

FIELD IDENTIFICATION NOTEBOOK

**Mussels of the White
River from Newport to
the Arkansas River**

**March 2002
Version 2.0**



By John L. Harris, Ph.D. and Cristin D. Milam

Front Cover Design by Linda M. Pearson

Front cover photos clockwise from top left: scaleshell (Leptodea leptodon), pink mucket (Lampsilis abrupta), ebonyshell (Fusconaia ebena), and fat pocketbook (Potamilus capax)

Acknowledgements: Patricia Jones, Jerry Farris, Bill Posey, and Susan Rogers were essential in organizing and conducting the classroom and field exercises.

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Field Identification Notebook

Mussels of the White River from Newport to the Arkansas River

Introduction

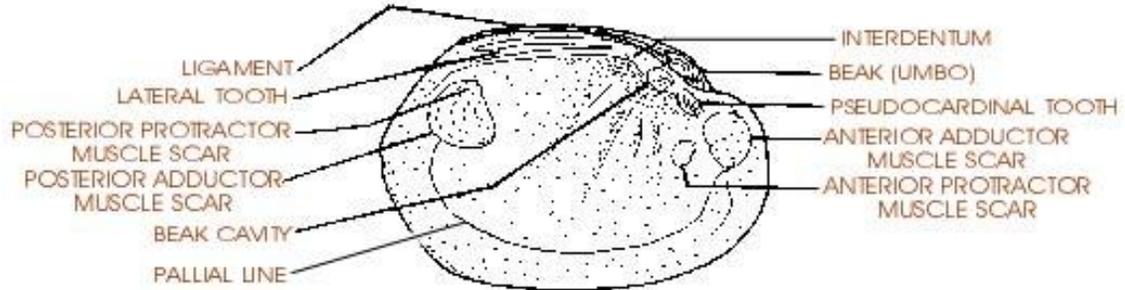
The purpose of this field notebook is to provide assistance in identification of freshwater mussels known to occur in the White River, Arkansas from Newport (River Mile 255) to the confluence with the Arkansas Post Canal (River Mile 10). Also, this document provides guidance regarding (1) planning of navigation maintenance activities to minimize impacts to mussel resources and (2) procedures to implement should mussel resources be encountered during maintenance activities.

Freshwater mussels are sedentary bottom dwelling inhabitants of rivers and lakes. When conditions are favorable, they occur in very dense, multi-species aggregations called mussel beds or beds. Sometimes these beds may encompass an area of 10,000 square meters and the mussels may occur in densities exceeding 100 individuals per square meter.

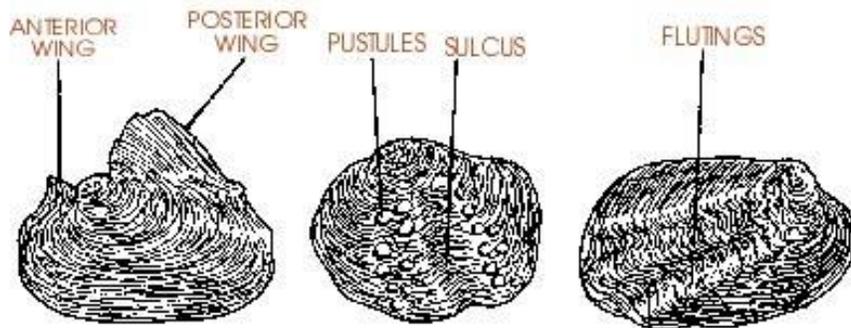
Mussels spend most of their lives with the majority of the shell buried in the river or lake bottom, and they obtain food, breathe, and reproduce by circulating water through the interior of the shell where the animal resides. In most species the sexes are separate, that is there are male and female individuals. Reproduction occurs when the female circulates sperm laden water through the gills where the eggs have been stored. The fertilized eggs called glochidia are stored in brood pouches on the gills until they are released to inhabit fish as a short term parasite. This parasitic stage is apparently required for the glochidia to metamorphose into juvenile mussels. After residing on the fish for a short period (one to two weeks), the juvenile mussels drop off and begin their free-living stage in the substrate.

The most obvious characteristic of all freshwater mussels is the shell which is composed of left and right valves. Externally the shell may be virtually smooth or heavily sculptured with small pimples, larger pustules, heavy ridges and grooves, and a variety of other features. Figures 1-3 illustrate various features of the shell, the specialized terminology, the terminology is defined in the glossary at the back of the notebook. These figures are used courtesy of R. G. Howells, senior author of the Freshwater Mussels of Texas (Howells et al., 1996).

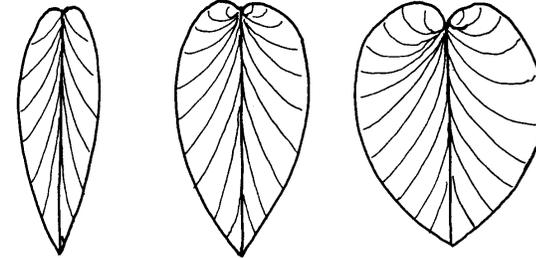
INTERNAL SHELL FEATURES



EXTERNAL SHELL FEATURES



SHELL WIDTH

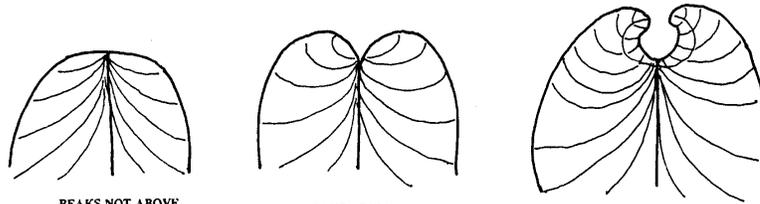


COMPRESSED

NORMAL

INFLATED

BEAK MORPHOLOGY

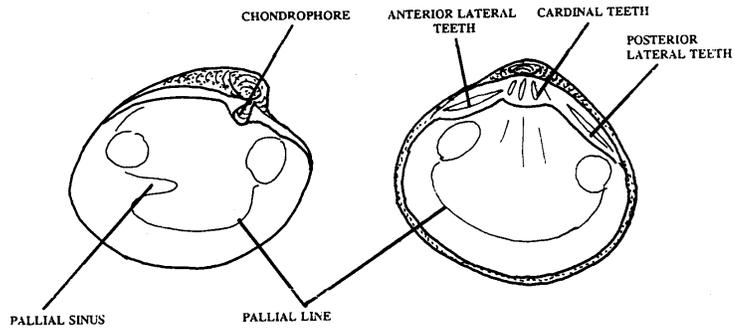


BEAKS NOT ABOVE HINGE LINE

BEAKS ABOVE HINGE LINE

BEAKS ELEVATED AND HOOKED

SHELL FEATURES (NON-UNIONID BIVALVES)



CHONDROPHORE

ANTERIOR LATERAL TEETH

CARDINAL TEETH

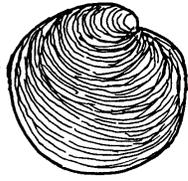
POSTERIOR LATERAL TEETH

PALLIAL SINUS

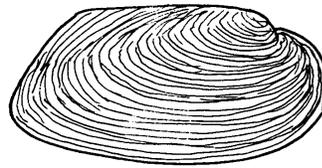
PALLIAL LINE

Figure 2. Examples of shell width and beak morphology of freshwater mussel shells and shell features of non-unionid bivalves.

SHELL SHAPE



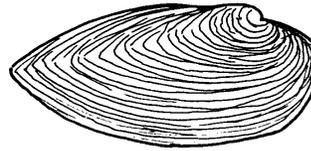
ROUND



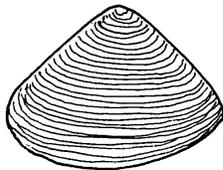
RHOMBOIDAL



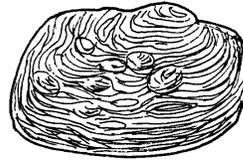
OVAL



ELLIPTICAL



TRIANGULAR



QUADRATE

BEAK SCULPTURING



SINGLE LOOPED



DOUBLE LOOPED

Figure 3. Examples of freshwater mussel shell shape and beak sculpturing.

The remainder of the field notebook consists of a key to the species occurring in the targeted portion of the White River, followed by more detailed descriptions of individual species. The individual descriptions contain a distribution map for each species, discussion of abundance in the river, a color photograph of a “typical specimen”, and a comparison of similar species with characters to discriminate between them. The individual species accounts are divided into three groups based on similarities in appearance. These three groups are the sculptured shells (15 species), the smooth, elongate shells (eight species), and the smooth, non-elongate shells (16 species). The key characteristics used for discrimination between and among species are highlighted in bold within each species description. I hope you find this format user friendly.

Key to Mussels

White River, Arkansas

Newport to Arkansas River

**Key to Freshwater Mussels in the White River, AR
Newport to Arkansas River**

1. a. External portion of shell having knobs, pustules, or parallel ridges2
 b. External portion of the shell mostly smooth 11

2. a. Shell with single row of knobs on the posterior ridge or on the middle portion of
 the shell, sulcus absent3
 b. Shell not as above4

3. a. Shell elongate, more than twice as long as deeprabbitsfoot (*Quadrula cylindrica*)
 b. Shell not elongate, knobs prominent and high.... threehorn wartyback (*Obliquaria reflexa*)

4. a. Shell with two indistinct rows of knobs or pustules, more prominent in the umbo
 region and more developed in smaller specimens; shell sculptured with a
 rough texture; lateral teeth poorly developed. rock pocketbook (*Arcidens confragosus*)
 b. Shell with two prominent rows of knobs or pustules; pseudocardinal teeth and
 lateral teeth well developed.....5
 c. Not as above.....6

5. a. A definite sulcus between the two rows of large pustules; sulcus without small
 pustules in the umbo region mapleleaf (*Quadrula quadrula*)
 b. A definite sulcus between two large rows of pustules; sulcus with small pustules
 in the umbo region; shell usually very pustulose throughout.....
southern mapleleaf (*Quadrula apiculata*)
 c. Pustules in definite rows, no sulcus between the rows; pustules sparse, one to
 three per row, sometimes a pustules may be present only on one row
wartyback (*Quadrula nodulata*)

6. a. Many pustules on shell; margin of shell nearly round; nacre purple
purple wartyback (*Cyclonaias tuberculata*)
 b. Rounded to slightly triangular shell with sulcus between posterior ridge and
 anterior half of shell; sulcus with wrinkled or striated appearance; shell
 colored with tiny flecks that become dense enough to form fine rays; posterior
 slope fluted.....
 western fanshell (*Cyprogenia aberti*)
 c. Shell with parallel ridges or with pustules more or less randomly scattered7

7. a. Posterior ridge with large knobs, ridge extends margin of the shell; external shell
 coloration usually with down-pointing pigmented markings.....
 monkeyface (*Quadrula metanevra*)
 b. Not as above.....8

- 8. a. Shell elongate, posterior ridge prominent and extends margin of the shell; pustules usually present, sometimes extremely prominent pistolgrip (*Tritogonia verrucosa*)
- b. Pustules randomly distributed on shell, abundant to almost absent; usually green pigmented area on umbo, especially in younger individuals; shell nearly round pimbleback (*Quadrula pustulosa*)
- c. Not as above..... 9

- 9. a. Shell with 3 or more parallel ridges beginning on the umbo and directed towards the posterior ventral margin; nacre usually white, sometimes with a purplish iridescence on the posterior marginthreeridge (*Amblema plicata*)
- b. Shell quadrate; usually with pustules and/or ridges..... 10

- 10. a. Umbo covered with small zigzag ridges; posterior slope fluted; exterior coloration black, not shiny; nacre usually white, often with copper or gold colored spots washboard (*Megaloniaia nervosa*)
- b. Posterior ridge prominent, posterior ventral margin appears pointed (especially in smaller individuals); pustules and ridges usually present but not prominent; nacre purple to copper colored..... bankclimber (*Plectomerus dombeyanus*)
- c. Posterior slope fluted; shell compressed and valves relatively thin; beaks low, narrow, not raised above hingeline; external coloration chestnut brown to dark brown, rays often present and prominent in smaller specimens; pseudocardinal teeth present, lateral teeth reduced or absentfluted shell (*Lasmigona costata*)

- 11. a. Shell decidedly more elongate than rounded; shape rhomboidal to elliptical12
- b. Shell round, oval or triangular in shape17

- 12. a. Shell background coloration yellow, with or without rays; posterior and anterior wings absent; shell moderately thick13
- b. Shell background coloration yellow, faint to prominent green rays usually present; posterior wing prominently to poorly developed; shell relatively thin; lateral and pseudocardinal teeth thin.....fragile papershell (*Leptodea fragilis*)
- c. Shell not as above14

- 13. a. Shell without distinct color rays, base color banana yellow yellow sandshell (*Lampsilis teres*)
- b. Shell with distinct, bold green or black color rays.....Louisiana fatmucket (*Lampsilis hydiana*)

- 14. a. Shell decidedly elongate, usually more than twice as long as deep15
- b. Shell elongate, rhomboidal in shape16

- 15. a. Shell with broad, green rays in small specimens, larger specimens uniformly black; dorsal margin rounded, somewhat inflated in large specimens; posterior end rounded in females, bluntly pointed in males; nacre usually white except in beak cavity where it is purple or salmonblack sandshell (*Ligumia recta*)

- b. Shell stout, external coloration uniformly dark; compressed at the dorsal margin; nacre usually dark purple; beak cavity absent..... spike (*Elliptio dilatata*)
 - c. Shell fragile; ventral margin broadly rounded; shell coloration yellow, olive, or brown; nacre rose colored in the beak cavity, iridescent bluish color over the remainder; when viewed from above (dorsal aspect), the shell has a somewhat twisted appearance, almost never is the shell straight ... scaleshell (*Leptodea leptodon*)
16. a. Shell inflated at the posterior end, broadly truncate in females; external coloration dark, black or green, sometimes with broad color rays in small specimens; pseudocardinal and lateral teeth well developed; nacre purple..... bleufer (*Potamilus purpuratus*)
- b. Shell greatly inflated in the umbo region and central part of shell; external coloration tan, olive, black; shell thin; teeth absent.. giant floater (*Pyganodon grandis*)
17. a. Shell with posterior ridge sharply angled (approaching 90 degrees), prominent18
- b. Shell with pronounced, regularly spaced, concentric ridges over the entire surface; external coloration greenish yellow to black and shiny; solid and strong at all sizes.....Asian clam (*Corbicula fluminea*)
- c. Not as above.....19
18. a. Shell triangular to oval; external coloration green, yellow brown, to brown, usually with distinct fine color rays often grouped together to form broad bands of colordeertoe (*Truncilla truncata*)
- b. Shell elongate, described as boat shaped; dorsal end pointed; external coloration yellow, green, tan to black, usually with dark wavy rayszebra mussel (*Dreissena polymorpha*)
19. a. Shell laterally compressed (thin) with posterior dorsal wing present, often prominent20
- b. Not as above21
20. a. Shell nearly circular; shell thin even in large specimens; small posterior wing present; external coloration yellowish tan to olive, shiny; lateral and pseudocardinal teeth absent flat floater (*Anodonta suborbiculata*)
- b. Shell oval with large, prominent posterior dorsal wing, often with small flutations or corrugations; pseudocardinal teeth rudimentary, lateral teeth absent; nacre whitewhite heelsplitter (*Lasmigona complanata*)
- c. Shell oblong to ovate with prominent posterior dorsal wing and a smaller anterior wing; external coloration greenish, reddish brown, or light brown, and shiny; nacre color light purple to pink; thin pseudocardinal teeth and lateral teeth short and curvedpink papershell (*Potamilus ohioensis*)

21. a. Shell oval to elliptical, often greatly inflated; external coloration yellow in small individuals to brownish yellow in larger specimens, almost always with prominent color rays; nacre white; beaks broad and raised above the hinge line; pseudocardinal and lateral teeth well developed plain pocketbook (*Lampsilis cardium*)
- b. Shell oval and greatly inflated; dorsal margin s-shaped; beaks broad, high and turned decidedly inward; external coloration tan, gray, or olive and color rays absent, shell shiny; nacre bluish white tinged with salmon..... fat pocketbook (*Potamilus capax*)
- c. Not as above22
22. a. Shell acutely to broadly triangular, thick; beaks inflated; coloration reddish brown to black.....23
- b. Not as above24
23. a. Shell acutely triangular (distinctly taller than wide); coloration dark brown to black; beaks elevated and hooked; sulcus absent in front of posterior ridge pyramid pigtoe (*Pleurobema rubrum*)
- b. Shell broadly triangular; coloration reddish brown to brown; beaks broad but not extremely elevated; posterior ridge prominent and often sharply angled; broad flat sulcus in front of posterior ridge Wabash pigtoe (*Fusconaia flava*)
24. a. Shell broadly triangular, laterally compressed; shell thick and stout; posterior ridge prominent and acutely angled; beaks broad and flattened on the side but pointed at the apex; external coloration yellow, yellow brown or greenish brown; color rays narrow to broad and covering entire shell, rays discontinuous with spots, bars, and chevron shapesbutterfly (*Ellipsaria lineolata*)
- b. Shell broadly triangular, moderately inflated; shell thin to moderately thick; posterior ridge not prominent, posterior slope gentle; external coloration yellow to yellowish green, color rays form vertical bands, w-shaped markings aligned horizontally on shell fawnsfoot (*Truncilla donaciformis*)
- c. Not as above25
25. a. Shell oval to circular, often somewhat elongated posteriorly; beaks thick and inflated; external coloration tan, brown to black, color rays sometimes present.....26
- b. Not as above.....27
26. a. Shell thick and stout, anterior end considerably thicker than posterior half; beaks elevated and hooked, strongly directed forward; nacre white; pseudocardinal teeth parallel to long axis of lateral teeth ebonyshell (*Fusconaia ebena*)
- b. Shell thick and stout, posterior end nearly as thick as anterior half; beaks stout, but not extensively elevated above hingeline; external coloration yellowish brown to brown, often with broad color rays; pseudocardinal and lateral teeth stout, not parallel; nacre white with pink in beak cavity or entirely pink.....pink mucket (*Lampsilis abrupta*)

27. a. Shell oval and elongate posteriorly; shell inflated anteriorly and thin posteriorly; beaks narrow, elevated and hooked; external shell color yellowish brown to olive brown with fine green rays over entire shell, rays may be faint to absent in larger specimens; pseudocardinal and lateral teeth well developed, not parallel; small pseudocardinal tooth (denticle) anterior to pseudocardinal of right valve; nacre white.....hickorynut (*Obovaria olivaria*)
- b. Shell outline quadrate to elliptical; shell stout and thick to very thick, compressed to inflated; beaks broad and only slightly elevated; external coloration tan, brown to black, often with broad color rays; pseudocardinal and lateral teeth thick; nacre white to pinkmucket (*Actinonaias ligamentina*)

Group 1

Shells with Knobs, Pustules, Folds and Ridges

Bankclimber
(*Plectomerus dombeyanus*)

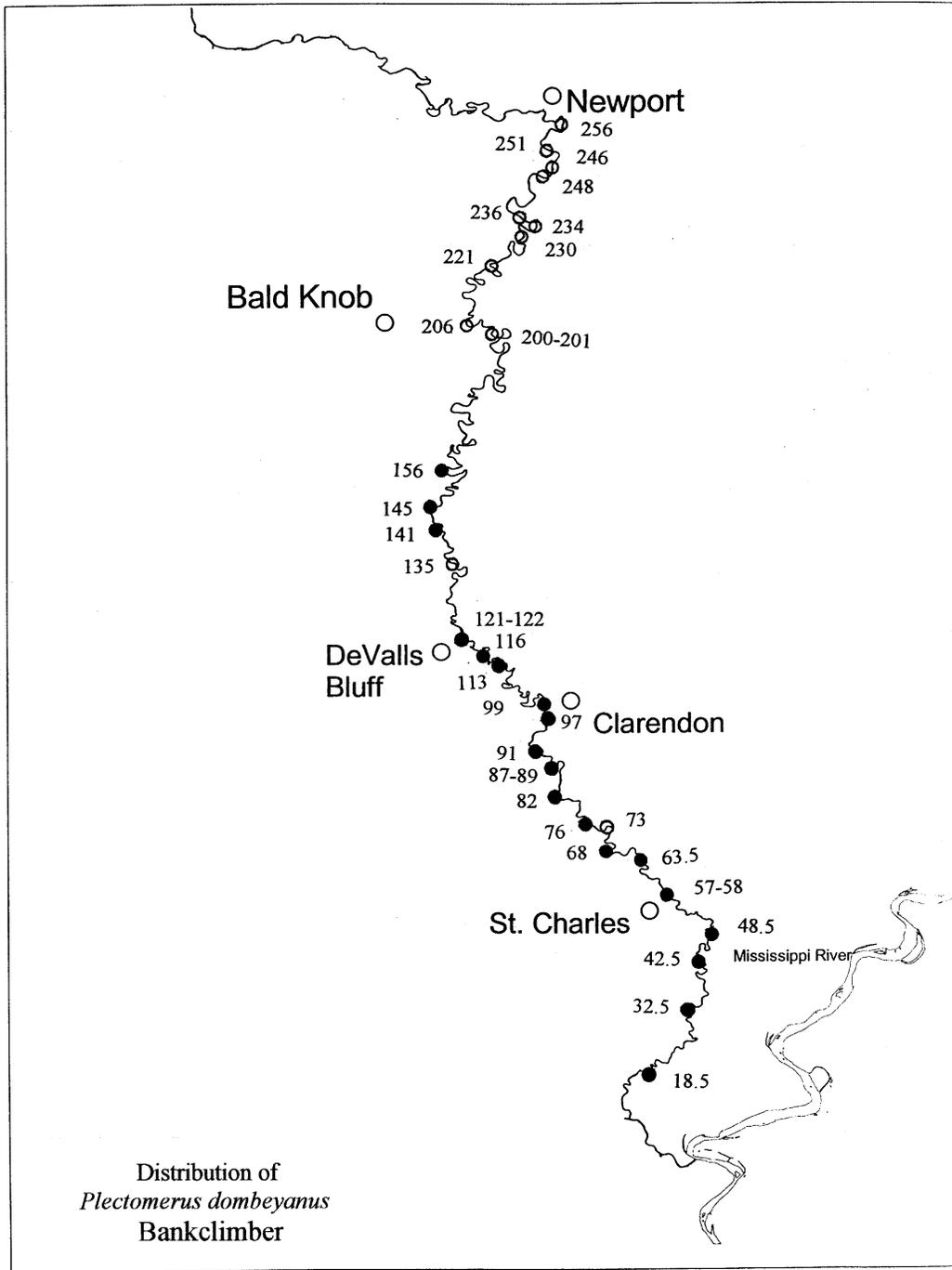
Description: **Shell quadrate**, compressed to moderately inflated with moderately thick valves. **Prominent, downturned posterior ridge with numerous small undulations anterior and posterior to the ridge.** External coloration is brown or black and rays are not evident; **nacre color is purple to copper**, often lighter outside the pallial line.

Similar species: Washboard has a less prominent posterior ridge, rounded posterior end (versus truncate), and white nacre. Three ridge is less quadrate, has 3-6 anterior to posterior ridges, generally lacks pustules and pimples anywhere on the shell, and has white nacre. Pistolgrip is more elongate with prominent knobs on the posterior ridge and a white or light purple nacre.

Relative abundance: Found primarily in the downstream half of the study region. Not abundant, usually comprises < 2% of total mussels in beds where it is found. Seems to do well in riprap areas that have been placed for bank stabilization such as found at DeValls Bluff and Clarendon.

Local names: bankclimber, washboard





Flutedshell
(*Lasmigona costata*)

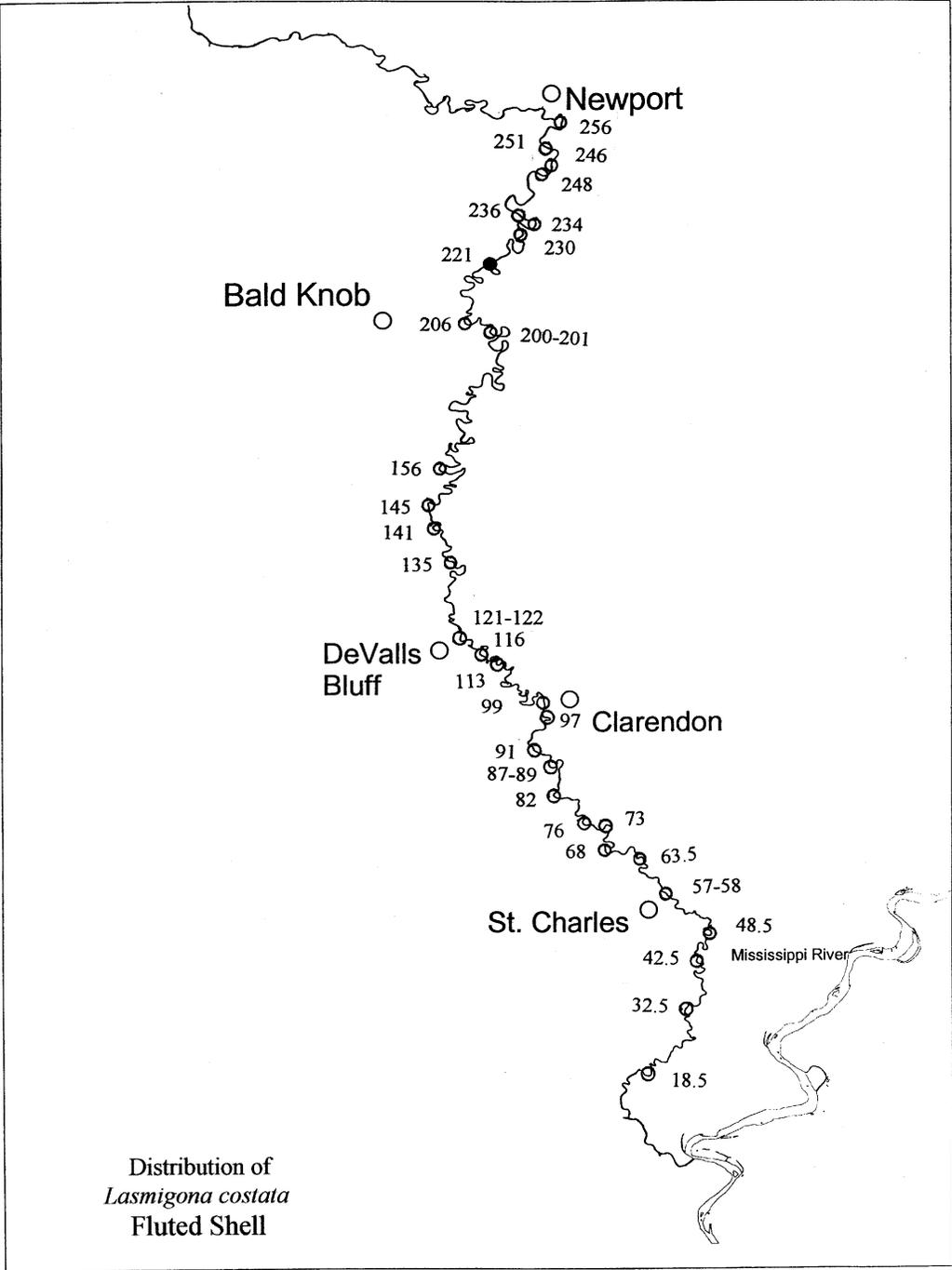
Description: **Shell elongate rhomboidal in shape**, compressed to moderately inflated; valves thin to moderately thick. **Posterior slope covered with prominent to sometimes indistinct flutings or small ridges.** External color tan to black with indistinct broad green rays often present. **Pseudocardinal teeth reduced, lateral teeth absent.** Nacre white to iridescent; soft tissues usually bright orange. Maximum length to seven inches.

Similar species: Mucket is similarly shaped but a much heavier shell lacking flutes on the posterior slope. Louisiana fatmucket is smooth shelled with prominent bold green rays. Fragile papershell is smooth shelled with a more or less well developed posterior wing. Spike is elongate but much heavier shelled, lacks flutings and usually has a purple nacre.

Relative abundance: Fluted shell is very rare in the study reach and has been recorded from only one site. It usually occurs in medium sized rivers and streams, and is expected to be more likely to occur upstream of River Mile 200.

Local names: flutedshell





Mapleleaf
(*Quadrula quadrula*)

Description: The **shell is roundly quadrate to broadly triangular** in outline, scarcely to moderately inflated, with moderately thick individual valves. The **posterior ridge is well developed, and a depression or sulcus occurs between the ridge and the mid-portion of the shell. Pustules or pimples usually occur on each ridge creating two rows of pustules** but these are occasionally absent. External color ranges from tan to brown, and green rays often occur near the pustules. The nacre is white, the teeth well developed, and a deep beak cavity is present. Maximum shell size is approximately five inches. There is wide variation in shell morphology for this species. *Four types are illustrated in the accompanying illustrations.*

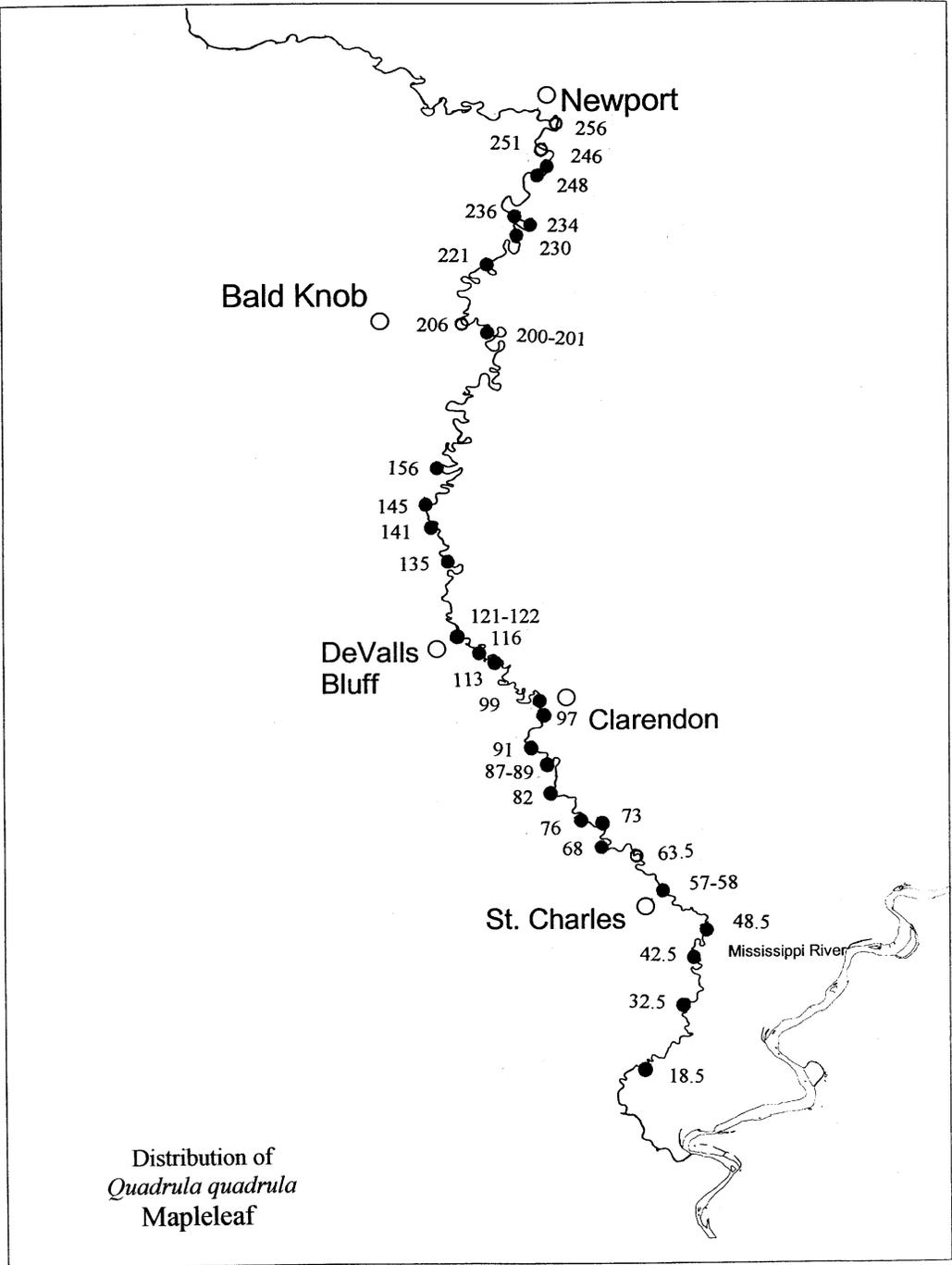
Similar Species: The mapleleaf is similar to the southern mapleleaf, wartyback, rock pocketbook, pimpleback, purple wartyback, and western fanshell. The mapleleaf and southern mapleleaf both have two rows of dorsal to ventral pustules with a sulcus in between. The southern mapleleaf has pimples in the sulcus in the umbo region and is very pustulose all over the shell. The mapleleaf should not have pustules in the sulcus in the umbo region. The rock pocketbook may have two rows of small knobs in the umbo region but lacks additional pustules, is thin shelled and inflated. The wartyback has two rows of pustules or knobs but no sulcus and is usually round, the mapleleaf quadrate. The pimpleback and purple wartyback lack the two distinct rows of pustules and do not have a sulcus. The western fanshell has a sulcus but completely lacks pustules.

Relative abundance: Distributed throughout the region, it is often the numerically dominant or co-dominant species in the lower 120 river miles. It is less abundant in upper half of the region.

Local names: None.

Shell variance of mapleleaf.





Monkeyface (*Quadrula metanevra*)

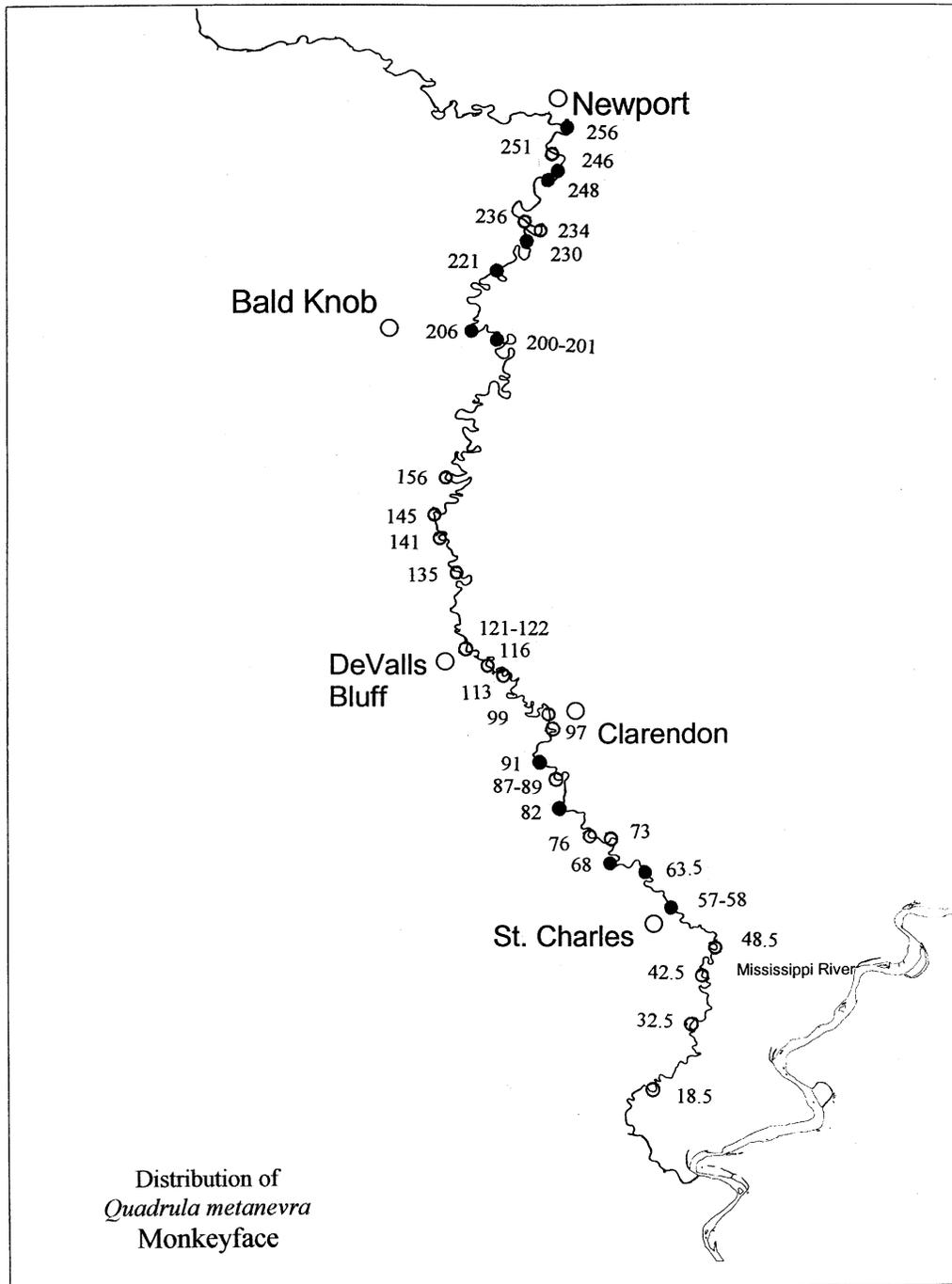
Description: **Quadrate**, moderately inflated shell with moderately thick to thick valves. **Prominent posterior ridge with a series of large knobs or pustules.** Smaller pustules usually prominent on other portions of the shell. External coloration is yellowish, tan, or brown with numerous small to large, dark green, down pointing triangles scattered randomly over the shell. Nacre is white. Maximum length about five inches.

Similar species: Rabbitsfoot has large knobs on the posterior ridge and similar coloration, but it is much more elongate than monkeyface. Mapleleaf, southern mapleleaf, wartyback and pimpleback do not possess the prominent posterior ridge with large knobs.

Relative abundance: Fairly widely distributed in the region. In the lower part of the river (River Miles 50 - 100), it usually makes up no more than 1-2% of the mussels in a bed. In the upper portion of the region (upstream of River Mile 200) it is more abundant, usually comprising from 2-10% of the total mussels in a bed.

Local names: monkeyface





Pimpleback
(*Quadrula pustulosa*)

Description: **Round shell**, moderately inflated, moderately thick to thick valves. External color tan to dark brown, **often with a green shower of color extending from the umbo** a short distance to the shell's center. **Shell exterior has few to many pustules and/or pimples (sometimes completely absent)**. **Nacre is white**, teeth are well developed, and a well developed beak cavity is present. Maximum length about three inches.

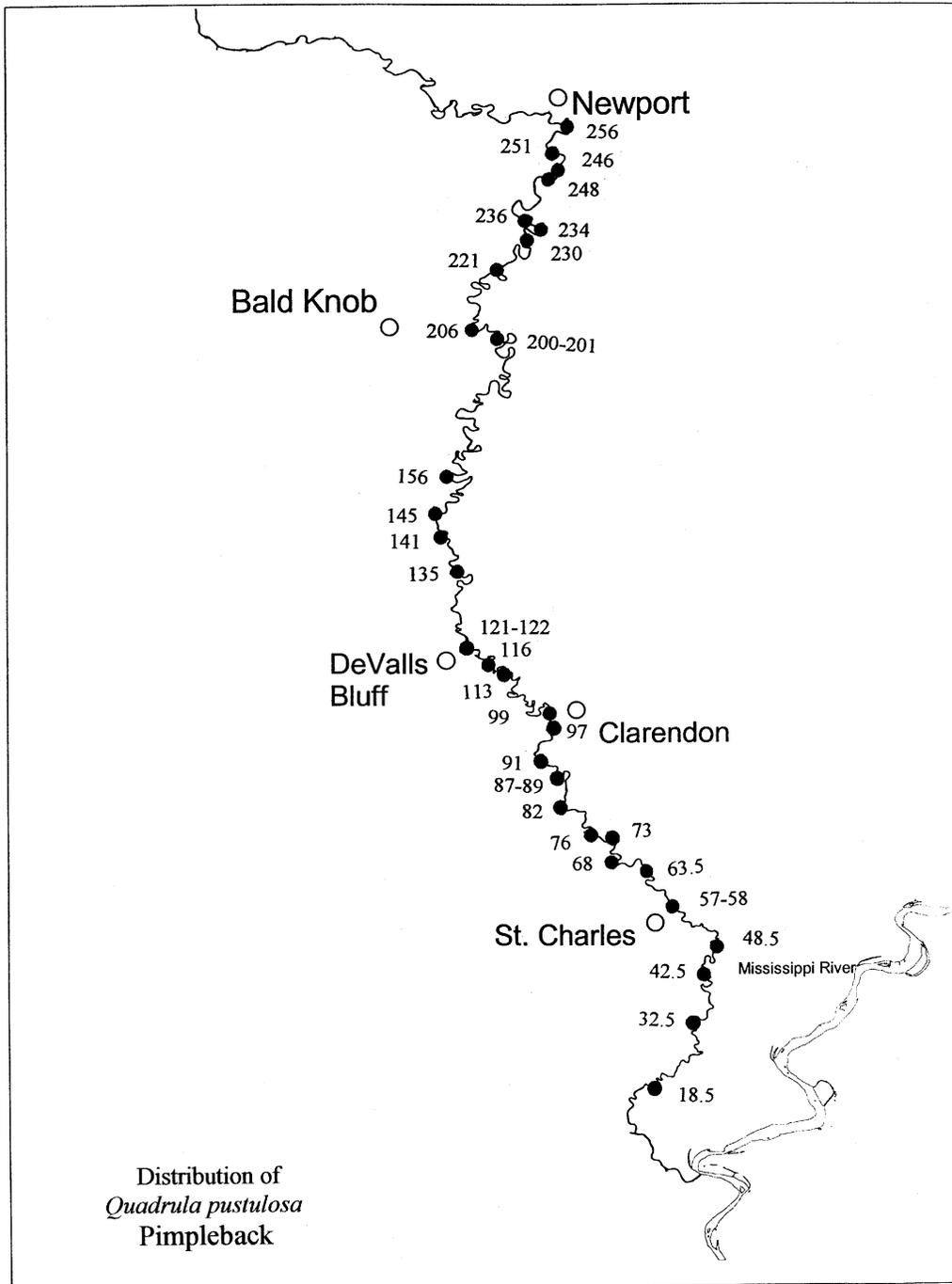
Similar species: Purple wartyback has purple nacre and taller, more prominent pimples over the posterior two thirds of the shell. Wartyback has a more wing-like posterior slope and never has green coloration on the umbo.

Mapleleaf and southern mapleleaf always have a sulcus and a more prominent posterior ridge. Pimpleback without pustules are difficult to separate from Wabash pigtoe. Wabash pigtoe has a more prominent posterior ridge, more acutely angled posterior slope, a broader, flatter umbo region, and triangular shape.

Relative abundance: Widely distributed throughout the study region. The pimpleback comprises from 5-15% of the total mussels in beds in the downstream half of the study region. In the upstream half of the study region, it comprises from 15-50% of the total mussels in beds.

Local names: pimpleback





Pistolgrip (*Tritogonia verrucosa*)

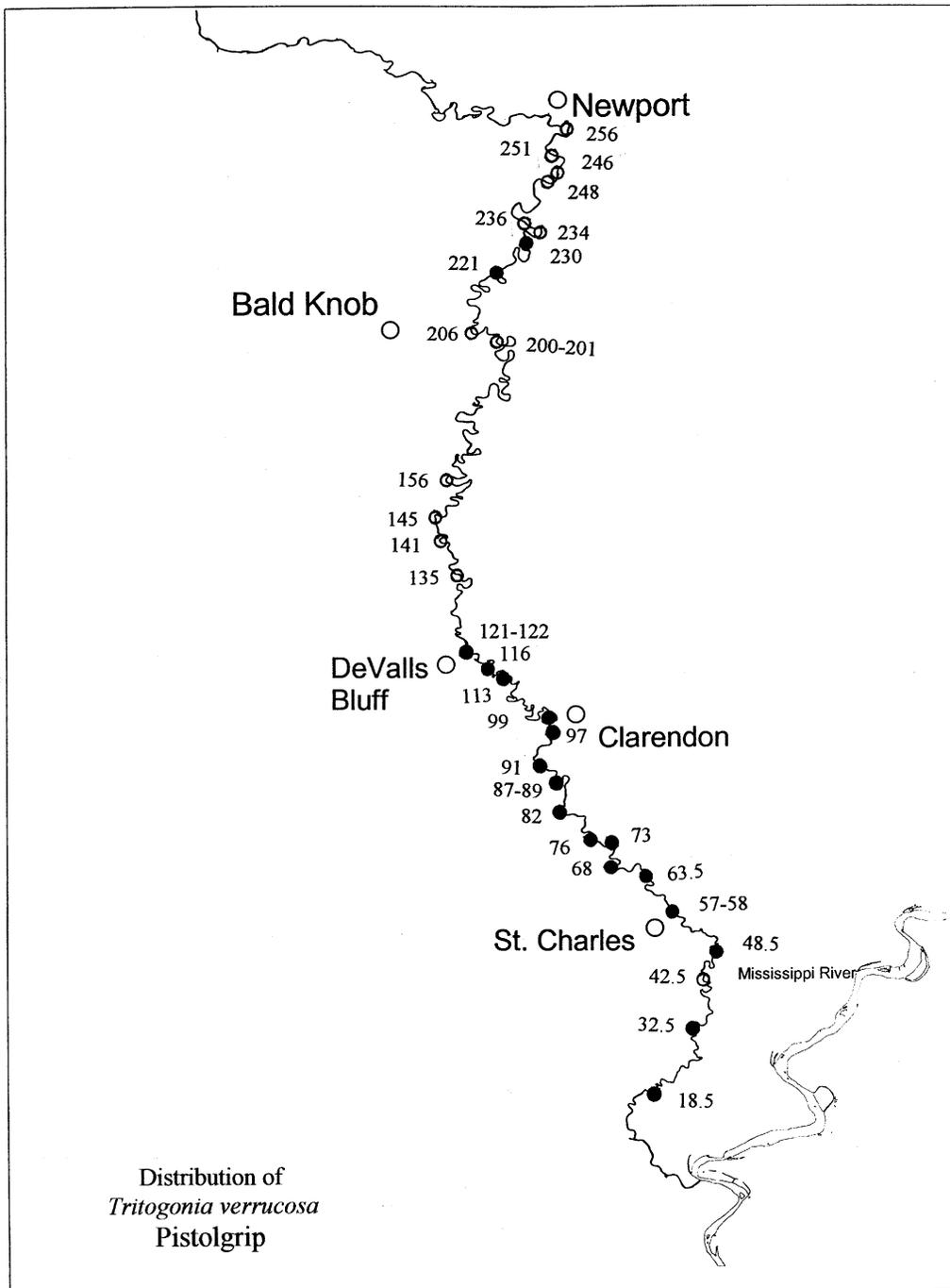
Description: Elongate to slightly quadrate shell with prominent posterior ridge that terminates in a bulge at the ventral margin. Shell compressed to slightly inflated, and valves are thick to moderately thick. Shell exterior covered with bumps, pustules and flutings, especially anterior to the posterior ridge. Posterior slope with flutings or wavy pustules. Exterior coloration brown, greenish brown, to black, occasionally with small greenish downpointing triangles in small specimens. Nacre is white, pink or light purple. Pseudocardinal and lateral teeth are well developed. Maximum length is 10-12 inches.

Similar species: Most similar to the bankclimber in shape, but bankclimber lacks pustules and is more quadrate in shape with a distinctive coppery to purple nacre. Threeridge and washboard are more quadrate and lack the prominent posterior ridge of pistolgrip. Spike and black sandshell are elongate and dark colored, but both of these are smooth shelled throughout.

Relative abundance: Pistolgrip is more widespread downstream of River Mile 125 but also occurs in the upper reaches of the study region. It is generally more common in the lower reaches and usually comprises from 2-5% of the total mussels in these beds.

Local names: buckhorn





Purple Wartyback (*Cyclonaias tuberculata*)

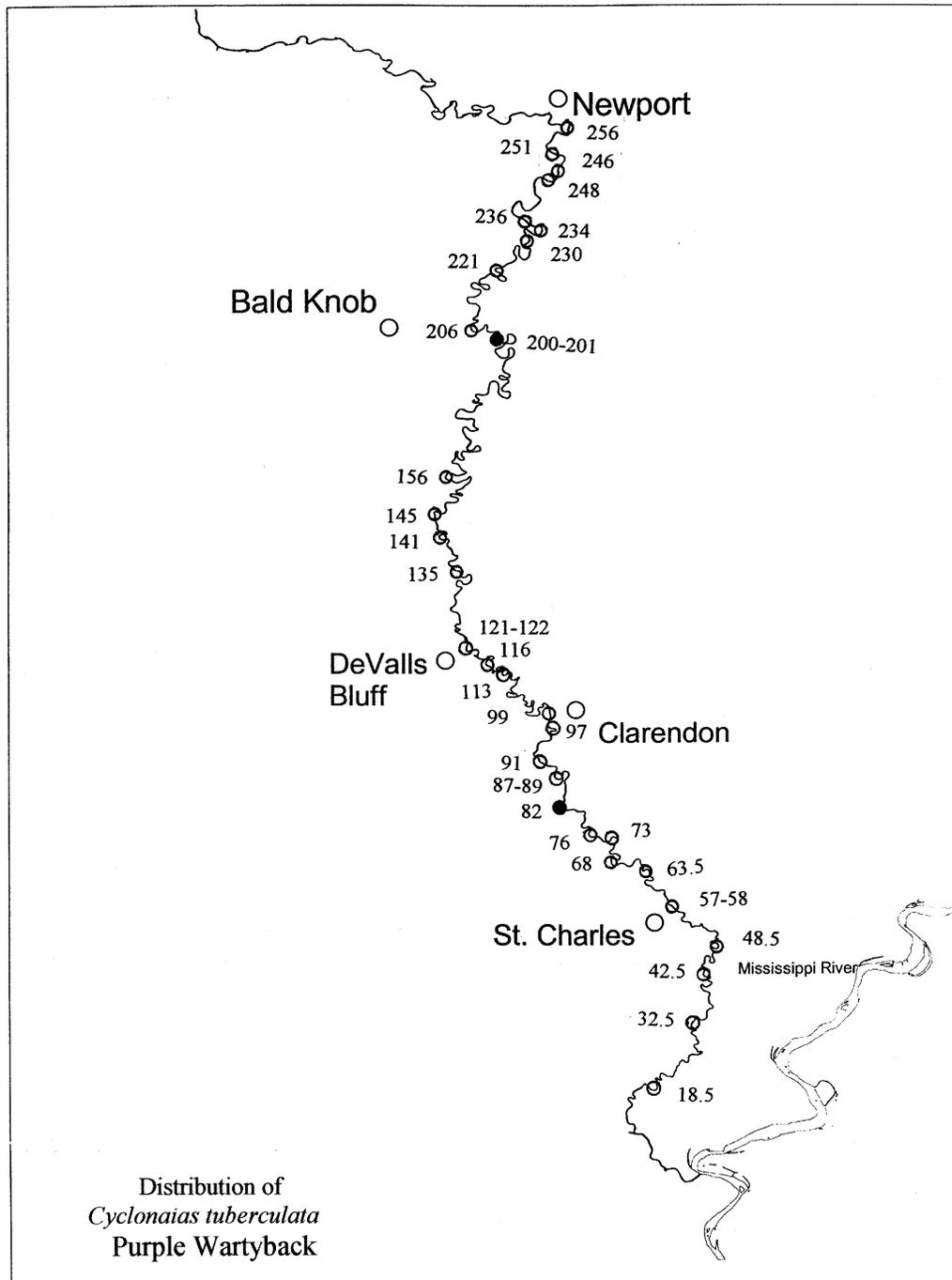
Description: Round shell with pustules and flutings densely distributed on the posterior two thirds of the shells exterior. Moderately thick valves and slightly inflated shell are characteristic of the White River form in this region. External color is dark brown to black in the big river form, **nacre is deep purple**. Pseudocardinal and lateral teeth are well developed. Maximum size is three inches.

Similar species: Most similar to the pimpleback which has a white nacre, and the pimples are seldom as “tall” or well developed as those of the purple wartyback. Also similar to the wartyback, mapleleaf, and southern mapleleaf but these species have two rows of pustules and white nacre.

Relative abundance: A rare member of the mussel fauna, the purple wartyback has been found at two locations in the region and in very low numbers at each site.

Local names: walnut, purple pimpleback





Rabbitsfoot (*Quadrula cylindrica*)

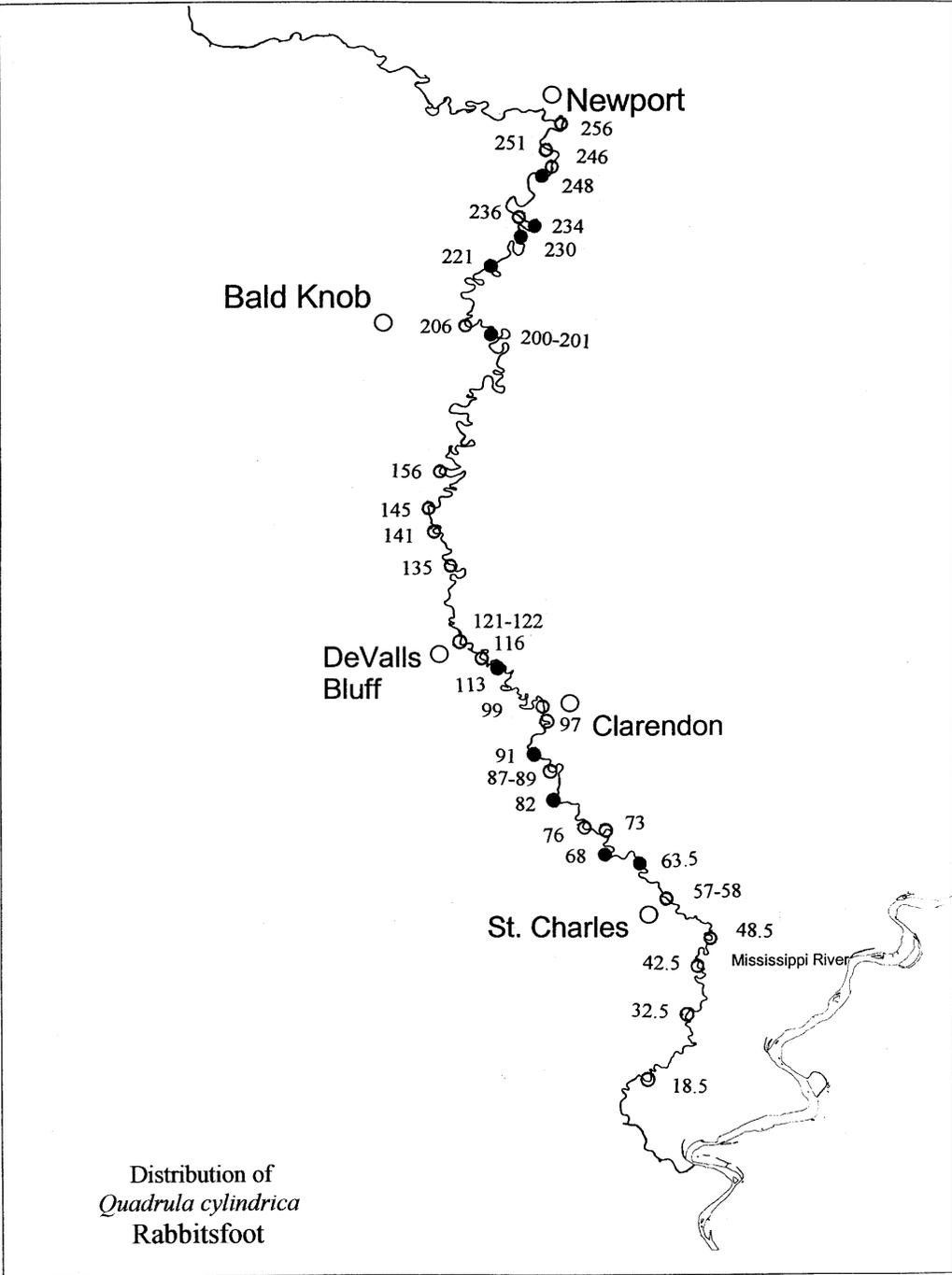
Description: An **elongated, quadrate shaped shell**, moderately inflated, with thick to moderately thick valves. The **posterior ridge has large, distinctive knobs**. The **shell generally maintains the same depth from the anterior to posterior ends**. External coloration is yellow to tan with extensive green chevrons covering the shell. The nacre is white and the teeth well developed. Maximum length is about four inches.

Similar species: The rabbitsfoot is probably most similar to the monkeyface, pistolgrip and small individuals of the bankclimber. The rabbitsfoot is much more elongate than the monkeyface, and the bankclimber lacks the characteristic knobs on the posterior ridge that define the rabbitsfoot. The pistolgrip tapers significantly from the anterior to posterior in females, is much deeper relative to its length than the rabbitsfoot, and also has few to many pustules on the shell. The rabbitsfoot is also superficially similar to other elongate species like the spike, black sandshell, and yellow sandshell however they are smooth shells.

Relative abundance: The rabbitsfoot is relatively rare but widespread in the White River. It has not been found in the lower portion of the river downstream of River Mile 60 (approximately St. Charles).

Local names: cucumber, corncob, cob shell





Rock Pocketbook (*Arcidens confragosus*)

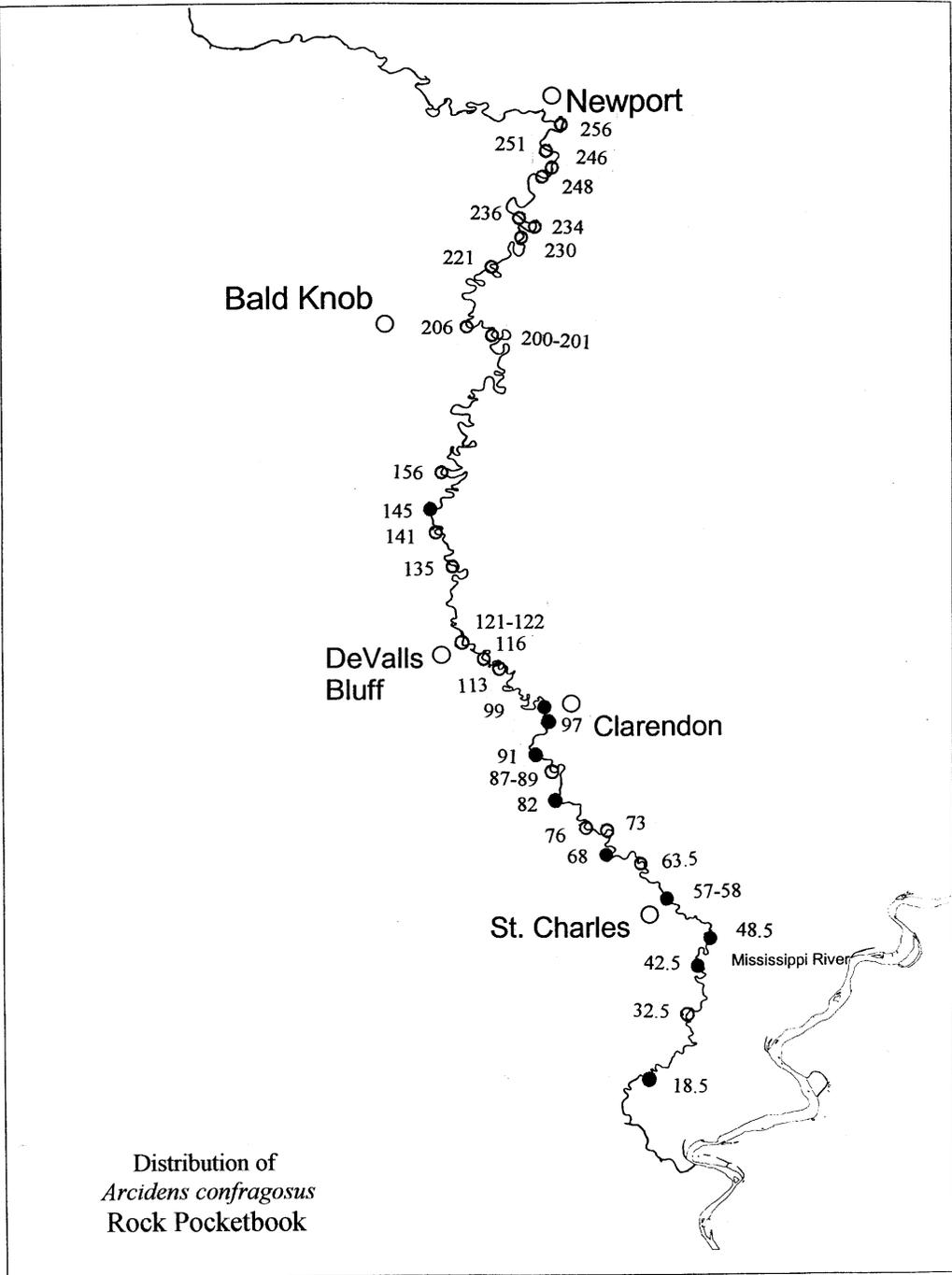
Description: Shell thin to moderately thick, **quadrate to elliptical, and inflated**. The umbos are elevated above the hingeline and located near the middle of the shell. The **umbos also have two rows of pustules or knobs that are more prominent in smaller shells** and generally become smaller to absent on the ventral half of the shell. The **pseudocardinal teeth are moderately developed but the lateral teeth are poorly developed to almost absent**. The nacre is white to iridescent. Maximum shell length is approximately eight inches.

Similar species: Young rock pocketbook resemble the mapleleaf, however the mapleleaf is a much heavier, less inflated shell. Also the pustules on the mapleleaf are usually well developed to the ventral margin of the shell. The threeridge has a similar shell outline, however the threeridge usually has the characteristic parallel ridges running anterior to posterior and the rock pocketbook lacks these ridges.

Relative abundance: The rock pocketbook is distributed throughout the lower 150 river miles of the White River. The rock pocketbook is relatively rare and comprises a small percentage (usually < 2%) of total mussels in most beds.

Local names: rockshell, grandmaw





Southern Mapleleaf
(*Quadrula apiculata*)

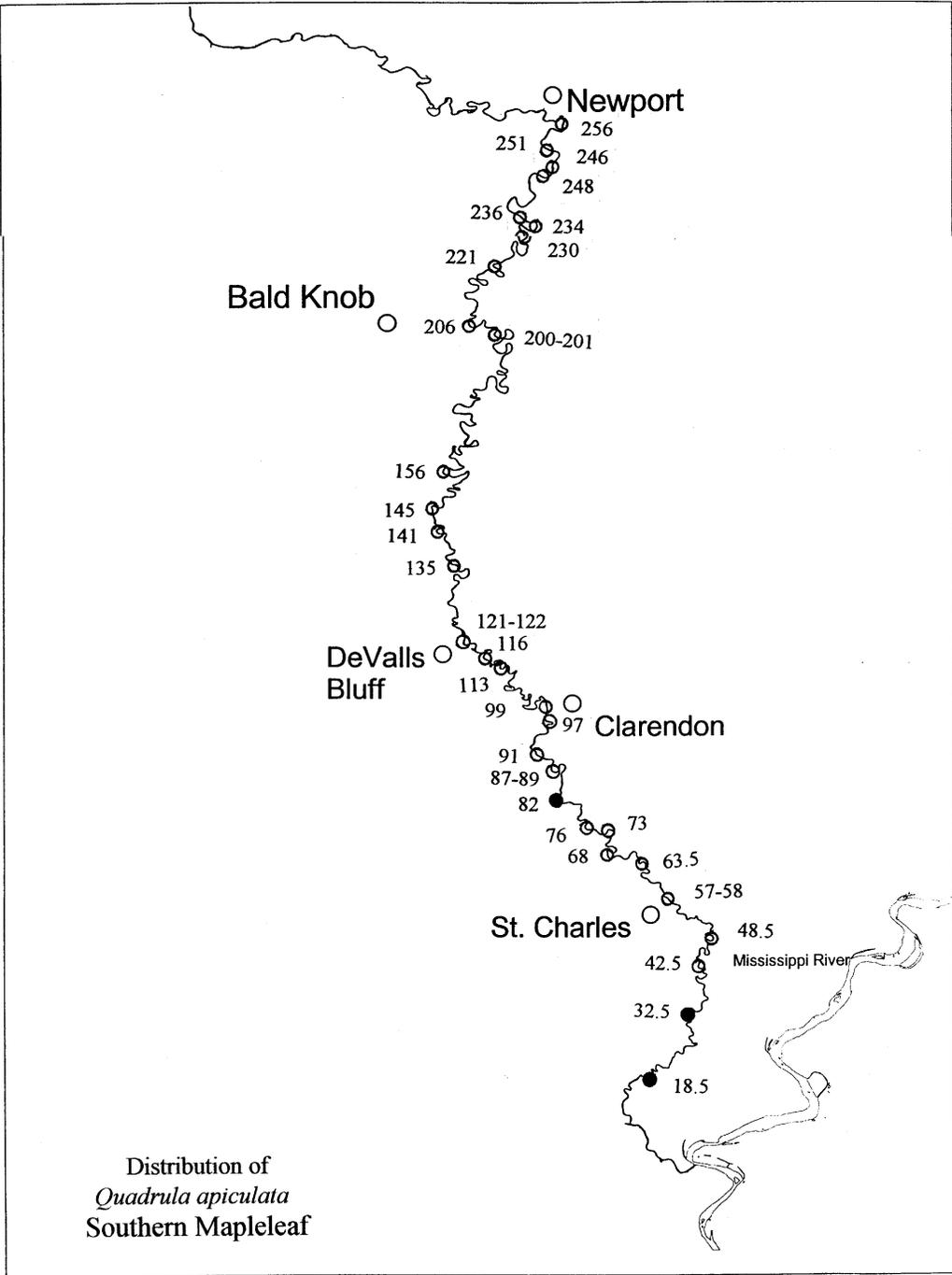
Description: **Shell shape quadrate**, solid, scarcely to moderately inflated. **Two rows of pustules from umbo to ventral margin, sulcus is present. Densely pustulose all over shell, small pustules in sulcus in the umbo region.** External shell color tan to brown, nacre white. Maximum length is four inches.

Similar species: Very similar to mapleleaf, but mapleleaf lacks pustules in the sulcus of the umbo region, and is usually not as pustulose over the rest of the shell as the southern mapleleaf. Pimpleback, wartyback, and purple wartyback all lack the sulcus. Western fanshell has the sulcus but lacks pustules. Rock pocketbook has two rows of knobs in the umbo region but lacks pustules over the remainder of the shell, and it is thinner shelled and more inflated.

Relative abundance: A relatively uncommon species that occurs in the lower most 80 river miles of the study region. It will seldom comprise more than 2% of total mussels in a bed.

Local names: mapleleaf





Threehorn Wartyback (*Obliquaria reflexa*)

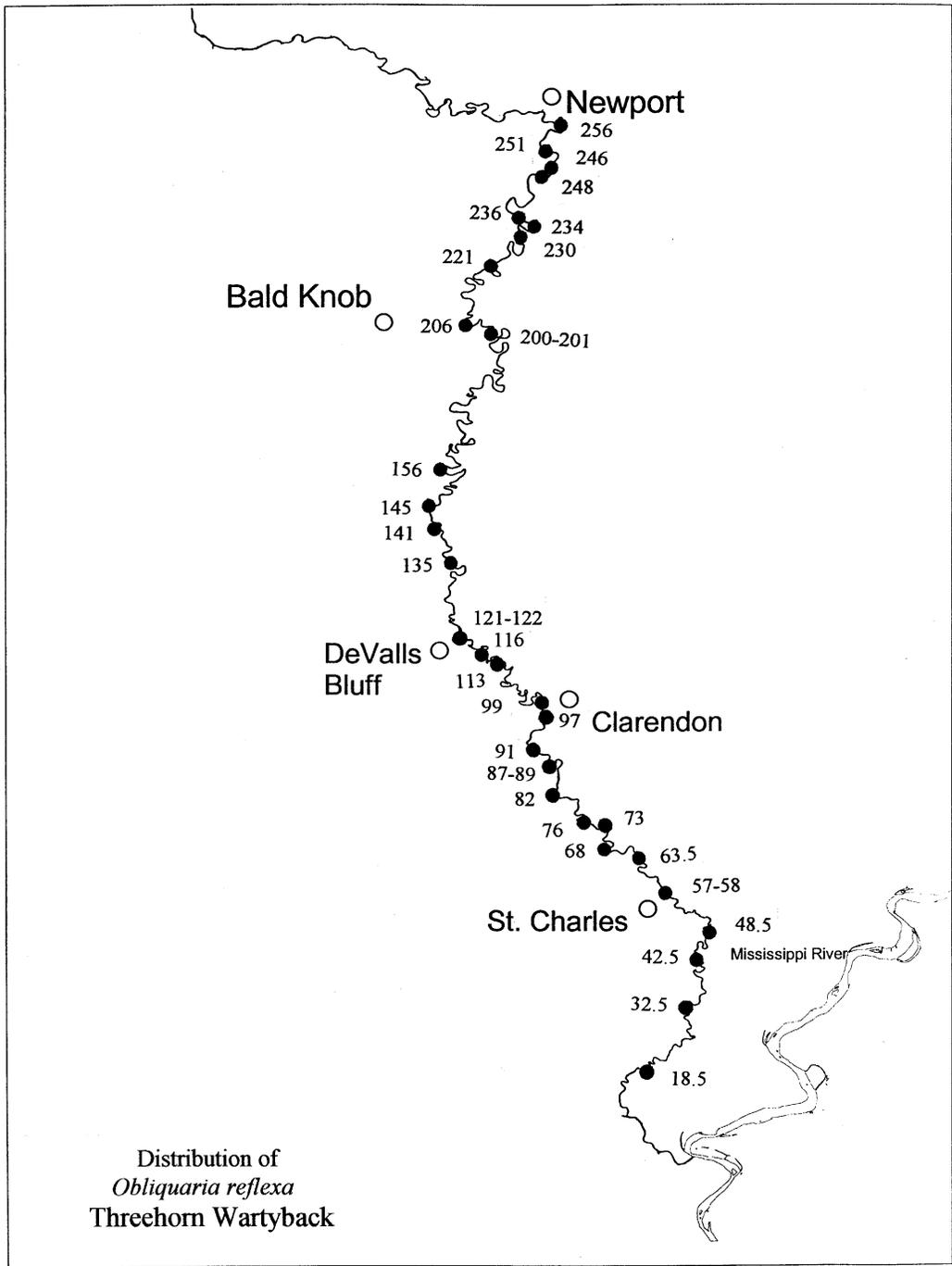
Description: The **shell is round to broadly triangular** in outline with **one to four (usually three) prominent knobs in a row down the middle of the shell from dorsal to ventral**, and a series of ridges on the posterior slope. Nacre color is white to iridescent, and the external color is yellow, yellow-green or tan or tan with fine green rays covering most of the shell. Valves are thick with well developed teeth. Maximum size is about three and a half inches.

Similar species: The threehorn wartyback is superficially similar to the mapleleaf and wartyback. The mapleleaf has two rows of pustules running dorsal to ventral with a sulcus in between, and the wartyback has somewhat larger pustules, also in two rows, but without a sulcus. Neither species has the large knobs or raying characteristic of the threehorn wartyback.

Relative abundance: The threehorn wartyback is distributed throughout the White River and is moderately abundant. It is usually not a dominant species in mussel beds but can contribute 10-15% of the total mussels in some beds.

Local names: three dot, hornyback, three knot





Threeridge (*Amblema plicata*)

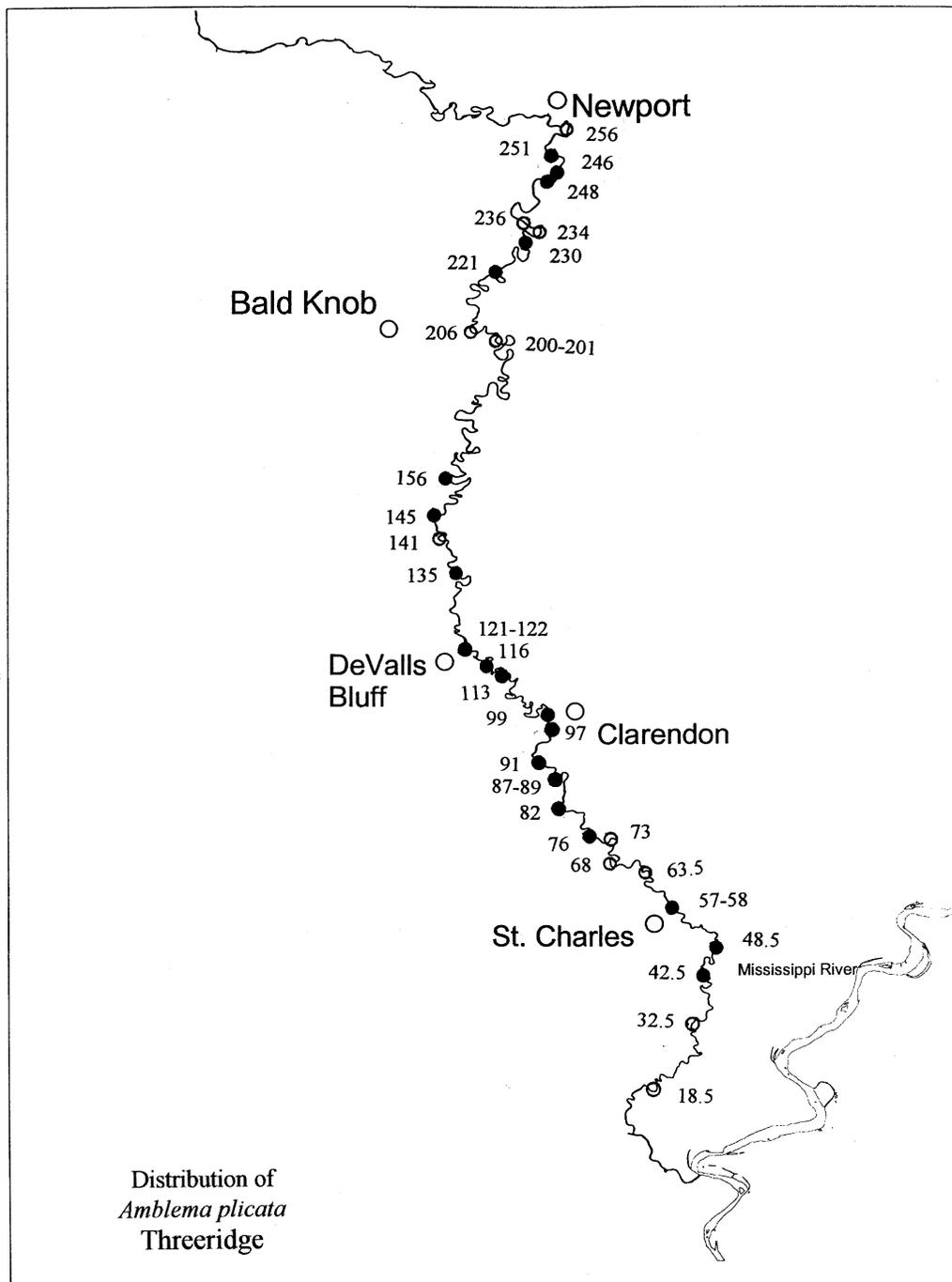
Description: Shell **rectangular to quadrate**, moderately compressed to moderately inflated, with thick to very thick valves. **Pseudocardinal and lateral teeth well developed** and large. **Three to six (occasionally more) undulating ridges running from the anterior to posterior**. External coloration ranges from tan to black. Nacre white, some specimens with blue, purple or pink tinge at posterior apex.

Similar species: Some specimens of washboard are very difficult to distinguish from threeridge. Washboard has pimples anterior to the umbo and much smaller pseudocardinal teeth when compared with comparable sized threeridge. Bankclimber has a more quadrate shape, lacks ridges, and possesses a prominent posterior ridge.

Relative abundance: Widespread throughout the study region, but never occurring in large numbers. Usually comprises 1-2% of the total mussels in the lower reaches of the river. More abundant upstream of River Mile 200 comprising 5-10% of the mussels in some beds.

Local names: bluepoint, threeridge





Wartyback
(*Quadrula nodulata*)

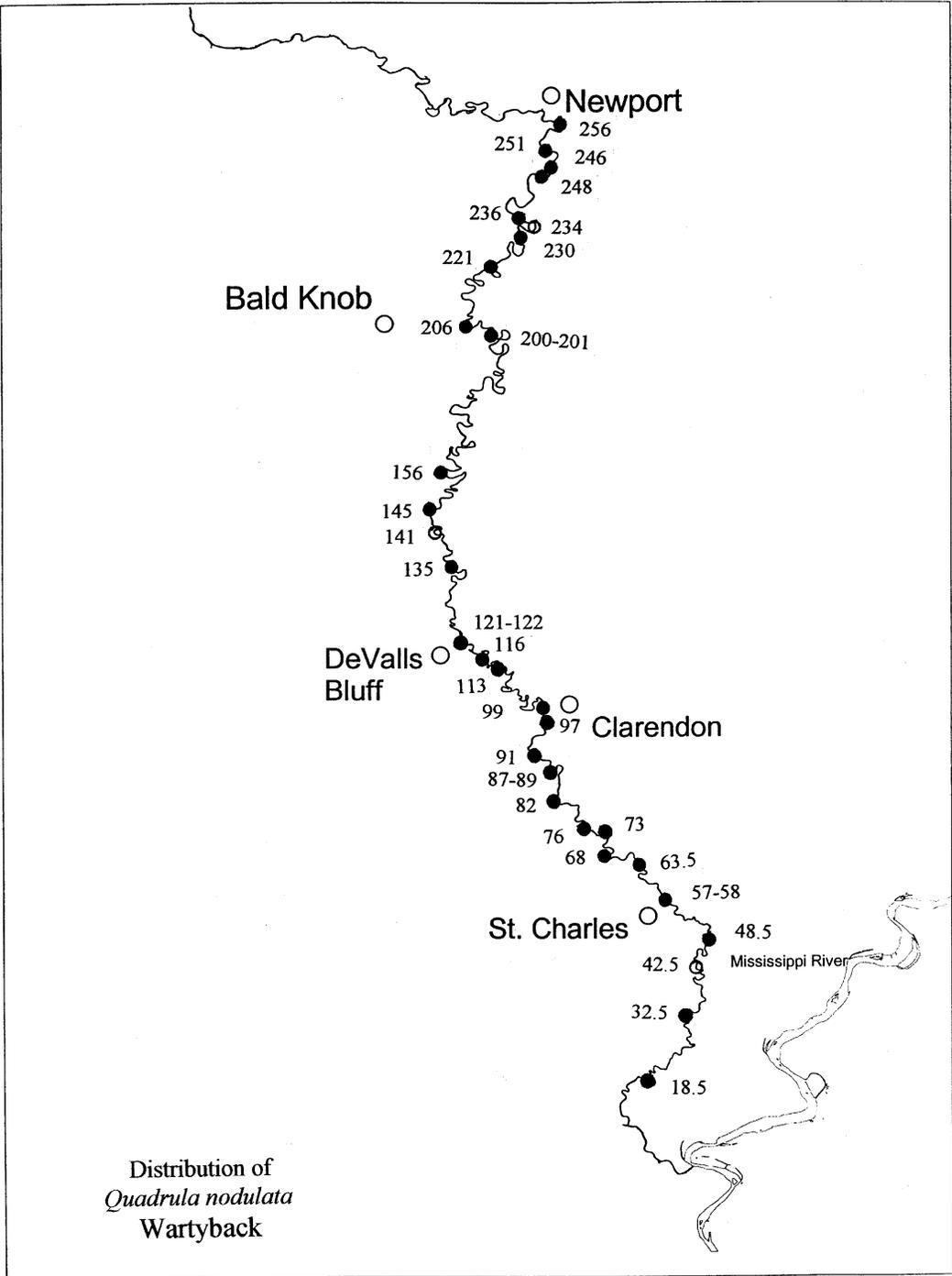
Description: **Round**, moderately inflated shell with moderately thick valves. **Two rows of large pustules from umbo to ventral margin.** There is **no sulcus** between the two rows of pustules or knobs. External shell color is yellow to tannish brown, and color rays are absent. Nacre is white. Maximum length is three inches.

Similar species: Most similar to the pimpleback, but pimpleback does not have distinct rows of knobs or pustules, and pimpleback will often possess green coloration in the umbo region. The mapleleaf and southern mapleleaf both have a sulcus between two rows of pustules and are quadrate in outline. The western fanshell lacks pustules and has a sulcus with small furrows. The threehorn wartyback is sometimes shaped and colored like the wartyback, however the threehorn wartyback has the single row of knobs down the center of the shell.

Relative abundance: The wartyback occurs throughout the region, but it is never very abundant, usually composing 1-2% of total mussels within a bed.

Local names: pimpleback, mapleleaf, purple wartyback





Washboard
(*Megalonaias nervosa*)

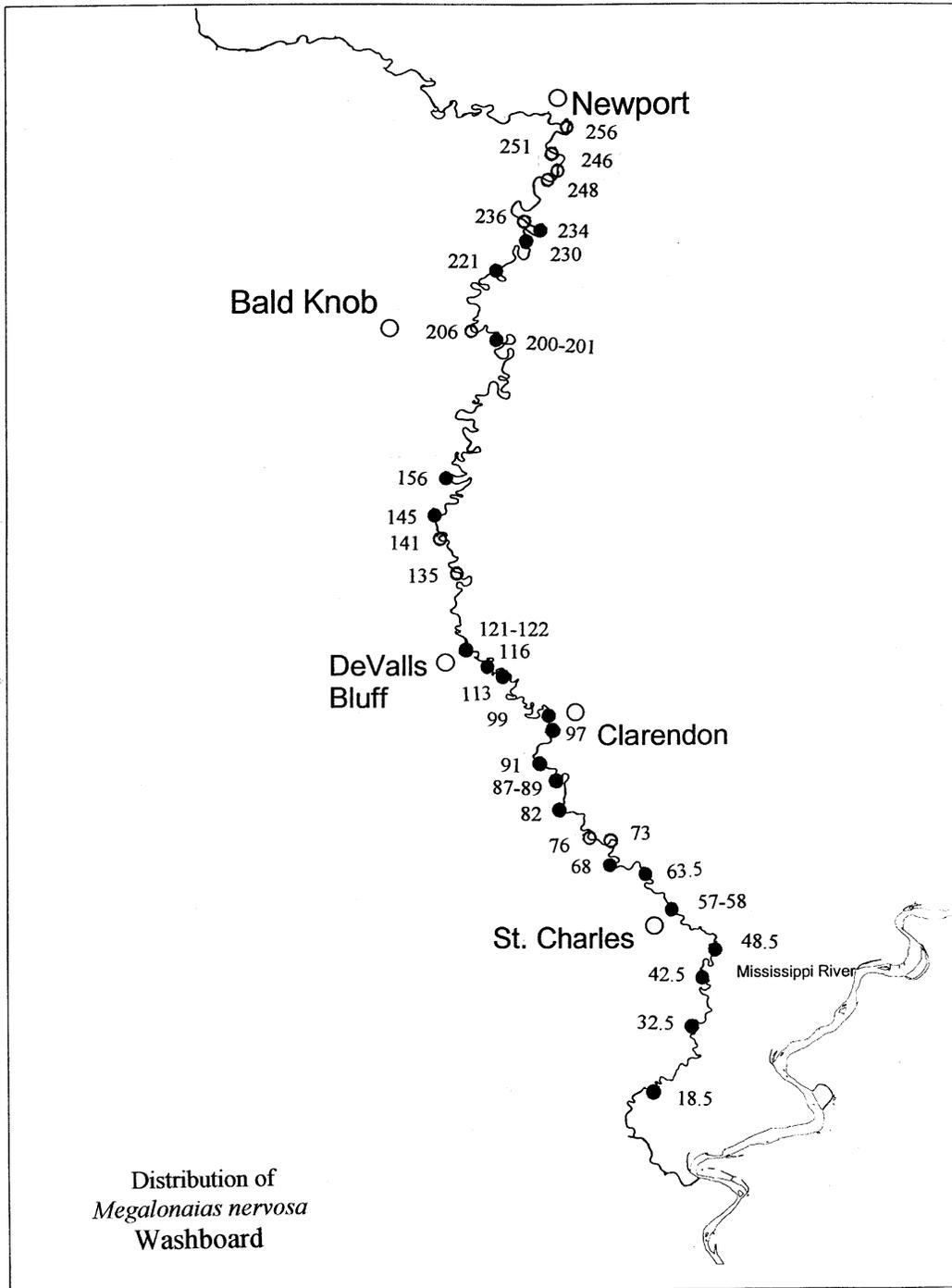
Description: **Shell quadrate to slightly elongate**, compressed to moderately inflated, valves thick. **External surface corrugated with a variety of small ridges, flutes, and pustules**. External color tan to black, nacre white. Lateral teeth well developed and large; **pseudocardinal teeth well developed but medium sized compared with total shell size**. Maximum length 10-12 inches.

Similar species: Threeridge usually has 3-6 distinct anterior to posterior ridges, generally lacks pustules or pimples anywhere on the shell, and the pseudocardinal teeth are much larger in relative size. Bankclimber is more quadrate in shape with more prominent, downturned posterior ridge, and coppery to purple nacre. Rock pocketbook has distinctive double row of small knobs on umbo, is more inflated with thinner valves, and has poorly developed teeth.

Relative abundance: Widely distributed in the region, a little more common in the lower half of the study area. Usually comprises from 2-5% of total mussels downstream of River Mile 125, and < 2% of further upstream beds.

Local names: washboard.





Western Fanshell
(*Cyprogenia aberti*)

Description: **Shell round to broadly triangular**, usually flattened laterally (compressed) but somewhat inflated in the big river form. **Posterior ridge raised, sulcus present that has furrows or a wrinkled appearance.**

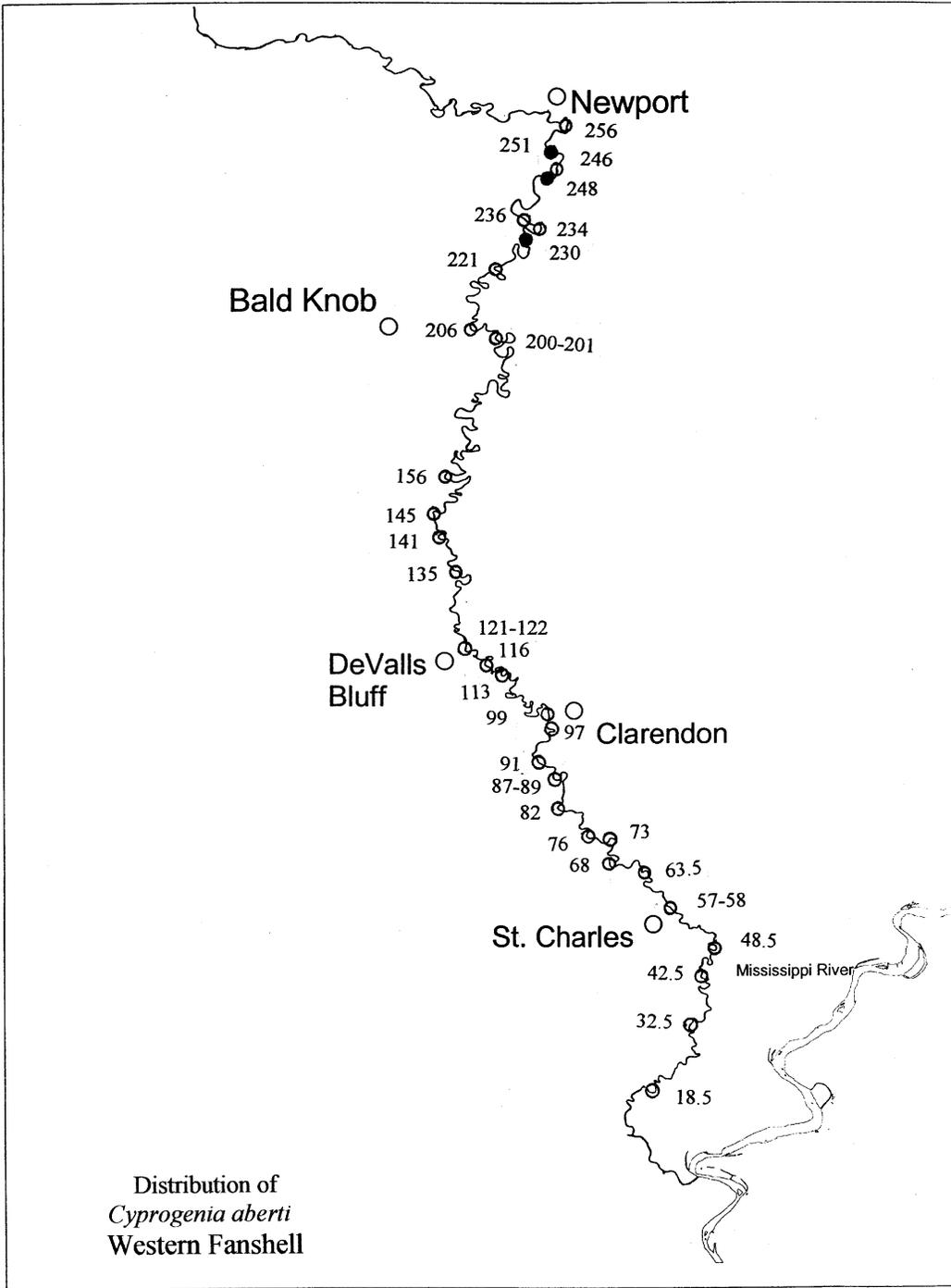
External shell coloration yellow, greenish yellow to tan. **Fine color rays present on most of shell, concentrated areas of rays alternate with less concentrated areas forming light and dark bands.** Nacre is white to iridescent. Maximum shell size three and a half inches.

Similar species: Superficially similar to pimpleback, wartyback, mapleleaf, and southern mapleleaf but none of these has the sulcus with furrows or wrinkles. The butterfly, deertoe, and fawnsfoot have similar coloration but also lack the sulcus with furrows.

Relative abundance: Western fanshell appears to be restricted to the upper portion of the region (upstream of River Mile 200) and is a rare component of the mussels in any bed.

Local names: mapleleaf





Group 2

Smooth Shells with Elongate Shape

Black Sandshell (*Ligumia recta*)

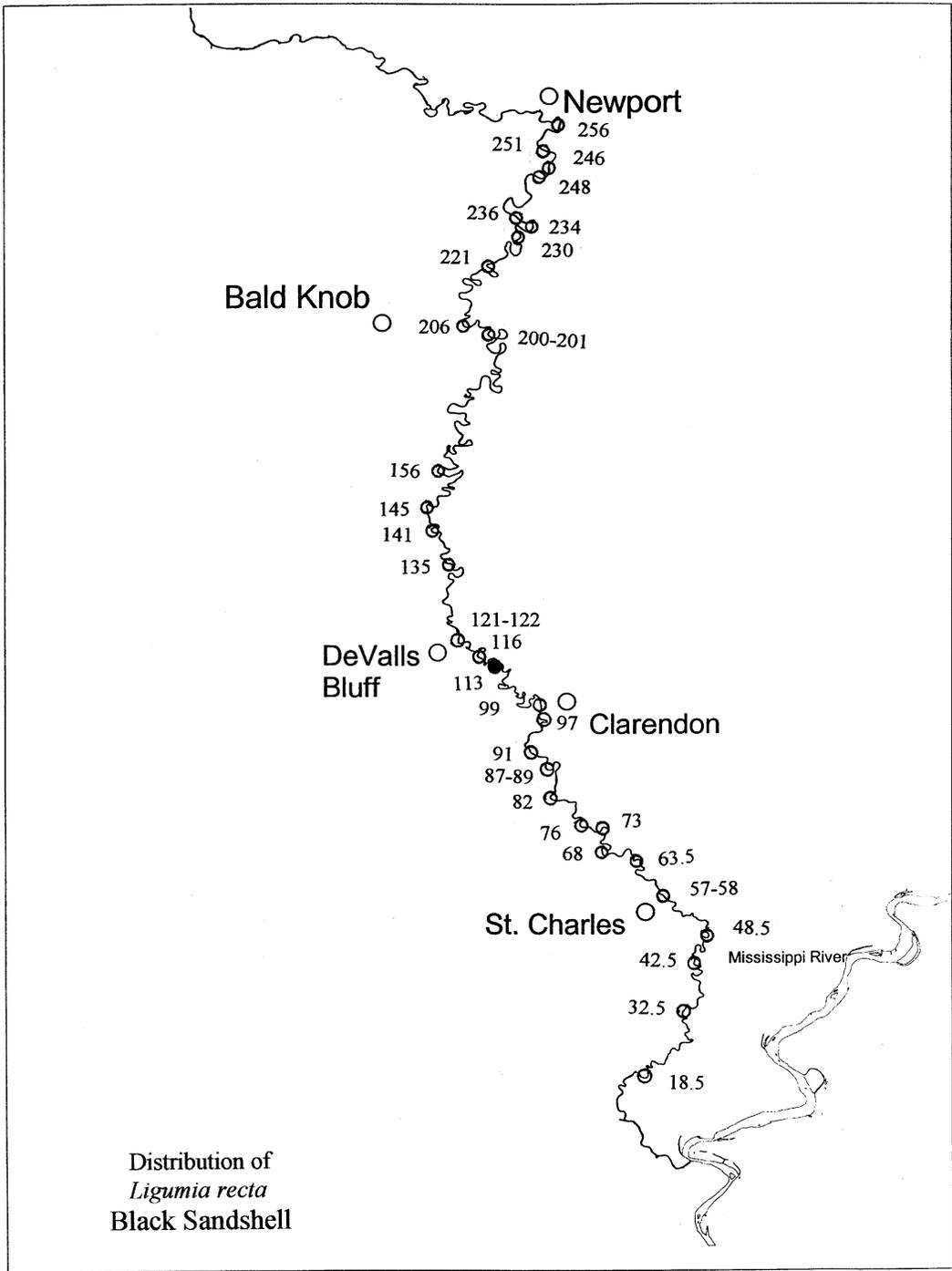
Description: **Shell elongate**, solid, moderately compressed. **External color shiny black to dark brown**, green rays visible on some small individuals. **Umbos low, only slightly elevated above the hingeline**. Pseudocardinal teeth well developed; lateral teeth long, moderately thin and straight. Posterior end of shell sharply rounded. Nacre variable from white, pink and salmon to purple. Maximum length 8-10 inches.

Similar species: Yellow sandshell has similar shape but yellow external coloration and white nacre. Spike is more compressed and usually has a purple nacre.

Relative abundance: Very rare in the White River within the study region.

Local names: butcher knife, lady's slipper





Bleufer
(*Potamilus purpuratus*)

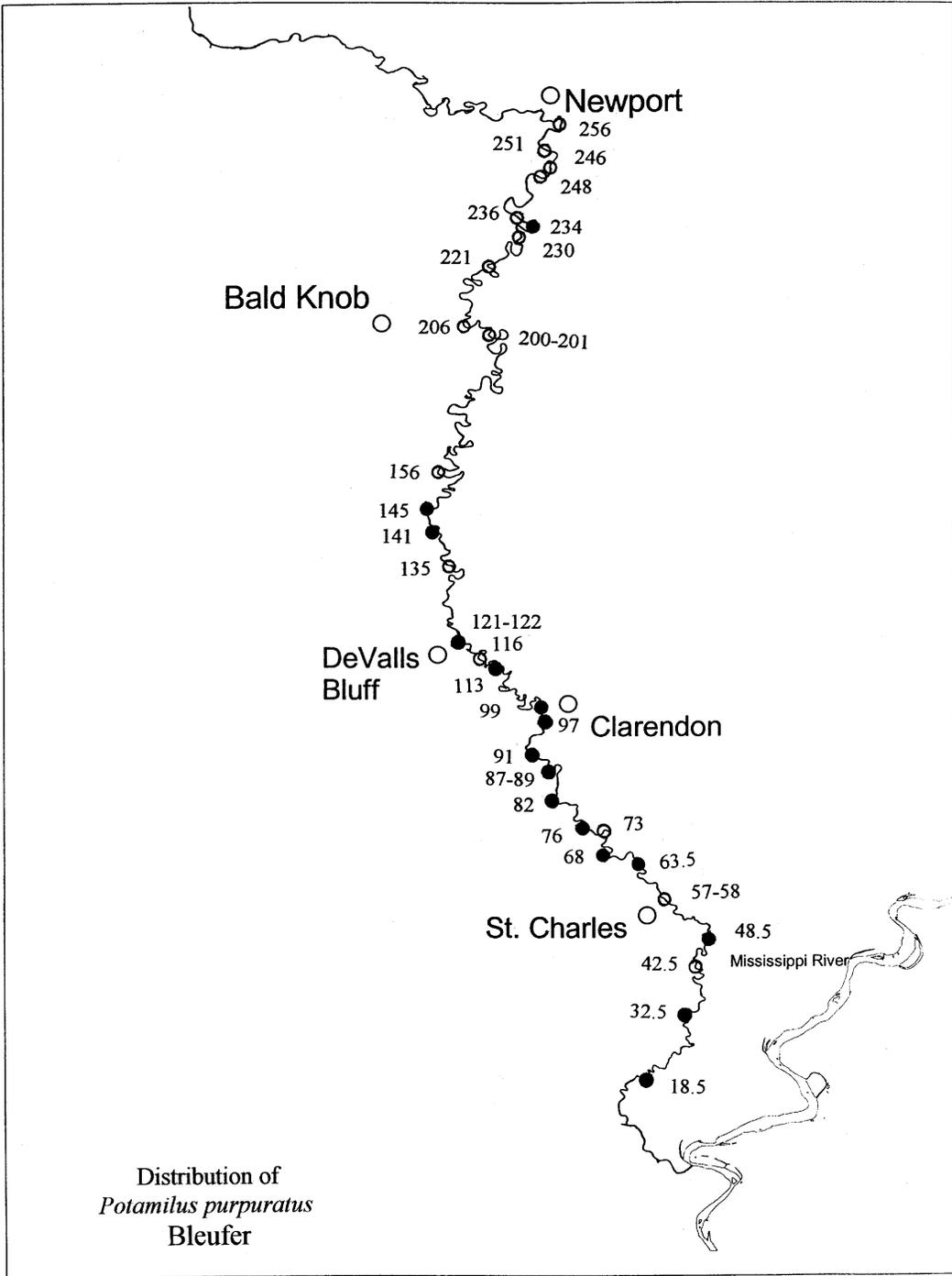
Description: **Shell rhomboidal, moderately to greatly inflated**, valves of medium thickness. **Low posterior wing sometimes present**; umbos slightly elevated. **Posterior end bluntly squared or truncated**. External color dark green, brown or black, rays sometimes visible in smaller specimens. Pseudocardinal teeth relatively small; lateral teeth long, thin and curved. **Nacre normally purple to rose**. Maximum length approximately eight inches.

Similar species: Plain pocketbook normally yellow with green rays; deep beak cavity; umbos raised above the hingeline; nacre white.

Relative abundance: Most common downstream of River Mile 150. Usually a minor component of most beds comprising < 2% of total mussels. Occasionally contributes up to 5% of total individuals.

Local names: blooper, blue mucket, blue hen





Fragile Papershell
(*Leptodea fragilis*)

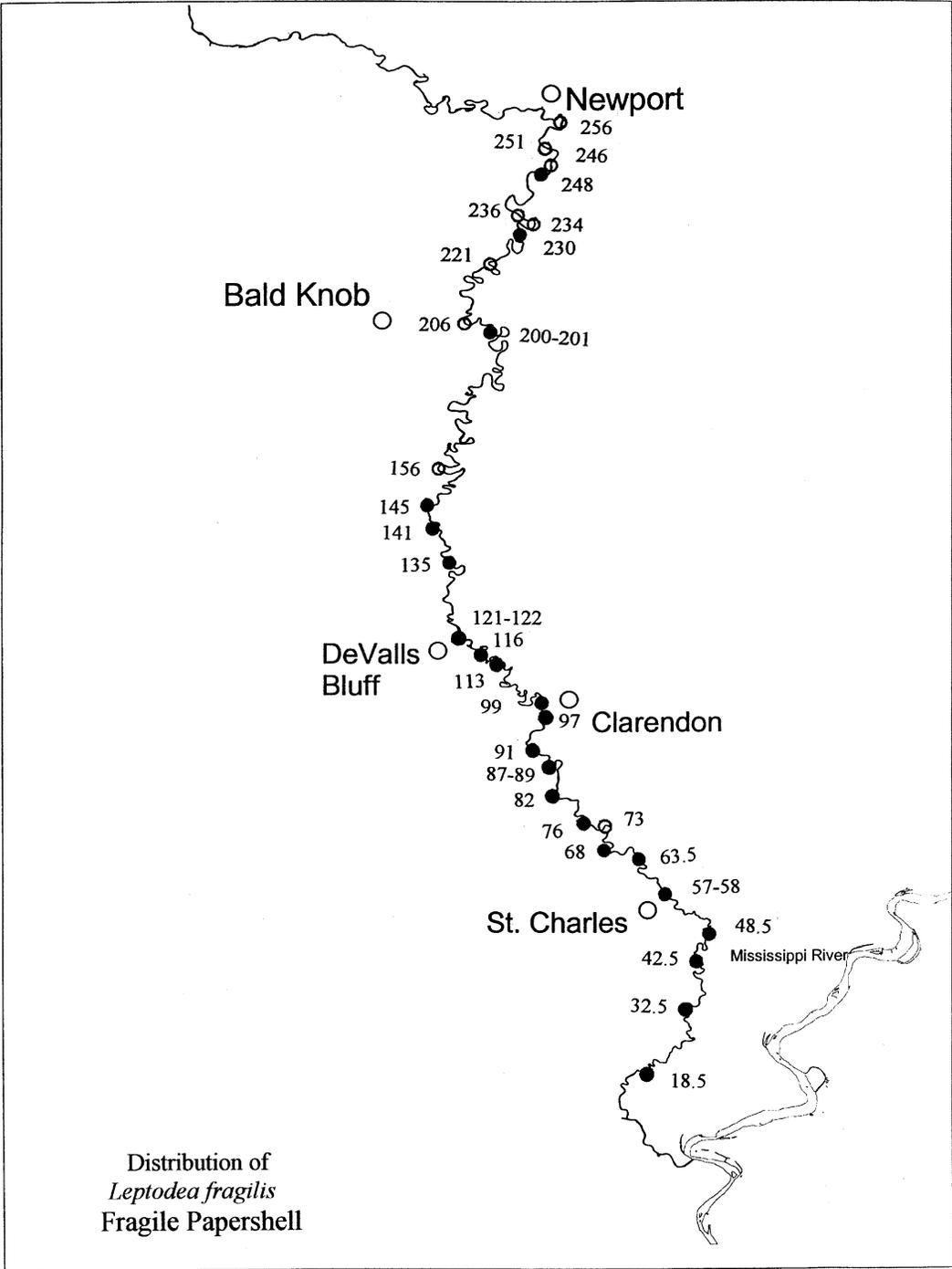
Description: **Shell thin, compressed, rhomboidal in shape. Posterior wing present posterior to the umbo, prominent to poorly developed. Pseudocardinal and lateral teeth present, but reduced.** External color yellow to tan with indistinct rays present over much of the shell (sometimes absent in larger specimens). Nacre iridescent. Maximum length is approximately eight inches.

Similar species: Scaleshell is darker externally, umbo is located more anterior than in fragile papershell, and shell twisted in dorsal aspect. White heelsplitter is more rounded in shape and laterally compressed, has thicker valves, a more prominent posterior wing, and lacks lateral teeth. Pink papershell has a more prominent posterior and anterior wings, and the nacre is pink or rose colored. Mucket is a heavier, more inflated shell that lacks a posterior wing, and has well developed, heavy pseudocardinal and lateral teeth.

Relative abundance: Widespread in the study region but more common in the downstream portion below River Mile 150. Very abundant in the downstream 30 miles of the river and contributes up to 30% of total mussels in beds. Upstream to River Mile 150, it typically comprises from 5-10% of the total mussels in these beds. Further upstream, it becomes less abundant and usually comprises < 2% of mussels in beds. It also adapts well to areas that have riprap for bank stabilization such as beds at Clarendon and DeValls Bluff.

Local names: papershell





Giant Floater
(*Pyganodon grandis*)

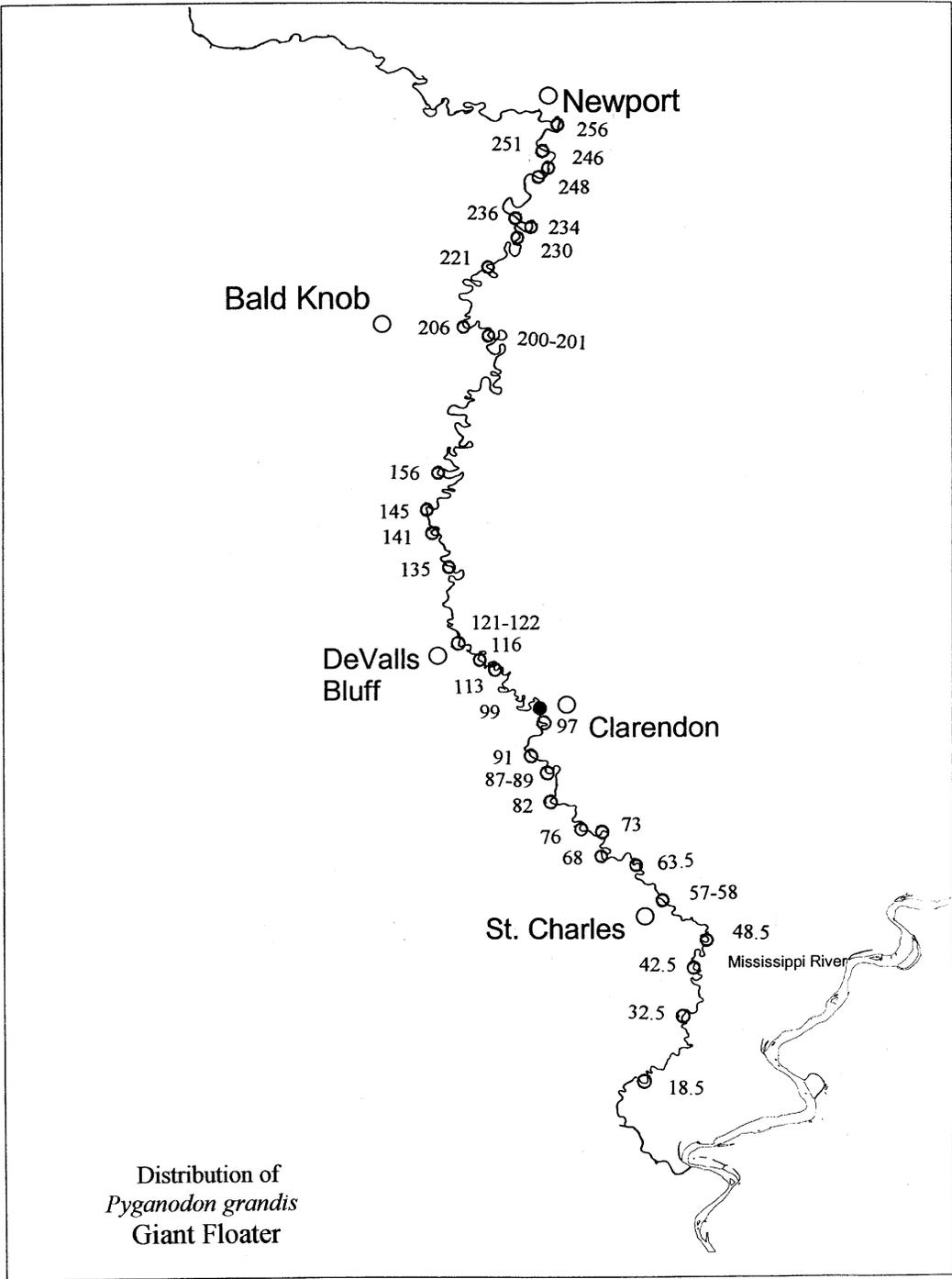
Description: **Shell rhomboid, inflated, valves thin. Beaks elevated above the hinge line**; posterior end bluntly rounded. External color dark green to tan to brown, rays usually absent. **Pseudocardinal and lateral teeth absent**, nacre white to iridescent. Beak cavity broad and rounded. Length to 10 inches.

Similar species: Flat floater is round and more compressed. Rock pocketbook has a similar shape but possesses two rows of knobs or pustules on the umbos and additional flutes and crenulations on the shell. Fat pocketbook is much more inflated; beaks greatly elevated above the hingeline; pseudocardinal teeth and lateral teeth present.

Relative abundance: Found in the mussel bed at Clarendon (River Mile 99). A species with preferred habitat of backwaters and sloughs. Probably more common in the river than our samples indicate because the preferred habitat is not often sampled.

Local names: hogshell, slopbucket, grandmaw





Louisiana Fatmucket
(*Lampsilis hydiana*)

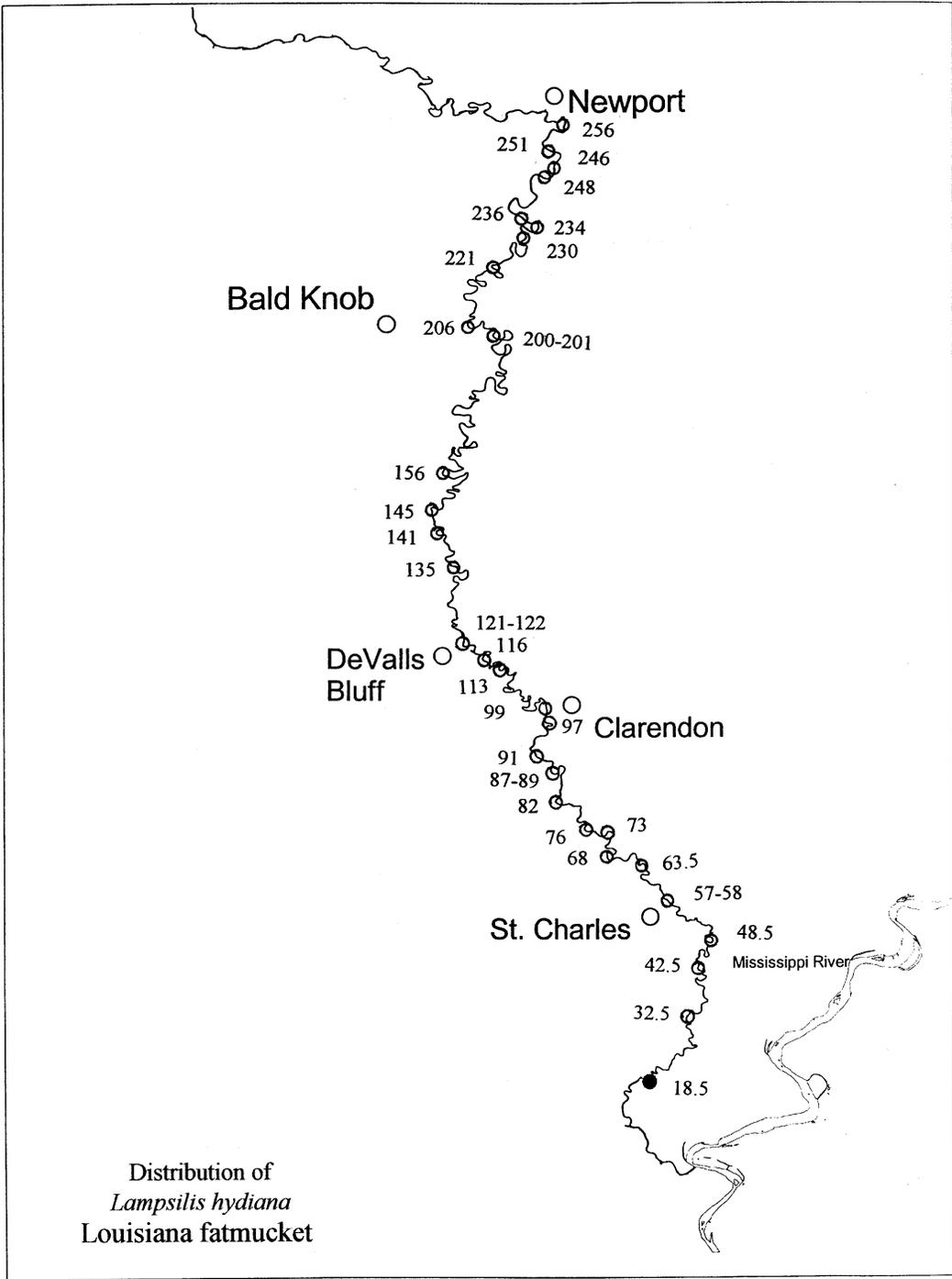
Description: **Shell elongate and rhomboidal, moderately inflated**, valves moderately thick uniformly throughout the shell's length. Pseudocardinal teeth elongate and compressed; lateral teeth well developed and curved. External color yellow to tan or brown with well defined; **thick, greenish rays on posterior two thirds of shell**. Nacre color white to iridescent. Maximum length five inches.

Similar species: Yellow sandshell is more elongate and inflated at the hingeline and does not have the broad color rays. Mucket is more compressed, has thicker valves, and is more quadrate with much thicker valves than Louisiana fatmucket.

Relative abundance: Only two specimens of Louisiana fatmucket have been taken from the White River in the study region. More common in tributaries than main channel.

Local names: grass mucket





Scaleshell
(*Leptodea leptodon*)

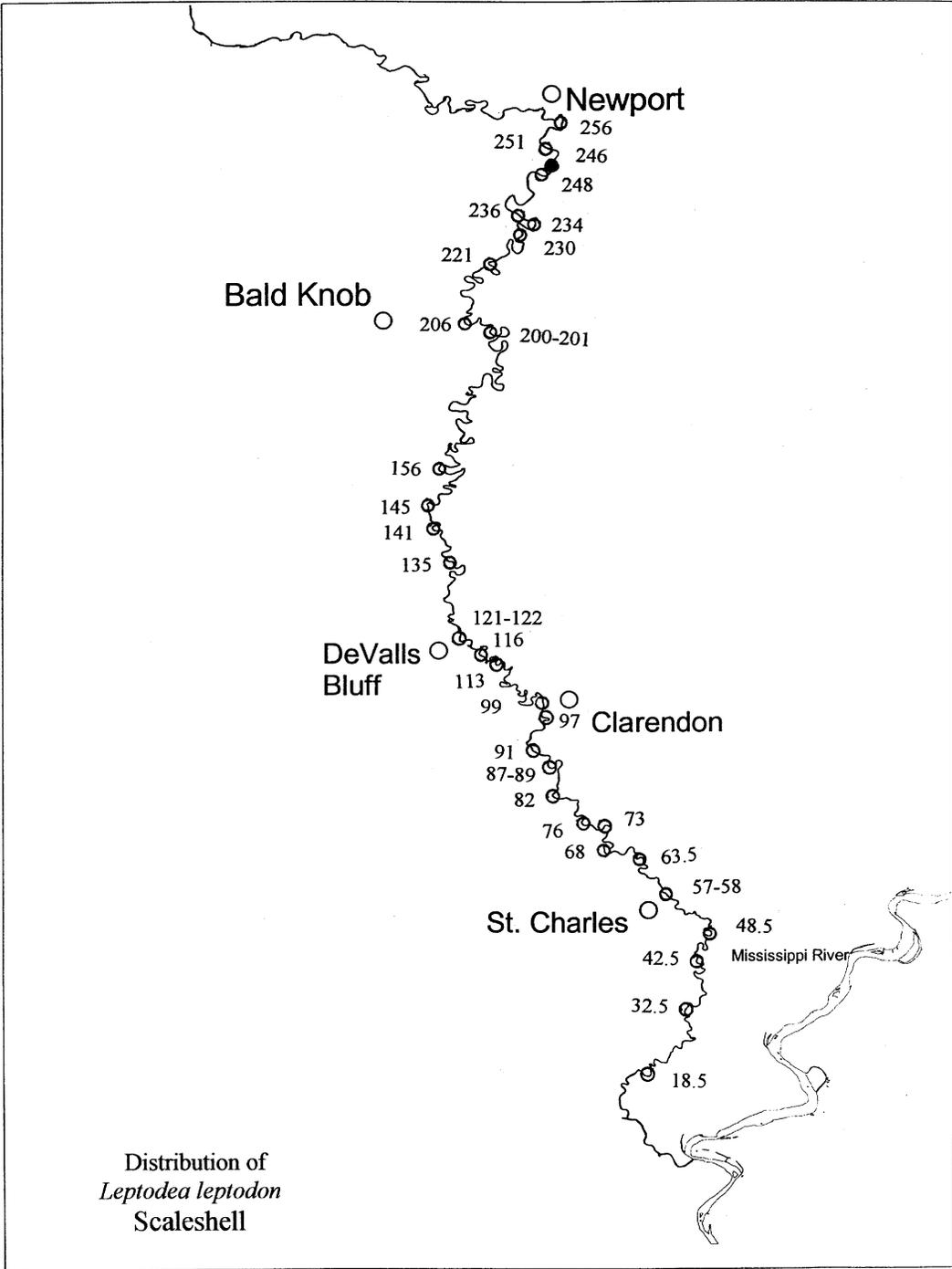
Description: **Shell elongate, compressed, and valves thin. Umbos small and low, about even with hingeline; located far anterior. Ventral margin of shell broadly rounded, like a butcher knife blade.** External color yellowish green to brown with faint green rays. Pseudocardinal teeth reduced; lateral teeth moderately long and low. Beak cavity very shallow to absent. **Nacre pinkish white or light purple and highly iridescent.** Maximum length five inches.

Similar species: Fragile papershell has a slightly higher posterior wing, the umbo is broader and located slightly more posterior, and the nacre is white to iridescent.

Relative abundance: A single specimen of scaleshell has been found at River Mile 248.

Local names: None





Spike
(*Elliptio dilatata*)

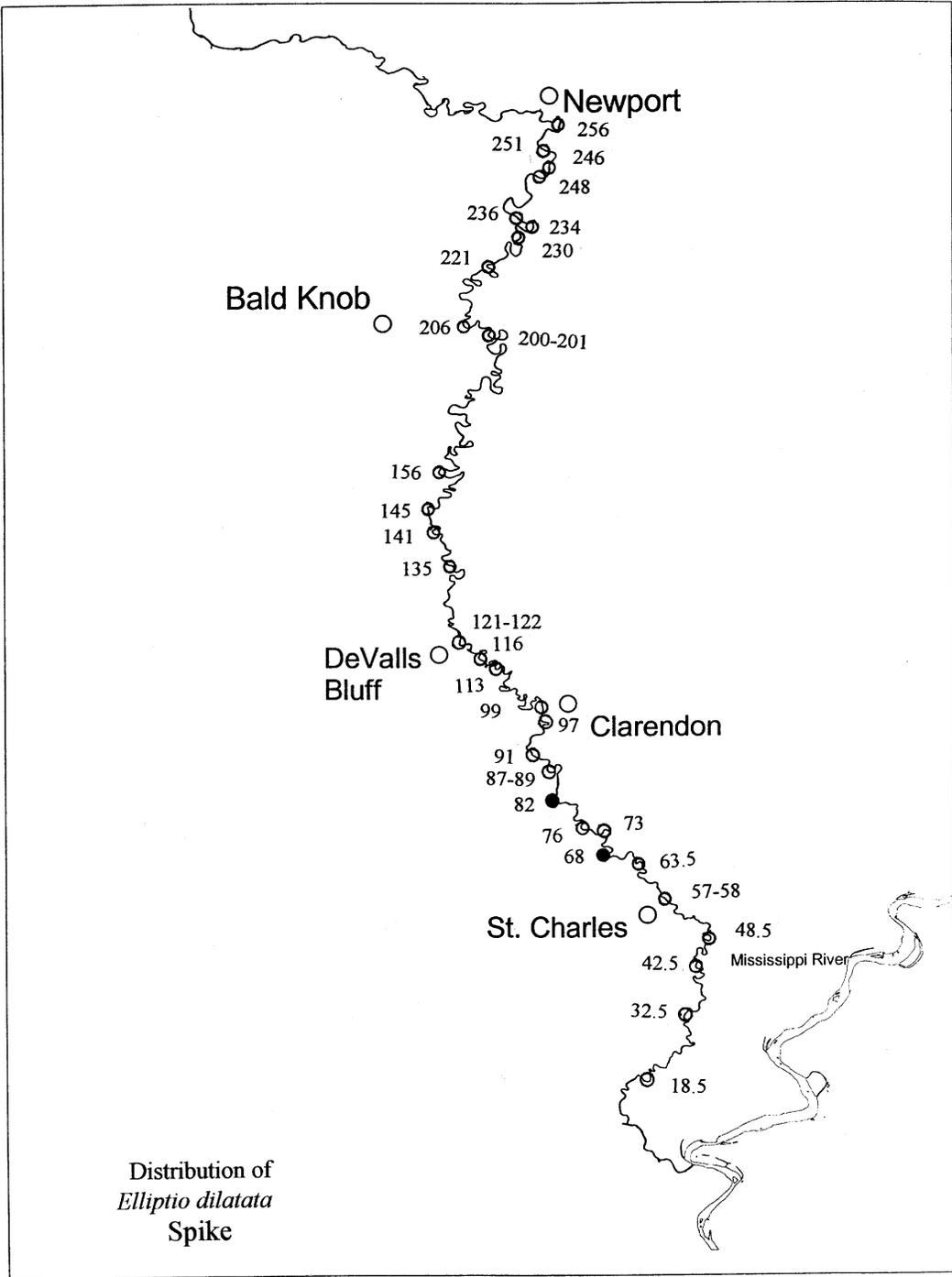
Description: **Shell elongate, laterally compressed with moderately thick valves. Umbos low, usually not elevated above hinge line. External color brown to black.** Pseudocardinal teeth well developed; lateral teeth short, roughened and straight. Beak cavity shallow; **nacre purple** (occasionally white). Maximum length about six inches.

Similar species: Black sandshell is usually more inflated, more pointed on the posterior end, and umbos are slightly elevated above the hingeline. Black sandshell nacre usually white.

Relative abundance: Rare within the study region. Found in the middle portion of the river between Clarendon and St. Charles.

Local names: lady finger





Yellow Sandshell (*Lampsilis teres*)

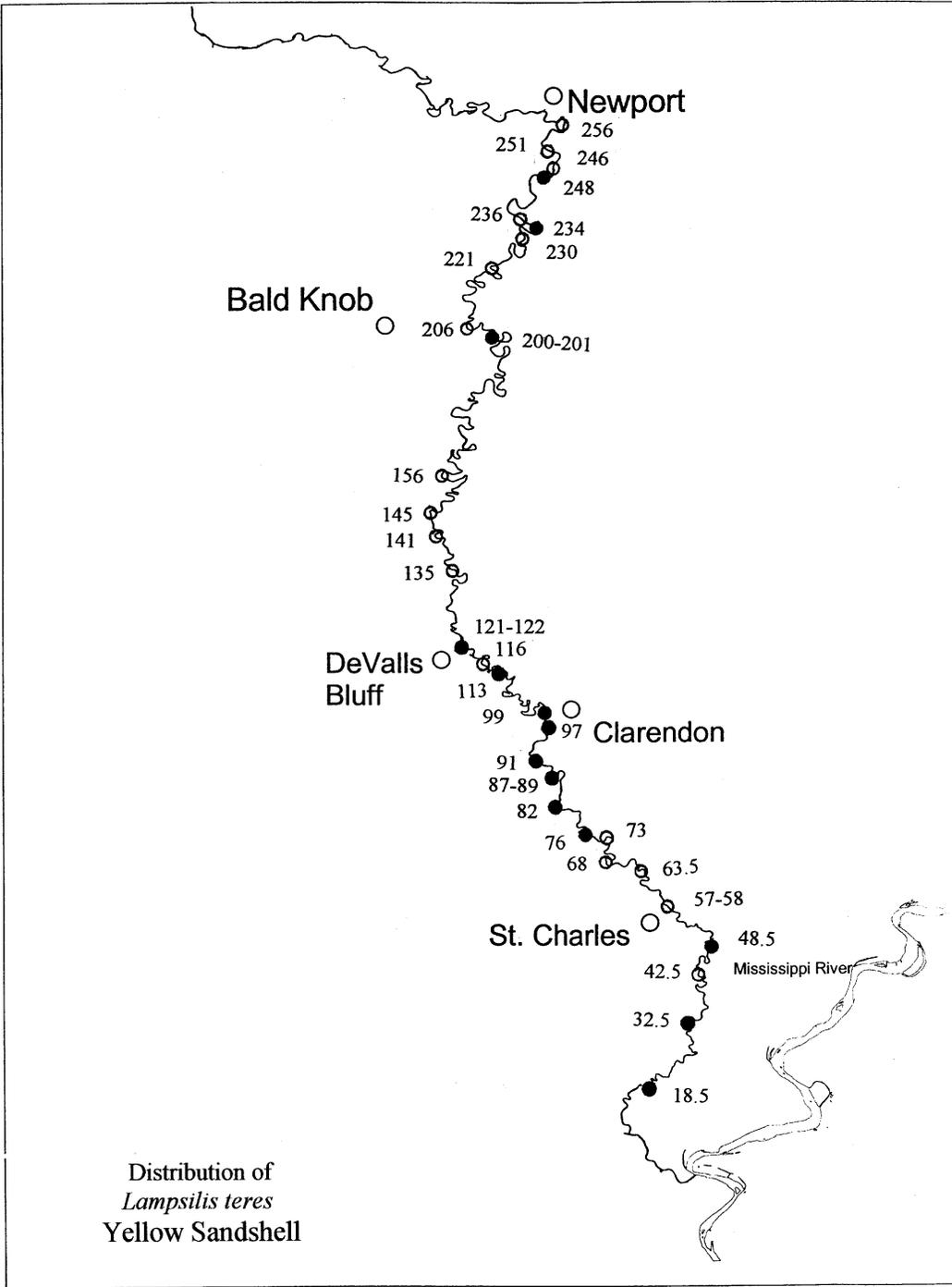
Description: **Shell elongate, moderately inflated, with smooth, shiny outer surface ranging from yellow to yellow-tan in color**, occasionally with faint green rays. Valves are moderately thick, but uniformly so throughout the length of the shell. Nacre is white. Pseudocardinal teeth elongate and compressed; lateral teeth long and straight to slightly curved. Maximum length to eight inches.

Similar species: Black sandshell external coloration is uniformly brown to black. Louisiana fatmucket usually has bold green rays over most of the shell, and is not as elongate as yellow sandshell. Fragile heelsplitter and scaleshell are more compressed, the umbo does not extend above the hinge line, and the valves are much thinner.

Relative abundance: Yellow sandshell is found throughout the study region, but is not abundant in any region. It usually averages approximately 1-3% of total mussels per bed throughout the study region.

Local names: creeper, sandshell





Group 3

**Smooth Shells with Round, Oval or
Triangular Shape**

Asian Clam
(*Corbicula fluminea*)

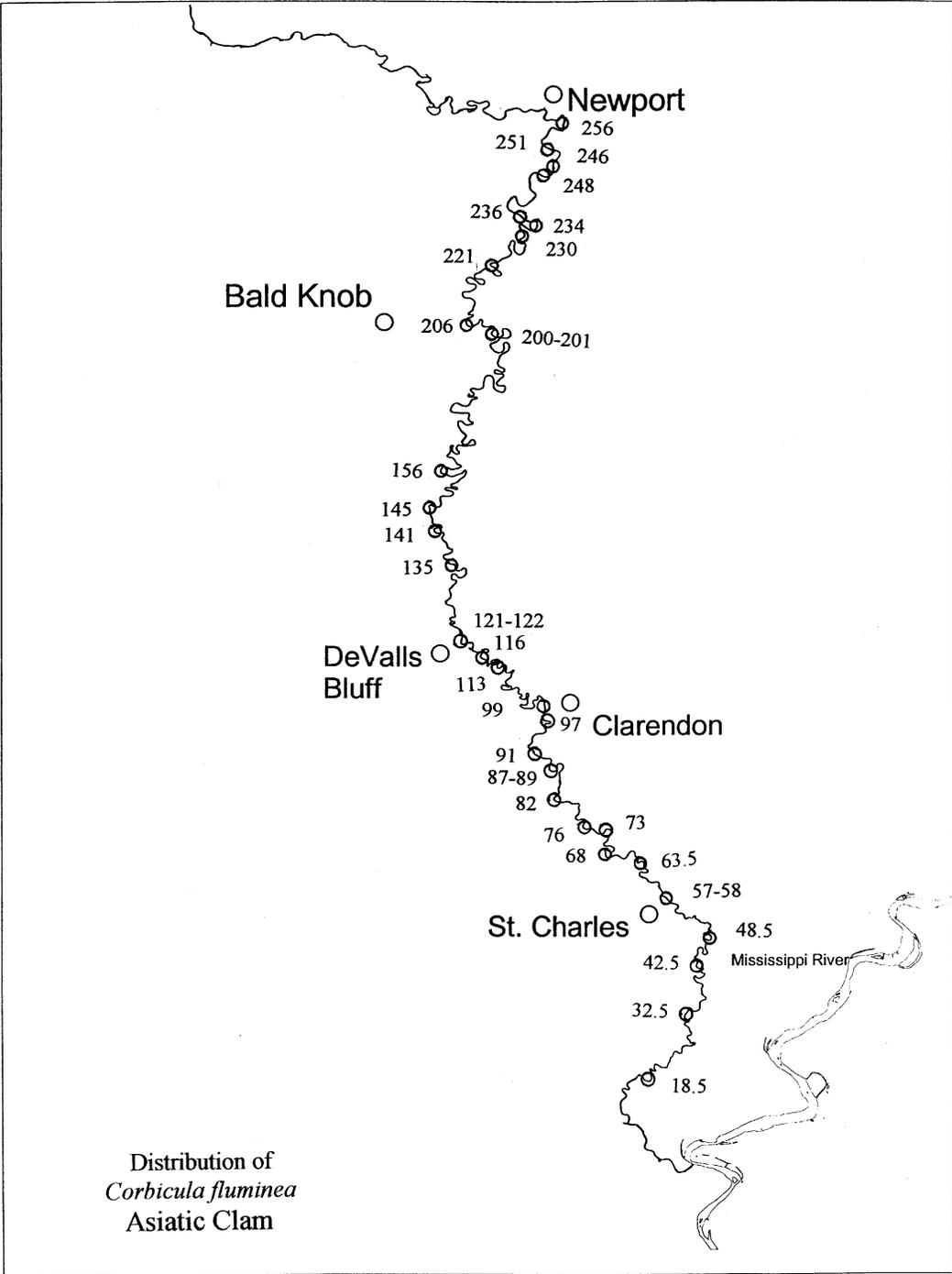
Description: **Shell triangular**, moderately inflated, valves moderately thick. **External surface covered with coarse, concentric, elevated ridges running around the shell.** Umbos high, centrally located, elevated above the hingeline. External color yellow, brown to black. **Serrated lateral teeth along each side of the pseudocardinals on each valve.** Beak cavity deep. Nacre white to deep purple. Length to two inches.

Similar species: Superficially similar to small specimens of triangular shaped species, but concentric, elevated ridges are diagnostic for this species.

Relative abundance: Found throughout the study region, very abundant in the downstream half of the river, somewhat less abundant in the upstream half of the river.

Local names: Asian clam, *Corbicula*





Butterfly
(*Ellipsaria lineolata*)

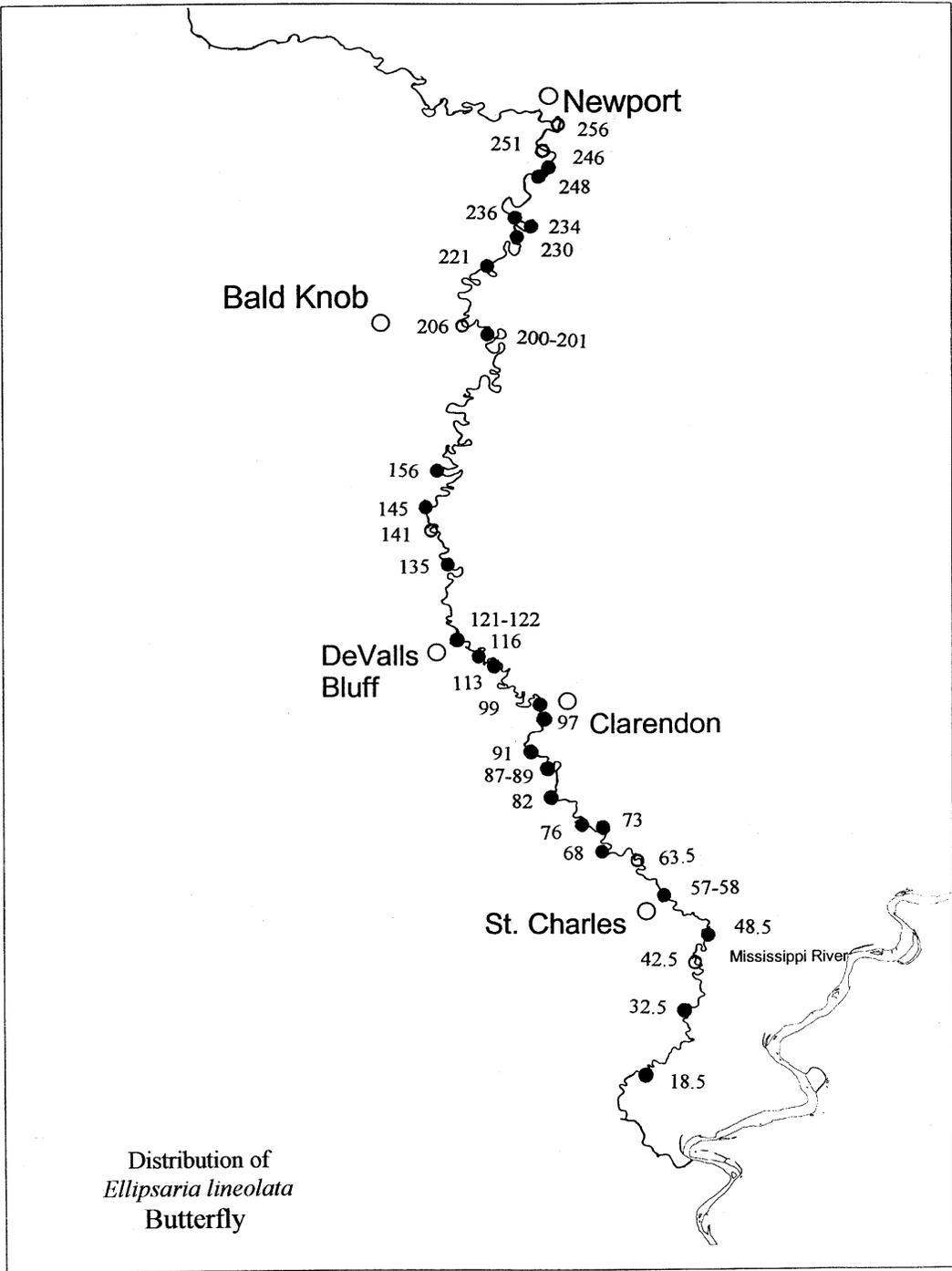
Description: **Shell broadly triangular**, laterally compressed, **posterior ridge sharply angled**, valves thick. **Umbos broad and flat, scarcely elevated but with swept back appearance. External color yellow or yellowish green, scattered rays broken into v-shaped or irregular rectangular blotches.** Pseudocardinal teeth large, lateral teeth short, heavy, and straight. Beak cavity shallow to moderately deep, nacre white and iridescent posteriorly. Maximum size to five inches.

Similar species: Deertoe is triangular but inflated with a sharply angled posterior ridge, and umbos do not appear swept back. Western fanshell is more inflated and has a furrowed sulcus down the center of the valves. Mucket is oval to quadrate, moderately inflated with a rounded posterior slope, and lacks the broken rays characteristic of the butterfly.

Relative abundance: Distributed throughout the study region. In the lower half of the study region, butterfly comprised from 2-10% of the total mussels in most beds. In the upper half of the study region, the butterfly usually comprised from 10-30% of the total mussels in beds. It is relatively more abundant in the upper half of the study region

Local names: butterfly





Deertoe
(*Truncilla truncata*)

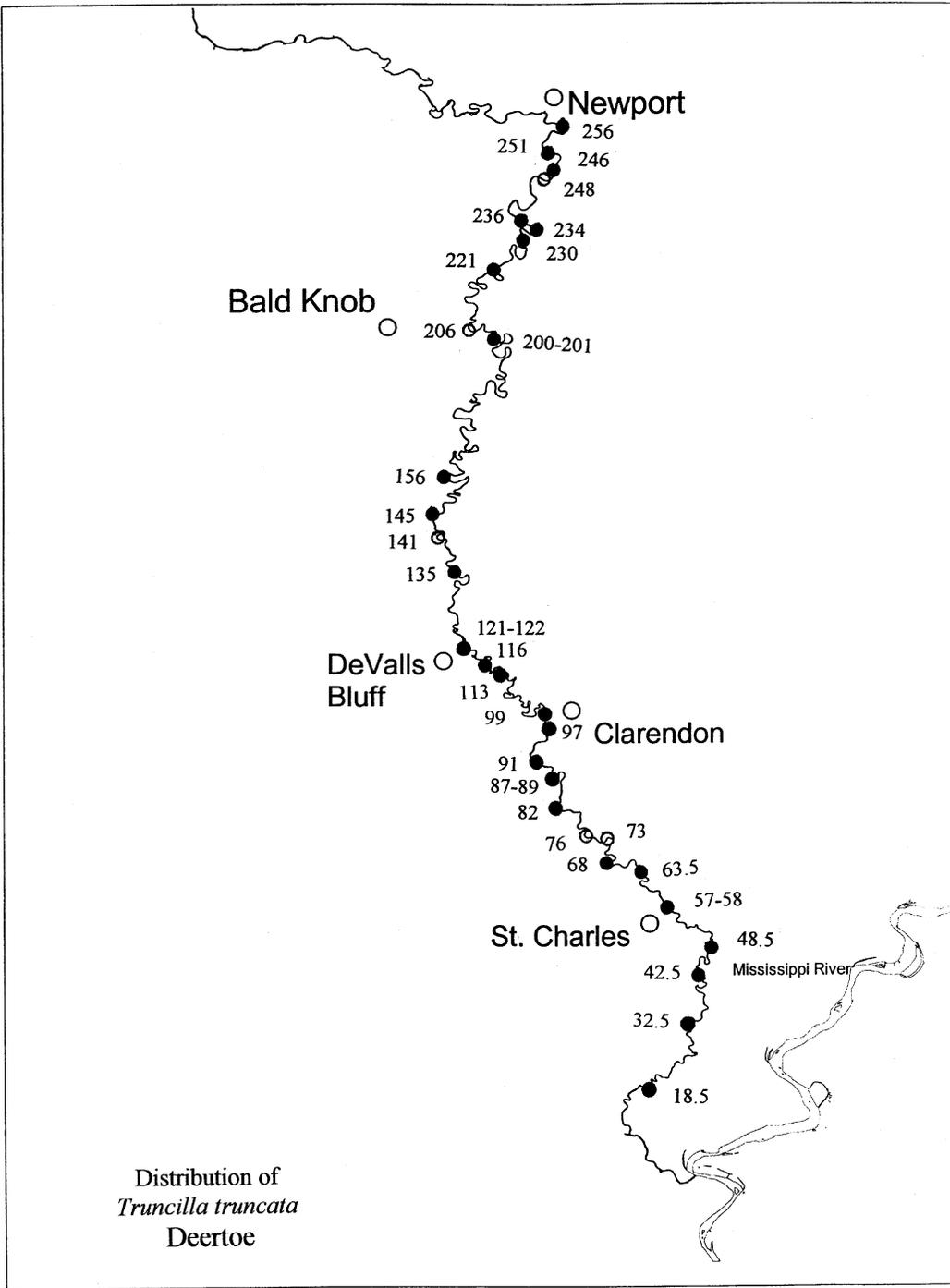
Description: **Shell triangular; prominent posterior ridge drops acutely to the hingeline**; moderately inflated, valves thin but solid. Umbos full and elevated well above the hingeline. External color tan to dark green with **numerous thin pigment rays extending from umbo to ventral margin; rays often bunched to form broad color bands**. Colored triangles and splotches often occur on the umbonal region. Teeth well developed but blade-like. Length to two inches.

Similar species: Wabash pigtoe shaped similarly but does not possess the acutely angled posterior ridge and slope nor the characteristic raying. Western fanshell has similar shape and raying but possesses a sulcus with furrows that is absent in the deertoe. Butterfly is somewhat similar in shape and raying, but is more compressed laterally, the posterior ridge is more rounded in profile, and the raying is broken and not continuous. Fawnsfoot is similar in size and shape, however the posterior ridge angle is less acute, (more rounded) and with zigzag raying running anterior to posterior in addition to the dorsal to ventral ray bands.

Relative abundance: Occurs throughout the study region. Moderately abundant in most mussels beds, comprising 2-10% of total mussels.

Local names: deerhorn





Ebonyshell
(*Fusconaia ebena*)

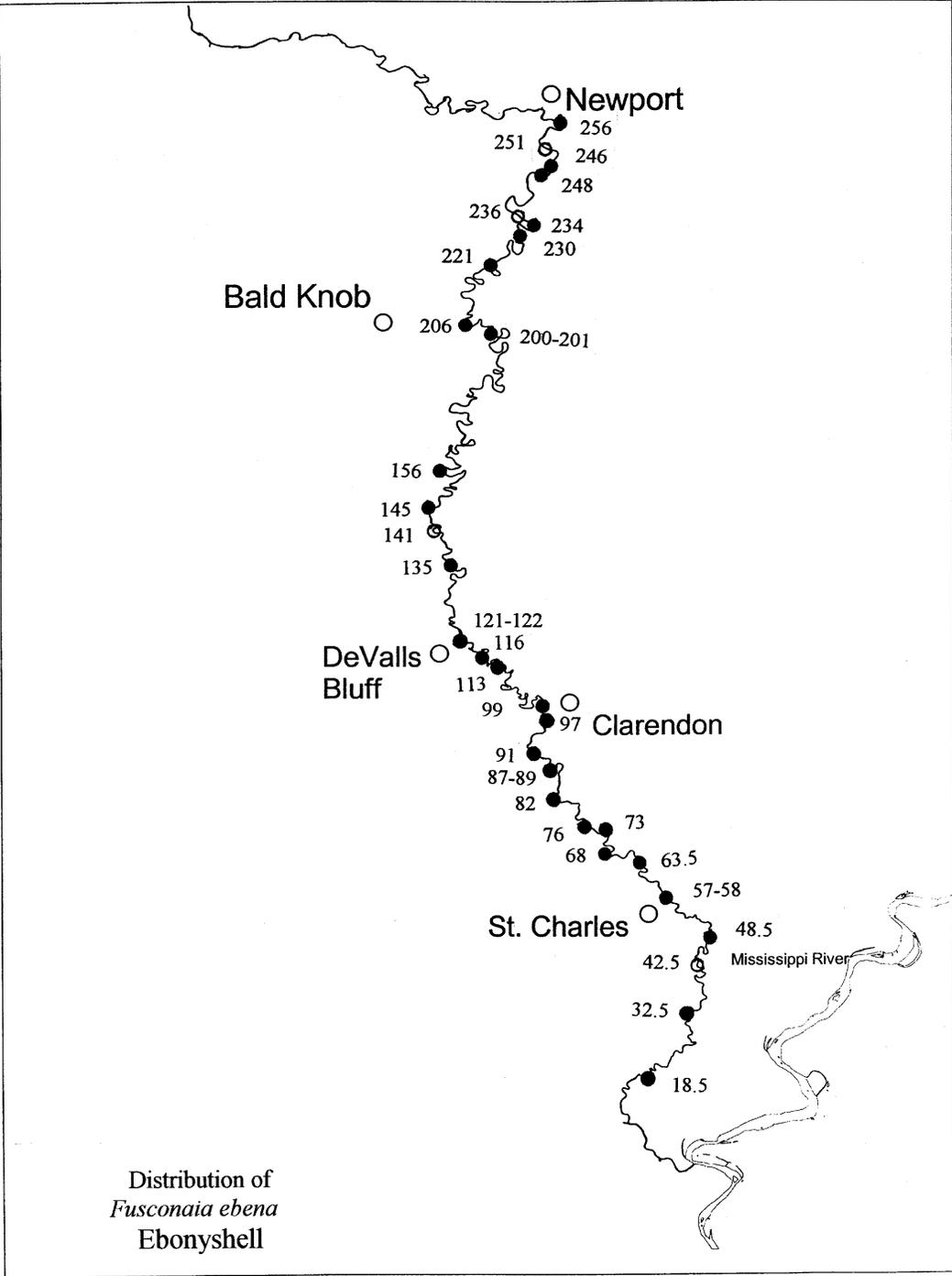
Description: **Shell round, inflated at the umbos** and thinner posteriorly, **umbos low** and about even with hingeline, **projecting anteriorly**. **External color tan, brown to black**, rays not prominent. **Pseudocardinal and lateral teeth well developed, aligned parallel to each other**. Beak cavity very deep, nacre white. Maximum length about five inches.

Similar species: Wabash pigtoe is triangular with flattened sulcus, umbos not projecting anteriorly.

Relative abundance: Ebonyshell is distributed throughout the study region. It is usually relatively abundant in most beds. In the lower half of the study region, it regularly comprised from 5-15% of total mussels per bed. In the upper half of the study region, ebonyshell comprised from 10-50% of total mussels per bed.

Local names: niggerhead, sheep's toe





Fat Pocketbook
(*Potamilus capax*)

Description: **Shell round**, sometimes truncate on the posterior end, **greatly inflated**, valves thin (in young) to moderately thick (in adults). **Umbo greatly inflated, elevated above hingeline, and turned inwards.** **Hingeline s-shaped in outline. External surface smooth and very shiny; color yellow, yellowish tan, olive or dark brown; rays absent.**

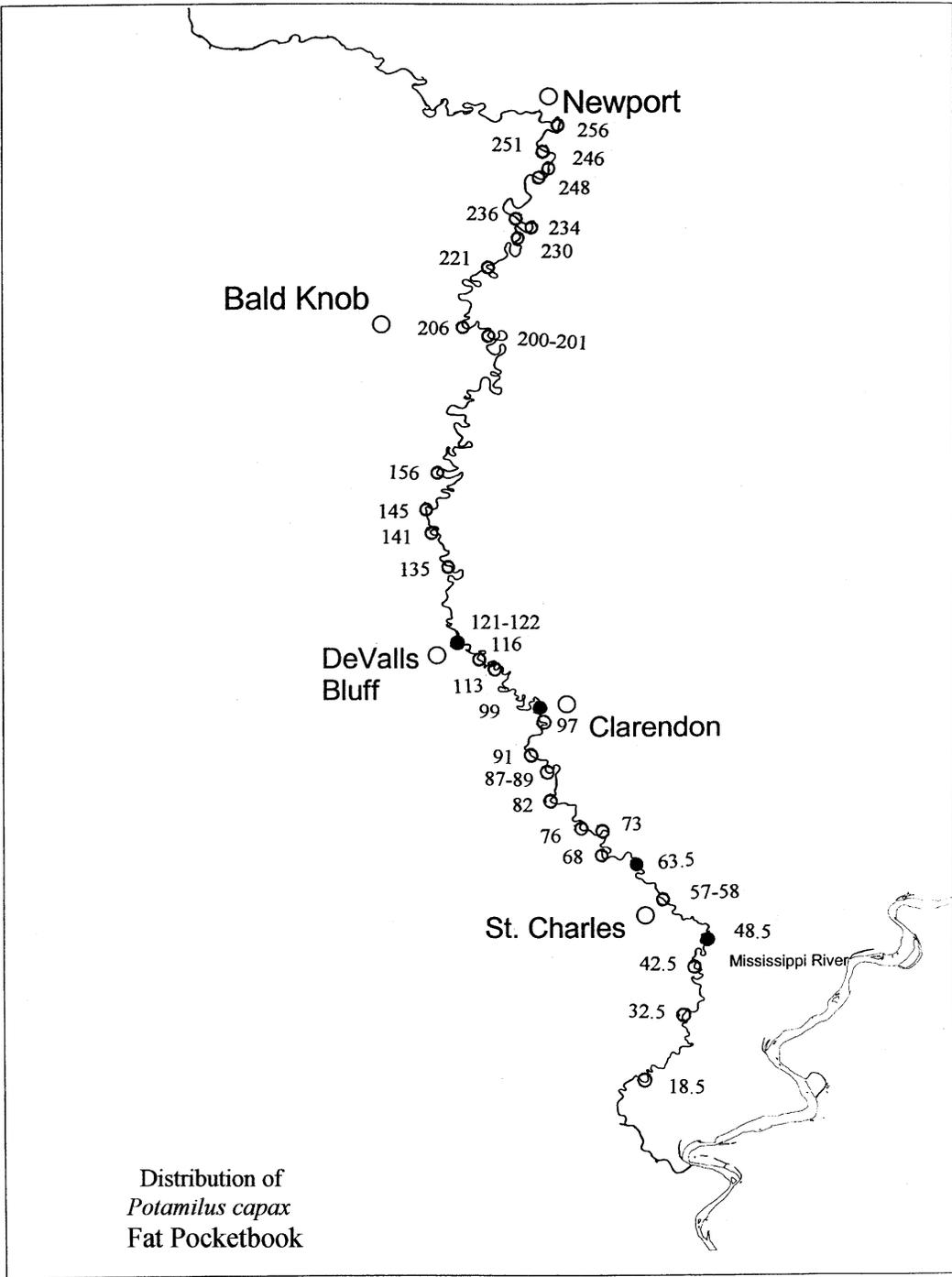
Pseudocardinal teeth thin, compressed, and elevated; lateral teeth thin and greatly curved. Beak cavity very deep, nacre white, sometimes tinged with pink or salmon. Maximum length approximately six inches.

Similar species: Plain pocketbook is less inflated, has a flattened hingeline (not s-shaped), usually has external color rays. Both mucket and pink mucket are moderately inflated; have thick valves; thick, well developed teeth; moderately elevated beaks and external color rays (especially pink mucket). Giant floater has a centrally located umbo, a rhomboid shape, no teeth, and a thin shell.

Relative abundance: Live specimens of fat pocketbook have not been recorded from the White River since the mid-1960's. It apparently has never been very abundant in this drainage.

Local names: pocketbook, grandmaw





Fawnsfoot
(*Truncilla donaciformis*)

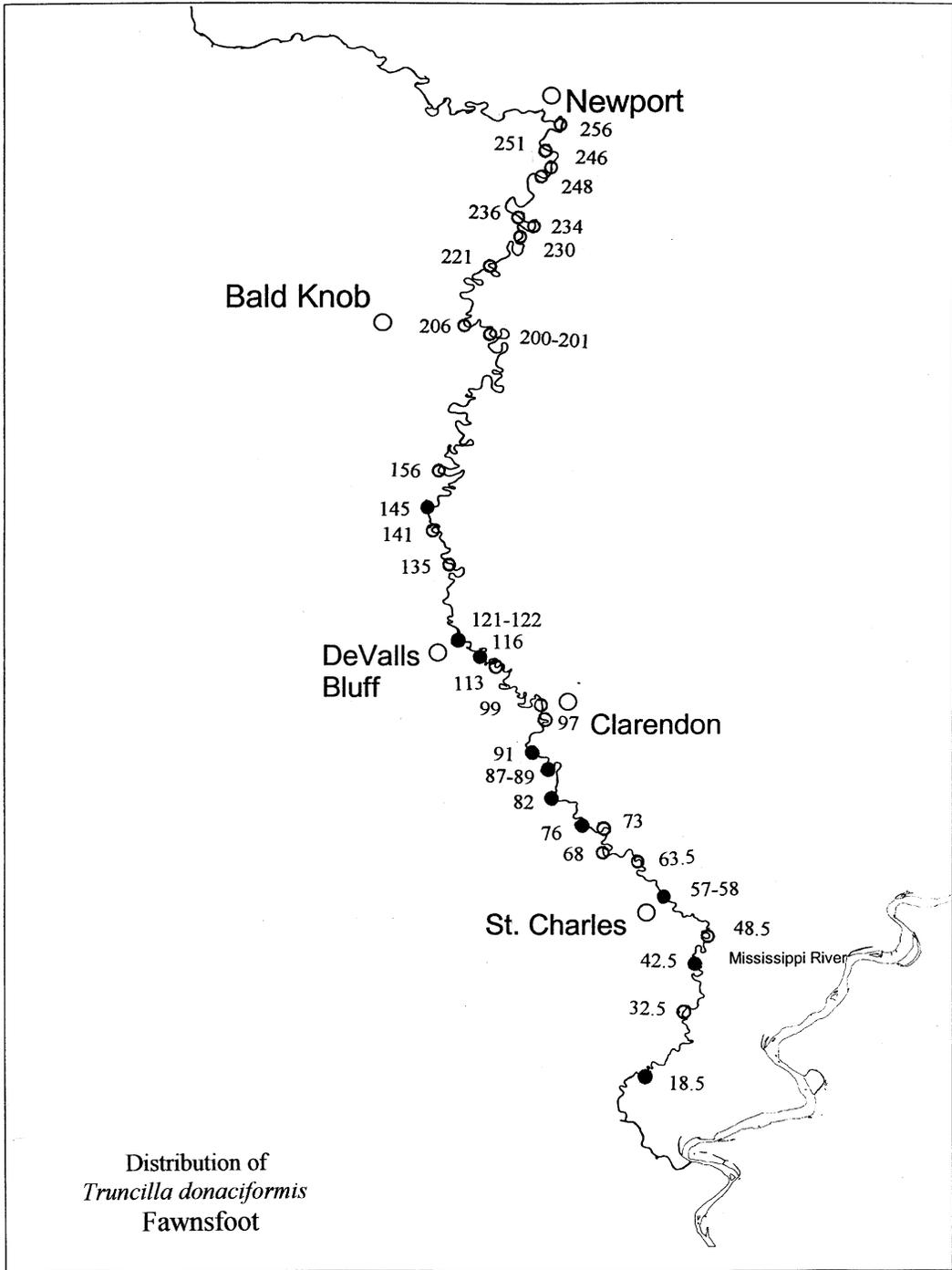
Description: **Shell broadly triangular to oblong**, moderately inflated, valves thin to moderately thick. Umbos full, centrally located, and beak slightly elevated above hinge line. **The posterior ridge not prominent; posterior slope not acutely angled** from posterior ridge to hinge line. External coloration yellow to greenish brown with **numerous green rays that form alternating bands of light and dark on the shell. Also, horizontal rows of w-shaped pigment are prominent.** Pseudocardinal teeth small; lateral teeth thin. Beak cavity moderately shallow. Nacre white, iridescent posteriorly.

Similar species: Deertoe with similar size and coloration, however, posterior ridge more acutely angled and external coloration without w-shaped pigments aligned anterior to posterior.

Relative abundance: Widespread in the downstream half of the study region. A relatively uncommon component of mussel beds, usually comprising < 2% of the total mussels per bed.

Local names: None





Flat Floater
(*Anodonta suborbiculata*)

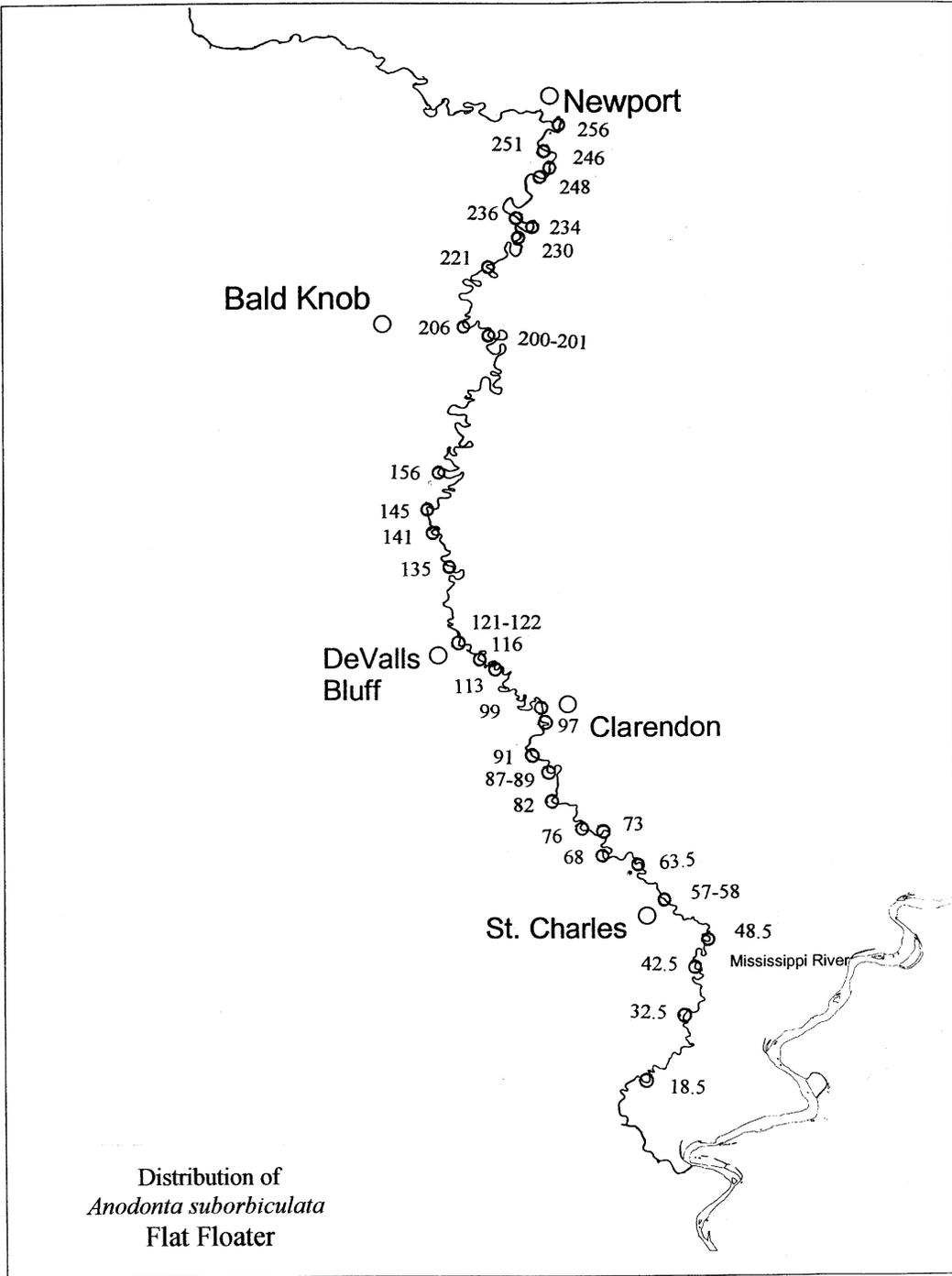
Description: **Shell rounded, laterally compressed, saucer-like in outline,** low posterior wing present, valves thin and fragile. **Umbos low, flattened, not raised above hingeline. External color yellow to tan to almost brown,** young specimens have faint green rays. **Teeth are absent,** beak cavity is large but shallow. Nacre is white. Maximum length approximately eight inches.

Similar species: Pink papershell is flattened but possesses posterior and anterior wings, and pink nacre. White heelsplitter is laterally compressed but possesses a significant posterior wing. Giant floater is much more inflated and umbos extend above the hingeline.

Relative abundance: Not abundant in the main river, a slough and backwater species not normally associated with main river mussel beds.

Common names: pearl leader, heelsplitter





Hickorynut
(*Obovaria olivaria*)

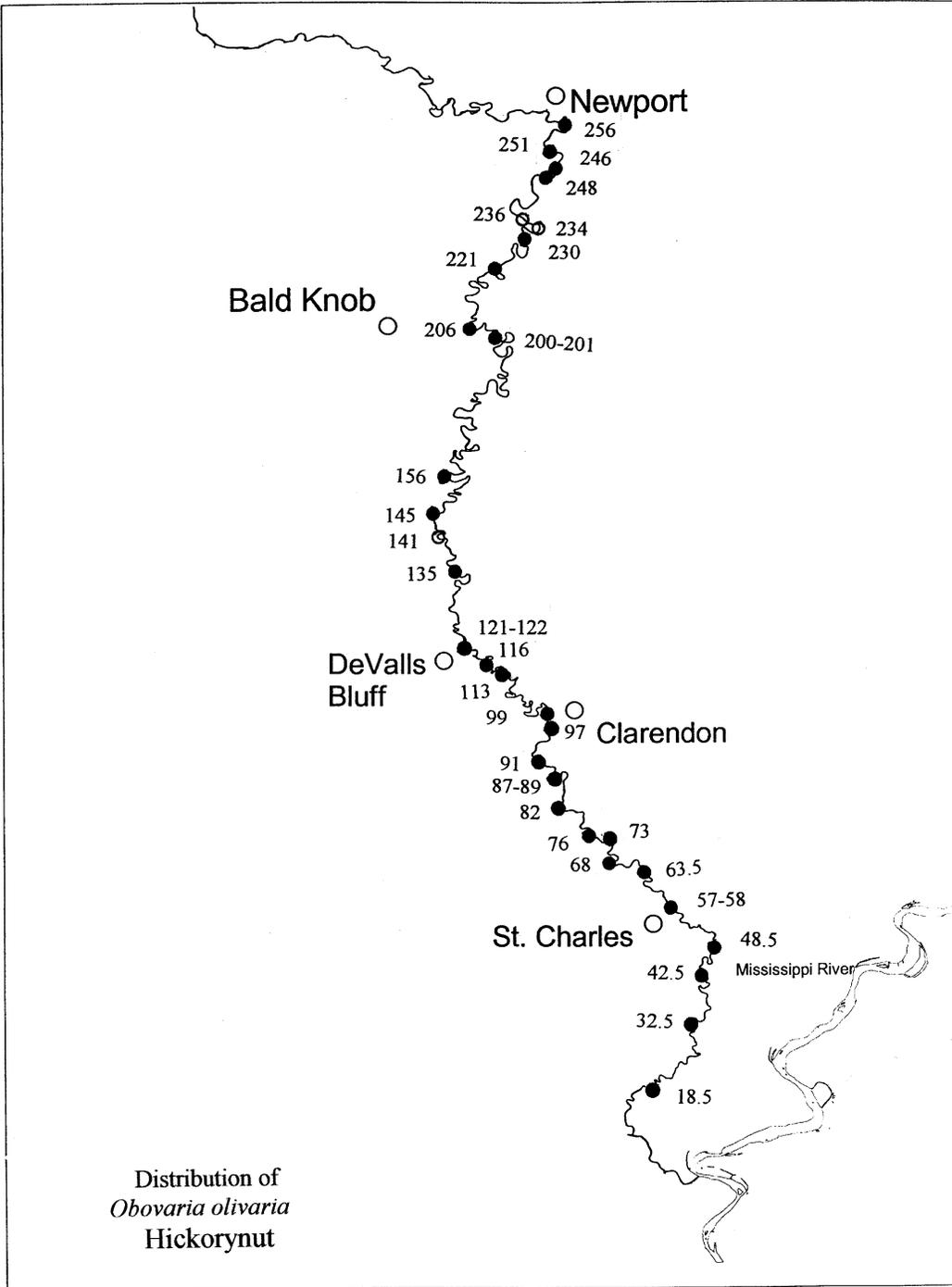
Description: **Shell oval, inflated anteriorly**, umbos slightly elevated above the hingeline and directed forward. **External color yellow, olive or yellowish brown, faint green rays present in small specimens.** Pseudocardinal teeth relatively small, lateral teeth straight to slightly curved and fairly long. Small pseudocardinal tooth (denticle) present anterior to main pseudocardinal of right valve. Beak cavity shallow; nacre white, iridescent posteriorly. Maximum length to five inches.

Similar species: Ebonyshell is more round, darker colored, and the umbo is more pointed and swept back anteriorly. Pink mucket is more inflated posteriorly, has darker coloration and usually possesses external rays, and the nacre is usually tinged with pink in the beak cavity.

Relative abundance: Hickorynut is distributed throughout the study region. It is moderately abundant throughout the river comprising 5-15% of total mussels in the majority of beds sampled.

Local names: eggshell, eggshell niggerhead





Mucket
(*Actinonaias ligamentina*)

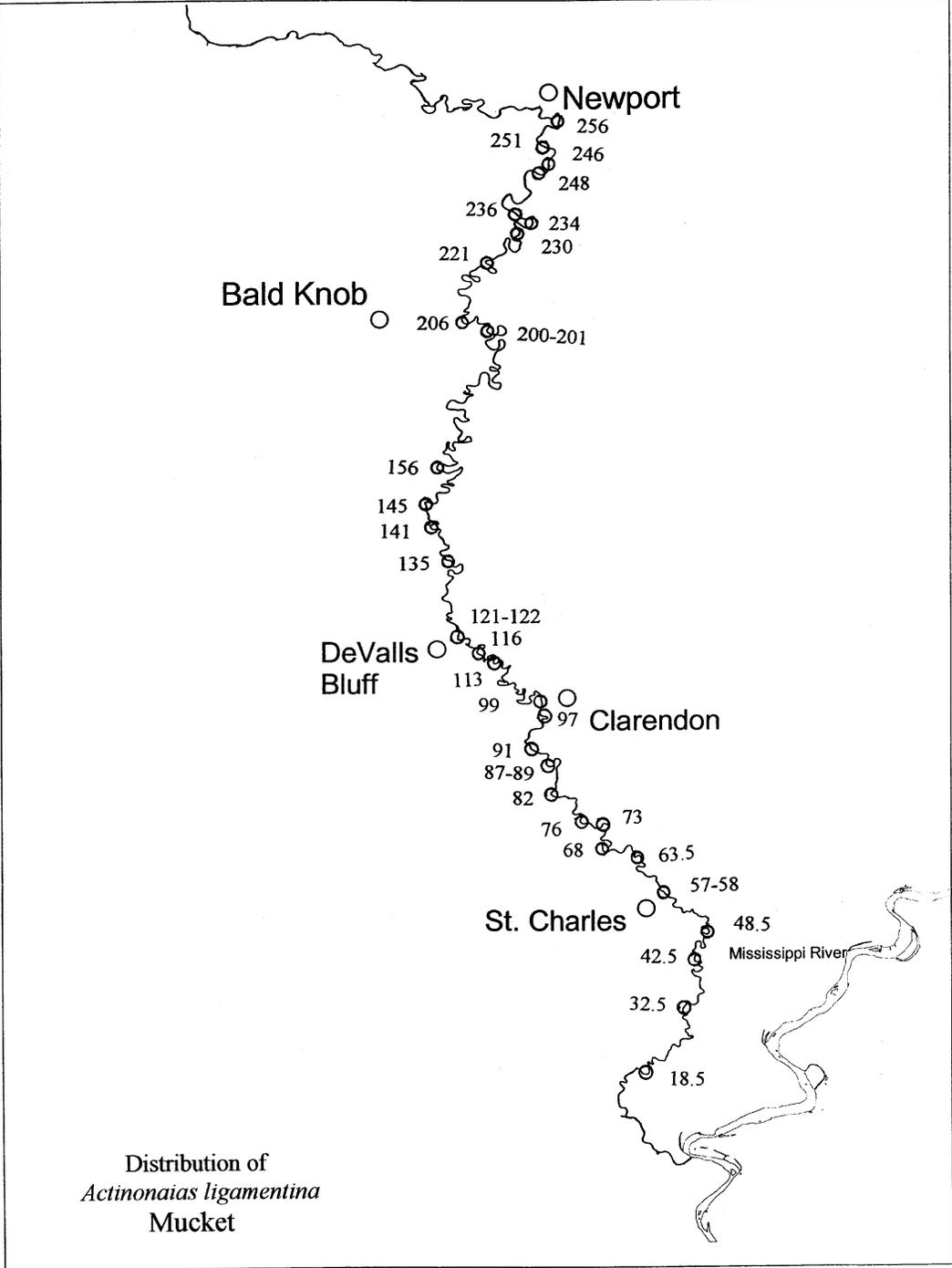
Description: **Shell rhomboid, moderately inflated**, valves thick, umbos slightly elevated above hingeline. External color yellow, olive or tan; rays prominent to absent. **Pseudocardinal teeth large; lateral teeth thin and long**. Beak cavity shallow to moderately deep. Nacre white to pink or salmon. Maximum length to seven inches.

Similar species: Plain pocketbook is more inflated, thinner shelled, and has more elevated umbos. Pink mucket is more inflated anteriorly, umbos are located more anterior. Hickorynut is more inflated anteriorly, external color is lighter, and umbos are swept back more anteriorly.

Relative abundance: Mucket is extremely rare in the study region.

Local names: brass mucket, niggerhead, steamboat mucket, grass mucket, Saline mucket





Pink Mucket
(*Lampsilis abrupta*)

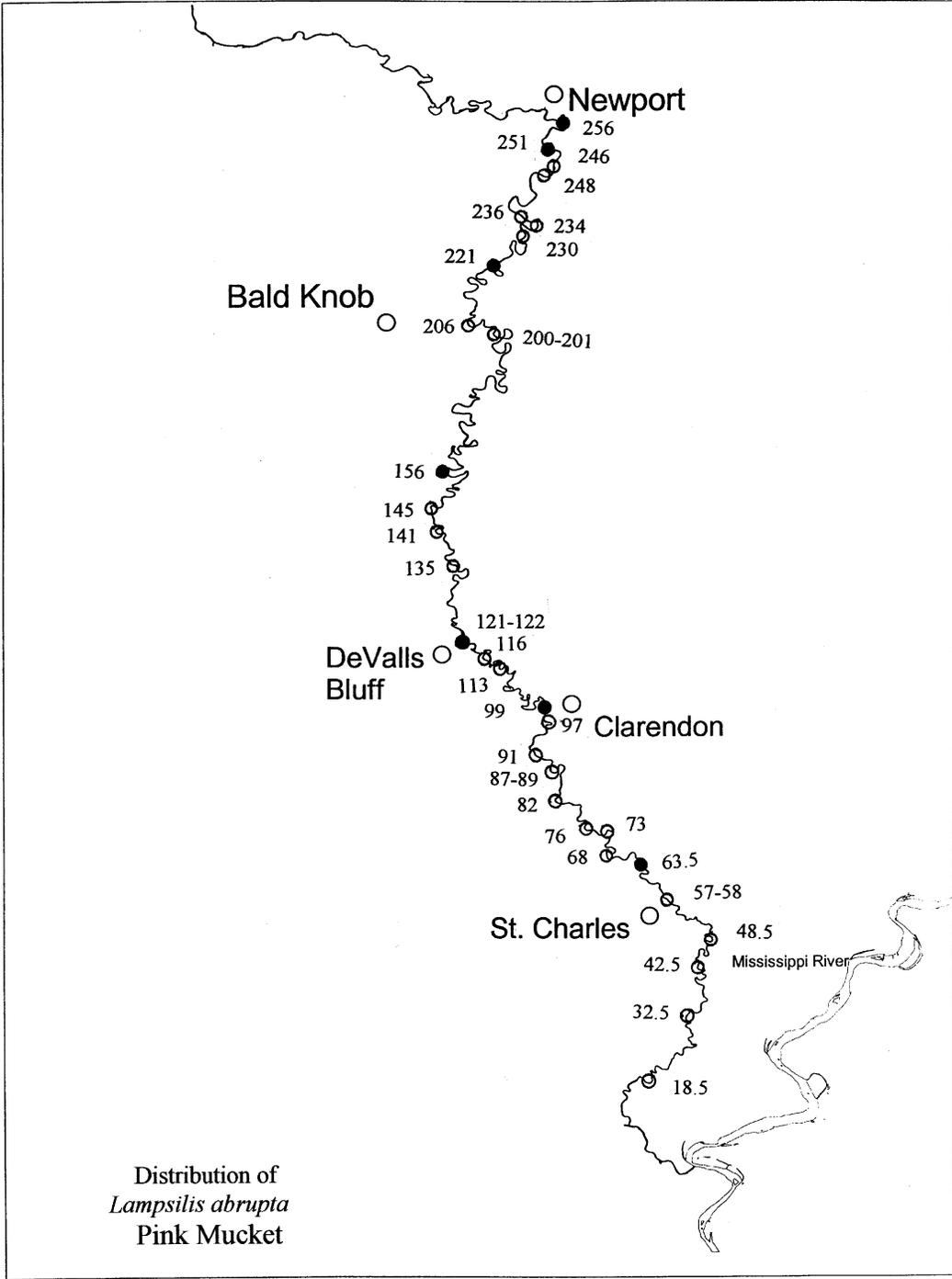
Description: **Shell oval and inflated**, valves thick, umbos slightly elevated above hingeline. **External color tan to brown with wide rays**, sometimes absent. Teeth well developed and stout. Beak cavity deep. **Nacre white, tinged with pink or salmon in beak cavity**. Length to five inches.

Similar species: Mucket is moderately inflated and the umbo is more central than in pink mucket. Plain pocketbook is more inflated, valves are thinner, umbos are more elevated and located more toward center of shell, and external color is more yellowish and shiny. Hickorynut has inflated umbos but is much thinner posteriorly, external color is yellow and lacks broad green rays, nacre is white. Ebonyshell is oval with swept back, more pointed umbos, lacks external rays, and teeth are arranged with parallel long axes.

Relative abundance: Distributed throughout the study region. The pink mucket is rare within the White River, comprising < 1% of the total mussels in beds where it has been found.

Local names: grandmaw, alkali mucket





Distribution of
Lampsilis abrupta
Pink Mucket

Pink Papershell
(*Potamilus ohiensis*)

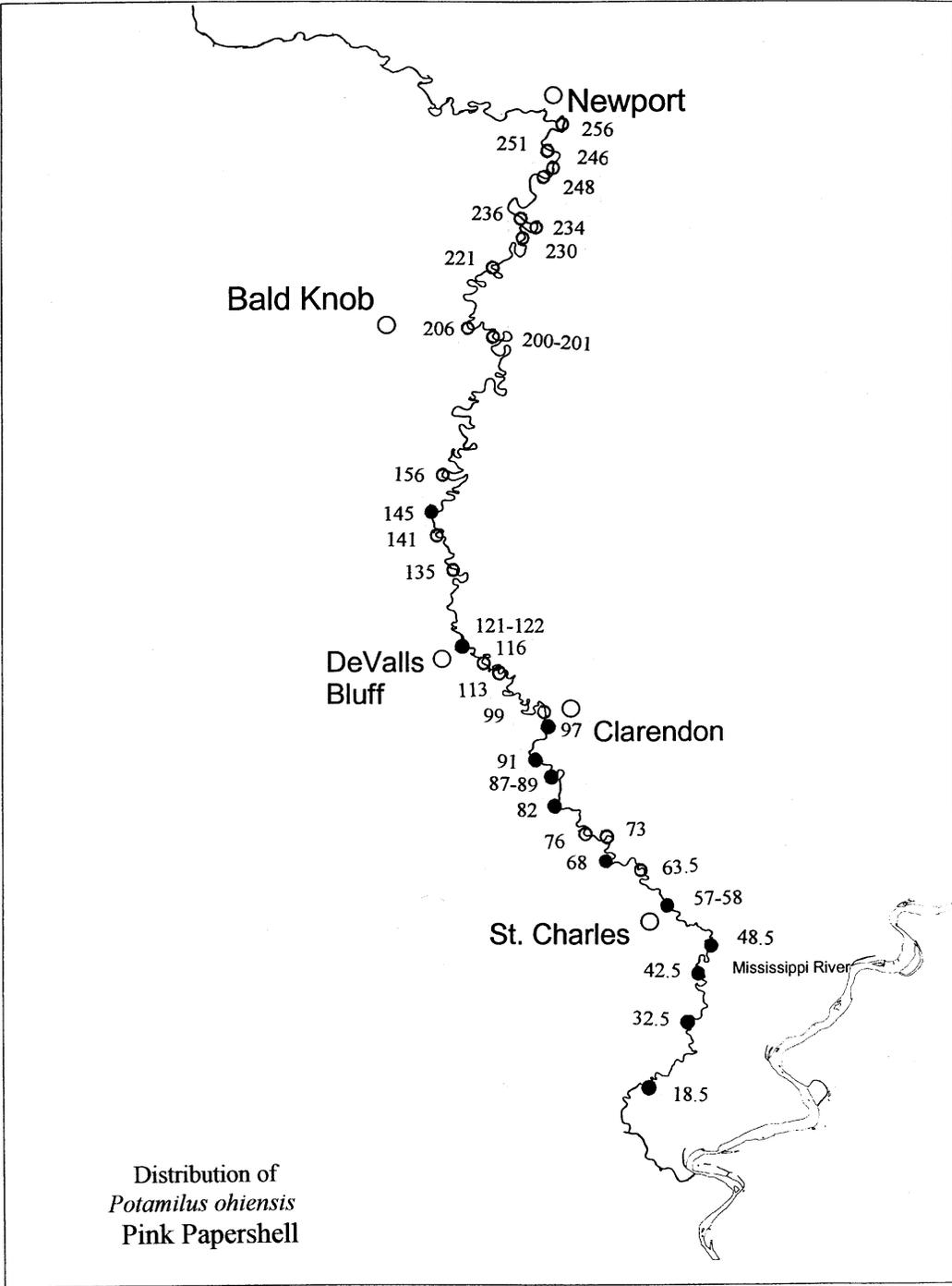
Description: **Shell elongate, compressed**; valves thin and fragile. **Posterior and anterior wings present**, umbos flattened and not elevated above the hingeline. **External color tan, olive to dark brown**, generally rayless. Pseudocardinal teeth thin and elongate, lateral teeth long and thin, straight to slightly curved. Beak cavity shallow, **nacre light purple to pink and iridescent**. Length to seven inches.

Similar species: Fragile papershell has smaller posterior wing, white iridescent nacre, and pseudocardinal teeth slightly stouter than in pink papershell. White heelsplitter has larger posterior wing with undulations, thicker valves, no lateral teeth, and white nacre. Flat floater lacks both the prominent posterior wing and teeth, and has a white nacre.

Relative abundance: Found in the downstream 150 river miles of the study region. A relatively uncommon component of most mussel beds comprising < 2% of total mussels.

Common names: papershell, fragile heelsplitter





Plain Pocketbook
(*Lampsilis cardium*)

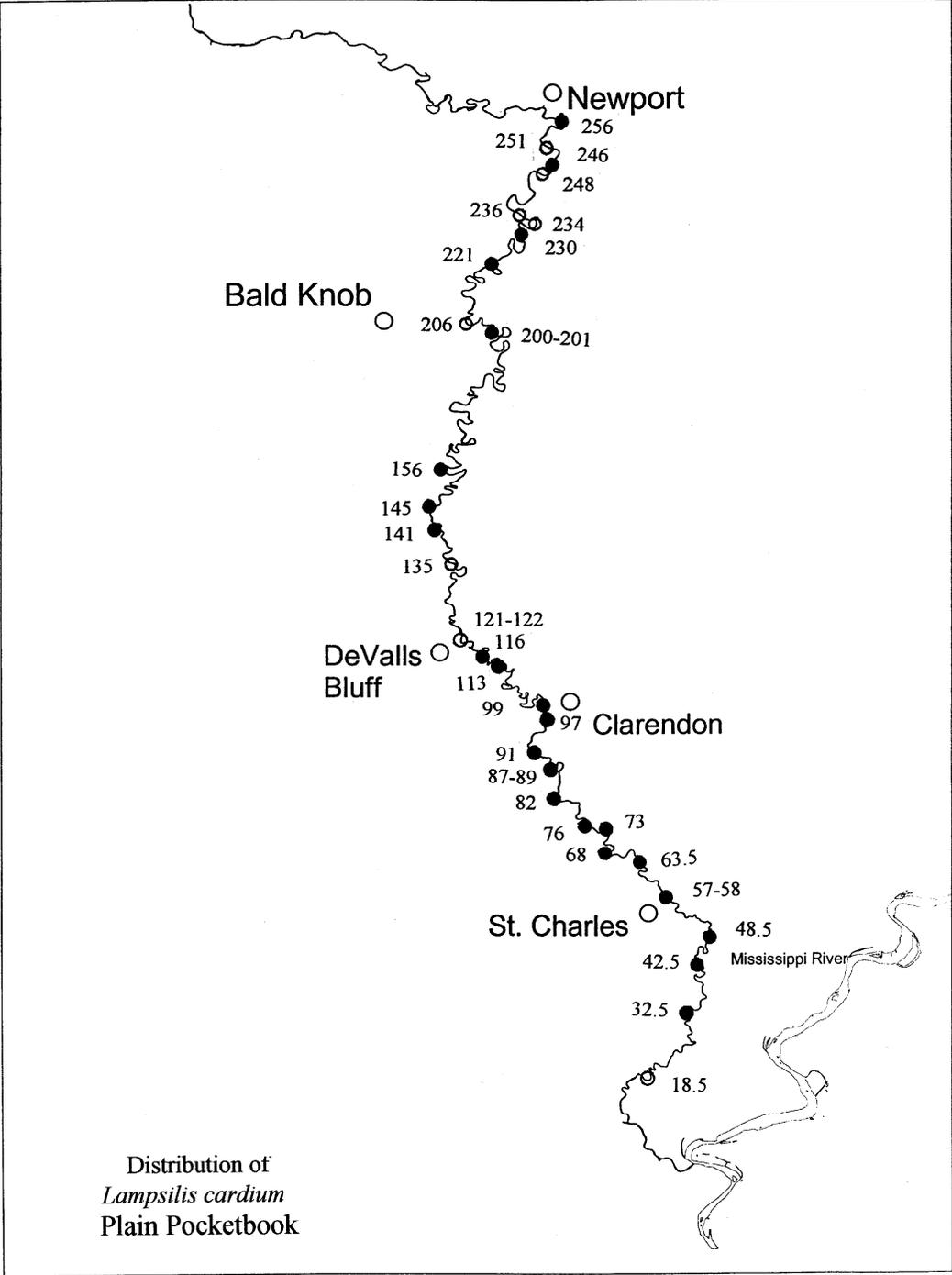
Description: **Shell round to quadrate, inflated**, valves moderately thick. Umbos elevated above the hingeline. **External color yellow, yellowish green to tan, smooth, usually with numerous dark green rays** of various width. Beak cavity deep, **nacre usually white**, occasionally pink and iridescent. Pseudocardinal teeth relatively large; lateral teeth well developed, straight to curved. Length to seven inches.

Similar species: Fat pocketbook is more inflated, umbos are raised higher above the hingeline creating an s-shaped dorsal outline, and color rays are never present. Mucket has thicker valves, is less inflated, and has umbos scarcely raised above the hingeline. Pink mucket has thicker valves, thicker teeth, is more inflated posteriorly, has umbos scarcely raised above the hingeline, usually has external color rays, and the nacre is usually pink in the beak cavity.

Relative Abundance: Distributed throughout the study area. A relatively uncommon component of most mussel beds comprising < 2% of total mussels.

Common names: grandmaw, pocketbook





Pyramid Pigtoe
(*Pleurobema rubrum*)

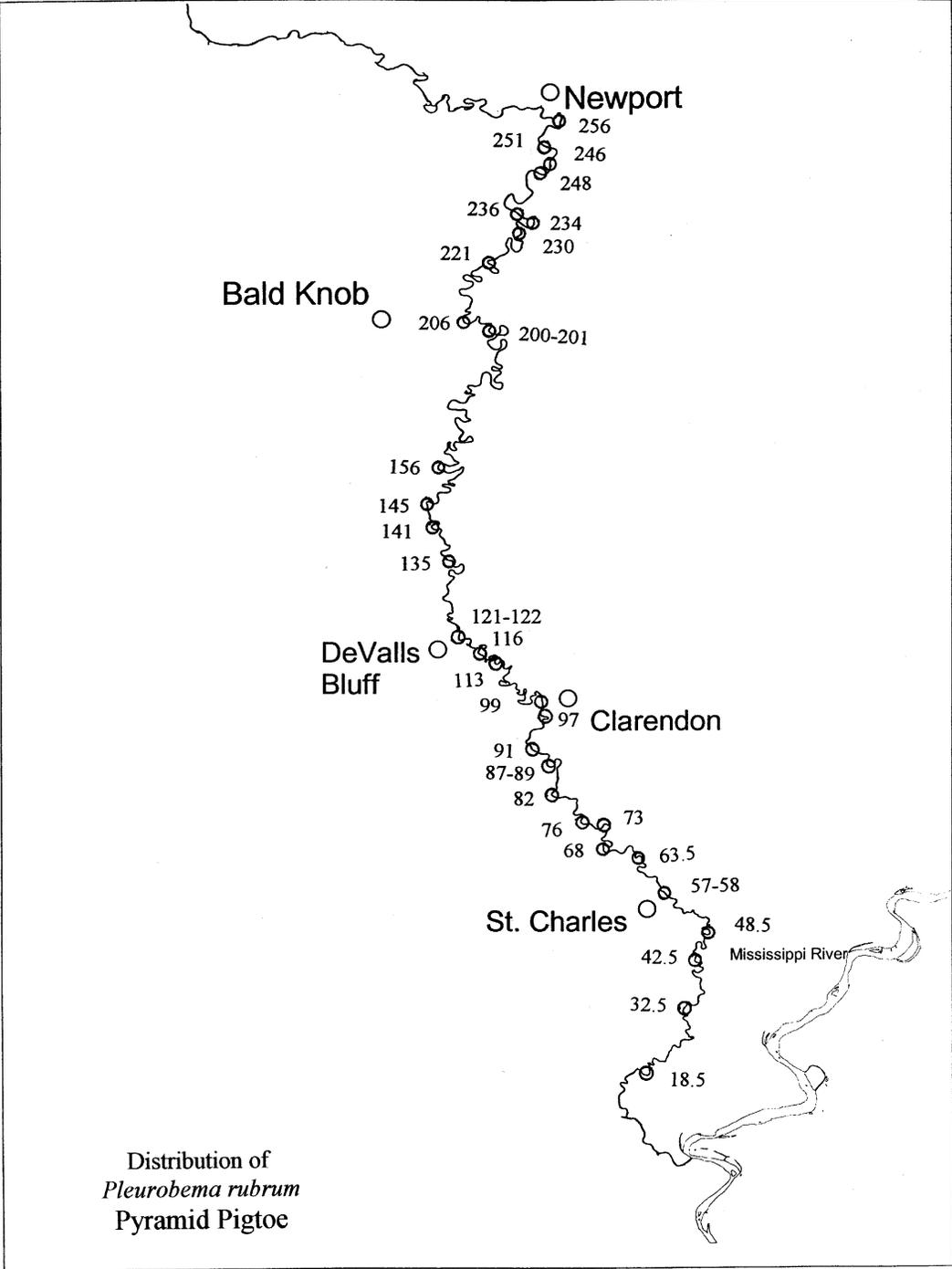
Description: **Shell triangular and elongate**, moderately inflated, valves relatively thick. **Umbos high, projected forward and anterior to rest of shell**. Shallow sulcus sometimes present. **External color brown or black**, rays not prominent. Pseudocardinal teeth well developed; lateral teeth straight to slightly curved. Beak cavity moderately deep. **Nacre pink, rose or white**. Length to four inches.

Similar species: Wabash pigtoe is broadly triangular and umbos are scarcely elevated. Ebonyshell is round, umbos are low and even with hingeline, beak cavity is very deep, pseudocardinal teeth aligned parallel to lateral teeth.

Relative abundance: A rare component of the White River mussel fauna, most specimens collected have been as dead shells only.

Local names: pink pigtoe





Wabash Pigtoe
(*Fusconaia flava*)

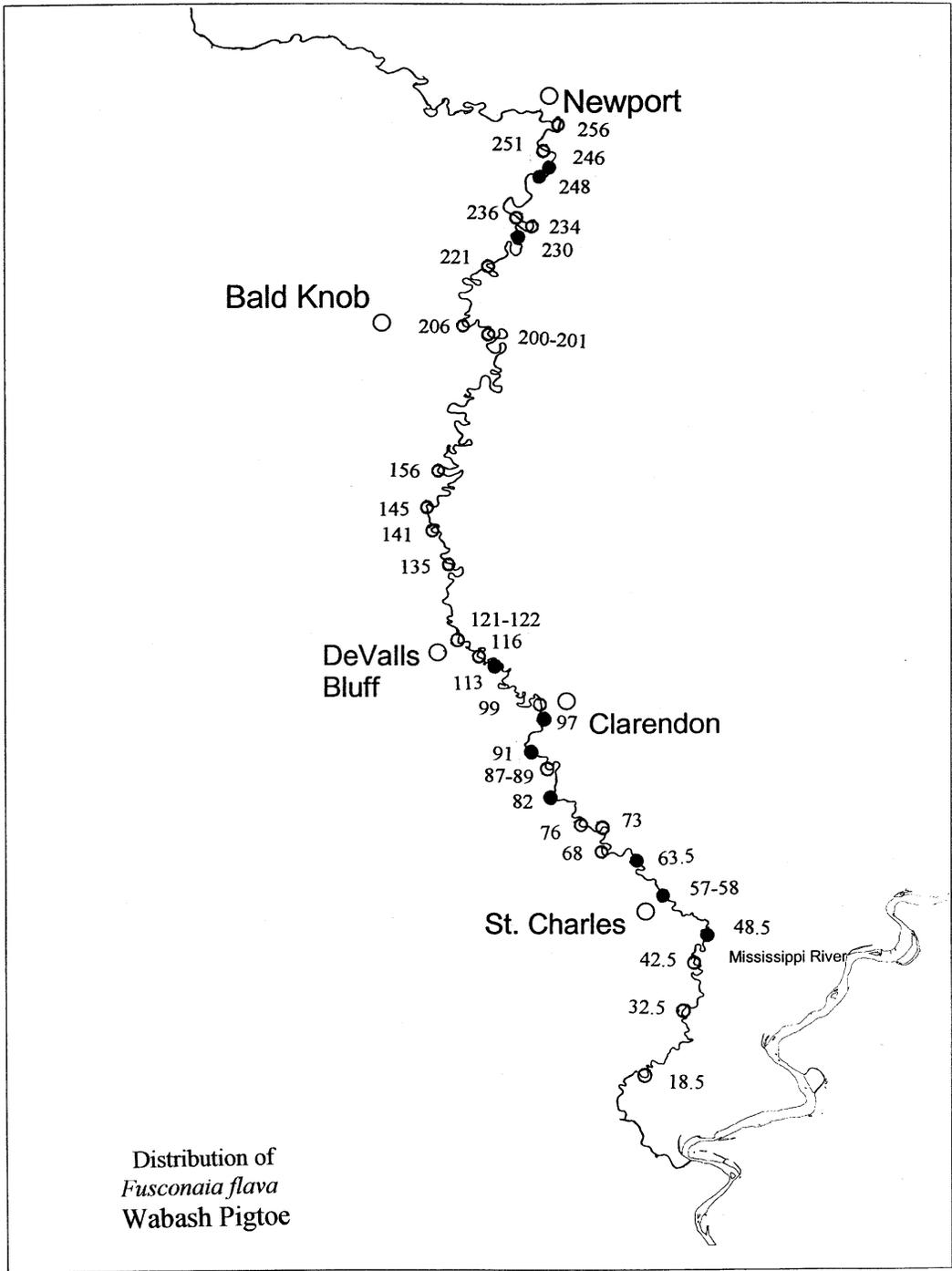
Description: **Shell broadly to sharply triangular**, moderately inflated, valves moderately thick. Umbos low to moderately elevated; **a wide shallow sulcus usually present on the ventral half of shell**. **External color brown to black**, faint rays visible in small specimens. Pseudocardinal teeth well developed; lateral teeth straight or slightly curved. **Beak cavity deep**. Nacre white, pink or salmon. Length to four inches.

Similar species: Ebonyshell is round, lacks a sulcus, and pseudocardinal teeth are aligned parallel to lateral teeth.

Relative abundance: Widely distributed throughout the study region. Wabash pigtoe is not abundant in the White River and comprises 1-2% of the total mussels sampled from beds.

Local names: sheep's nose, pigtoe





White Heelsplitter
(*Lasmigona complanata*)

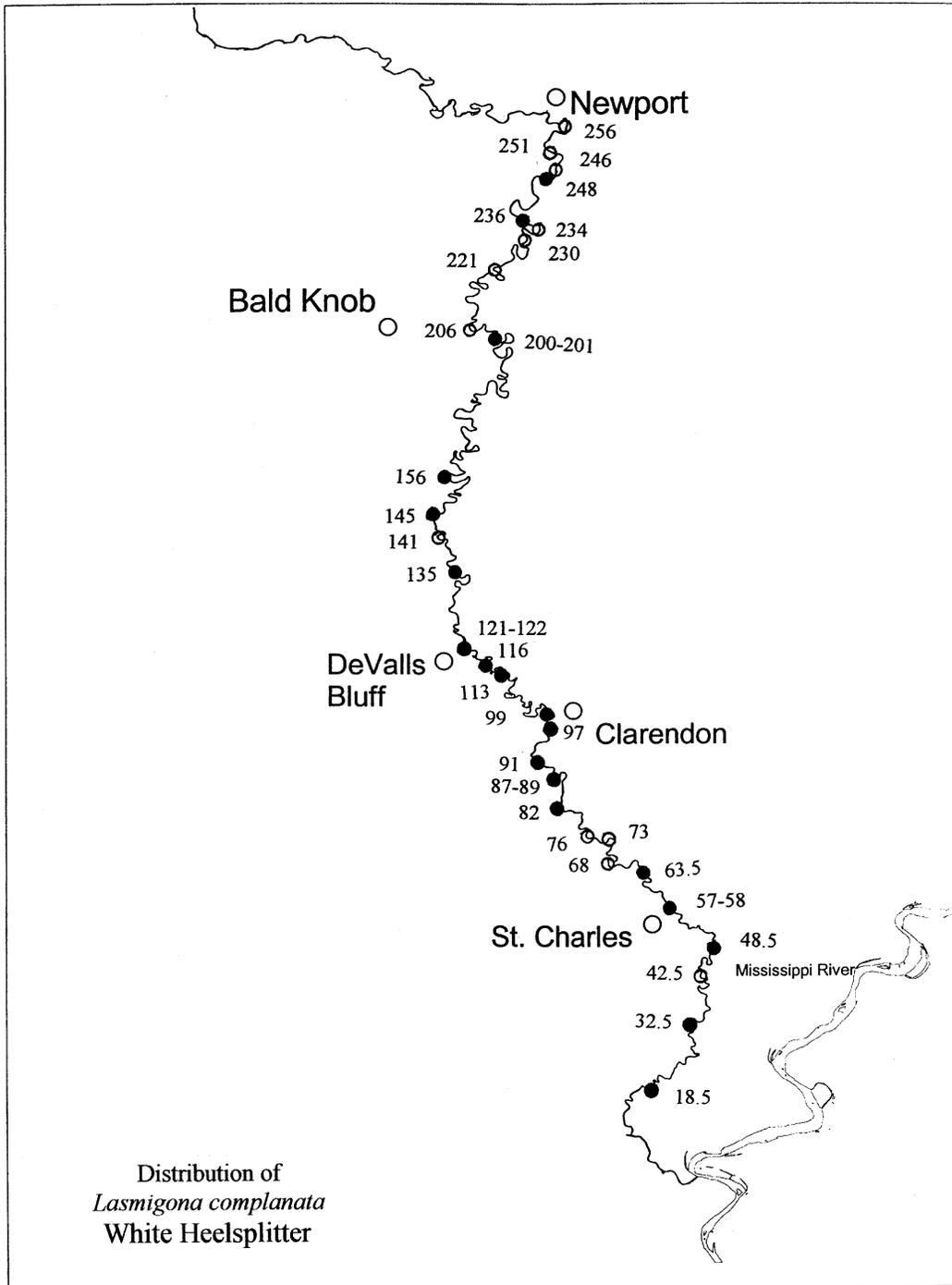
Description: **Shell round, compressed**, valves thin to moderately thick. **Large posterior wing with several shallow folds or ridges that extend onto the posterior slope.** Umbos flattened and not projecting above hingeline. **External coloration brown or black.** Pseudocardinal teeth well developed, **lateral teeth poorly developed.** Beak cavity shallow to moderately deep. Nacre white. Length to eight inches.

Similar species: Flat floater is more round, has a small dorsal wing, valves are very thin, and lateral teeth are absent. Pink papershell has well developed posterior wing, moderate anterior wing, moderate to small pseudocardinal teeth, and pink nacre.

Relative abundance: Distributed throughout the study region. An uncommon component of most mussel beds usually contributing 1-3% of total mussels per bed.

Common names: pancake, razorback, hackle-back





Zebra Mussel
(*Dreissena polymorpha*)

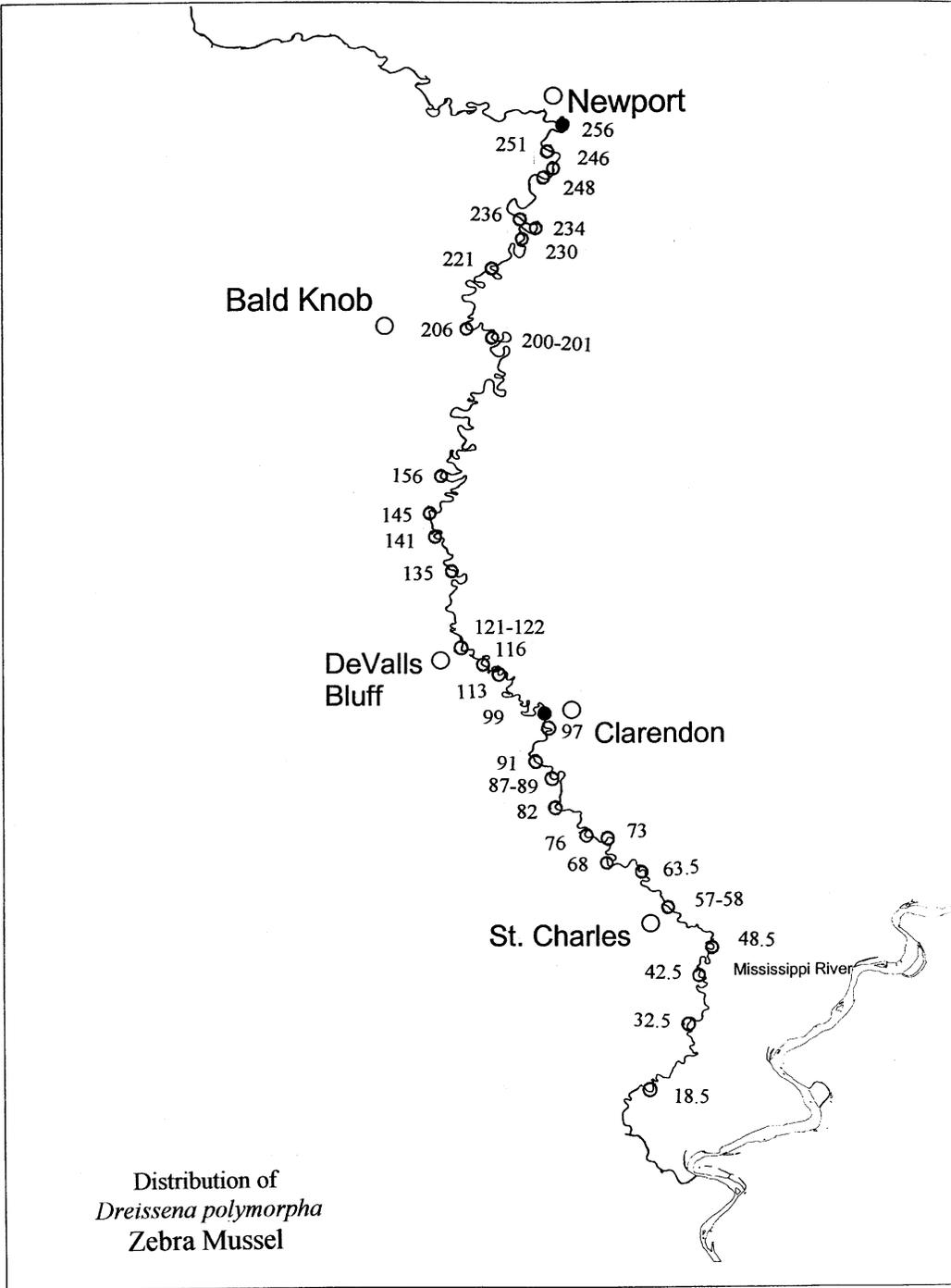
Description: **Shell elongate, triangular, and inflated**; very distinctive. **External color variable, most are white or cream-colored with lateral brown to black stripes or bands**. No pseudocardinal or lateral teeth. Moderately deep beak cavity. Nacre white. **Attaches to solid structures like rocks, woody debris, and mussel shells**. Length to 1.5 inches.

Similar species: None

Relative abundance: An introduced species that has infiltrated the White River via barge and boat traffic. Known to occur in the vicinity of Newport (River Mile 255) and Clarendon (River Mile 99). It is probable that the zebra mussels will invade most portions of the White River where barge traffic travels. Can become extremely abundant in suitable habitat.

Local names: None





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Glossary

Anterior: front or forward.

Anterior slope: area across the dorsal portion of the valve from the beak to the anterior margin.

Anterior wing: a wing positioned along the dorsal margin anterior to the beak.

Beak: the raised portion of the dorsal margin of a shell; formed by embryonic shell around which the rest of the shell develops.

Beak cavity: the hollow on the inside of each valve leading into the beak, under the interdentum.

Cardinal teeth: teeth located between the two sets of lateral teeth as in *Corbicula*.

Chevron: shaped like a wide-angled V; appearing as lines or rays on the epidermis (periostracum) or external portion of the shell.

Compressed: flattened out or pressed together.

Concentric: having a common center, such as ridges or loops radiating from the beak of a mussel valve.

Corrugated: marked by wrinkles or ridges and grooves.

Denticle: a small swelling, tooth-like projection or minor tooth on the hinge line, usually anterior to the major pseudocardinal tooth or teeth.

Dorsal: the top or back; in mussels, the hinge area.

Elliptical: elongated, having the form of an ellipse.

Elongate: long or extended.

Fluted: valves in which the posterior margin or slope is corrugate, the corrugations (usually parallel) opening onto the margin of the shell.

Glochidium (pl. glochidia): the bivalved larvae of freshwater mussels in the superfamily Unionoidea which are generally parasitic on the gills of fish.

Hinge ligament: an elastic, elongate, corneous structure that unites the two valves dorsally along the hinge plate.

Hinge plate: the dorsal area of the unionoid mussel shell, including the pseudocardinal and lateral teeth and the interdentum, if present.

Inflated: moderately to greatly swollen.

Interdentum: a flattened area of the hinge plate between the pseudocardinal and lateral teeth.

Iridescent: showing lustrous colors like those of a rainbow.

Knob: a protuberance exteriorly on the shell, usually large in size and few in number.

Lateral teeth: the elongate, raised, and interlocking structures along the hinge line of the valve.

Marsupial swelling: a section of the posterior ventral margin of certain female unionoid shell, which is enlarged or inflated to provide space for expansion of the marsupium with the development of the glochidia.

Marsupium: in unionoids, a brood pouch for eggs and developing glochidia, formed by a restricted portion of the outer gill, the complete outer gill or all four gills.

Nacre: the interior iridescent, thin layer of a mussel shell.

Nodule: a small rounded mass of irregular shape.

Oval: egg-shaped, broadly elliptical.

Pallial line: an indented groove or line approximately parallel with the ventral margin of a bivalve shell which marks the line of muscles attaching the mantle to the shell.

Periostracum: exterior or outside layer of the shell.

Periphery: the external boundary on a surface; edge.

Plications: parallel ridges on the surface of the shell.

Posterior: hind or rear.

Posterior ridge: a ridge on the exterior of a mussel shell, extending from the umbo to the posterior margin.

Posterior slope: the area across the dorsal portion of the valve extending from the umbo to the posterior margin, often above or behind the posterior ridge.

Pseudocardinal teeth: triangular-shaped hinge teeth near the anterior-dorsal margin of the shell.

Pustule: small, raised structure on the external or outside surface of the shell.

Quadrante: square or nearly square in outline.

Ray: a streak or linear mark, either broken or continuous; often in a radiating pattern in unionids.

Rhomboid: having generally four distinct sides, two sides being longer than the others.

Serrated: notched or grooved, like saw blade teeth.

Solid: shells which are thick and heavy.

Species: group of interbreeding natural populations that are reproductively isolated from all other such groups.

Sulcus: a longitudinal furrow or depression.

Triangular: a shape having three sides and three angles, like a triangle.

Truncate: having an end squared off.

Tubercle: small, raised, rounded knob on the outside of the shell.

Umbo: the dorsally raised, inflated area of the bivalve shell, centrally or anteriorly placed along the dorsal margin of the valve.

Undulation: pattern with waves; raised ridges or bars.

Unionoids: refers to any member of the freshwater bivalve mollusks that belong to the superfamily Unionoidea, and by definition, glochidial larvae.

Valve: the right or left half of a mussel (or unionoid) shell.

Ventral: the underside or bottom.

Wing: the usually thin, flat extension of the dorsal margin above the hinge line.

Appendix I

Planning Procedures

1. Planning Dredging Procedures on the White River
2. Discovery of Mussel Resources during Dredging Operations

Procedures for Scheduling Dredging Operations on the White River

The Memphis District Corps of Engineers (CE) shall submit the current pre-dredging season thalweg of the navigation channel to the U.S. Fish and Wildlife Service (FWS) and the Arkansas Game and Fish Commission (AGFC). Potential dredging locations will be marked with the nearest river miles indicated on the thalweg. This information will be provided at least 30 days prior to the dredging season.

Following review of the proposed dredge sites, the FWS and AGFC shall identify potential problem sites and notify the CE of their determination in writing within 14 calendar days from receipt of thalweg. A coordination meeting will be held if necessary. Upon conclusion of any coordination meeting(s) and/or resolution of problem dredging sites, a confirmation letter will be sent to CE.

For potential problem sites, the CE will submit a map of the existing river bottom contours, an overlay of the area to be dredged, an overlay of any known mussel beds in the vicinity in relation to the proposed dredge site, an estimate of the quantity of material to be removed, and the location of the dredge disposal site. All mapped data will be to scale. Additional information (i.e., previous dredging locations) will be provided as necessary. Coordination meetings and data acquisition shall be conducted in a timely manner.

Procedures to Follow if Mussel Resources Are Discovered During Dredging Operations

1. During dredging operations, the monitoring staff shall be close enough to the disposal site at all times to determine immediately if mussel resources are being impacted. In potential problem areas, the dredging operation will periodically cease so the inspector(s) may check the disposal area for mussels.
2. Any time endangered or threatened species of mussels occur in dredge disposal site, regardless of number of individuals (either living or dead), dredging must cease in the immediate area.
3. When concentrations of mussels occur in the dredge disposal pile, dredging operations shall cease immediately until a determination is made regarding significance.
 - a. The government mussel monitor must first determine if live mussels occur in the dredge disposal site, how many and what species are present. If only relic shells of non-endangered species are present, dredging can proceed at the discretion of the monitor. If live mussels have been deposited, then dredging shall cease in the immediate area. The monitor should contact the Administrative Contracting Officer (ACO) if an endangered/threatened species or a concentration of mussels are encountered. At the discretion of the monitor (including coordination with the ACO), dredging may proceed in other portions of the site that do not impact mussels. Photo-documentation should be gathered along with other data.
 - b. If the government mussel monitor is not present, the Contractor must contact the ACO, Don Tutor, at the Wynne Area Office, (901)-544-3851/3856, as soon as possible. The ACO will issue corrective measures and may place the dredge in an idle standby status (by oral notification) until satisfactory corrective measures have been made, or the Contractor is directed to move to another location.
4. The mussel monitor should record the number and type of mussels that have been deposited in the dredge disposal sites. Live specimens should be returned to the river at approximately the same depth and distance from the shore but at least 100 feet downstream of the location of the cutter head at the time of impact. If endangered species are deposited in the dredge disposal site, they should be photographed with graphic scale comparison (using a macro lens for close up), and measured for length, width and depth prior to being returned to the river. Shells that have been chipped or cracked but the soft parts are not exposed should be returned to the river. Shells that have been broken by the cutter head should be collected, the soft parts removed, and stored for later review. If endangered species are irreparably damaged by dredging, the specimens should be collected. There are two options for storage of specimens. Both require containers to be permanently labeled with precise location, date/time, and name of collector. In both options, the specimens are packed on ice or otherwise refrigerated. The first option is to place shell and soft parts (if necessary to separate, label accordingly) in a tightly sealed glass container of absolute alcohol. A second option for collection is to utilize a high quality Ziploc bag(s). All pertinent data (including information regarding relic shells

encountered) will be provided to the CE Environmental and Economic Analysis Branch personnel. The Environmental staff will contact the FWS Law Enforcement Officer, Ron Parker, @ (501) 513-4474 for final curation of the specimen(s).

5. The mussel monitor and regulatory agencies must be aware that individual mussels of certain species can occur at any point in the river. Individuals of plain pocketbook, fragile papershell, threehorn wartyback, yellow sandshell, pink heelsplitter and Asiatic clam regularly occur in shallow depositional areas (sand or gravel bars) and live individuals are likely to occur in dredge disposal sites. Occurrence of low numbers of these species in dredge disposal sites are to be expected and should not be considered reason to cease dredging activities.
6. The ACO shall immediately notify CE Environmental and Economic Analysis Branch personnel when significant mussel resources or endangered and threatened species have been encountered during dredging operations. One of the following individuals should be notified:

Patricia Jones, Biologist	(901) 544-0705 (W) (870) 739-4007 (H)
Joe Hockmuth, Fisheries Biologist	(901) 544-0973 (W) (870) 933-7166 (H)
Mark Smith, Aquatic Biologist	(901) 544-0670 (W) (901) 324-8219 (H)
Environmental Analysis Branch FAX	(901) 544-3857 (901) 544-3955

7. The Environmental and Economic Analysis Branch personnel shall immediately notify the following FWS and AGFC personnel when significant mussel resources or endangered and threatened species have been encountered:

FWS: (Only one of the following individuals needs to be contacted.)

- a) Joe Krystofik,
Lower White River Basin Biologist (870) 347-1506
Mobile (501) 730-3703
FAX (870) 347-2908
- b) Allan Mueller,
Field Supervisor, Conway Field Office (501) 513-4475
FAX (501) 513-4480

AGFC: (Only one of the following individuals needs to be contacted.)

- a) Bill Posey, Malacologist (501) 776-0218 ext. 17
WATTS Line (877) 847-2690 ext. 17
Mobile (501) 539-0891
FAX (501) 776-8362
- b) Craig Uyeda, Chief, River Basins (501) 219-4311
FAX (501) 219-4315

8. Within five working days of notification of the discovery, all parties shall attempt to resolve the issue of how to proceed when significant mussel resources or endangered species have been impacted. A field meeting shall be held at the earliest possible time following the discovery. It shall be the responsibility of the Memphis District CE to provide sufficient data regarding mussel resources and dredging activities to resolve the issue.
9. These procedures may be modified to reflect the FWS comments in the Biological Opinion on endangered species regarding White River maintenance dredging.