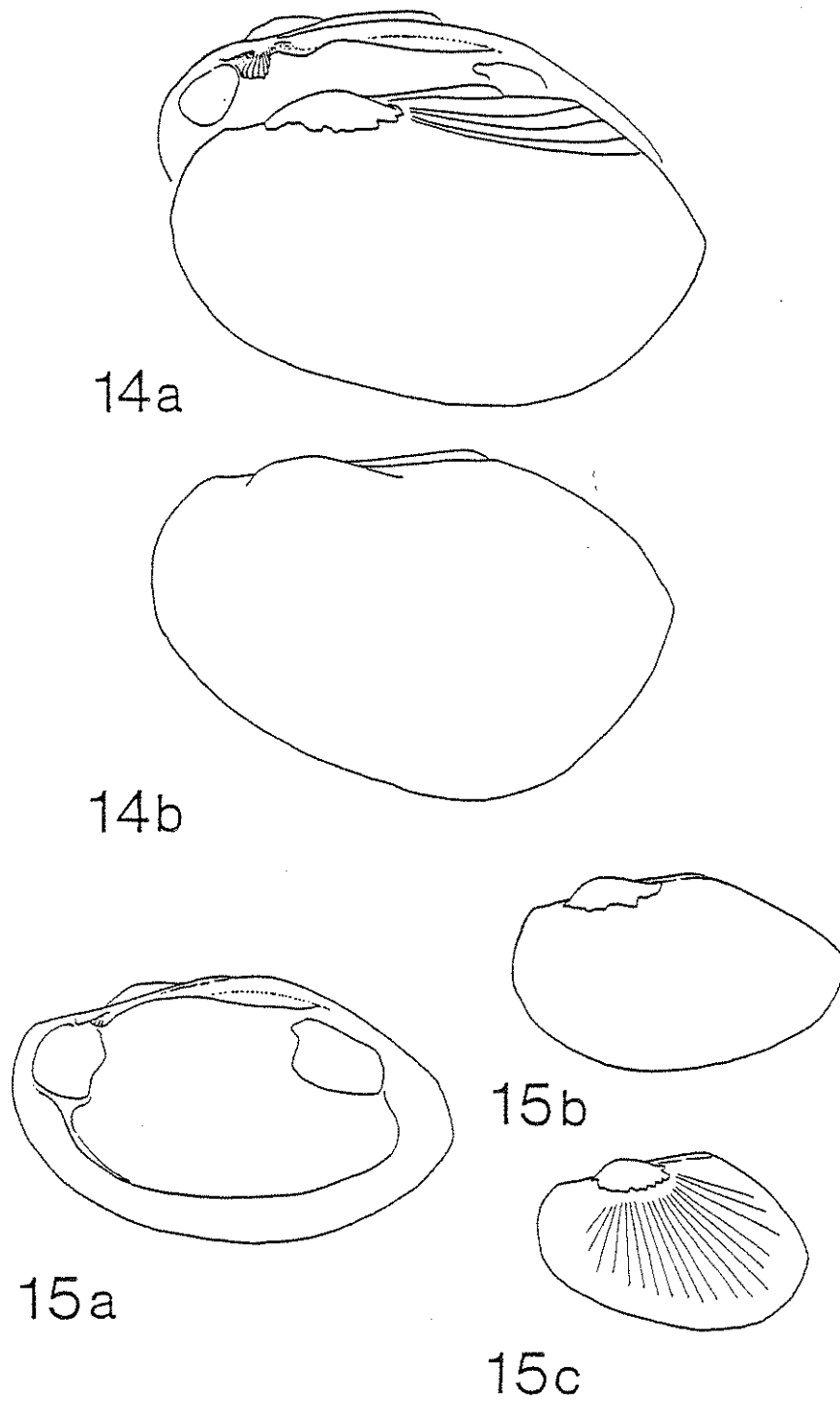


Figure 14. *Lampsilis cariosa* shells: (a), male; (b), female (actual size). Figure 15. *Leptodea ochracea* shells: (a), shell interior; (b), male; (c), female with rayed periostacum (actual size).

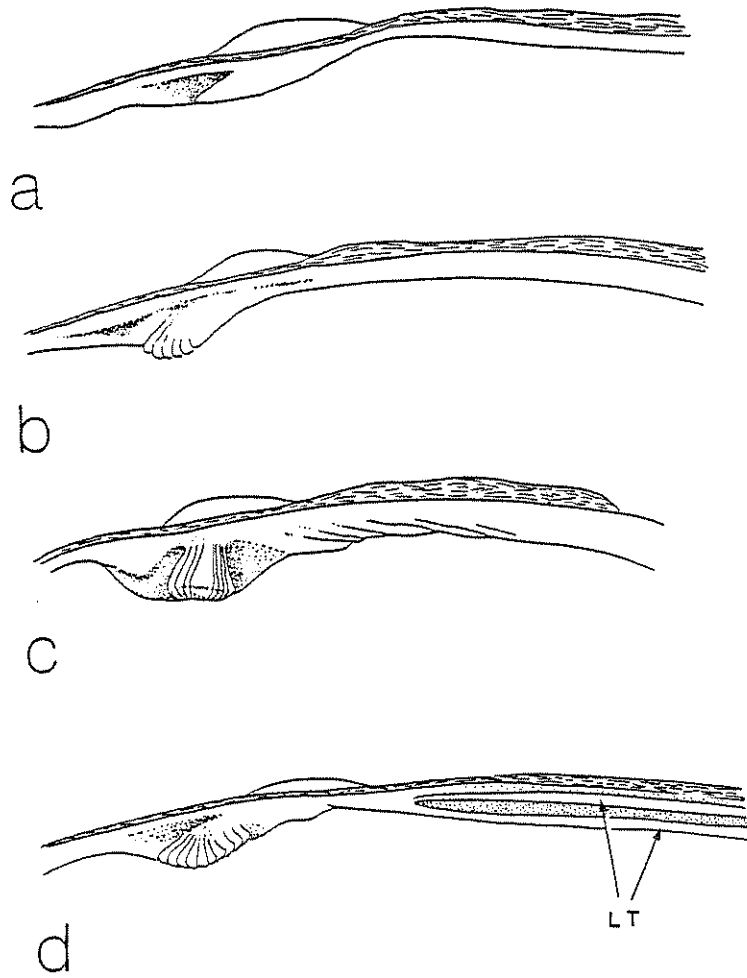
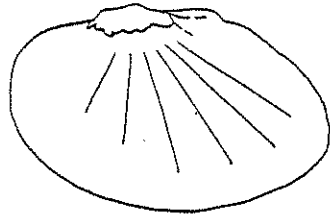
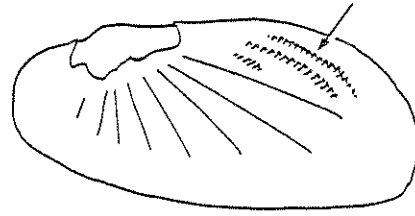


Figure 16. Hinge morphology of four unionid species: (a), Strophitus undulatus; (b), Alasmidonta varicosa; (c), A. undulata; (d), A. heterodon. LT=lateral teeth.



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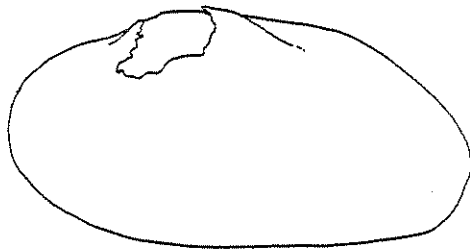
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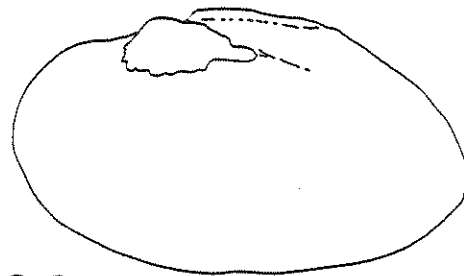
19a



19b



20a



20b

Figure 17. Alasmidonta undulata (actual size). Figure 18. Alasmidonta varicosa (actual size). Figure 19. Alasmidonta heterodon, (a), male; (b), female (actual size). Figure 20. Strophitus undulatus shells (a and b) (actual size).

- 7a (6) Shell trapezoidal, quadrate or elongate quadrate (Figs. 1a,13c) without sexual dimorphism, periostracum rayed in juveniles (<50 mm), brown to black in older specimens; ventral mantle margin plain Elliptio complanata
- 7b Shell rounded (Figs. 13e,14a,b,15a-c) or elongate with pointed posterior (Pictorial key, 8), sexually dimorphic, periostracum rayed or not; ventral mantle margin with patterned pigment and modifications to inner edge or plain8
- 8a (7) Shell elongate-rostrate with pointed posterior, periostracum rayed in juveniles and occasionally in adults, otherwise black; ventral mantle margin patterned with ochre and brown, with medially directed extensions (Pictorial key, 8b).....Ligumia nasuta
- 8b Shell oval, broadly oval or circular, periostracum rayed or not, color variable but never black; ventral mantle margin patterned, modified, or plain9
- 9a (8) Periostracum bright yellow or yellowish-brown, without rays on disc (Figs. 14a,b); ventral mantle margin smooth and patterned with grey, ochre, and cream, with edge modified into a flap and with a distinct eyespot (Pictorial key, 11a,b)..... Lampsilis cariosa
- 9b Periostracum usually not yellow, or if so with rays on disc; ventral mantle margin not as in 9a10
- 10a (9) Periostracum yellowish-green to brown, usually with rays on disc (Fig. 13e); ventral mantle margin patterned with grey, cream, and black, roughened with numerous tubercles, edge modified into a small flap, eyespot absent (Pictorial key, 12a,b)
.....Lampsilis r. radiata
- 10b Periostracum copper, pink, or brassy colored, sometimes with fine rays on disc (Fig. 15a-c); ventral mantle margin plain (Pictorial key, 13).....Leptodea ochracea
- 11a (6) Pseudocardinal teeth well developed with distinct cusps, lateral teeth absent (Figs. 16c,17).....Alasmidonta undulata
- 11b Pseudocardinal teeth without well developed cusps or lateral teeth, or with cusps and two (2) lateral teeth in right valve12
- 12a (11) Pseudocardinal teeth developed but delicate, two (2) lateral teeth in right valve (note 4), one in left (Fig. 16d), shell rarely over 40 mm (Fig. 19a,b)..... Alasmidonta heterodon
- 12b Pseudocardinal teeth not well developed, no lateral teeth (Fig. 16a,b).....13
- 13a (12) Pseudocardinal teeth simple swellings along hinge line (Fig. 16a), shell without external sculpturing (Fig. 20a,b).....
.....Strophitus undulatus

- 13b Pseudocardinal teeth produced as weak knobs with a few serrations (Fig. 16b), shell exterior sculptured with a series of small ridges perpendicular to growth lines (Pictorial key, 6; Fig. 18).....
.....Alasmidonta varicosa
- 14a (2) Shell with beaks central or anterior relative to foot (Figs. 1b, 25-31); animal with two well formed tubular siphons, outer (posterior) gills as high as inner (anterior) gills, juveniles in gills separated by size class (Figs. 21,22); shells usually over 6 mm in length (note 5)15
- 14b Shell with beaks posterior relative to foot (Figs. 6,34,43-48); animal with a single well formed siphon (anal), outer (posterior) gill as high or not as high as inner (anterior) gill, or outer gill absent, juveniles in gills not separated into individual size groups (Figs. 2b,33,35-37); shells usually less than 6 mm in length (note 6).....21
- 15a (14) Shell with a weak longitudinal ridge in center of shell interior (Fig. 23), beaks without "caps" (note 7) (Fig. 28), cusp AIII of anterior lateral teeth reduced, cusps with few, weak tubercles (Fig. 24d).....Sphaerium (Herringtonium) occidentale
- 15b Shell without internal longitudinal ridge, beaks with or without "caps," anterior lateral teeth with well developed cusps and many tubercles (Fig. 24a-c) or without tubercles16
- 16a (15) Shell delicate and usually with "caps" (Fig. 25) on beaks, anterior lateral teeth without tubercles; adults containing several larvae of different sizes (Fig. 21) Musculium17
- 16b Shell strong and without "caps" anterior lateral teeth with well developed tubercles (Fig. 24a-c); larvae of each size class few in number (Fig. 22).....Sphaerium (in part) 19
- 17a (16) Shell, in lateral view, with ventral margin curving sharply upward anteriorly (Fig. 25), adult shell usually less than 8 mm; occurring in temporary and permanent habitatsMusculium securis
- 17b Shell with ventral margin evenly curved (Fig. 26a,b), adult shell usually over 8 mm; occurring in temporary and permanent habitats18
- 18a (17) Dorsal margin fairly straight, junction of dorsal and posterior margins of shell forming a sharp angle (Fig. 26a,b); typically found in temporary habitatsMusculium partumeium
- 18b Dorsal margin curved, junction of dorsal and posterior margins rounded (Fig. 27); typically found in permanent habitats
..... Musculium lacustre (note 8)