

Athearn

# THE FRESHWATER MUSSELS OF NOVA SCOTIA

By H. D. ATHEARN<sup>1</sup> AND A. H. CLARKE, JR.<sup>2</sup>

## INTRODUCTION

The material for this study was collected by one of us (Athearn) during seven trips to Nova Scotia between 1946 and 1954 and by the other (Clarke) during a single expedition in the summer of 1960. Specimens were found at seventy-one localities, and although the region near Halifax was most thoroughly covered, collections were made in nearly all the counties within the province. Additional records were obtained from the collections in the National Museum of Canada and the Museum of Comparative Zoology. It is felt that the coverage is now sufficiently complete to allow some general conclusions to be made with respect to the zoogeography of the Bivalvea in Nova Scotia and its significance.

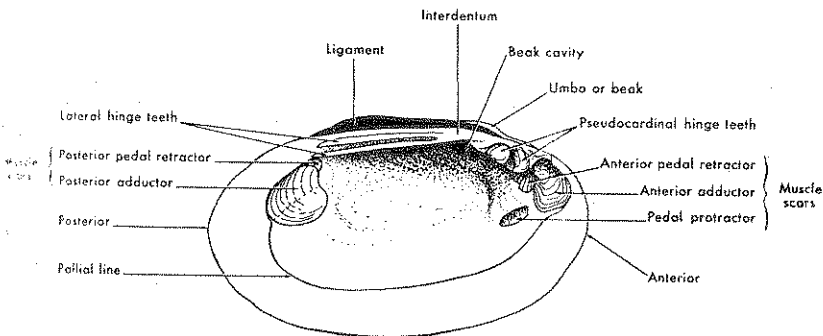
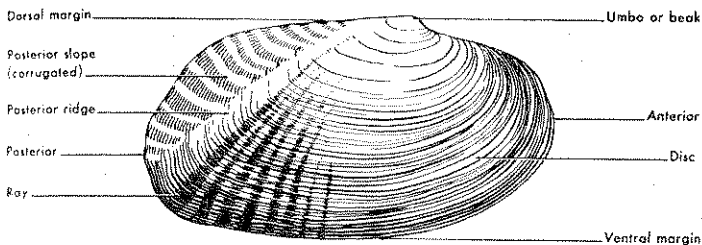


FIG. 1. External and internal morphology of typical unionid shells. Upper figure, *Lasmigona costata* (Say) (schematic). Lower figure, *Lampsilis radiata radiata* (Gmelin). From Clarke and Berg, 1959.

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As far as we now know, Nova Scotia contains nine clearly defined species of freshwater mussels and a tenth form whose status will be discussed. Although the narrow and marshy Isthmus of Chignecto provides the only land connection between Nova Scotia and the mainland, the total number of unionid species present is not significantly less than what might be expected if a much wider and more suitable land bridge existed. The only apparently missing species is *Alasmidonta heterodon* (Lea). That species has been found in the Petitcodiac River of New Brunswick (Athearn 1953) and not in Nova Scotia. Its distribution is erratic and discontinuous even on the mainland, however (Clarke and Berg, 1959).

Before proceeding to discuss the ecology and systematics of the species and the details of their distribution, it is appropriate to consider briefly the work which has already been done on the unionid fauna of Nova Scotia

#### PREVIOUS WORK

Only two reports dealing exclusively and comprehensively with the molluscs of Nova Scotia have been issued. The first was by Willis (1857) who, in a privately published and remarkably complete catalogue, cited 193 species of marine, land, and freshwater molluscs and even included locality data, all on a single page. Of the eight unionids included, the only ones that can be positively identified are *Unio complanatus* Lea (= *Elliptio complanatus* (Solander)), *Unio radiata* Lam. (= *Lampsilis radiata radiata* (Gmelin)), *Anodonta implicata* (= *Anodonta implicata* Say) and *Alasmidonta margaritifera* (= *Margaritifera margaritifera margaritifera* (Linn.)). The other species can be identified only tentatively and in part, viz., *Unio* . . . (?) "Dartmouth Lakes" (possibly *Alasmidonta undulata* (Say)), *Anodonta ferussaciana* "Dartmouth Lakes, common" (probably *Anodonta cataracta* Say), and *Anodonta* . . . (?), "two varieties . . . St. Mary's river, Truro" (unidentifiable).

The second report was by Jones (1877) who included four unionids among the 189 species of marine, land, and freshwater molluscs listed from the province. All are readily identifiable. They are *Unio complanatus* Lea (= *Elliptio complanatus* (Solander)), *U. radiatus* Barnes (= *Lampsilis radiata radiata* (Gmelin)), *Margaritana arcuata* St. (= *Margaritifera margaritifera margaritifera* (Linn.)), and *Anodon implicata* Gould (= *Anodonta implicata* Say).

Additional studies that give information on the freshwater mussel fauna of Nova Scotia are by Simpson (1914), Ortmann (1919), Brooks (1936), Smith (1938), Brooks and Brooks (1940), Johnson (1946, 1947), Athearn (1953, 1961), La Rocque (1953, 1961a, 1961b), and Clarke and Berg (1959). Smith lists *Anodonta marginata* Say as occurring in Lake Jesse, Yarmouth County, but, as pointed out elsewhere (e.g., Clarke and Berg, 1959), the status of that species is in doubt. None of the other workers cited give additional species specifically from Nova Scotia. Simpson and several subsequent authors, however, list *Anodonta cataracta* Say, *Alasmidonta undulata* (Say), *Lampsilis cariosa* (Say), *Ligumia nasuta* (Say), and *Strophitus undulatus* (Say) (often as *S. rugosus* Swain.) as occurring in the Atlantic drainage from the St. Lawrence system south, thereby implying that they may be expected to occur in Nova Scotia.

#### PRELIM

The present authors have in Nova Scotia:

*Margaritifera margaritifera*  
*Elliptio complanatus*  
*Alasmidonta undulata*  
*Alasmidonta varicosus*  
*Strophitus undulatus*  
*Anodonta implicata* ♀  
*Anodonta cataracta* ♂  
*Anodonta cataracta* ♂  
*Lampsilis ochracea* ♂  
*Lampsilis radiata* ♂

The distribution of freshwater mussels is not random or uniform. *S. undulatus* at a single locality close to the Isthmus and *L. radiata* are more general in the northern or southern extremities. *E. complanatus*, *A. implicata*, and *A. cataracta* are distributed farther and appear to be more common (Table VI). Clearly, postglacial mussels have not reached completion but is still in progress.

It is of interest to note that the distribution corresponds roughly to the pattern of freshwater fishes, i.e., an irregular distribution of species present with increasing abundance of course, mussel glochidia in the diet of many species of fish, and such a correlation is not coincidental. More information is needed on the parasitism by the mussels in correlation with the fishes. This correlation can be made more definite.

Since neither *Ligumia nasuta* nor *Anodonta cataracta* are found in the northeast of Maine, their appearance in Nova Scotia is surprising. Both of these species, however, have been found to occur in that province. They have been included in the key.

#### KEY TO THE FRESHWATER

1. Articulating hinge teeth absent . . . . . *S. undulatus*
2. Articulating hinge teeth present . . . . . 2
3. Vestigial pseudocardinal teeth present . . . . . *A. cataracta*
4. Vestigial pseudocardinal teeth absent . . . . . 3
5. Beak sculpture not noticeably thickened anteriorly . . . . . *A. implicata*
6. Beak sculpture noticeably thickened anteriorly . . . . . *A. cataracta*
7. Shell not as above . . . . . 4
8. Nacre salmon or copper colored . . . . . *A. cataracta*
9. Nacre white . . . . . 5
10. Length of adult specimen . . . . . *A. cataracta*
11. Length of adult specimen . . . . . *A. implicata*
12. Shell not thickened anterior-ventrally . . . . . *A. cataracta*
13. Shell thickened anterior-ventrally . . . . . *A. implicata*

Adapted from Clarke and Berg, 1959, and the Atlantic Drainage of the United States. Modified in the key.

## PRELIMINARY CONCLUSIONS

The present authors have collected the following species of unionids in Nova Scotia:

- Margaritifera margaritifera margaritifera* (Linn.)  
*Elliptio complanatus* (Solander)  
*Alasmidonta undulata* (Say)  
*Alasmidonta varicosa* (Say)  
*Strophitus undulatus* (Say)  
*Anodonta implicata* Say  
*Anodonta cataracta cataracta* Say  
*Anodonta cataracta brooksiana* van der Schalie  
*Lampsilis ochracea* (Say)  
*Lampsilis radiata radiata* (Gmelin)

The distribution of freshwater mussels in Nova Scotia is by no means random or uniform. *S. undulatus* and *L. ochracea* are each known from only a single locality close to the Isthmus of Chignecto. *A. undulatus*, *A. varicosa*, and *L. radiata* are more generally distributed but have not reached either the northern or southern extremities of the province. *M. margaritifera*, *E. complanatus*, *A. implicata*, *A. c. cataracta*, and *A. c. brooksiana* have migrated farther and appear to occur all over Nova Scotia (see Maps Plate VI). Clearly, postglacial repopulation of the province has not yet reached completion but is still going on.

It is of interest to note that the distribution of freshwater mussels corresponds roughly to the pattern observed by Livingstone (1951) for the freshwater fishes, i.e., an irregular but progressive decrease in the number of species present with increased distance from the Isthmus of Chignecto. Of course, mussel glochidia in general are obligate parasites of certain species of fish, and such a correlation in distribution patterns is probably not coincidental. More information is necessary on what species of fish are parasitized by the mussels in question before a more detailed examination of this correlation can be made.

Since neither *Ligumia nasuta* nor *Lampsilis cariosa* has been collected in the northeast of Maine, their apparent absence from Nova Scotia is not surprising. Both of these species, and *Alasmidonta heterodon*, may eventually be found to occur in that province, however; and for that reason all three have been included in the key.

## KEY TO THE FRESHWATER MUSSELS OF NOVA SCOTIA\*

1. Articulating hinge teeth absent or vestigial ..... 2  
 Articulating hinge teeth present ..... 5  
 2. Vestigial pseudocardinal teeth indicated by a depression and thickening just anterior to beak. Beak sculpture coarse and without a central sinuation. Shell not noticeably thickened anterior-ventrally. Length not exceeding 100 mm. Rare in Nova Scotia. .... *Strophitus undulatus* (Say), pl. 3, figs. 7 and 8.  
 Shell not as above ..... 3  
 3. Nacre salmon or copper coloured. Shell prominently thickened anterior-ventrally. Length of adult specimens exceeding 100 mm. Common. .... *Anodonta implicata* Say, pl. 2, figs. 1 and 2.  
 Shell not thickened anterior-ventrally ..... 4

\*Adapted from Clarke and Berg, 1959. All species found in the Maritime Provinces of Canada and the Atlantic Drainage of the United States south to and including the Delaware River system are treated in the key.

contains nine clearly defined forms whose status will be discussed by Chignecto provides and the mainland, the total is significantly less than what might have been if a land bridge existed. *Unio heterodon* (Lea). This species is erratic and discontinuous (see Berg, 1959).

comprehensively with the first was by Willis (1857) and a complete catalogue of molluscs and even included eight unionids included. These are *Unio complanatus* Lam., *Unio radiata* Lam. (= *Lampsilis radiata* Lam.), *Anodonta implicata* Say, *Margaritifera margaritifera margaritifera* (Linn.) (possibly *Alasmidonta heterodon* (Lea)), and *Strophitus undulatus* (Say). (See also Willis, 1857, p. 100, "two varieties").

who included four unionid freshwater molluscs listed in the key are *Unio complanatus* Lam., *Unio radiata* Lam. (= *Lampsilis radiata* Lam.), *Margaritifera margaritifera margaritifera* (Linn.), and *Anodonta implicata* Gould (= *Anodonta implicata* Say).

the freshwater mussels of Nova Scotia (1919), Brooks (1936), Simpson (1946, 1947), Atherton and Clarke and Berg (1959), and Berg (1959) in Lake Jesse, Yarmouth County, Nova Scotia. Clarke and Berg, loc. cit. and other workers cited in the key. Simpson and several others (1946, 1947) listed *Unio radiata* Lam., *Alasmidonta heterodon* (Lea), *Ligumia nasuta* (Say), and *Lampsilis cariosa* (Swain.) as occurring in Nova Scotia, thereby implying their presence in the province.



TABLE I. Locality, habitat, and abundance data for stations cited

Sta. No.	Locality	Habitat	<i>M. m. margaritifera</i>	<i>H. complanatus</i>	<i>A. undulata</i>	<i>A. varicosa</i>	<i>A. imbricata</i>	<i>A. c. colurata</i>	<i>A. c. brooksiana</i>	<i>S. undulatus</i>	<i>L. ochraceus</i>	<i>L. c. radialis</i>
1	CUMBERLAND COUNTY: Halfway River West Lake, 1 mi. S. of Newville	Small lake. Bottom muddy, vegetated.		AR	AR				A			R
2	River Hebert, Newville	Just below lake outlet. Current moderate. Bottom, sand.		AR	AR				O		RC	
3	Maccan River, Southampton	Stream rapid and cold. Bottom rocky. Total hardness 24 p.p.m.	C									
4	Tidnish River, 10 mi. ENE. of Amherst	Stream narrow and rather rapid. Bottom, sand and rock.	O	C								
5	River Philip, 1 mi. S. of town of River Philip	River medium sized, rather rapid and shallow. Bottom, gravel and rocks.	C									
6	River Philip, 3/4 mi. N. of Collingwood	River medium sized. Current moderate. Bottom, sand, gravel, and rocks.	O									
7	Wallace River, 9 mi. S. of Pugwash	River wide, shallow. Current moderate. Bottom, rocks and gravel.										O
8	ANTIGONISH COUNTY: West River Antigonish, 2 mi. S. of Antigonish	River wide, shallow. Current rather swift. Bottom, gravel.		A								
9	South River Antigonish, 2 mi. S. of South River	River medium sized, shallow. Current moderate. Bottom gravel.		A								
10	INVERNESS COUNTY: McIntyre Lake, 8 mi. ENE. of Port Hawkesbury	Small pond. Bottom sand and gravel.		AR								

ominent. Beak sculpture mainly and extending rather far out of the shell.

de Schalie, pl. 2, figs. 3 and 4. Beak sculpture more prominent. Beak sculpture on 5 to 7) and not extending to 8.

varicosa Say, pl. 2, figs. 5 and 6. Crossing lines of growth. Posterior extensively rayed. Length not common.

varicosa Say, pl. 3, figs. 5 and 6. Otherwise not as above.

d, or absent

veloped

usually less than .50. Valves found only in streams. Common in Nova Scotia. *lifer* (Linn.), pl. 1, figs. 1 to 4. Lateral teeth double in the right valve and single in the left valve.

from Nova Scotia. *odon* (Lea), pl. 3, figs. 1 and 2. Lateral teeth double in the right valve and single in the left valve.

r subcylindrical (width/height) black or black and not extensively pointed centrally. *Nacera* (Say), pl. 1, figs. 7 and 8.

mpressed, and obliquely subcylindrical. Usually dark and rayless. *Nacera* (Say), pl. 4, figs. 3 and 4. Lateral teeth double in the right valve and single in the left valve.

gs. 5 and 6; pl. 4, figs. 7 and 8. Lateral teeth double in the right valve and single in the left valve.

or less rayed. Posterior ridge not prominent. *Nacera* (Say), pl. 4, figs. 1 and 2. Lateral teeth double in the right valve and single in the left valve.

of medium thickness. Pseudo-umbilical. *Nacera* (Say), pl. 4, figs. 1 and 2. Lateral teeth double in the right valve and single in the left valve.

only. Periostracum yellowish. *Nacera* (Say), pl. 4, figs. 1 and 2. Lateral teeth double in the right valve and single in the left valve.

whole shell. Periostracum morphism obscure. Relatively common. *Nacera* (Gmelin), pl. 4, figs. 5 and 6.

used to express the relative abundance (specimens found at the station), 'C' for common (10 to 29 specimens per half-hour), and 'R' for rare (1 to 9 specimens per half-hour).



16	Pond on branch of Northeast Margaree R., 7 mi. SW. of Northeast Margaree	Small, deep pond with muddy, narrow beaches.	A						
17	VICTORIA COUNTY: Pond on branch of Northeast Margaree R., 2 mi. NW. of Finlayson	Small, deep pond with muddy, narrow beaches.	A						C
18	Baddeck River, 3 mi. NW. of Baddeck	River medium sized. Bottom, gravel and sand.	A						O
19	CAPE BRETON COUNTY: McMullin Lake, on Mira River, 3 mi. W. of Victoria Bridge	Lake small. Bottom, rocks and gravel.	R						
20	RICHMOND COUNTY: River Franboise, 3 mi. N. of Franboise	River small. Current rather rapid. Bottom, sand and rocks.	O						C R

21	RICHMOND COUNTY: Cont. Brook at outlet of pond, 3 mi. E. of Loch Lomond Church	Very small brook. Bottom, muddy.								R
22	Loch Lomond, middle lake at passage to lower lake	Lake large. Bottom, sand.								C
23	Loch Lomond at outlet into Grand River	Lake large. Bottom, sand.								O
24	Grand River, 6 mi. E. of town of Grand River	River small, Bottom, sand and rocks.	O							
25	Grand River, 2 mi. E. of town of Grand River	River small. Bottom, sand and rocks.	A							A
26	GUYSBOROUGH COUNTY: Pond, 1 mi. W. of Mulgrave	Pond small and deep. Bottom, rocky.								
27	Two Mile Lake, near Aspen	Lake medium sized but long and shallow. Bottom, sand and mud.	C							R
28	St. Mary River, Sherbrooke	River small and shallow. Bottom, rocky.	A O							O
29	HALIFAX COUNTY: Musquodoboit River, 1.4 mi. NE. of Musquodoboit	Small ponded area of stream. Bottom, muddy and heavily vegetated.								
30	Musquodoboit River, 2 mi. E. of Elderbank	River medium sized, deep, and with small shoals.	A							
31	Musquodoboit River, 2 mi. S. of Crawford Bridge	River medium sized, deep and muddy. Unionids from muskrat middens.	O A							
32	Musquodoboit River, 2 mi. N. of Musquodoboit Harbour	River wider, shallow, and with mud and sandy shoals. Total hardness 28 p.p.m.	A							C
33	Musquodoboit River, 1 mi. N. of Musquodoboit Harbour	River narrow, moderately deep and swift. Bottom, gravel and rocks.	A O							O
34	DeSaid Lake, 2 mi. N. of Eastern Passage	Medium-sized pond. Bottom mud, rocks, and wood fragments. Now filled by Halifax Airport.	C O							
35	Morris Lake, 2 mi. E. of Imperoyal	Small lake with narrow outlet to ocean. Bottom, sandy.								C
36	Fish Lake, 2 mi. S. of Waverly	Small lake with outlet to ocean. Bottom, rocky.	R O							C C

Sta. No.	Locality	Habitat	<i>M. m. margaritifera</i>	<i>L. complanatus</i>	<i>A. undulata</i>	<i>A. varicosa</i>	<i>A. implexata</i>	<i>A. c. caltracata</i>	<i>A. c. brookstana</i>	<i>S. undulatus</i>	<i>L. ochracea</i>	<i>L. r. rudis</i>
	HALIFAX COUNTY—Cont.											
37	Outlet of Fish Lake, 2 mi. S. of Waverly	Stream rather narrow. Bottom, rocky.		O	O	O	O					
38	Lake William, at outlet. Waverly	Medium-sized lake. Bottom, sand and rocks.		C	R	A	A					
39	Rocky Lake, 5 mi. NE. of Bedford	Medium-sized lake. Bottom, sandy.		O								
40	Small lake, 3 mi. E. of Lower Sackville	Collections made near and in outlet. Bottom, gravel and rocks.										
41	Sackville River, 1 mi. N. of Bedford	Medium-sized river, shallow. Current moderate. Bottom, rocky.										
42	Brine Lake, 1 mi. S. of French Village	Small, shallow lake. Bottom, mud, sand, and rocks.	A									
43	Gays River, Gays River	Small river. Bottom, sand and gravel.								A		
44	Brook flowing into Gays River, 4 mi. S. of Shubenacadie	Small stream flowing through cow pasture. Bottom, muddy.										R
45	Outlet of Fletcher Lake, Wellington Station	Wide, slow-flowing stream. Bottom, mud. Unionids from muskrat middens.		A	R							
46	Shubenacadie River, 1 mi. S. of Enfield	Medium-sized river, shallow and swift. Bottom, gravel.		A	O							
47	Outlet of Lower Egmont Lake, Lake Egmont	Outlet deep, slow moving. Banks, peat.		A								
48	Long Lake at narrows, 3 mi. NW. of Preston	Small channel connecting two sections of Lake. Bottom, rocky.										O



43	Gays River, Gays River	Small, shallow lake. Bottom, mud, sand, and rocks.				A
44	Brook flowing into Gays River, 4 mi. S. of Shubenacadie	Small river. Bottom, sand and gravel.			C	C
45	Outlet of Fletcher Lake, Wellington Station	Small stream flowing through cow pasture. Bottom, muddy.				R
46	Shubenacadie River, 1 mi. S. of Enfield	Wide, slow-flowing stream. Bottom, mud. Unionids from muskrat middens.			A	R
47	Outlet of Lower Egmont Lake. Lake Egmont	Medium-sized river, shallow and swift. Bottom, gravel.			A	O
48	Long Lake at narrows, 3 mi. NW. of Preston	Outlet deep, slow moving. Banks, peat.			A	C
		Small channel connecting two portions of Lake. Bottom, rocks.			A	O

49	QUEEN'S COUNTY: Ten Mile Lake, 10 mi. NE. of Milton	Large lake. Soggy bottom.				
50	Ponhook Lake, 4 mi. SSE. of South Brookfield	Large lake. Sandy bottom.				
51	YARMOUTH COUNTY: Killam Lake, 4 mi. NE. of Port Maitland	Medium-sized lake. Bottom, sandy.				C
52	Killam Lake, 7 mi. SSW. of Norwood	Medium-sized lake. Bottom, sandy.			A	C
53	Cedar Lake, 6 mi. SW. of Norwood	Medium-sized lake. Bottom, sandy.				O
54	DUGBY COUNTY: Capitis Lake, Hectanooga	Medium-sized pond, very shallow. Bottom, sand and rocks.				C
55	Bonangs Lake	Medium-sized pond. Bottom, sandy.			A	R
56	Lake, Sissaboo River System	Pond, about 1/4 mi. in diameter.				A
57	Lake, North Range					O
58	ANNAPOLIS COUNTY: Annapolis River, Lawrencetown	River, wide and fairly swift. Apparently slightly polluted.				
59	Nictaux River, 2 mi. S. of Middleton	River, medium sized, quite rapid and deep. Water, turbid. Bottom, gravel.				O
60	Springfield Lake, Springfield	Small lake. Bottom, sandy.			R	
61	KINGS COUNTY: Lake Torment outlet, 1 mi. below Lake Torment Dalhousie East	Medium-sized creek. Bottom, sand and rocks, heavily vegetated.				A
62	Gaspereau River, 2 mi. S. of South Alton	River, narrow and rapid. Bottom, sand and boulders.				R
63	Gaspereau River, 1/4 mi. W. of Whitetock Mills	River narrow. Current moderate. Bottom, gravel, sand, and mud.				O
						C

Sta. No.	Locality	Habitat	<i>M. m. margaritifera</i>	<i>B. complanatus</i>	<i>A. undulata</i>	<i>A. varicosus</i>	<i>A. imphicta</i>	<i>A. c. calarctus</i>	<i>A. c. brooksiana</i>	<i>S. undulatus</i>	<i>L. ochracea</i>	<i>L. r. radialis</i>
64	HANTS COUNTY: Cornwallis River, 1 mi. S. of Waterville	River, narrow and deep. Bottom, mud and sand with shoals.		A O			C					
65	Kennetcook River, 3 mi. E. of Clarksville	River wide, shallow, and with sand shoals. Total hardness 28 p.p.m.										
66	Pond, Mt. Uniack, 20 mi. N. of Halifax	Pond large. Bottom, mud and rocks.										O
67	COLCHESTER COUNTY: Stewiacke River, 5 mi. E. of Stewiacke	River wide, shallow and swift. Bottom, gravel.	A A R R									
68	Tatamagouche River, 2 mi. SW. of Tatamagouche	River moderately wide, shallow, and with gravel bottom. A	A									
69	Baird Brook, Crow Mills	Collections made in dammed area. Bottom, sand.										C
70	Beaver Brook, 1 mi. N. of Belmont	Small brook. Bottom, sand and gravel.	A									
71	Chiganois River, 3 mi. SW. of Belmont	River medium sized and shallow. Bottom, gravel and rocks.	O									

SYSTEM

Superfa

Family *M*

Genus MARGAR

***Margaritifera marg***

Plat

*Mya margaritifera* Linn., 1758:  
p. 671 (type locality: Eur*Description*

This unionid is easily distinguished (long) and elongate and often are its black periostracum, white and obsolete or absent lateral

*Distribution*

*M. m. margaritifera* is the commonest in both Asia as well as in North America and both sides of the Gulf of St. Lawrence (Anticosti Island and Newfoundland) is found occurring from species and the subspecies are America.

During this survey *margaritifera* (see table). These are plotted on from Nova Scotia are: East River and "Rivers in Annapolis [Cous

*Ecology*

Jones's (1877) statement that lakes as well as in streams is not *margaritifera* at over one hundred America and have found it only in streams found to contain this characteristics, i.e., moderate to rocky substrate. Although only water hardnesses (less than 50 case. This agrees with statement only in soft water. Hendelberg (1 lives to be over 100 years old.

Murphy (1942) has shown function as hosts for the western have suggested that the native *l. tentalis* (Mitchell), is the pro *tentalis* and *M. m. margar*

For more complete information on the and Berg, 1959.

SYSTEMATIC SECTION<sup>1</sup>

## Superfamily UNIONACEA

## Family MARGARITIFERIDAE

Genus MARGARITIFERA Schumacher, 1817

**Margaritifera margaritifera margaritifera** (Linn.)

Plate I, figs. 1 to 4

*Mya margaritifera* Linn., 1758: Systema Naturae, 10th ed., p. 671 (type locality: Europe).*Description*

This unionid is easily distinguished by its large size (up to 6 inches long) and elongate and often arcuate shape. Other prominent characteristics are its black periostracum, whitish nacre, heavy pseudocardinal hinge teeth, and obsolete or absent lateral teeth.

*Distribution*

*M. m. margaritifera* is the only freshwater mussel that occurs in Europe and Asia as well as in North America. In this continent it is known from both sides of the Gulf of St. Lawrence south to Pennsylvania and from Anticosti Island and Newfoundland. In the West the subspecies (*falcata* Gould) is found occurring from Alaska to New Mexico. Both the typical species and the subspecies are absent from the central part of North America.

During this survey *margaritifera* was collected at twenty-three stations (see table). These are plotted on Map I as filled-in circles. Other records from Nova Scotia are: East River, Pictou County (Nat. Mus. Canada) and "Rivers in Annapolis [County]" (Willis, 1857).

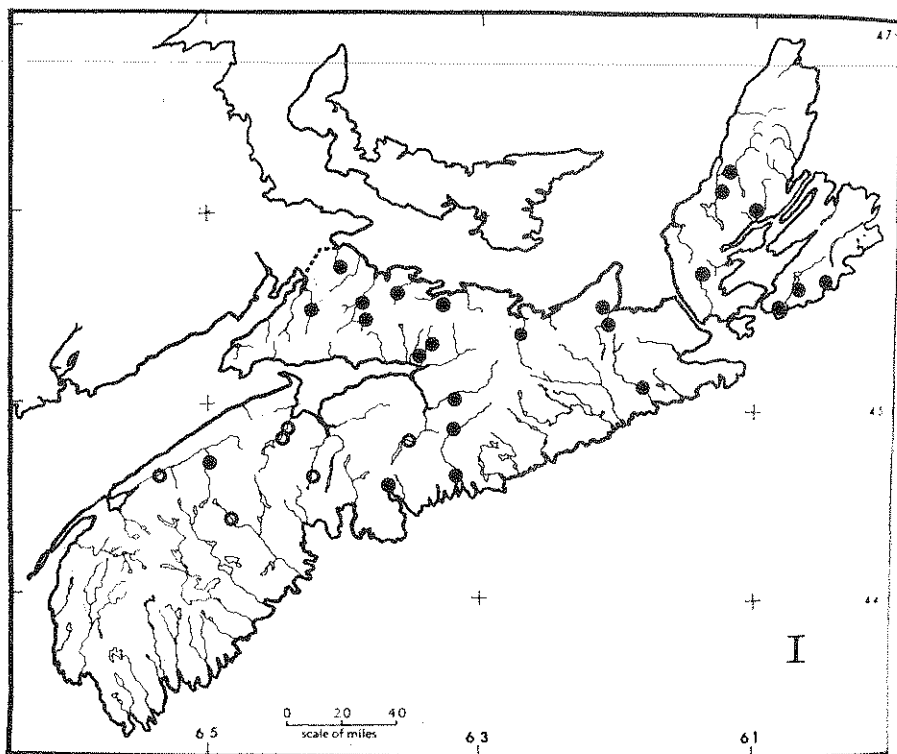
*Ecology*

Jones's (1877) statement that in Nova Scotia the species occurs in lakes as well as in streams is no doubt incorrect. The authors have collected *margaritifera* at over one hundred different localities in northeast North America and have found it only in streams, never in lakes or ponds. All streams found to contain this species have exhibited similar ecological characteristics, i.e., moderate to quite rapid current, and sand, gravel, or rocky substrate. Although only a few water samples were analysed, low water hardnesses (less than 50 p.p.m. total hardness) were found in each case. This agrees with statements in the literature that the species occurs only in soft water. Hendelberg (1960) has shown that this species sometimes lives to be over 100 years old.

Murphy (1942) has shown that both the brown and rainbow trout function as hosts for the western subspecies *falcata*. Clarke and Berg (1959) have suggested that the native brook or eastern speckled trout, *Salvelinus fontinalis* (Mitchell), is the probable host for *margaritifera* s.str. Both *S. fontinalis* and *M. m. margaritifera* are unusually abundant and wide-

<sup>1</sup>For more complete information on the following species see Simpson, 1914; Ortmann, 1919; and Clarke and Berg, 1959.

69	Baird Brook, Crow Mills	River moderately wide, shallow, and with gravel bottom.	A
70	Beaver Brook, 1 mi. N. of Belmont	Collections made in dammed area. Bottom, sand.	C
71	Chiganois River, 3 mi. SW. of Belmont	Small brook. Bottom, sand and gravel. River medium sized and shallow. Bottom, gravel and rocks.	A O



MAP I. *Margaritifera margaritifera margaritifera*. Filled-in circles represent stations in which the species was found. Open circles represent negative stations which did not appear ecologically suitable for the species.

spread in Nova Scotia and occur in identical habitats. Also, since *fontinalis* is the only widely distributed trout in the province, it is very probably the principal host for the glochidia of *margaritifera*. The only other generally distributed salmonid in Nova Scotia is *Salmo salar* Linn., the Atlantic salmon, an anadromous fish that does not occur as far inland elsewhere in North America as does *margaritifera*.

This species is the *Margaritana margaritifera* of authors. The name *Margaritana* has been placed on the Official List of Rejected and Invalid Generic Names in Zoology (1958) by the International Commission on Zoological Nomenclature.

#### Subfamily UNIONINAE

Genus ELLIPTIO Rafinesque, 1819

#### *Elliptio complanatus* (Solander)

Plate I, figs. 5, 6; Plate IV, figs. 7, 8

*Mya complanata* Solander, 1786: Portland Catalogue, p. 11, lot 2190 (type locality: Maryland). Johnson (1948) has restricted the type locality to Potomac River, Washington, D.C.

#### Description

Although exceedingly variable, it is possible to recognize. The shell is moderately compressed, subelliptical to subrhomboid. It has a dark and usually rayed surface and lateral hinge teeth, and is white or salmon coloured.

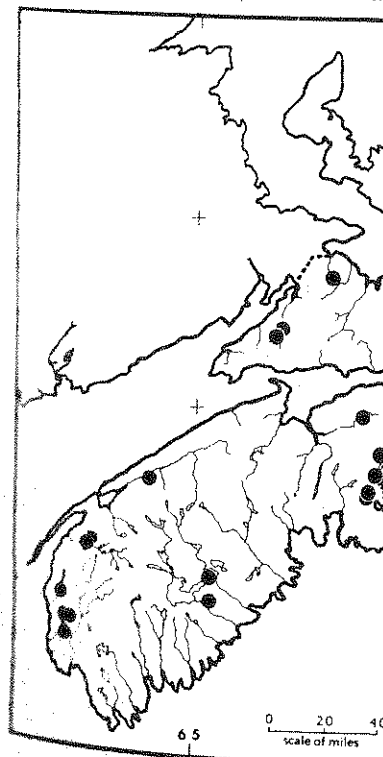
#### Distribution

This species is found in the Maritime Provinces from Lawrence to Georgia and in Lake Erie. It also occurs in the St. Lawrence and their tributaries, and in parts of the northern distribution remain to be determined.

During this survey *E. complanatus* was found at stations (see table). It has also been recorded from Harbour Lake, and at the narrow end of Mus. (Canada). All these records are from Nova Scotia.

#### Ecology

In Nova Scotia, as elsewhere, it is found in rivers, and streams, and on near-shore waters.



MAP II. *Elliptio complanatus*. Pos.

*Description*

Although exceedingly variable, *Elliptio complanatus* is quite easy to recognize. The shell is medium sized (up to 5 inches long), rather compressed, subelliptical to subrhomboid in shape, and of medium thickness. It has a dark and usually rayless periostracum, prominent pseudocardinal and lateral hinge teeth, and naere that is often purple but occasionally white or salmon coloured.

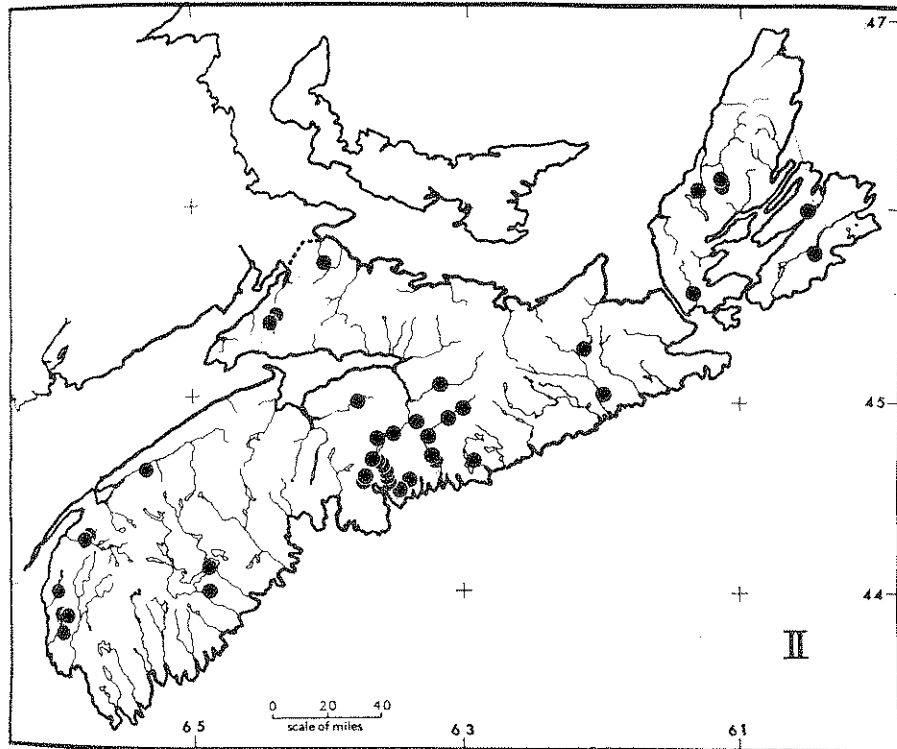
*Distribution*

This species is found in the Atlantic Drainage from the Gulf of St. Lawrence to Georgia and in the St. Lawrence Drainage east of eastern Lake Erie. It also occurs in Lake Huron and Lake Superior, in some of their tributaries, and in parts of the Hudson Bay Drainage. Details of its northern distribution remain to be worked out.

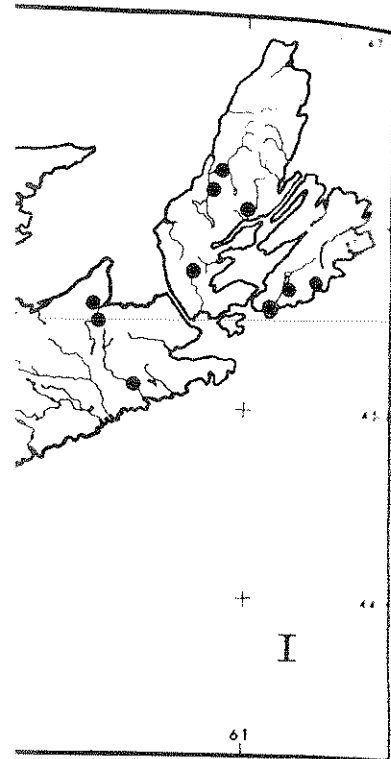
During this survey *E. complanatus* was collected at thirty-seven stations (see table). It has also been taken in Sydney River Lake, Ship Harbour Lake, and at the narrows in Grand Lake, Nova Scotia (all, Nat. Mus. Canada). All these records are plotted on Map II.

*Ecology*

In Nova Scotia, as elsewhere, this species is found in lakes, ponds, rivers, and streams, and on nearly all kinds of substrates. Only very small



Map II. *Elliptio complanatus*. Positive localities are plotted as filled-in circles.



Filled-in circles represent stations where *Elliptio complanatus* was collected. Crosses represent negative stations where it was not collected.

habitats. Also, since *fontinalis* is a riverine species, it is very probably *fontinalis*. The only other general form is *almo salar* Linn., the Atlantic form, which occurs as far inland elsewhere.

*fontinalis* of authors. The name *fontinalis* is in the List of Rejected and Invalid Names of the International Commission on Zoological Nomenclature.

## HINAE

Linnaeus, 1819

(Solander)

IV, figs. 7, 8

Catalogue, p. 11, lot 2190 (type). The name has restricted the type locality.

brooks appear to be unsuitable. It is very common and is usually the dominant species where it occurs.

According to Lefevre and Curtis (1912) and Matteson (1948), the yellow perch, *Perca flavescens* (Mitchill), is the host for *E. complanatus*. Livingstone (1951) has stated that *P. flavescens* does not occur in Cap-Breton Island, however; and the presence of *E. complanatus* there poses a problem. Either another host fish is involved or *P. flavescens* does occur there but was not detected.

Subfamily ANODONTINAE

Tribe ALASMIDONTINI

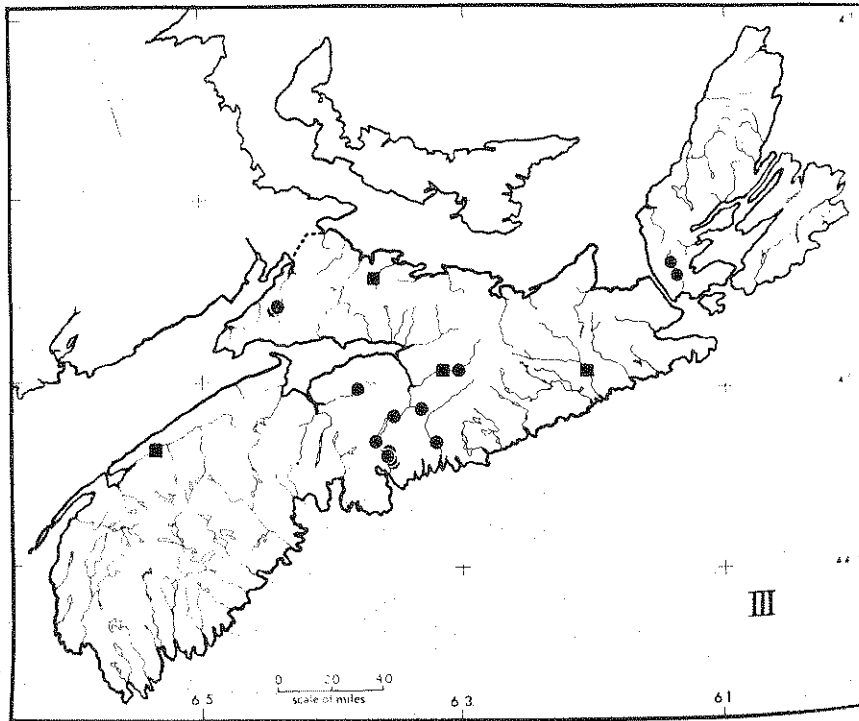
Genus ALASMIDONTA Say, (1818)

Subgenus ALASMIDONTA, s.str.

***Alasmidonta (Alasmidonta) undulata* (Say)**

Plate III, figs. 3, 4

*Monodonta undulata* Say, 1817: Nicholson's Encyclopedia, 1st. ed., 2, pl. 3 fig. 3 (type locality: Delaware and Schuylkill rivers).



MAP III. *Alasmidonta undulata* and *A. varicosa*. Positive localities for *A. undulata* are plotted as filled-in circles. Positive localities for *A. varicosa* are plotted as filled-in rectangles.

*Description*

*A. undulata* is well characterized by its short, subtriangular shape; dark, thickened anterior. The pseudocardinal hinge teeth sculpture is unusually coarse and

*Distribution*

This species is distributed in the St. Lawrence to North Carolina tributaries east of Lake Erie. In North America, it is found in all the central part of the I Map III.

*Ecology*

*Alasmidonta undulata* occurs in the bottom. It is sporadic in its occurrence. Authors have found it dominant in North America. The host fish is u

Subgenus DECURA

***Alasmidonta (Decura)***

Plate I

*Alasmidonta varicosa* Lamareck, 1819: An Schuylkill River near Philad

*Description*

The small size (up to 2½ inches) and the corrugated posterior slope, a which clearly distinguish this species. The pseudocardinal hinge teeth are s

*Distribution*

*A. varicosa* is found in the A New Brunswick to South Carolina. These loc stations in Nova Scotia. These loc

*Ecology*

*A. varicosa* occurs only in mo riffles or rapids, and in sand or ar *Margaritifera m. margaritifera* is unknown.

*Description*

*A. undulata* is well characterized by its small size (up to 3 inches long); short, subtriangular shape; dark or rayed periostracum; and prominently thickened anterior. The pseudocardinal hinge teeth are well developed and stubby, but the lateral teeth are nearly or entirely absent. The beak sculpture is unusually coarse and heavy.

*Distribution*

This species is distributed in the Atlantic Drainage from the Gulf of St. Lawrence to North Carolina and in the St. Lawrence River and its tributaries east of Lake Erie. In Nova Scotia it was found at twelve stations, all in the central part of the province. These stations are plotted on Map III.

*Ecology*

*Alasmidonta undulata* occurs in lakes and in rivers usually on a sandy bottom. It is sporadic in its occurrence and almost never abundant. The authors have found it dominant at only a few localities in northeastern North America. The host fish is unknown.

Subgenus *DECURAMBIS* Rafinesque, 1831

***Alasmidonta (Decurambis) varicosa* (Lamarck)**

Plate III, figs. 5, 6

*A. varicosa* Lamarck, 1819: Anim. sans Vertèbres, 6: 68 (type locality: Schuylkill River near Philadelphia, Pennsylvania).

*Description*

The small size (up to 2½ inches long), subovate shape, inflated posterior edge, corrugated posterior slope, and characteristic periostracum and hinge teeth clearly distinguish this species. The periostracum is more or less distinctly rayed and is usually lighter coloured anteriorly than posteriorly. Pseudocardinal hinge teeth are small but usually distinct. Lateral teeth are absent.

*Distribution*

*A. varicosa* is found in the Atlantic Drainage from Nova Scotia and New Brunswick to South Carolina. The authors have found it at only four stations in Nova Scotia. These localities have been plotted on Map III.

*Ecology*

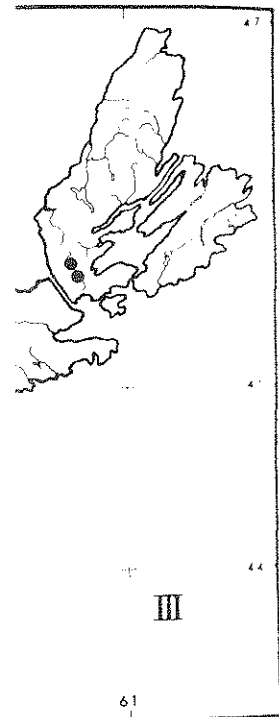
*A. varicosa* occurs only in moderate to rapidly flowing streams, often in riffles or rapids, and in sand or among gravel or rocks. Its usual associates are *Margaritifera m. margaritifera* and *Elliptio complanatus*. The host fish is unknown.

n and is usually the

Matteson (1948), the  
t for *E. complanatus*.  
es not occur in Cape  
*planatus* there poses a  
*flavescens* does occur

ia (Say)

pedia, 1st. ed., 2. pl. 3.  
vers).



localities for *A. undulata*  
for *A. varicosa* are plotted

Tribe ANODONTINI  
Genus ANODONTA Lamarek, 1799

**Anodonta implicata** Say

Plate II, figs. 1, 2

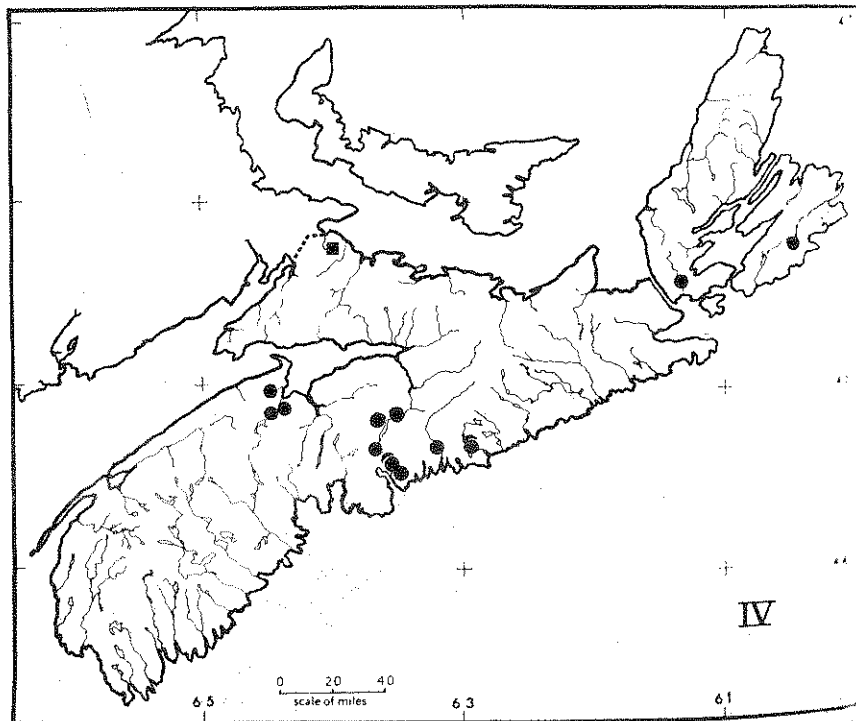
*Anodonta implicata* Say, 1829: New Harmony Dissem., 2, no. 22, p. 340 (type locality: Danvers, Massachusetts, U.S.A.). Neotype selected by Johnson, 1946 (neotype locality: Agawam River, Plymouth, Massachusetts).

*Description*

*A. implicata* may be distinguished from other species by its large size (up to 6½ inches long), by its elongate-elliptical shell which is prominently thickened anterior-ventrally, and by the complete absence of hinge teeth. The periostracum is usually heavy, yellowish, brownish, or black, and is not rayed except obscurely in occasional young specimens. The naere is normally salmon coloured or pinkish, sometimes white or bluish.

*Distribution*

This species is recorded with certainty only from Nova Scotia south to South Carolina. During the present survey it was collected at 12 stations. These have been plotted on Map IV.



MAP IV. *Anodonta implicata* and *Strophitus undulatus*. Positive localities of *A. implicata* are plotted as filled-in circles. The single positive locality of *S. undulatus* is plotted as a filled-in rectangle.

*Ecology*

The host fish for *A. impl. pseudoharengus* (Wilson), a m. and lakes in the spring to spawr to coastal regions frequented by substrates, rarely on mud. Alth in the Great Lakes and in the specimens of *A. implicata* have

**Anodonta c.**

Plat

*Anodonta cataracta* Say, 1817: fig. 4 (type locality not spe

*Description*

The shell of *Anodonta cataracta* (6 inches long), thin, inflated, and green or greenish brown. Two b anterior slope. It may be disting *brookiana* by its beak sculptu *cataracta* s.str. but concentric "Remarks" under *brookiana*.)

*Distribution*

Typical *A. cataracta* occurs Lawrence System to North C species also occur in Michigan, in from South Carolina to Alabam distribution require further inves

During this survey, typical stations. The National Mus Yarmouth, Nova Scotia. Th is filled-in rectangles.

*Ecology*

This species occurs in lakes a moving streams. Although s occupied substrates, gravel and ro in Nova Scotia it is usually the on

Host fish of *A. c. cataracta* ar habitat similarities between that sp *catulus nebulosus* Le Sueur) to, to withstand the low oxyge variant, muddy habitats suggest



*Ecology*

The host fish for *A. implicata* is the alewife (or gaspereau), *Alosa pseudoharengus* (Wilson), a marine fish that migrates into coastal rivers and lakes in the spring to spawn. *Anodonta implicata* is therefore restricted to coastal regions frequented by its host. There it occurs on sand or gravel substrates, rarely on mud. Although *A. pseudoharengus* is also landlocked in the Great Lakes and in the Finger Lakes of New York, no authentic specimens of *A. implicata* have been seen from those areas.

*Anodonta cataracta cataracta* Say

Plate II, figs. 5, 6

*Anodonta cataracta* Say, 1817: Nicholson's Encyclopedia, 1st ed., 2, pl. 3, fig. 4 (type locality not specified).

*Description*

The shell of *Anodonta cataracta cataracta* is medium to large (up to 6 inches long), thin, inflated, and without hinge teeth. The periostracum is green or greenish brown. Two broad green rays are often present on the posterior slope. It may be distinguished from the closely related *A. cataracta brooksiana* by its beak sculpture, which is typically double-looped in *cataracta* s.str. but concentric and single-looped in *brooksiana*. (See "Remarks" under *brooksiana*.)

*Distribution*

Typical *A. cataracta* occurs in the Atlantic Drainage from the lower St. Lawrence System to North Carolina. Specimens closely related to this species also occur in Michigan, in parts of the Hudson Bay Drainage, and from South Carolina to Alabama. Details of its northern and southern distribution require further investigation.

During this survey, typical specimens of *cataracta* were collected at seven stations. The National Museum of Canada also possesses a specimen from Yarmouth, Nova Scotia. These records have been plotted on Map V as filled-in rectangles.

*Ecology*

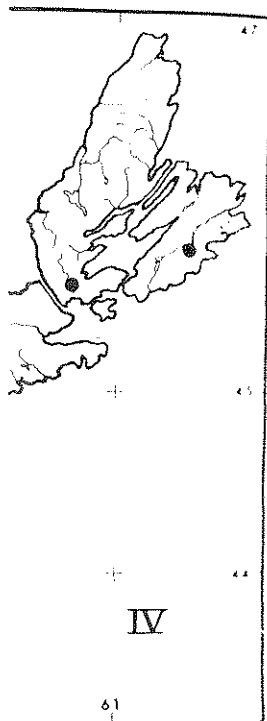
This species occurs in lakes and ponds and in large and small, usually slow-moving streams. Although sand and mud are the more frequently occupied substrates, gravel and rocky areas are also sometimes inhabited. In Nova Scotia it is usually the only unionid found in soft, muddy habitats.

Host fish of *A. c. cataracta* are unknown. However, zoogeographic and habitat similarities between that species and the brown bullhead (*Ictalurus nebulosus nebulosus* Le Sueur) together with the unusual ability of both species to withstand the low oxygen concentrations characteristic of semi-stagnant, muddy habitats suggest a possible parasite-host relationship.

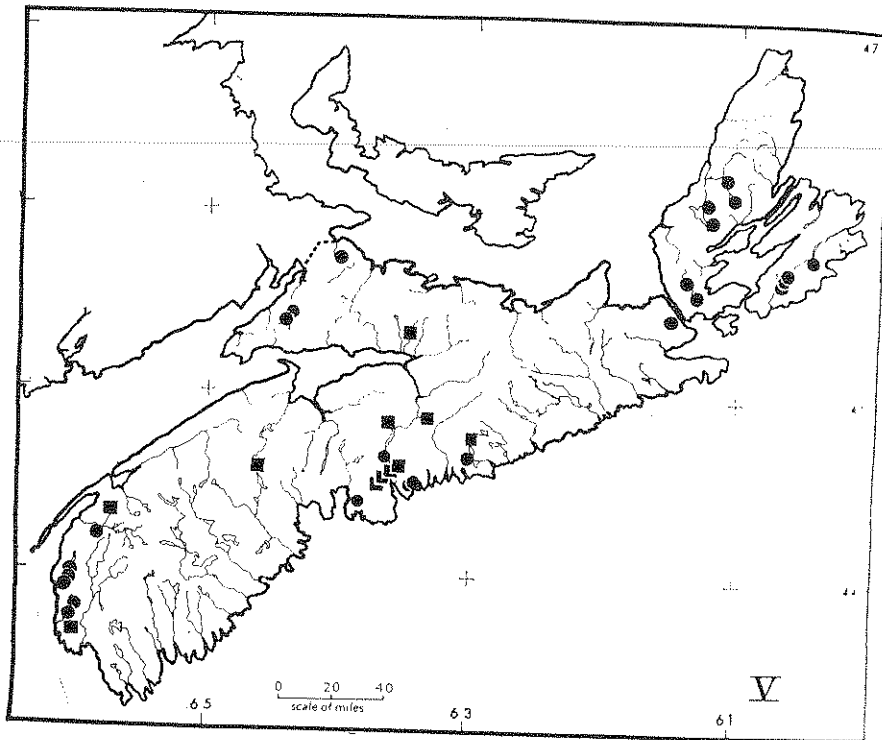
sem., 2, no. 22, p. 340  
(Neotype selected by  
Ver, Plymouth, Massa-

species-by its large size  
which is prominently  
absence of hinge teeth  
greenish, or black, and is  
specimens. The nacre is  
white or bluish.

from Nova Scotia south  
collected at 12 stations



Positive localities for *A. c. cataracta*  
single positive locality for



MAP V. *Anodonta cataracta brooksiana* and *A. c. cataracta*. Positive localities for *A. c. brooksiana* are plotted as filled-in circles. Positive localities for *A. c. cataracta* are plotted as filled-in rectangles.

***Anodonta cataracta brooksiana* van der Schalie**

Plate II, figs. 3, 4

*Anodonta brooksiana* van der Schalie, 1938: Ann. Carnegie Mus. 167-169, pl. 16, fig. 1 and 2 (type locality, Sprout Pond Arm, Ferryback District, Newfoundland).

**Distribution**

The shell of *brooksiana* is of medium size (up to nearly 5 inches long), thin, elliptical, and inflated. The beaks and posterior slope are low, and a poorly defined wing is present. The periostracum is straw yellow, crossed by numerous fine green rays, and on the posterior slope two prominent green rays are usually present. The nacre is thin, uniform in thickness, with a bluish-silvery hue. Hinge teeth are completely absent.

The most distinctive character of *brooksiana* is the beak sculpture. In the original description (van der Schalie, l.c.) this was described as "consisting of numerous (8-12) more or less irregularly concentric corrugated folds which extend well out on the disc; the first two or three look somewhat double-looped while the others are irregular and often appear to

anastomose." As such, it differs from the form found in eastern Canada which is "modular" (Van der Schalie, l.c.).

**Distribution**

In addition to Newfoundland and Brunswick (Athearn, 1961). Specimens were also collected during the 1930s in Nova Scotia. These stations are plotted on the map.

**Ecology**

*A. c. brooksiana* occupies the same habitats as *A. c. cataracta* s. str., i.e., lakes, ponds, and streams of various varieties of substrates. Like *A. c. cataracta*, its ecology is unknown.

**Remarks**

Through the kindness of the University of Michigan Museum of Zoology, specimens of *Anodonta brooksiana* were examined which are characterized by a beak sculpture which is characteristic of lots of *A. cataracta* from the United States. The University of Michigan Museum of Zoology has indicated the presence of occasional specimens of *A. c. brooksiana* in northern populations. The form *brooksiana* does not appear to be a distinct species. Its status needs careful study and should be regarded as a subspecies of *A. c. cataracta*.

Genus STROPHITUS

**Strophitus**

Plate

*Anodonta undulata* Say, 1817: N. Amer. Zool., ed. 2: 20-21, pl. 3, fig. 6 (type locality, near Philadelphia, Pennsylvania).

**Description**

This species is medium-sized, with a rather smooth and shining surface. The hinge teeth are usually present just anterior to the beak and are completely absent. The nacre is usually translucent near the beaks, and is usually green or greenish brown. The best conchological characters are the best conchological characters.

anastomose." As such, it differs from the beak sculpture of other anodontas found in eastern Canada which is "characteristically double-looped and regular" (Van der Schalie, l.c.).

#### Distribution

In addition to Newfoundland, this form has been recorded from New Brunswick (Athearn, 1961). Specimens agreeing with the above description were also collected during this survey at twenty-five stations in Nova Scotia. These stations are plotted on Map V.

#### Habitat

*A. c. brooksiana* occupies habitats similar to those occupied by *cataracta* s. str., i.e., lakes, ponds, rivers, and streams, and is found on a variety of substrates. Like *cataracta*, the host fish of *brooksiana* are unknown.

#### Remarks

Through the kindness of Dr. Henry van der Schalie, University Museums, University of Michigan, we have been able to study paratype specimens of *Anodonta brooksiana*. These specimens exhibit the concentric beak sculpture which is characteristic of that form. Examination of a number of lots of *A. cataracta* from various localities in northeastern United States has indicated the presence of similar concentric beak-sculpture in occasional specimens of *cataracta*. This character appears to be more common in northern populations, however. On the basis of present information the form *brooksiana* does not correspond with the accepted definition of a species. Its status needs careful re-evaluation, but in this paper it is regarded as a subspecies of *cataracta* s. str.

### Genus STROPHITUS Rafinesque, 1820

#### *Strophitus undulatus* (Say)

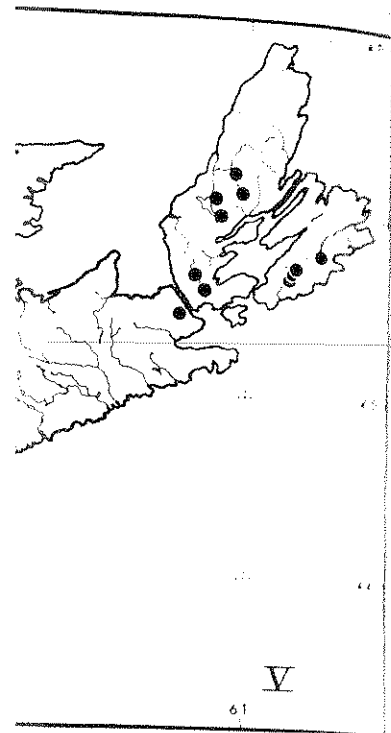
Plate III, figs. 7, 8

*Anodonta undulata* Say, 1817: Nicholson's Encyclopedia, Philadelphia, 1st ed., 2: 20-21, pl. 3, fig. 6 (type locality not specified but presumably near Philadelphia, Pennsylvania).

#### Description

This species is medium-sized (up to 3½ inches long) and fairly thin and has a rather smooth and shining yellowish brown to black periostracum. Pseudocardinal hinge teeth are usually indicated by slight to clearly visible swellings just anterior to the beaks of each valve. Lateral hinge teeth are completely absent. The naere is bluish white with yellowish or salmon suffusions near the beaks, and is bordered at the edge of the valves with olive green or greenish brown. The vestigial hinge teeth and characteristic naere are the best conchological characteristics in this species.

55945-0-3



Map V. *A. c. cataracta*. Positive localities indicated by circles. Positive localities for *A. c. brooksiana* indicated by dots.

Van der Schalie

3, 4

1938: Ann. Carnegie Mus., 27: 1-12, pl. 1, fig. 1, Sprout Pond Arm, Ferryville, Nova Scotia.

Size (up to nearly 5 inches long) and thickness (posterior slope are low, and the beak is straw yellow, crossed by a narrow, anterior slope two prominent greenish brown, uniform in thickness, with a narrow, slightly absent.

*brooksiana* is the beak sculpture (Van der Schalie, l.c.) this was described as being less irregularly concentric, or as a single disc; the first two or three folds are irregular and often appear to

### Distribution

*S. undulatus* is widely distributed and occurs from Lake Huron eastward in the St. Lawrence Drainage, south to North Carolina in the Atlantic Drainage, and throughout the Ohio-Mississippi-Missouri Drainage. In Nova Scotia it was found at only one locality, the Tidnish River, 10 mi. NE. of Amherst (see Map IV).

### Ecology

*S. undulatus* occurs with greatest frequency in small rivers and creeks on fine gravel, sand, or mud. Occasionally it also occurs in lakes. The largemouth black bass, *Micropterus salmoides* (Lacépède), and the northern creek chub, *Semotilus atromaculatus* (Mitchill), have served, under experimental conditions, as satisfactory hosts for the glochidia of *S. undulatus*. Only the latter fish occurs in Nova Scotia (Livingstone, 1951).

This species is the *Strophitus rugosus* (Swainson) of authors.

## Subfamily LAMPSILINAE

Genus LAMPSILIS Rafinesque, 1820

### *Lampsilis ochracea* (Say)

Plate IV, figs. 3, 4

*Unio ochraceus* Say, 1817: Nicholson's Encyclopedia 2, pl. 3, fig. 8 (type locality: Delaware and Schuylkill rivers).

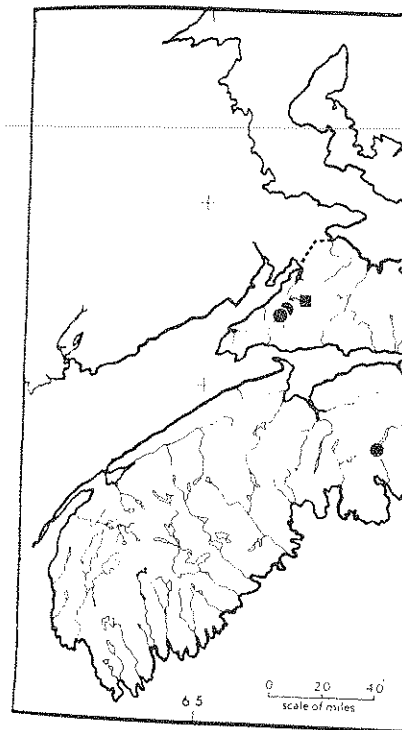
### Description

*L. ochracea* is medium sized (up to 3½ inches long), subovate and rather thin. Sexual dimorphism is prominent: females are enlarged posteriorly, but males are not. The periostracum is brownish and with or without rays. Pseudocardinal and lateral teeth are both well developed but narrow. The nacre is white, bluish white, or tinged with pink or salmon.

Distinguishing characters between this species and other lampsilids, i.e., *L. cariosa* (Say) and *L. radiata radiata* (Gmelin), are as follows. In *cariosa* the shell and hinge teeth are thickened; the periostracum is yellowish, and when rays are present they are confined to the posterior slope only. In *ochracea* the shell and hinge teeth are thin; the periostracum is brownish; and when rays are present, they are distributed over the whole surface. *L. radiata* may be distinguished by the absence of prominent sexual dimorphism and the more heavily thickened shell. Also, the interdentum in *ochracea* is thin and compressed, but in *cariosa* and *radiata* it is thick and heavy. *L. cariosa* has not been found in Nova Scotia.

### Distribution

This species is quite sporadic in its distribution. It has been recorded from New Brunswick (Athearn, 1961) south to the Ogeechee River, Georgia. In Nova Scotia it was found only at station 2: the River Hebert at Newville. This station is plotted on Map VI.



Map VI. *Lampsilis radiata radiata* and *L. ochracea* are plotted as filled-in circles. *L. ochracea* is plotted as a filled-in rectangle.

### Ecology

*L. ochracea* occurs in ponds, creeks, or muddy bottoms. It is most abundant in the latter. Its host fish is unknown.

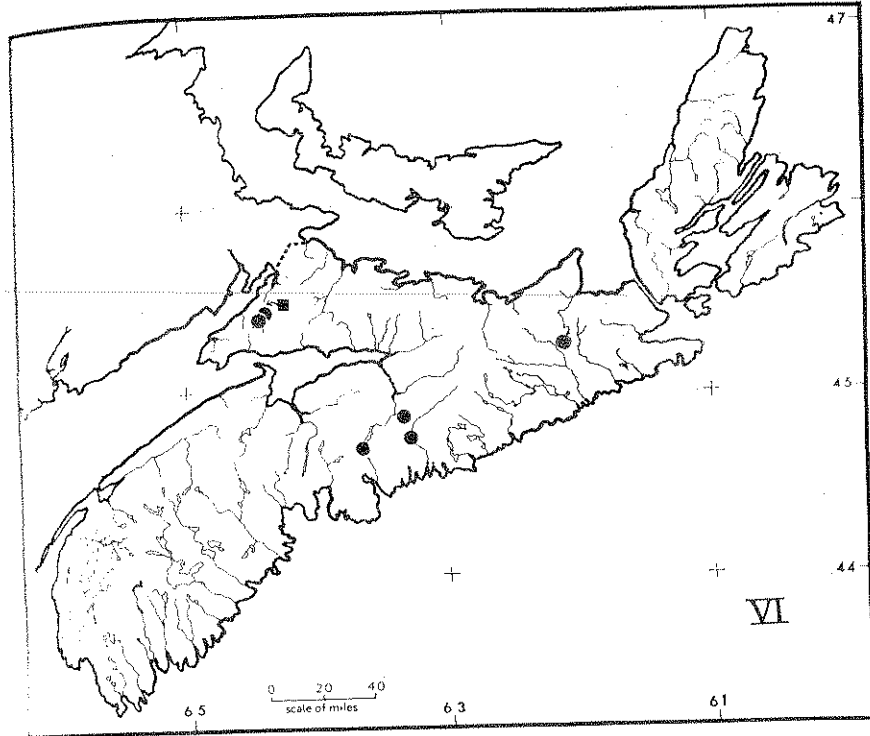
## *Lampsilis radiata*

Plate IV

*Unio radiata* Gmelin, 1792: Syster locality, Virginia).

### Description

The shell of this species is mediolobate, thickened anteriorly, and has prominent lateral teeth. The periostracum is brownish, yellowish, greenish, brownish, or black. It is generally distributed over the shell but is more prominent on coloured individuals. The nacre is white or pink.



VI. *Lampsilis radiata radiata* and *L. ochracea*. Positive localities for *L. r. radiata* are plotted as filled-in circles. The single positive locality for *L. ochracea* is plotted as a filled-in rectangle.

1820

*L. ochracea* occurs in ponds, canals, and slow-flowing rivers on sandy or silty bottoms. It is most abundant in ponds near the sea-coast. The life history is unknown.

#### *Lampsilis radiata radiata* (Gmelin)

Plate IV, figs. 5, 6

*L. radiata* Gmelin, 1792: Systema Naturae, 13th ed., p. 3220 (type locality, Virginia).

#### Description

The shell of this species is medium sized (up to 4½ inches long), sub-ovate, thickened anteriorly, and has well-developed pseudocardinal and lateral teeth. The periostracum is roughened by close, concentric wrinkles; yellowish, greenish, brownish, or blackish in colour; and has darker rays generally distributed over the shell but prominent only in young or light-colored individuals. The nacre is white, bluish white, or tinted with salmon or pink.

55045-0-31

from Lake Huron eastward to the Carolina in the Atlantic drainage. In the Missouri Drainage. In the Tidnish River. 10 mi.

small rivers and creeks and occurs in lakes. The large (side), and the northern are served, under experimental conditions of *S. undulatus* (stone, 1951).  
(n) of authors.

1820

dia 2, pl. 3, fig. 8

(4-5 inches long), subovate and males are enlarged and brownish and with both well developed lateral teeth with pink or salmon rays and other lampsilid (Gmelin), are as follows: the periostracum is yellowed to the posterior side; thin; the periostracum is distributed over the whole absence of prominent sexual. Also, the interdentum and *radiata* it is thick and Scotia.

tion. It has been recorded on the Ogeechee River, Georgia; River Hebert at Newville

### Distribution

*L. r. radiata* ranges from Lake Ontario through the lower St. Lawrence Drainage and south in the Atlantic Drainage to North Carolina. A closely related inland subspecies, *L. r. siliquioidea* (Barnes), also occurs in the St. Lawrence Drainage, and intergrades with *radiata* in that region are common (Clarke and Berg, 1959).

During this survey *radiata* was collected at only six stations. These stations have been plotted on Map VI.

### Ecology

This species is relatively common throughout most of its range. It occurs in lakes and rivers on substrates of gravel or sand and occasionally on mud. The host fish is unknown. It may be significant, however, that the yellow perch, *Perca flavescens* (Mitchill), and the smallmouth bass, *Micropterus dolomieu dolomieu* Lacépède, have both been implicated as hosts for *L. r. siliquioidea*, and both occur in Nova Scotia.

### ACKNOWLEDGMENTS

The authors wish to thank Mr. D. K. Crowdis, Director of the Nova Scotia Museum of Science, and Dr. W. J. Clench, Curator of Mollusks, Museum of Comparative Zoology, for the privilege of examining specimens in those institutions. Thanks are also extended to Messrs. F. R. Cooke and D. E. McAllister of the National Museum staff for reading the manuscript and offering useful comments.

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*Unio* Say. *Biol.*, 1: 143

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re reproduction and range

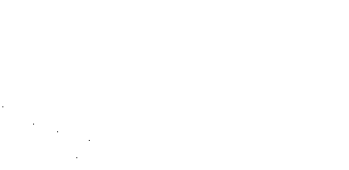
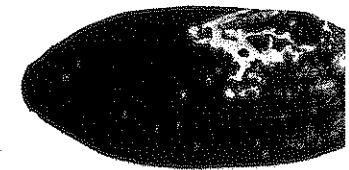
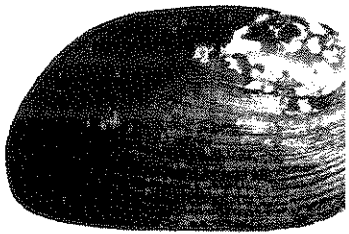
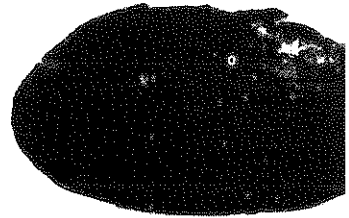
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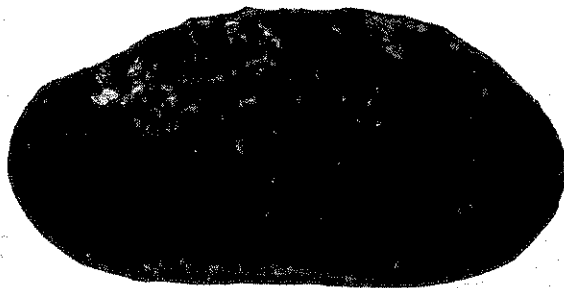
## PLATE I

- Figs. 1, 2. *Margaritifera margaritifera margaritifera*, adult  
Figs. 3, 4. *M. m. margaritifera*, sub-adult  
Figs. 5, 6. *Elliptio complanatus*, adult  
Figs. 7, 8. *Ligumia nasuta*, adult

All figures .55X







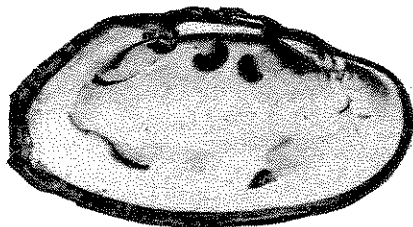
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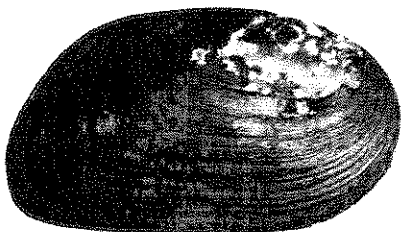
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Plate I  
*Margaritifera margaritifera*, adult  
, sub-adult  
s, adult  
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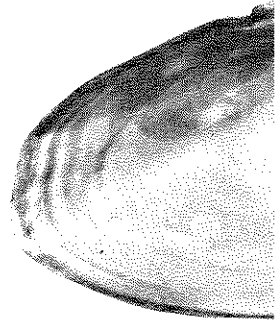
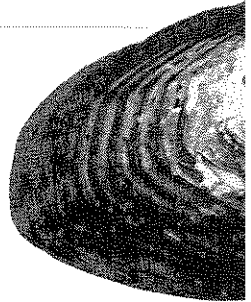
PLATE II

Figs. 1, 2. *Anodonta implicata*, adult

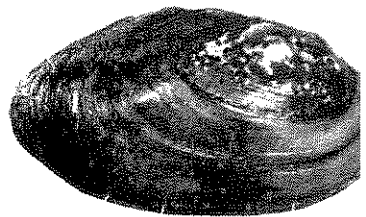
Figs. 3, 4. *Anodonta cataracta brooksiana*, adult

Figs. 5, 6. *Anodonta cataracta cataracta*, adult

All figures .69X

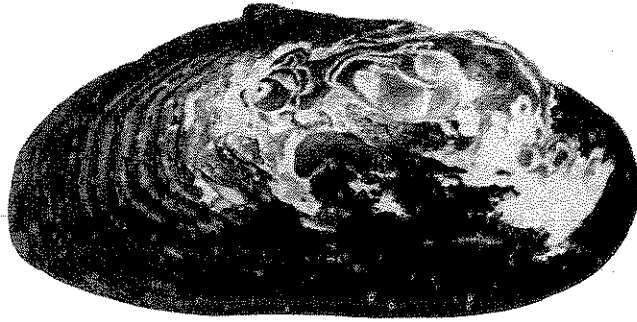


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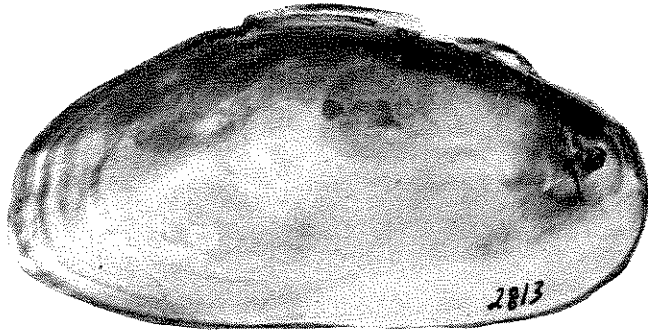


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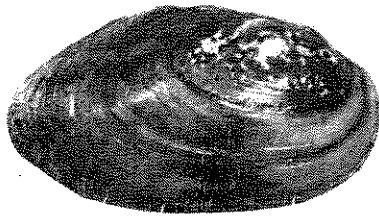




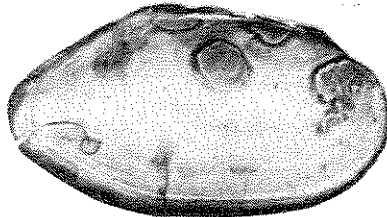
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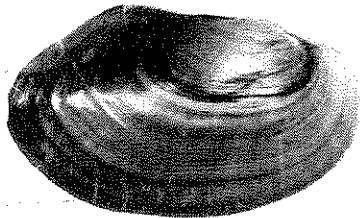
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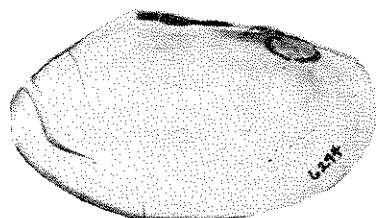
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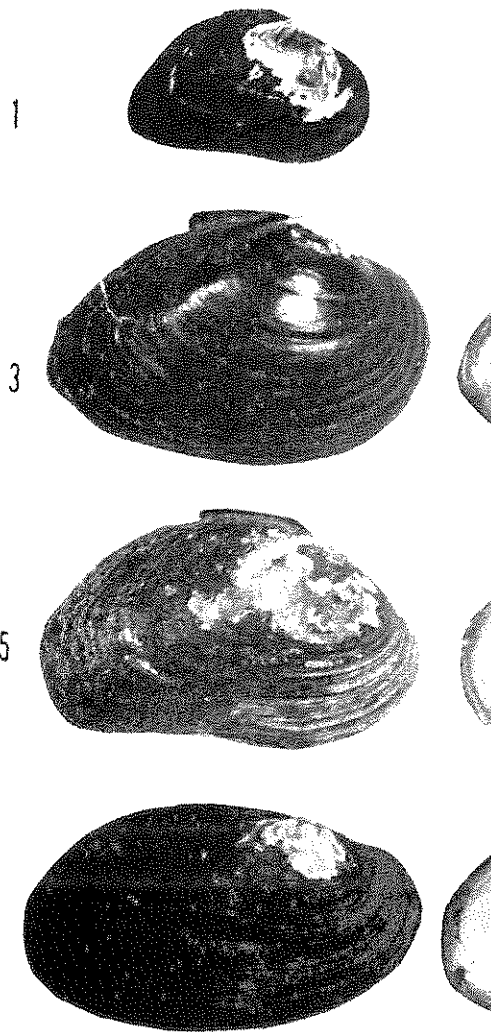
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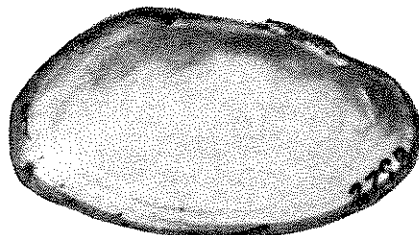
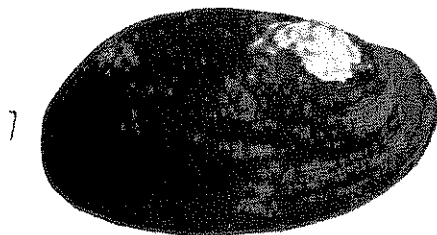
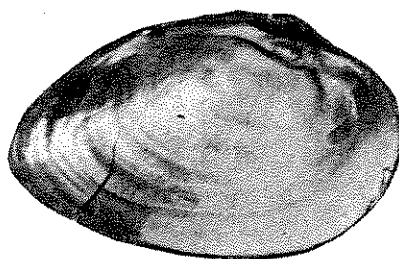
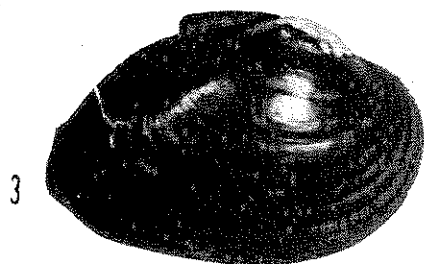
*...siana, adult*  
*...ucta, adult*

## PLATE III

Figs. 1, 2. *Alasmidonta heterodon*, adult  
 Figs. 3, 4. *Alasmidonta undulata*, adult  
 Figs. 5, 6. *Alasmidonta varicosa*, adult  
 Figs. 7, 8. *Strophitus undulatus*, sub-adult

All figures .82X



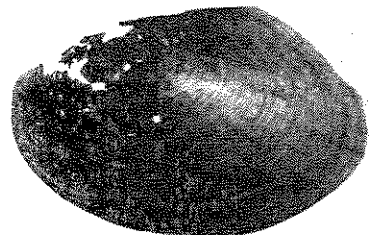
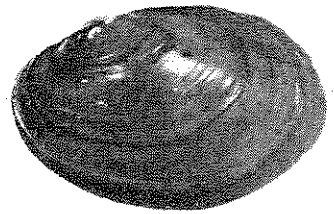


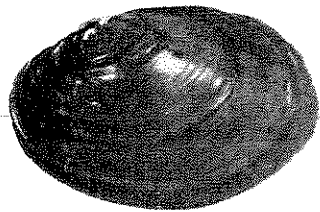
*erodon*, adult  
*lulata*, adult  
*icosa*, adult  
*atus*, sub-adult  
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## PLATE IV

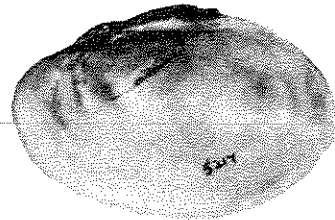
- Figs. 1, 2. *Lampsilis cariosa*, juvenile male  
 Figs. 3, 4. *Lampsilis ochracea*, adult female  
 Figs. 5, 6. *Lampsilis radiata radiata*, adult female (?)  
 Figs. 7, 8. *Elliptio complanatus*, adult

All figures .69X

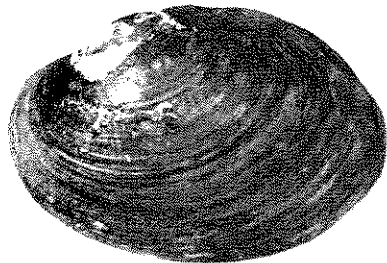




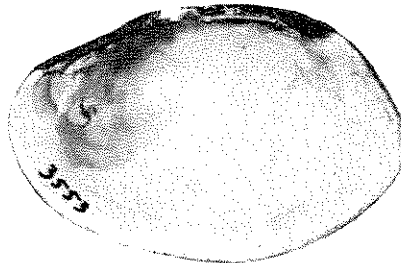
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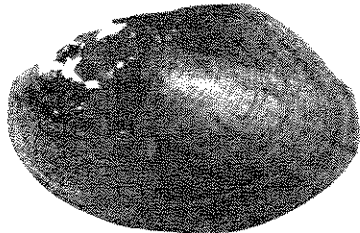
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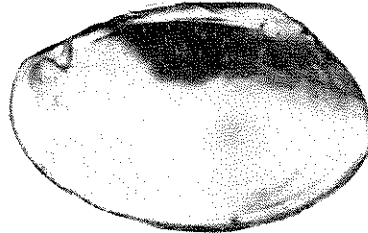
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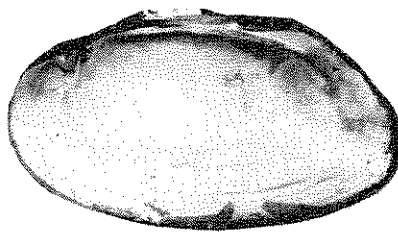
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male (?)