Freshwater snails of the family Lymnaeidae (Mollusca: Basommatophora) from western Montana

Richard H. Russell
The University of Montana

Follow this and additional works at: https://scholarworks.umt.edu/etd

Let us know how access to this document benefits you.

Recommended Citation
https://scholarworks.umt.edu/etd/6739

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.
FRESHWATER SNAILS OF THE FAMILY LYMNAEIDAE
(MOLLUSCA: BASOMMATOPHORA) FROM WESTERN MONTANA

by

Richard H. Russell

B. A. University of Montana, 1965

Presented in partial fulfillment of the requirements for the degree of Master of Arts

UNIVERSITY OF MONTANA

1967

Approved by:

[Signatures]

Chairman, Board of Examiners

Dean, Graduate School

MAY 31 1967

Date
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of maps.</td>
<td>iii</td>
</tr>
<tr>
<td>List of plates.</td>
<td>iv</td>
</tr>
<tr>
<td>Introduction.</td>
<td>1</td>
</tr>
<tr>
<td>Description of study area.</td>
<td>5</td>
</tr>
<tr>
<td>Materials and methods.</td>
<td>7</td>
</tr>
<tr>
<td>Acknowledgements.</td>
<td>9</td>
</tr>
<tr>
<td>The family Lymnaeidae</td>
<td>10</td>
</tr>
<tr>
<td>List of species.</td>
<td>11</td>
</tr>
<tr>
<td>Key to species.</td>
<td>12</td>
</tr>
<tr>
<td><strong>Systematic treatment</strong></td>
<td></td>
</tr>
<tr>
<td>Genus <em>Lymnaea</em>.</td>
<td>15</td>
</tr>
<tr>
<td>Genus <em>Radix</em>.</td>
<td>21</td>
</tr>
<tr>
<td>Genus <em>Stagnicola</em>.</td>
<td>26</td>
</tr>
<tr>
<td>Genus <em>Fossaria</em>.</td>
<td>53</td>
</tr>
<tr>
<td>Summary</td>
<td>66</td>
</tr>
<tr>
<td><strong>Appendices</strong></td>
<td></td>
</tr>
<tr>
<td>A. Distributional data.</td>
<td>67</td>
</tr>
<tr>
<td>B. Species studied from adjacent areas.</td>
<td>89</td>
</tr>
<tr>
<td>C. The family Lancidae</td>
<td>93</td>
</tr>
<tr>
<td>Maps.</td>
<td>95</td>
</tr>
<tr>
<td>Plates.</td>
<td>119</td>
</tr>
<tr>
<td>Literature cited.</td>
<td>135</td>
</tr>
</tbody>
</table>
### LIST OF MAPS

<table>
<thead>
<tr>
<th>Map Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Major watersheds of western Montana</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>Probable extent of Cordilleran Ice Sheet in western Montana</td>
<td>98</td>
</tr>
<tr>
<td>3</td>
<td>Counties in western Montana</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Distribution of <em>Lymnaea stagnalis</em> and <em>Radix</em> in western Montana</td>
<td>102</td>
</tr>
<tr>
<td>5</td>
<td>World-wide distribution of <em>Lymnaea stagnalis</em></td>
<td>104</td>
</tr>
<tr>
<td>6</td>
<td>World-wide distribution of <em>Radix auricularia</em></td>
<td>106</td>
</tr>
<tr>
<td>7</td>
<td>Distribution of <em>Stagnicola palustris</em> in western Montana</td>
<td>108</td>
</tr>
<tr>
<td>8</td>
<td>Distribution of forms of <em>Stagnicola emarginata</em> in western Montana</td>
<td>110</td>
</tr>
<tr>
<td>9</td>
<td>Distribution of <em>Stagnicola</em>, subgenus <em>Hinkleyia</em> in western Montana</td>
<td>112</td>
</tr>
<tr>
<td>10</td>
<td>Distribution of <em>Fossaria modicella</em> in western Montana</td>
<td>114</td>
</tr>
<tr>
<td>11</td>
<td>Distribution of <em>Fossaria obrusa</em> in western Montana</td>
<td>116</td>
</tr>
<tr>
<td>12</td>
<td>Distribution of <em>Fossaria parva</em> and <em>F. dalli</em> in western Montana</td>
<td>118</td>
</tr>
</tbody>
</table>
# LIST OF PLATES

<table>
<thead>
<tr>
<th>Plate</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Lymmaeid shell and genitalia</td>
<td>120</td>
</tr>
<tr>
<td>II</td>
<td>Radulae of Lymmaeidae</td>
<td>122</td>
</tr>
<tr>
<td>III</td>
<td>Shells of <em>Lymnaea stagnalis</em> and <em>Radix</em></td>
<td>124</td>
</tr>
<tr>
<td>IV</td>
<td>Shells of <em>Stagnicola</em></td>
<td>126</td>
</tr>
<tr>
<td>V</td>
<td>Shells of <em>Stagnicola</em></td>
<td>128</td>
</tr>
<tr>
<td>VI</td>
<td>Shells of <em>Stagnicola</em>, subgenus <em>Hinkleyia</em>, and <em>Fossaria</em></td>
<td>131</td>
</tr>
<tr>
<td>VII</td>
<td>Shells of <em>Fossaria</em> and Lymmaeidae from areas adjacent to western Montana</td>
<td>134</td>
</tr>
</tbody>
</table>
INTRODUCTION

This study was undertaken for two reasons: (1) to survey the species of the family Lymnaeidae in Montana west of the Continental Divide; and (2) to construct keys for the identifications of these species. As a result of this study, distributional data were collected for much of western Montana. My interest in this problem stems from ten years of collecting land and fresh-water mollusca in Montana and of becoming aware of many of the difficulties encountered in separating genera and species.

Very little has been published on any molluscan group in western Montana. The records for the Lymnaeidae are sporadic. Six new species or subspecies have been described from western Montana, and for most of these the only records are the original descriptions.

The family Lymnaeidae is a world-wide group of fresh-water snails, important as intermediate hosts for a large number of parasitic worms, particularly those of the family Fasciolidae. The anatomical similarity among species within the family as a whole and the variation within any single population of one species create a number of unusual taxonomic problems.

The first work of any consequence on the family Lymnaeidae in North America was written by W. G. Binney in his Land and Fresh-Water Shells of North America (1865). Numerous
authors since then have added to our knowledge of this group in North America. Probably the most significant contributions have been made by Frank Collins Baker.

Baker spent many years describing the fresh water molluscan faunas of this continent, and his works of 1911 and 1928 are regarded as basic to the study of the Lymnaeidae of North America. Baker considered the Lymnaeidae to consist of several genera and a large number of species. However, Colton (1914) questioned the generic groupings in Baker's 1911 monograph, and suggested that the generic names used by Baker be used as subgenera within the single genus *Lymnaea*.

Baker published many anatomical drawings and radular formulae, giving one the impression of a very precise taxonomic system within American lymnaeids. However, several works (see below) since Baker have shown that much of his data is incorrect. Most of his anatomical drawings are misleading. Radular formulae are never as consistent as Baker's descriptions would lead one to believe.

Hubendick (1951) revised the Lymnaeidae of the world based primarily on the shell and on a few characteristics of the genitalia. As a result of a careful biometric analysis of several populations of the complex species-group *Radix peregra* (L.) in western Europe, Hubendick came to the conclusion that many of the specific names in the Lymnaeidae
referred to ecological variants of but a few species. As a result, he reduced nearly 1800 specific names to approximately 40, and included all but a few of the world Lymnaeidae in the one genus Lymnaea.

Walter (1961) thoroughly studied the anatomy of one species of lymnaeid snail, Stagnicola emarginata serrata (Haldeman), in an attempt to determine which anatomical features would best serve as taxonomic criteria. As a result of his investigations, he rejected the thesis of F. C. Baker, Hubendick, and others, that the only anatomical structures of taxonomic significance are found in the distal part of the male genitalia. Particularly, he noted the taxonomic value of certain parts of the female genitalia. His findings indicate that, for the most part, the generic groupings used by Baker are valid.

Both Hubendick and Walter, from somewhat different points of view, seem to think that the most reliable taxonomic characters are to be found in the shells.

In addition to anatomy, other characteristics have been used in the taxonomy of the family Lymnaeidae. Wright (1959) incorporated paper chromatography of fluorescent substances in the body-surface mucous in his studies. Burch (1960a, b), in his studies of the chromosomes of aquatic pulmonate snails, found that chromosome numbers and the nature of mitotic figures can be useful in clarifying systematic relationships.
within the Basommatophora. Bondeson (1950) used the morphology of the egg masses to show taxonomic differences among fresh-water snails, primarily on the familial and higher levels, but to a certain extent within genera and species.

Recent American authors seem to favor recognition of several genera in the family Lymnaeidae. Taylor, Walter, and Burch (1963, p. 239) stated:

"The fact that varying degrees of relationships within this group can be recognized, primarily on the basis of genitalia and radula, but to a certain extent from shell sculpture, size of nuclear whorls, and other features, is a weighty objection to including all species in the one genus Lymnaea."

The generic separations used here are those used by Baker (1928). The same divisions are used by Zilch (1959-60), and are recognized by most recent workers in this country.
DESCRIPTION OF STUDY AREA

Western Montana, as treated in this paper, consists of that area in Montana west of the Continental Divide. This area, of approximately 25,000 square miles, is drained by the Clark Fork and Kootenai Rivers. The Kootenai River also drains a large portion of British Columbia before it enters western Montana. The Clark Fork can be divided into seven major watersheds (map 1), all of which originate in western Montana except for a part of the Flathead. The North Fork of the Flathead River enters Montana from British Columbia.

Western Montana is characterized by a series of distinct mountain ranges and intervening valleys (map 4). North of Missoula the general trend of these mountain ranges is nearly parallel to the Continental Divide, or northwest. South of Missoula, the mountain ranges are all oriented in a more north and south direction. The intermontane basins are for the most part quite wide, although usually not as wide as the intervening mountain ranges. South of Missoula, the valleys are wider and the mountain ranges are more irregular.

During the Pleistocene, a sizeable portion of western Montana was glaciated. The most extensive glaciation was probably during the Wisconsin stage of the Pleistocene. The approximate extent of the Cordilleran ice sheet in the Wisconsin stage is shown on map 2. In addition to this extensive mass of ice from British Columbia, there were local
Pleistocene glaciers in the Cabinet Range, the Whitefish Range, the Glacier Range, the Flathead Range, the Swan Range, the Mission Range, the Bitterroot Range, the Flint Creek Range, (John Long Mountains), and the Anaconda Range. The Couerdalene, Garnet, and Sapphire mountain ranges were essentially unglaciated. Also, large portions of the Bitterroot Range escaped glaciation (Alden, 1953).

To the south of the Cordilleran ice, much of the lowland area was covered by Glacial Lake Missoula. This lake, of approximately 3,300 square miles, was impounded by an ice dam 2000 feet high on the Clark Fork River near the Montana-Idaho border. This lake probably impounded water to an elevation of 4200 feet.
MATERIALS AND METHODS

For this study, snails were collected in all types of aquatic environments in western Montana. Most collecting was done either by hand picking or by the use of an aquatic dip net. Species were determined on the basis of anatomical characters. Although the purpose of this investigation was to study the family Lymnaeidae, other aquatic molluscs were collected.

Snails were prepared for anatomical study by relaxing them by means of menthol crystals and then fixing in a 4% solution of buffered formalin. After fixation overnight, snails were transferred to a solution containing 70% ethyl alcohol and 5% glycerine.

Snails were dissected in a petri dish which had a dark paraffin bottom. This "dissecting tray" was flooded with glycerine-alcohol, and dissections were done under a binocular dissecting microscope. Low magnification (15 X) was found to be suitable for most work. Micro-dissecting instruments (secured from Clay Adams Co.) and fine insect pins were used.

Radular membranes were obtained by heating buccal masses in a 5% solution of potassium hydroxide. After dissolving the tissues of the buccal mass, radulae were washed first in water and then in alcohol. Permanent slides were made using a glycerine-jelly double mount (Mitchell and Cook,
1952). It was found that the most satisfactory method was to separate the radular membrane from the jaw and mount each separately. As a result, the radular membranes could be made to lie flat, thus facilitating microscopic examination.

In examining radulae, care was taken to study the newer, more complete teeth near the posterior end of the membrane. The older, worn teeth towards the anterior end give an inaccurate picture of the true nature of the radula. In addition, at the anterior end, many of the teeth are found to be absent from the sides of the membrane.

Descriptions of shells, genitalia, and radulae are based on my own observations, and have been compared, where possible, with those in the literature.
ACKNOWLEDGEMENTS

Many persons gave valuable assistance in the completion of this study, and I should like to take this opportunity to express my appreciation to them.

Most of all, I should like to thank Dr. Royal Bruce Brunson of the Department of Zoology, University of Montana, for directing this work, for his much needed assistance and encouragement, and for giving me access to his collections. I should also like to thank Dr. W. B. Rowan for his interest in this project and for his help.

Dr. Bengt Hubendick, curator of the Naturhistoriska Museet in Göteborg, Sweden, has been of much assistance and has offered many worthwhile criticisms. Dr. Harold Walter of the Dayton Museum of Natural History has helped considerably in interpreting several of the problems dealing with separating species.

I should also like to thank Mrs. Marie Mooar of Ypsilanti, Michigan for access to her collections and records made throughout western Montana.

In addition, I am grateful to the many others who have assisted in collecting, and to the many friends and fellow students in the Department of Zoology who have given encouragement throughout this study.
THE FAMILY LYMNAEIDAE Broderip, 1839

SHELL: (Pl. I, fig. 1) Dextral (except for a few species in the Pacific islands); columnellar wall thickened, often twisted; spire attenuated to some degree in most species; outer lip thin; shell with periostracum.

ANIMAL: Foot broad, rounded; tentacles triangular, thin; eyes at inner base of tentacles; surface of body somewhat striated. Genital apertures separated; male opening behind right tentacle, female opening posteriad to that of male system and nearer to pneumostome. Male organs consist of penis, preputium, penis sheath, vas deferens, and prostate. Female organs consist of vagina, oviduct, seminal receptacle or spermatheca, and albumin gland with associated accessory glands. Hermaphroditic organs include ovitestis and duct. Preputium and penis sheath with one or more retractors inserted in columnellar muscle (Pl. I, fig. 2). With one superior and two smaller lateral jaws. Central tooth of radula asymmetrical, with a small cusp to right of single central tooth; laterals with two or three cusps; marginals generally with as many as six or more cusps (Pl. II).
LIST OF WESTERN MONTANA LYMNAEIDAE

Family LYMNAEIDAE Broderip, 1839

Lymnaea Lamarck, 1799

1. Lymnaea stagnalis jugularis (Say) 1817
2. Lymnaea stagnalis brunsoni Russell 1967

Radix Montfort 1810

3. Radix auricularia (Linne') 1758

Stagnicola Jeffreys 1830

Subgenus Stagnicola s.s. Jeffreys 1830

Group of "palustris"

4. Stagnicola palustris elodes (Say) 1821
5. Stagnicola palustris wyomingensis Baker 1936

Group of "emarginata"

6. Stagnicola binneyi (Tryon) 1865
7. Stagnicola elrodiana Baker 1935
8. Stagnicola elrodi Baker and Henderson 1933
9. Stagnicola emarginata n. ssp.

Subgenus Hinkleyia Baker 1928

10. Stagnicola caperata (Say) 1829
11. Stagnicola montanensis (Baker) 1913

Fossaria Westerlund, 1885

12. Fossaria parva (Lea) 1841
13. Fossaria dalli (Baker) 1905
14. Fossaria medicella (Say) 1825
15. Fossaria obrussa obrussa (Say) 1825
16. Fossaria obrussa rodecki Baker 1936
KEY TO THE GENERA AND SPECIES OF LYMNAEIDAE
OF WESTERN MONTANA

1 Body whorl enlarged or swollen, consisting of at least 75% of shell; generally thin and fragile  2

1' Body whorl not significantly enlarged or only slightly enlarged, making up less than 70% of shell; shell often somewhat thickened, seldom very fragile  4

2 Body whorl greatly enlarged, consisting of approximately 90% of shell (Pl. III, fig. 13); outer lip expanded (flaring); length of shell 25-30 mm; spire short, less than ½ length of aperture; radula with tricuspid first laterals; penis sheath longer than preputium  Radix auricularia (Linne')

2' Body whorl enlarged but not greatly, seldom consisting of more than 75% of shell; colunnellar wall broad, completely closing umbilical area; length of spire greater than ½ length of aperture; length of shell 20-50 mm; radula with bicuspid laterals, first laterals occasionally tricuspid; penis sheath less than ½ length of preputium  Lymnaea

3 Length of spire equal to or greater than length of aperture (Pl. III, fig. 1); length 30-50 mm; generally distributed  Lymnaea stagnalis appressa (Say)

3' Length of spire less than length of aperture (Pl. III, fig. 10); length of shell 20-30 mm; Flathead Lake  L. stagnalis brunsoni Russell

4 Surface of shell with distinct spiral sculpture (Pl. I, fig. 1); colunnella generally twisted or with plait; often with a red band or varix parallel to outer lip; size of shell varies, 6-30 mm; radula with bicuspid laterals (Pl. II, fig. 4)  Stagnicola

4' Surface of shell without distinct spiral sculpture, often with prominent growth lines; colunnella smooth; shell seldom with red varix near outer lip; shell small, generally 3-10 mm; radula with tricuspid laterals (Pl. II, fig. 4)  Fossaria  11

5 Shell small, length 6-15 mm; spire generally longer than aperture; colunnella smooth, not plicate; surface of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
shell often somewhat hirsute; lower part of oviduct globular, wide; penis wide and thick, with a constriction near the center

Subgenus **Hinkleyla** Baker 10

5° shell medium, length 15-30 mm; length of spire varies in relation to length of aperture; columella usually twisted or plicate; lower part of oviduct narrowly pyriform; penis slender, with muscular ridges near proximal end

Subgenus **Stagnicola** (Leach) Jeffreys

6° Length of spire greater than length of aperture; surface sculpture fine, generally not obvious without magnification

**Stagnicola palustris elodes** (Say)

6° Length of spire equal to or less than length of aperture; surface sculpture coarse, prominent, often giving somewhat of a beaded appearance

Group of **Stagnicola** **emarginata** 7

7° With distinct umbilical chink; inner lip forming flat, shelf-like projection over columella; columella without plait

8° Inner lip folded over columella closing umbilicus; generally without umbilical chink; axis twisted, columella with plait

8° Parietal wall together with columellar wall straight or only slightly curved; body whorl ovate; whorls somewhat flattened; aperture elongate or ovate; length of aperture equal to or greater than width of shell (Pl. IV, figs. 22, 23); mountain lakes

**Stagnicola elrodiana** Baker

8° With distinct angle between parietal wall and columellar wall; body whorl globular; whorls rounded or angulate; aperture round; length of aperture less than width of shell (Pl. V, figs. 15-19); size to 30 mm; Holland Lake

**Stagnicola** **emarginata** n. ssp.

9° Periostracum yellow; body whorl elongate; axis twisted; aperture varies from rounded and expanded to narrowed and flattened; spire acute; size to 30 mm. (Pl. V, figs. 1-14); Flathead Lake

**Stagnicola** **marginal** Baker and Henderson

9° Periostracum brown; body whorl globular; outer edge of
aperture flatly rounded but not expanded; spire broad; size to 20 mm. (Pl. IV, figs. 24-26); Clearwater River

**Stagnicola binneyi** (Tryon)

10 Shell swollen; with raised, spiral ridges of periostracum which run in incised lines; widely distributed

**Stagnicola caperata** (Say)

10° Shell narrowly elongate; surface shiny, without incised sculpture or ridges of periostracum; Bitterroot Range in Montana

**Stagnicola montanensis** (Baker)

11 Whorls rounded

11° Whorls shouldered or spire whorls flattened (Pl. VI, figs. 14, 15)

12 Shell narrow to wide; aperture oval; body whorl rounded (shell generally quite variable, spire whorls may be flattened or flatly rounded); size 9-13 mm. (Pl. VI, figs. 13-20); widely distributed

**Fossaria obrussa** (Say)

12° Shell narrow; spire long, narrow; aperture elongate; body whorl flattened; size 9-10 mm. (Pl. VI, figs. 21-24); Swan and Clearwater drainages

**Fossaria obrussa rodecki** Baker

13 Spire broadly conic; length of spire usually equal to length of aperture; sutures not deeply impressed; spire whorls may be somewhat flattened; growth striae prominent; size 7-15 mm. (Pl. VI, figs. 21-30)

**Fossaria modicella** (Say)

13° Spire acute, turreted; length of spire longer than length of aperture; sutures generally deeply impressed

14 Inner lip erect, forming a dent or constriction where it meets parietal wall; size 3-6 mm. (Pl. VII, figs. 8-12)

**Fossaria dalli** (Baker)

14° Aperture round; inner lip not erect, size 4½-9 mm. (Pl. VII, figs. 3-7)

**Fossaria parva** (Lea)
SYSTEMATIC TREATMENT

Genus LYMMNEA Lamarck, 1799


Shell generally thin as compared to other Lymnaeids; spire attenuated, spire whorls flattened, sutures indistinct. Last whorl of shell expanded, outer lip seldom flares. Columellar wall and parietal wall usually continuous; umbilicus closed by wide columellar wall. Surface sculpture consisting of fine impressed spiral lines and closely set growth lines. Aperture round to slightly ovate, elongate in immature shells. Preputium large, four or more times length of penis sheath. Penis sheath narrow. Generally two preputium retractors, posterior one usually larger. Lateral teeth of radula usually bicuspid, although occasional specimens may have first laterals tricuspid.

This genus is accepted in the sense of F. C. Baker (1911, 1928) and not as used by Hubendick (1951). As Hubendick defines the genus Lymnaea, all of the species (here described under several genera) would be included in one genus.

LYMNAEA STAGNALIS JUGULARIS (Say) 1817

(P1. III, figs. 1-9)


SHELL: Elongated, thin, periostracum yellowish to brownish-black. Surface shining, numerous crowded growth lines and fine impressed spiral lines. Whorls six to six and one-half, spire whorls flattened or flatly rounded, first few whorls increasing slowly in size. Sutures shallowly impressed; spire generally longer than aperture. Columella wide, covering columellar area; columellar wall may have a slight plait (or twist). Body whorl enlarged, comprising nearly 3/4 of shell.

Hubendick (1951) considered the American forms of Lymnaea stagnalis to be distinct from those in Europe, and preferred to use Say’s name appressa for the American subspecies. Most American authors, however, consider appressa to be synonymous with the earlier name jugularis.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell height</th>
<th>Shell width</th>
<th>Aperture height</th>
<th>Aperture width</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.9</td>
<td>22.3</td>
<td>27.2</td>
<td>19.3</td>
</tr>
<tr>
<td>48.2</td>
<td>21.5</td>
<td>23.7</td>
<td>16.0</td>
</tr>
<tr>
<td>47.1</td>
<td>20.0</td>
<td>24.3</td>
<td>15.4</td>
</tr>
<tr>
<td>40.9</td>
<td>20.6</td>
<td>22.2</td>
<td>16.0</td>
</tr>
<tr>
<td>40.2</td>
<td>18.5</td>
<td>21.1</td>
<td>13.5</td>
</tr>
<tr>
<td>41.5</td>
<td>19.9</td>
<td>21.9</td>
<td>14.8</td>
</tr>
<tr>
<td>39.5</td>
<td>17.0</td>
<td>19.4</td>
<td>13.3</td>
</tr>
</tbody>
</table>

McWinniger Slough " " Spencer Lake
<table>
<thead>
<tr>
<th>Shell height</th>
<th>Shell width</th>
<th>Aperture height</th>
<th>Aperture width</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.9</td>
<td>16.1</td>
<td>19.5</td>
<td>11.8</td>
</tr>
<tr>
<td>34.3</td>
<td>14.2</td>
<td>17.4</td>
<td>11.6</td>
</tr>
<tr>
<td>36.1</td>
<td>15.6</td>
<td>17.9</td>
<td>11.8</td>
</tr>
<tr>
<td>25.1</td>
<td>10.9</td>
<td>12.9</td>
<td>8.1</td>
</tr>
<tr>
<td>30.2</td>
<td>15.2</td>
<td>17.4</td>
<td>10.9</td>
</tr>
</tbody>
</table>

GENITALIA: Preputium stout, tapering toward distal end. Penis sheath small, 1/6 length of preputium. Proximal portion of vas deferens (before it enters columnar muscle) nearly 5 times length of preputium and penis sheath. With one large preputium retractor and one or more smaller preputium retractors, one of which may be inserted on larger retractor. Penis sheath retractor narrow, inserted on large preputium retractor.

RADULA: Central tooth as in family. In most specimens small cusp on right side of central tooth is indistinct. Lateral teeth bicuspid, occasionally first tooth has a small endocone. Fourteen to eighteen lateral teeth. Last lateral tooth, intermediates, and first few marginal teeth may have a small cusp above ectocone. In some specimens, ectocone present only in laterals, marginals have no ectocone. Number of marginals 18 to 28; total number of teeth on one side 39 to 50.

ECOLOGY AND DISTRIBUTION: In western Montana, Lymnaea stagnalis jugularis appears to be generally distributed in the Flathead, Swan, and Clearwater drainages to the north of Missoula. To the south of Missoula, it has been found only...
in the sloughs along the Bitterroot River (map 4). This subspecies is usually found in more or less stagnant water (Baker, 1928, p. 202). In Montana, most of the collections are made in relatively clear, still or slowly moving water. Elrod (1902a, p. 110) reports this snail from "...a small pool along the Bitter Root River. A large spring supplies the pool with clear, fresh water." In the larger lakes, *L. stagnalis jugularis* is typically found in the more stagnant, protected areas; and when found in rivers (such as the Clearwater) it is generally in the quiet pools.

**LYMNAEA STAGNALIS BRUNSONI** Russell 1967

(Pl. III, figs. 10, 11)


**SHELL**: Medium in size, light horn in color, surface with fine impressed growth lines. Whorls 5½, flat sided; sutures indistinct; body whorl large, rounded. Spire acute, nuclear whorl rounded. Aperture roundly ovate, elongate in immature shells. Inner lip folded over columella leaving a narrow umbilical chink. Columella with distinct plait.

Holotype: Height 28.5 mm; width 16.0 mm; aperture height 17.2 mm; aperture width 11.9 mm. USNM. 683584. Paratypes in the Invertebrate Museum, Department of Zoology, University of Montana, and in the collection of the author.
MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell height</th>
<th>Shell width</th>
<th>Aperture height</th>
<th>Aperture width</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.5</td>
<td>16.0</td>
<td>17.2</td>
<td>11.9</td>
</tr>
<tr>
<td>27.3</td>
<td>14.8</td>
<td>17.0</td>
<td>11.1</td>
</tr>
<tr>
<td>27.7</td>
<td>14.8</td>
<td>15.6</td>
<td>10.8</td>
</tr>
<tr>
<td>25.4</td>
<td>14.8</td>
<td>15.5</td>
<td>10.6</td>
</tr>
<tr>
<td>25.3</td>
<td>14.5</td>
<td>14.9</td>
<td>10.5</td>
</tr>
<tr>
<td>24.9</td>
<td>13.8</td>
<td>13.9</td>
<td>9.7</td>
</tr>
<tr>
<td>24.4</td>
<td>13.6</td>
<td>15.3</td>
<td>10.3</td>
</tr>
<tr>
<td>23.7</td>
<td>13.5</td>
<td>13.7</td>
<td>9.7</td>
</tr>
<tr>
<td>23.2</td>
<td>13.8</td>
<td>13.9</td>
<td>10.0</td>
</tr>
<tr>
<td>23.2</td>
<td>13.2</td>
<td>13.8</td>
<td>9.5</td>
</tr>
<tr>
<td>22.5</td>
<td>12.2</td>
<td>12.8</td>
<td>8.6</td>
</tr>
<tr>
<td>21.9</td>
<td>11.8</td>
<td>12.8</td>
<td>8.7</td>
</tr>
<tr>
<td>21.2</td>
<td>12.5</td>
<td>12.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>

COMPARISONS OF SHELLS: This race resembles in shell characters the Great Lakes L. stagnalis sanctaemariae Walker and L. s. occidentalis Hemphill from Lake Whatcom, Washington. However, the characters of the genitalia and radula are closer to F. C. Baker's L. stagnalis lilliamae. Lymnaea stagnalis brunaoni should not be confused with any other Lymmaeaid in western Montana except possibly Stagnicola elrodi. Lymnaea stagnalis brunaoni can easily be distinguished by its flat sided spire whorls. Shells of L. s. brunaoni can be separated from L. stagnalis jugularis (Say) by its smaller size and shorter spire.

GENITALIA: Similar to L. stagnalis jugularis. Penis sheath retractor inserted in posterior preputium retractor. Preputium retractors consist of two heavy muscles. Protractors two in number. Vas deferens, before it enters columnellar muscle, approximately seven times length of penis sheath.
and preputium. Length of preputium in holotype 3.88 mm.;
penis sheath 1.15 mm.; vas deferens 35 mm.

RADULA (Pl. II, fig. 2): Radula with eleven laterals, first lateral tricuspid in some specimens. Mesocone of seventh lateral long and acute, considerably longer than in L. a. jugularis. Mesocone becomes smaller in laterals eight through eleven. Endocone of intermediates with one to four cusps. Endocone of marginals one through seven with three to six cusps. Marginals eight through twenty-three show a gradual reduction in number of cusps. Formula: 23-3-11-1-11-3-23 (37-1-37). In some specimens central tooth shows a small cusp on right side of main cusp. Superior jaw well arched, higher than in L. a. jugularis. In the one jaw of L. a. brunsoni which was examined, the median cusp was worn and indistinct.

DISTRIBUTION: Lyymnea stagnalis brunsoni appears to be restricted to Flathead Lake in offshore waters (map 4).

The cosmopolitan occurrence of Lyymnea stagnalis is probably the result of a southward ingress from a circumboreal distribution (map 5). The northern populations of this species were probably adversely affected by glaciation during the Pleistocene, along with many other animals and plants. Few of the organisms which did survive this period were able to compete with and to remain distinct from those which later moved into these areas. Lyymnea stagnalis brunsoni lives in
a restricted environment which has existed from pre-glacial
times (Alden, 1953). Anatomical and shell characters are
unique among North American lymnaeids, and some features are
closer to the European forms of Lymnaea stagnalis.

Baker (1928) and Walter (1961) noted that tricuspid
laterals are seldom found in American Lymnaea stagnalis.
The presence of tricuspid first laterals in L. stagnalis
brunsomi would possibly indicate an affinity with the Euro­
pean Lymnaea stagnalis which, according to Hubendick (1951),
generally shows tricuspid lateral teeth.

Lymnaea stagnalis brunsomi represents a microgeographi­
cal race, and may be considered as a Pleistocene relict.

Genus RADIX Montfort 1810

Radix Montfort, 1810, Conch. Syst., II, p. 226. (for Helix
auricularia Linne*).

Shell ovate, spire short, last whorl extremely large in
proportion to size of shell. Outer lip thin, simple, often
flaring. Columellar wall reflexed over umbilicus. Umbilicus
usually open. Preputium large; penis sheath long and narrow,
usually as long or longer than preputium. First lateral
teeth of radula tricuspid, rest of laterals tricuspid or
bicuspid.
RADIX AURICULARIA (Linne')

(Pl. III, figs. 12-15)


SHELL: Generally thin and fragile. Body whorl rounded, inflated, consisting of nearly 90% of shell. Spire very short, conical; sutures deeply impressed; aperture large, flaring in old shells. Whorls usually five; length of most shells from 20 to 30 mm. Most of the shells from western Montana are malleated, producing on the shell a decussated pattern. Of all the specimens from the Clearwater River, none has shown a finished outer lip. Shells from the other populations generally have the outer lip finished.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.1</td>
<td>23.6</td>
<td>24.0</td>
<td>16.3</td>
</tr>
<tr>
<td>26.8</td>
<td>21.1</td>
<td>21.9</td>
<td>14.0</td>
</tr>
<tr>
<td>26.6</td>
<td>22.3</td>
<td>21.3</td>
<td>15.5</td>
</tr>
<tr>
<td>21.5</td>
<td>15.2</td>
<td>16.0</td>
<td>10.7</td>
</tr>
<tr>
<td>19.7</td>
<td>14.8</td>
<td>15.1</td>
<td>11.0</td>
</tr>
<tr>
<td>19.6</td>
<td>13.6</td>
<td>14.0</td>
<td>9.4</td>
</tr>
<tr>
<td>23.2</td>
<td>20.3</td>
<td>20.2</td>
<td>13.3</td>
</tr>
<tr>
<td>22.7</td>
<td>20.0</td>
<td>19.4</td>
<td>13.0</td>
</tr>
<tr>
<td>21.8</td>
<td>19.0</td>
<td>17.9</td>
<td>12.0</td>
</tr>
<tr>
<td>18.5</td>
<td>14.9</td>
<td>14.9</td>
<td>9.5</td>
</tr>
</tbody>
</table>

GENITALIA: Penis sheath narrow, nearly as long as preputium. With a prominent bulb-like swelling on distal end of preputium. It is often difficult to distinguish between penis sheath and vas deferens. With one distal preputium
retractor which is inserted on columelllar muscle near the single small penis sheath retractor. Specimens which were examined usually had four posterior preputium protractors and three anterior protractors.

RADULA (Pl. II, fig. 3): First lateral tricuspid, other laterals generally tricuspid (occasionally, all of the laterals excepting the first few are bicuspid). Eleven to fourteen laterals. Endocone of first few marginals with three or more cusps. Ectocone absent in marginals. Cusps reduced or absent in last ten or so marginals. Total number of teeth on one side varies between radulae. Usual number between 38 and 40 (although as few as 32 and as many as 41 have been observed). Formula (based on averages of 13 membranes): 23-2-12-1-12-2-23 (38-1-38). Baker (1911) for R. auricularia gives a formula which reduces to: 32-4-14-1-14-4-32 (50-1-50).

DISTRIBUTION: In Montana, Radix auricularia has been collected from the Clearwater drainage and from Flathead Lake (map 3). In the Clearwater drainage, it has been found only in Harper's Lake and in the Clearwater River. Both of these localities are at the southern end of the drainage. In Flathead Lake, R. auricularia has been collected at two places, both of which are at the southern end of the lake. These two localities in Flathead Lake are on the opposite sides of the lake.
A paleartic species, *Radix auricularia*, has been reported from many places in North America, and has always been considered to be a synanthropic species. It was introduced into North America during the beginning of the twentieth century (Hubendick, 1951, p. 153) and now is widely distributed in the eastern United States and in the Great Lakes region of Canada (La Rocque, 1953). In addition, this species has been collected in California (Henderson, 1932), Utah (Roscoe, 1950), Nevada (Walter, 1961), Oregon (unpublished data), Washington (Eyerdam, 1941), Idaho (Henderson, 1931), Wyoming (Beetle, 1961), Colorado (Henderson, 1924, 1935, McCoy, 1964), Montana (Brunson and Russell, unpublished), and southern Alaska (Eyerdam, 1941).

Until the description of *Radix junturae* from the Pliocene of Oregon by Taylor in 1963, no fossil Lymnaeids of the superspecies *Radix auricularia* were known to occur in North America. In his summary of North American Blancan non-marine molluscs, Taylor (1966) has figured two specimens which he assigns to *Radix intermontana* (=*Lymnaea idahoensis* Yen, preoccupied). The shell features of Taylor's figures of *R. intermontana* are indistinguishable from typical *R. auricularia*.

The discovery of *Radix* in Pliocene deposits in western North America leads one to speculate on the possibility of *Radix auricularia* being native to the Western Hemisphere. It is my contention that there may be populations of *R.*
auricularia in the northwestern part of the United States or the western part of Canada which are the remnants of a late Tertiary migration from Asia via the Bering Land Bridge. The few occurrences of this species in southern Alaska are most likely the result of such a migration. This would be in accordance with the theory of Roszkowski (1928) on the distribution of Lymnaeids across intercontinental land bridges. The populations of R. auricularia in the eastern United States, however, are probably all syanthropic.

C. A. Wright (1959) hypothesized that Radix paregra and R. auricularia are respectively the western and eastern paleartic derivatives of a common ancestral stock which was separated during one of the major glaciations. Hubendick (1951, p. 177) considers R. auricularia to be Asiatic in origin, with R. paregra as a secondary offshoot from forms similar to R. auricularia. If either of these theories is correct, it would be easy to see how one could account for the migration of R. auricularia to North America. The apparent absence of R. auricularia in most of Siberia may correspond to its scarcity in Alaska (map 6), and can probably be explained by considering the effects of glaciation.

The populations of R. auricularia in Montana may be relict populations (map 4). Several observations suggest this conclusion. In the first place, it is difficult to visualize an introduction having occurred in such remote and thinly populated areas. Most introductions of such
molluscs usually occur near larger concentrations of human population. Secondly, there has been no apparent movement from these areas as seems to be the case when such molluscs have been introduced into other areas. Of possibly greater significance, all of these areas have somewhat unusual invertebrate faunas, which would indicate that there are other relict forms in these areas.

In Flathead Lake, Lymanea stagnalis brunsoni and Stagnicola elrodi are undoubtedly relict forms. In addition, Pisidium idahosense Roper (Brunson, et al, unpublished) is very likely a remnant in Flathead Lake. Its distribution in Montana and in other parts of North America (Herrington, 1962) would suggest this. Presumably, there was open water in parts of Flathead Lake during the Pleistocene (Smith, 1966) so that isolated populations conceivably could have survived throughout this period.

Further study will have to be done on the anatomy of Radix from Montana to determine if the above hypothesis of discontinuous distribution can be accepted. Possibly a study of the morphology of the egg masses would shed some light on the problem, inasmuch as the egg masses of Radix have an unique morphology among Lymanaeid snails (Bondeson, 1950).

Genus STAGNICOLA Jeffreys, 1830

Stagnicola Leach, Proof-sheets, pp. 141, 145, 1819.  
Jeffreys, Linn. Trans., 16(2): 376, May 29, 1830.
Surface of shell with spiral sculpture, columella generally twisted or with plait. Often with a red varix or thickening near periphery of aperture and parallel with outer lip. Size and shape somewhat variable; usually from 10 to 30 mm. Radula typically with bicuspid lateral teeth. Penis sheath equal to or slightly shorter than preputium.

STAGNICOLA PALUSTRIS ELODES (Say) 1821

(P1. IV, figs. 1-17)

Limnaea palustria Elrod, Naut., 15:111, 1902.
Limnaea nuttalliana Elrod, Naut., 15:111, 1902.

SHELL: Medium in size; elongate or elongate ovate; usually rather thin. Color varies from pale brown to black. Surface dull or shiny. Surface sculpture as in genus, consisting of fine growth lines and impressed spiral lines. Last whorl or whole shell may be malleated (Pl. IV, figs. 3, 12, 15). Occasionally, zebretion occurs to greater or lesser degree (Pl. IV, fig. 16), probably of no taxonomic significance (see Hubendick, 1951, p. 37). Whorls six to seven, generally rounded. Sutures vary from shallow to deeply impressed. Length of spire generally greater than length of aperture. Aperture rounded, often elongated or expanded. Columellar wall usually with plait; umbilicus narrow or
Hubendick (1951) suggested that the "palustris" complex might well be called a superspecies, including *amarginata* and *palustris* as the two main subdivisions. *Stagnicola palustris* is an European species. American *S. palustris* seems to be distinct anatomically, so that the American species should bear Say’s name *S. elodes*. Baker (1928) has used this terminology, calling the American species *Stagnicola palustris elodes* (Say).

In this paper, the western Montana forms of *S. palustris* are included under the one name. This is because at this time no pattern or consistency (either in shell features or in distribution) can be demonstrated in the many populations which have been studied. The works of Baker (1911) and Henderson (1924, 1936) include descriptions of many western lymnaeids which belong to the one protean species *S. palustris*. Most of the "species" referred to by Baker and Henderson (such as *leali, traskii*, and *magister*) can be represented by a few individuals from single populations of *S. palustris elodes* in western Montana. (For example, compare Pl. XXXIX, figs. 1-3 of *S. leali* in Baker’s monograph, and Pl. II, fig. 7 in this paper.) The one exception to this in western Montana is the form *S. p. wyomingensis* Baker which is quite consistent in the population at Byrne Resort. Consequently, *S. p. wyomingensis* is treated here as a separate subspecies.
MEASUREMENTS OF SHELLS in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Height</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.0</td>
<td>14.0</td>
<td>15.1</td>
<td>10.2</td>
</tr>
<tr>
<td>30.1</td>
<td>13.8</td>
<td>14.4</td>
<td>9.9</td>
</tr>
<tr>
<td>29.8</td>
<td>14.3</td>
<td>16.0</td>
<td>10.0</td>
</tr>
<tr>
<td>27.5</td>
<td>12.5</td>
<td>13.8</td>
<td>9.2</td>
</tr>
<tr>
<td>26.4</td>
<td>12.5</td>
<td>13.0</td>
<td>8.1</td>
</tr>
<tr>
<td>26.0</td>
<td>12.4</td>
<td>13.5</td>
<td>8.9</td>
</tr>
<tr>
<td>25.6</td>
<td>12.5</td>
<td>14.5</td>
<td>9.2</td>
</tr>
<tr>
<td>24.5</td>
<td>11.5</td>
<td>12.2</td>
<td>8.2</td>
</tr>
<tr>
<td>24.4</td>
<td>12.3</td>
<td>13.0</td>
<td>9.0</td>
</tr>
<tr>
<td>22.9</td>
<td>11.0</td>
<td>11.4</td>
<td>7.4</td>
</tr>
<tr>
<td>22.8</td>
<td>10.8</td>
<td>11.9</td>
<td>7.7</td>
</tr>
<tr>
<td>22.1</td>
<td>11.0</td>
<td>12.0</td>
<td>8.8</td>
</tr>
<tr>
<td>20.3</td>
<td>10.4</td>
<td>11.0</td>
<td>7.2</td>
</tr>
<tr>
<td>20.0</td>
<td>10.4</td>
<td>10.9</td>
<td>7.0</td>
</tr>
<tr>
<td>19.9</td>
<td>10.1</td>
<td>10.9</td>
<td>7.0</td>
</tr>
<tr>
<td>19.1</td>
<td>9.2</td>
<td>9.1</td>
<td>6.4</td>
</tr>
<tr>
<td>17.9</td>
<td>8.8</td>
<td>9.0</td>
<td>6.0</td>
</tr>
<tr>
<td>16.0</td>
<td>8.9</td>
<td>8.6</td>
<td>5.5</td>
</tr>
<tr>
<td>15.9</td>
<td>8.3</td>
<td>8.8</td>
<td>6.3</td>
</tr>
<tr>
<td>15.8</td>
<td>8.1</td>
<td>7.9</td>
<td>5.4</td>
</tr>
<tr>
<td>13.1</td>
<td>6.9</td>
<td>6.9</td>
<td>4.2</td>
</tr>
<tr>
<td>24.5</td>
<td>12.9</td>
<td>15.8</td>
<td>10.0</td>
</tr>
<tr>
<td>21.0</td>
<td>10.2</td>
<td>11.4</td>
<td>7.1</td>
</tr>
<tr>
<td>20.7</td>
<td>11.2</td>
<td>12.3</td>
<td>8.4</td>
</tr>
<tr>
<td>19.1</td>
<td>9.0</td>
<td>9.9</td>
<td>6.4</td>
</tr>
<tr>
<td>16.5</td>
<td>8.9</td>
<td>10.3</td>
<td>6.4</td>
</tr>
<tr>
<td>13.0</td>
<td>6.7</td>
<td>7.4</td>
<td>4.8</td>
</tr>
<tr>
<td>11.9</td>
<td>6.3</td>
<td>6.9</td>
<td>4.0</td>
</tr>
<tr>
<td>11.8</td>
<td>6.0</td>
<td>6.5</td>
<td>4.3</td>
</tr>
<tr>
<td>11.5</td>
<td>5.9</td>
<td>6.2</td>
<td>4.0</td>
</tr>
<tr>
<td>11.4</td>
<td>6.3</td>
<td>6.5</td>
<td>3.9</td>
</tr>
<tr>
<td>11.0</td>
<td>5.3</td>
<td>6.1</td>
<td>3.8</td>
</tr>
</tbody>
</table>

GENITALIA: Preputium long, slender, nearly uniform in diameter throughout. Length of preputium almost twice length of penis sheath. With single heavy preputium retractor inserted at the junction of preputium and penis sheath. Penis sheath narrow, about 1/3 the diameter of preputium. Penis sheath with bulbous expansion at the distal end. Proximal portion of vas deferens 1 1/2 times length of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
preputium and penis sheath. With two anterior preputium protractors which divide several times before attaching to preputium. Penis sheath retractor somewhat longer than length penis sheath, and inserting on columellar muscle slightly posteriad to insertion of preputium retractor.

RADULA: Laterals bicuspid, although very seldom a few lateral teeth will have a small endocone bearing from 1-4 cusps. Number of laterals 8-12, average 9. Intermediate teeth with unicuspoid endocone; usually three, four, or five intermediates, an occasional specimen with 2 or 6. From fifteen to 23 marginals (as few as fourteen is rare), average number nineteen. Total number of teeth on one side 26-36 (as few as 22 and as many as 37 have been observed), average number 33. Using the average numbers, the formula would be: 19-4-9-1-0-4-19 (33-1-33). This is very close to that given by Baker (1928, p. 215) for S. palustris elodes: 21-4-9-1-9-4-21 (34-1-34).

DISTRIBUTION AND ECOLOGY: Stagnicola palustris elodes is widely distributed in western Montana (map 7). This snail is typically found in stagnant or slow moving bodies of water. It is seldom found in permanent waters such as the larger lakes and rivers. This snail is characteristic of most waters that are temporary or that have a seasonal fluctuation in depth.
STAGNICOLA PALUSTRIS WYOMINGENSIS Baker 1927

(Pl. IV, figs. 18-21)


**ORIGINAL DESCRIPTION:** "Shell differing from typical *palustris* in being more scalariform, having a more obese body whorl, a longer and more acute spire, which is pyramidal, and with more tightly coiled whorls, the spire being longer than the aperture, which is rounder, not elongate-ovate. There is usually a distinct umbilical chink, which is absent or but feebly developed in typical *palustris*.

L. 19.5; W. 9.0; Ap.L. 9.0; W. 4.5 mm. Type U. of Ill., Z21682
L. 19.5; W. 9.0; Ap.L 9.0; W. 4.2 mm. Paratype U. of Ill., Z21683
L. 19.0; W. 9.5; Ap.L. 8.8; W. 4.5 mm. Paratype U. of Ill., Z21683.
L. 18.5; W. 7.3; Ap.L. 7.3; W. 3.8 mm. Paratype U. of Ill., Z21683


The new variety will probably be found widely distributed in the mountain regions of Wyoming, Utah, Montana, and Colorado."

(Baker, *Naut.*, 40(3): 84, 85, 1927)

**MEASUREMENTS OF SHELLS:** in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5</td>
<td>11.5</td>
<td>11.9</td>
<td>8.4</td>
</tr>
<tr>
<td>24.9</td>
<td>10.9</td>
<td>10.9</td>
<td>7.7</td>
</tr>
<tr>
<td>22.0</td>
<td>9.7</td>
<td>10.5</td>
<td>7.3</td>
</tr>
<tr>
<td>21.2</td>
<td>8.7</td>
<td>9.3</td>
<td>6.4</td>
</tr>
<tr>
<td>20.5</td>
<td>8.6</td>
<td>9.5</td>
<td>6.1</td>
</tr>
<tr>
<td>16.9</td>
<td>7.3</td>
<td>7.4</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
DISTRIBUTION AND ECOLOGY: In western Montana, this form has been collected only at Byrne Resort, approximately 30 miles east of Missoula (map 7). This area is very old geologically (Alden, 1952) and the ponds here are kept warm by spring water from the Bearmouth Fault. The ponds all have thick deposits of marl; something which is not common in western Montana.

This subspecies can readily be separated from other forms of S. palustris in western Montana by its scalariform shape and more evenly rounded whorls.

GROUP OF EMARGINATA

This uniquely American group of Stagnicola species is characterized by generally having a heavier shell than does S. palustris and by inhabiting clear, usually well-oxygenated waters such as lakes or rivers. Members of this group are never found in temporary or stagnant bodies of water. The shell has a well-marked surface sculpture, often giving the shell a beaded appearance. The shell is generally shorter than S. palustris and the aperture is usually more rounded.

Hubendick (1951) suggested that all the forms belonging to this group be included in the one species, Lymnaea emarginata (Say). Stagnicola apicina and S. idahoensis (Appendix B) are included by Hubendick in this species.

In this paper, the forms belonging to this complex are
treated under the separate specific designations. They probably more correctly should be given subspecific rank in the species *S. emarginata* (Say), but to avoid any more confusion at this time, the names are used as they have appeared in the literature. Further studies on other forms in this group from throughout North America may indicate that Hubendick was correct in lumping these forms under the one specific name.

On the basis of the morphology of the genitalia and radula, I have seen no essential differences between the various members of this group which I have studied. The shells of the forms belonging to this species-group overlap in the range of variation. The only real isolating factors are environmental and geographical. The distributions of these forms are shown on map 8.

Walter (personal communication) thinks that there is more involved here than simple ecological variation. He says, instead, that there is probably microgeographical genetic variation of an exceedingly complex nature with some superimposed genetic variation. I believe that these are probably in the process of developing into distinct species. Breeding experiments with these forms, which in nature are isolated, may eventually serve to clarify some of the relationships.

It is likely that in western Montana these are all
relict types; each is either restricted in its distribution, or is endemic to a particular lake or river drainage.

STAGNICOLA BINNEYI (Tryon) 1865
(Pl. IV, figs. 24-26)


SHELL: Medium in size, spire short, body whorl globose; spire whorls flatly rounded, sutures not deeply impressed. Length of aperture generally greater than length of spire. Columellar wall completely closing umbilicus or leaving a small chink. Columella plaited. Outer lip may be somewhat expanded, but never flares. Surface sculpture prominent, usually giving shell a beaded appearance. Shell covered with a brown periostracum.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Length</th>
<th>Aperture Width</th>
<th>Clearwater River</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.3</td>
<td>13.8</td>
<td>13.7</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>19.9</td>
<td>12.3</td>
<td>11.8</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>19.7</td>
<td>12.4</td>
<td>11.7</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>19.3</td>
<td>12.0</td>
<td>11.7</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>18.8</td>
<td>11.6</td>
<td>11.2</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>18.8</td>
<td>10.7</td>
<td>10.2</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>18.4</td>
<td>11.3</td>
<td>11.3</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>18.3</td>
<td>11.4</td>
<td>11.0</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>18.2</td>
<td>11.0</td>
<td>11.0</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>Shell Height</td>
<td>Shell Width</td>
<td>Aperture Length</td>
<td>Aperture Width</td>
<td>Origin</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>----------------</td>
<td>---------------</td>
<td>--------</td>
</tr>
<tr>
<td>17.8</td>
<td>11.2</td>
<td>11.4</td>
<td>7.9</td>
<td>Clearwater River</td>
</tr>
<tr>
<td>17.5</td>
<td>10.8</td>
<td>10.4</td>
<td>6.6</td>
<td>&quot;</td>
</tr>
<tr>
<td>17.2</td>
<td>11.0</td>
<td>10.9</td>
<td>7.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>17.2</td>
<td>10.5</td>
<td>10.5</td>
<td>7.3</td>
<td>&quot;</td>
</tr>
<tr>
<td>17.0</td>
<td>11.0</td>
<td>10.8</td>
<td>7.0</td>
<td>&quot;</td>
</tr>
<tr>
<td>16.6</td>
<td>8.7</td>
<td>9.7</td>
<td>6.1</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.8</td>
<td>9.3</td>
<td>9.7</td>
<td>6.9</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.7</td>
<td>10.0</td>
<td>9.6</td>
<td>6.7</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.7</td>
<td>9.7</td>
<td>10.2</td>
<td>6.6</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.4</td>
<td>11.1</td>
<td>11.2</td>
<td>7.0</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.4</td>
<td>10.6</td>
<td>10.5</td>
<td>7.4</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

ORIGINAL DESCRIPTION: "Shell globosely inflated, spire moderate, convex; apex acute; sutures impressed; aperture suboval, outer lip very convex, inner lip broad, folded, sharp-edged, not appressed to the body, and exposing a moderate umbilicus; surface shining, densely crowded with fine striae of growth.


GENITALIA: Penis sheath shorter than preputium, with small knot on distal end of penis sheath. Preputium retractor two; posterior preputium protractors two, smaller than retractors. Posterior protractors generally divide just before they insert on preputium. Penis sheath retractor long, narrow, inserted either on most distal preputium retractor or at insertion of that muscle on columnellar muscle.

RADULA: Laterals bicuspid, occasionally ectocone of last few laterals has two cusps. A few of last lateral teeth may have a small endocone (this has never been seen to
be characteristic of all of the last laterals of any one membrane. Number of lateral teeth 9-14, average eleven. From two to five intermediates, occasionally just one. Average number of intermediates, three. Rarely a few intermediates may have a bicuspid ectocone. Between 14 and 21 marginals; average 17. Formula (using average figures), 17-3-11-1-11-3-17 (31-1-31). In one membrane examined, last lateral to right of central tooth was serrated on medial side, but this cannot be said to be characteristic.

DISTRIBUTION: The only forms from western Montana which can be assigned to this species with any certainty are those from the Clearwater and Blackfoot Rivers. Certain shells of *S. elrodi* from Flathead Lake resemble this species, but the flaring outer lip which is often seen in *S. elrodi* is not characteristic of *S. binneyi*. Also, considering the total range of variation of *S. elrodi*, there should be no problem in separating the two forms.

In discussing the status of *Stagnicola binneyi*, Baker (1927) has stated:

"A restudy of *binneyi, apicina, and solida* leads the writer to change completely the opinion given in the Monograph of the Lymmaelidae concerning these species. *Binneyi* is a river species, its type locality being the Hell Gate River, Montana, which is a tributary of the Columbia, the Pacific coast drainage. All authors have confused several species with the true *binneyi*, which should be restricted to river forms conforming to the diagnosis and figure of Tryon in the *Jour. Conch.*, p. 229, pl. 23, fig. 3. This is different from the lake shells under consideration, which all
have a short spire and a differently shaped aperture."

The type locality of *S. binneyi* was given by Tryon as the "Hell Gate River, Oregon." Baker (1911) and others have considered that the Hell Gate River in which the specimens were originally collected was in western Montana. Henderson (1936) stated that he was unable to find any limmaeids in the Hell Gate River, Montana. The specimens of *S. binneyi* which have been collected in Montana were from the Clearwater and Blackfoot Rivers, approximately 30 miles east of the junction of the Blackfoot River with the Clark Fork. The Clark Fork River was formerly known as the Hell Gate River.

**STAGNICOLA ELRODIANA** Baker, 1935

(Pl. IV, figs. 22, 23; Pl. V, fig. 20)


**SHELL:** Medium to large in size; spire elongate, whorls well-rounded, sutures impressed. Aperture round or slightly elongate, body whorl ovate, length of aperture generally less than either length of spire or width of shell. Inner
lip usually straight or only slightly curved, reflected and forming a broad, flat expansion over the umbilical area. Umbilical chink large. Axis generally somewhat gyrate (twisted), but columellar wall seldom with a plait. Whorls have appearance of being coiled somewhat obliquely. Surface sculpture coarse, giving shell a rough, beaded appearance.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
<th>McDonald Lake</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.6</td>
<td>14.4</td>
<td>15.7</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>28.0</td>
<td>14.3</td>
<td>15.1</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>26 (broken)</td>
<td>15.2</td>
<td>13.5</td>
<td>10.9</td>
<td></td>
</tr>
<tr>
<td>25.3</td>
<td>12.2</td>
<td>13.0</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>25.1</td>
<td>12.0</td>
<td>12.2</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td>24.2</td>
<td>12.0</td>
<td>12.5</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>23.2</td>
<td>12.3</td>
<td>12.2</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>22.5</td>
<td>12.3</td>
<td>12.2</td>
<td>8.5</td>
<td></td>
</tr>
</tbody>
</table>

ORIGINAL DESCRIPTION: "Shell large, globose, thin and fragile; of a light horn color, in many cases tending to light pearl gray, in many instances there is an abrupt line between the lighter portion and the horn colored portion, the lighter portion being next to the aperture; the last whorl constituting about three-fourths the length of the shell; malleations obscure or absent, distinguishable in occasional specimens; lines of growth fine, and quite regular; spire short, consisting of three obliquely twisted whorls and the nucleus; suture well impressed; aperture about two-thirds as long as wide; outer lip thin, acute, inner lip reflexed near its junction with the columella.


The species is found sparingly in Sin-yale-a-min lake in the Mission range of western Montana, and abundantly in McDonald lake, some 15 miles north of the former. A few were taken in Swan lake, on the opposite side of the range."

(Elrod, Naut., 15: 111, 1902)
GENITALIA (specimens from McDonald Lake): Preputium large, cylindrical, diameter 1/5 of length. Penis sheath large, length greater than 3 length of preputium. Diameter of penis sheath 3 diameter of preputium. Preputium retractor broad, strap-like, twice width of penis sheath retractor. Penis sheath retractor inserted on preputium retractor near insertion of the latter on columellar muscle. With three posterior preputium protractors and four anterior protractors. Distal protractors are longest. Penis sheath expanded distally. Penis with prominent penial knot. Prostate with a single fold.

Mantle edge wide, fleshy. Vas deferens easily seen through body wall just posteriad to right tentacle.

RADULA: Laterals bicuspid, number of laterals 10-17, average eleven. Average number of intermediate teeth five, with three, four, or five being most common. (In many membranes, it is difficult to distinguish the intermediates; there is a gradual transition from laterals to marginals, and each horizontal row in one membrane may not be the same.) Endocone of first marginals with one to four cusps; as many as five cusps on some marginals. Ectocone becomes larger in first four or five marginals, and usually disappears by tenth marginal. Mesocone generally not diminishing in size in outer marginals (although the number of cusps on the endocone becomes less). Average number of marginals 23, with as many as 26 and as few as 15. Usual number from 18 to 24.

DISTRIBUTION: In western Montana, this species has been found in several lakes high in the Mission Range, particularly at the southern end. Specimens which tentatively can be assigned to this species have also been collected in several other western Montana lakes. In addition, Beetle (1961) has reported this species from Wyoming. Until anatomical studies can be completed on specimens from all of these areas, the total distributional range of Stagnicola elrodiana will remain uncertain. Anatomically, S. elrodiana is somewhat distinct from all the other species in the group of S. emarginata in western Montana.

STAGNICOLA EIRODI Baker and Henderson, 1933
(Pl. V, figs. 1-14)


SHELL: Medium to large, apex acute, elongate, spire whorls well rounded. Sutures vary, may be deeply impressed or shallow. In most specimens, sutures are indistinct. Outer lip rounded or flattened, often narrowed. Many specimens have outer lip expanded. Shells in which aperture is narrowed may have anterior portion of aperture twisted, producing an S-shaped curve in columellar wall (as in Pl. V,
fig. 2). Columellar wall plicate, umbilical chink small.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5</td>
<td>14.2</td>
<td>14.2</td>
<td>10.3</td>
</tr>
<tr>
<td>21.3</td>
<td>11.8</td>
<td>13.6</td>
<td>9.9</td>
</tr>
<tr>
<td>20.9</td>
<td>12.9</td>
<td>13.6</td>
<td>9.3</td>
</tr>
<tr>
<td>20.7</td>
<td>12.1</td>
<td>12.5</td>
<td>9.2</td>
</tr>
<tr>
<td>20.0</td>
<td>12.0</td>
<td>11.5</td>
<td>8.8</td>
</tr>
<tr>
<td>19.9</td>
<td>12.0</td>
<td>11.8</td>
<td>8.2</td>
</tr>
<tr>
<td>19.8</td>
<td>13.2</td>
<td>12.6</td>
<td>10.0</td>
</tr>
<tr>
<td>19.6</td>
<td>12.7</td>
<td>12.7</td>
<td>9.5</td>
</tr>
<tr>
<td>18.9</td>
<td>10.9</td>
<td>11.0</td>
<td>7.4</td>
</tr>
<tr>
<td>18.8</td>
<td>11.4</td>
<td>10.9</td>
<td>7.7</td>
</tr>
<tr>
<td>17.9</td>
<td>10.5</td>
<td>10.6</td>
<td>7.7</td>
</tr>
<tr>
<td>17.6</td>
<td>10.6</td>
<td>10.7</td>
<td>7.4</td>
</tr>
<tr>
<td>16.7</td>
<td>10.2</td>
<td>9.7</td>
<td>6.9</td>
</tr>
<tr>
<td>16.0</td>
<td>9.4</td>
<td>8.8</td>
<td>6.6</td>
</tr>
<tr>
<td>29.2</td>
<td>17.0</td>
<td>18.1</td>
<td>12.0</td>
</tr>
<tr>
<td>27.0</td>
<td>15.0</td>
<td>15.1</td>
<td>9.2</td>
</tr>
<tr>
<td>26.7</td>
<td>13.9</td>
<td>15.0</td>
<td>9.9</td>
</tr>
<tr>
<td>26.7</td>
<td>13.6</td>
<td>14.6</td>
<td>8.7</td>
</tr>
<tr>
<td>26.5</td>
<td>14.6</td>
<td>15.3</td>
<td>9.9</td>
</tr>
<tr>
<td>26.0</td>
<td>14.0</td>
<td>14.6</td>
<td>10.1</td>
</tr>
<tr>
<td>25.9</td>
<td>14.8</td>
<td>13.8</td>
<td>10.3</td>
</tr>
<tr>
<td>25.7</td>
<td>14.8</td>
<td>14.2</td>
<td>10.1</td>
</tr>
<tr>
<td>25.3</td>
<td>13.4</td>
<td>14.4</td>
<td>9.0</td>
</tr>
<tr>
<td>24.9</td>
<td>13.9</td>
<td>13.0</td>
<td>8.5</td>
</tr>
<tr>
<td>24.3</td>
<td>13.9</td>
<td>13.6</td>
<td>9.5</td>
</tr>
<tr>
<td>22.0</td>
<td>14.8</td>
<td>13.4</td>
<td>8.7</td>
</tr>
<tr>
<td>20.7</td>
<td>12.4</td>
<td>11.5</td>
<td>8.6</td>
</tr>
<tr>
<td>20.2</td>
<td>11.4</td>
<td>11.4</td>
<td>7.9</td>
</tr>
<tr>
<td>15.8</td>
<td>9.6</td>
<td>9.4</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Yellow Bay, Flathead Lake
Elmo Bay, Flathead Lake

Coll. M.J. Elrod, 1897 (probably east shore near Big Fork, Elmo Bay, Flathead Lake.

ORIGINAL DESCRIPTION: "Shell large, fusiform, rather thin, light to dark horn color; surface shining with well marked growth lines crossed by incised spiral lines; whorls 6½, well rounded with deep sutures; nuclear whorl dark wine colored; body whorl large, convex; spire very acute, forming a well marked pyramid; aperture ovate in adult, elongate ovate in immature shells; outer lip thin, without variegal thickening; inner lip wide, flattened, emarginate, reflected over the umbilical region leaving only a very small umbilical chink; columellar axis with
strong plait; color of aperture light brownish or pinkish.

Length 24.5 mm., diam. 13.6 mm., aperture length 15 mm., diam. 7.8 mm. Holotype. Adult. Two immature paratypes measure 18X5.6 mm., 10X5.1 mm., and 18X 9.8 mm., 11.5 x 5.6 mm.

Type locality: West shore Flathead Lake, 13½ miles north of Polson, Montana. Types: Museum Natural History, University of Illinois, No. Z33780; University of Colorado Museum, No. 19134."

(Baker and Henderson, Naut., 47(1): 30-32, 1933.)

GENITALIA (specimens from Flathead Lake): Preputium stout, length slightly more than twice width. Penis sheath ½ as long as preputium; with a prominent bulblike swelling on its distal end. Preputium retractor a broad, strap-like muscle; penis sheath retractor similar. With one large posterior preputium protractor muscle and one or more small posterior protractors.

RADULA: Laterals tricuspid, from 10 to 15 lateral teeth. Mesocone of laterals long and acute, becoming longer towards marginals. Difficult to distinguish between lateral and intermediate teeth. Endocone becomes bicuspid at about fifteenth to twentieth tooth, and then seldom develops more than two cusps. Occasionally serrations or extra cusps present on medial side of most teeth in a longitudinal row (but this is not characteristic). Often a few teeth in a single longitudinal row with an endocone with three cusps. (In one membrane examined, all the teeth in the 21st row on the right and the 23rd row on the left had
4 cusps on the endocone, while the rest of the marginals had no more than two cusps.) Usual number of teeth on one side of horizontal 35. The greatest number was 39.

DISTRIBUTION: *Stagnicola elrodi* has been found to be widely distributed in Flathead Lake (map 5), and anatomical and shell characters would seem to separate it as a distinct race. The robust shape, heavy shell, and coarse beaded sculpture would place it in the "emarginata" group of *Stagnicola*. A very interesting relationship between environment and shell shape can be seen in the various populations of this species in Flathead Lake. The shells from the protected bays, primarily on the west shore, are high-spired with a narrow or small aperture (as in Pl. IV, figs. 1-6). However, shells found in exposed areas on the east shore have a larger aperture and a shorter, broader spire than those from the more sheltered areas (Pl. IV, figs. 7-12). The shells from exposed areas are generally smaller than shells from areas which are less exposed. Specimens from Seeley Lake (Pl. IV, figs. 13, 14), probably collected at the southwest end, are very similar to those from the west side of Flathead Lake.

**STAGNICOLA EMARGINATA n. ssp.**

*(Pl. V, figs. 15-19)*

**SHELL**: Large, whorls rounded or slightly angulated. Spire broad, sutures well-marked; aperture round or ovate,
often narrowed anteriad. With a distinct umbilical chink, inner lip forming a flat shelf-like projection over columella. Inner lip forming a distinct angle at junction of columnellar wall and parietal wall. Inner lip without plait. Body whorl globose, length of aperture generally less than width of shell.

**MEASUREMENTS OF SHELLS: in mm.**

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.4</td>
<td>18.3</td>
<td>17.1</td>
<td>12.8</td>
</tr>
<tr>
<td>28.4</td>
<td>17.8</td>
<td>17.9</td>
<td>12.7</td>
</tr>
<tr>
<td>28.0</td>
<td>20.6</td>
<td>17.4</td>
<td>12.9</td>
</tr>
<tr>
<td>26.7</td>
<td>16.4</td>
<td>15.9</td>
<td>9.1</td>
</tr>
<tr>
<td>26.0</td>
<td>17.6</td>
<td>15.7</td>
<td>11.1</td>
</tr>
<tr>
<td>25.5</td>
<td>16.5</td>
<td>15.0</td>
<td>10.9</td>
</tr>
<tr>
<td>25.3</td>
<td>17.3</td>
<td>15.3</td>
<td>10.7</td>
</tr>
<tr>
<td>25.3</td>
<td>17.1</td>
<td>15.5</td>
<td>11.3</td>
</tr>
<tr>
<td>25.5</td>
<td>15.8</td>
<td>15.5</td>
<td>9.9</td>
</tr>
<tr>
<td>25.3</td>
<td>15.4</td>
<td>15.2</td>
<td>12.0</td>
</tr>
<tr>
<td>25.2</td>
<td>17.5</td>
<td>15.2</td>
<td>10.9</td>
</tr>
<tr>
<td>25.1</td>
<td>15.3</td>
<td>15.5</td>
<td>10.6</td>
</tr>
<tr>
<td>24.8</td>
<td>16.0</td>
<td>15.4</td>
<td>9.4</td>
</tr>
<tr>
<td>24.7</td>
<td>18.1</td>
<td>14.6</td>
<td>11.0</td>
</tr>
<tr>
<td>24.6</td>
<td>15.2</td>
<td>14.7</td>
<td>10.6</td>
</tr>
<tr>
<td>24.2</td>
<td>15.8</td>
<td>15.0</td>
<td>11.9</td>
</tr>
<tr>
<td>24.0</td>
<td>14.7</td>
<td>14.0</td>
<td>9.7</td>
</tr>
<tr>
<td>24.0</td>
<td>14.4</td>
<td>14.0</td>
<td>9.4</td>
</tr>
<tr>
<td>23.9</td>
<td>15.2</td>
<td>13.5</td>
<td>10.9</td>
</tr>
<tr>
<td>23.7</td>
<td>14.3</td>
<td>14.1</td>
<td>9.1</td>
</tr>
<tr>
<td>23.6</td>
<td>15.5</td>
<td>13.9</td>
<td>9.4</td>
</tr>
<tr>
<td>23.5</td>
<td>15.5</td>
<td>14.1</td>
<td>10.5</td>
</tr>
<tr>
<td>23.4</td>
<td>13.8</td>
<td>14.2</td>
<td>10.1</td>
</tr>
<tr>
<td>23.3</td>
<td>16.1</td>
<td>15.2</td>
<td>10.5</td>
</tr>
<tr>
<td>23.3</td>
<td>15.7</td>
<td>14.6</td>
<td>11.5</td>
</tr>
<tr>
<td>23.3</td>
<td>15.0</td>
<td>14.8</td>
<td>10.8</td>
</tr>
<tr>
<td>23.2</td>
<td>15.6</td>
<td>14.8</td>
<td>10.8</td>
</tr>
<tr>
<td>23.0</td>
<td>15.3</td>
<td>14.0</td>
<td>10.7</td>
</tr>
<tr>
<td>22.6</td>
<td>15.8</td>
<td>14.4</td>
<td>10.7</td>
</tr>
<tr>
<td>22.6</td>
<td>15.0</td>
<td>14.1</td>
<td>10.3</td>
</tr>
<tr>
<td>22.4</td>
<td>13.9</td>
<td>13.4</td>
<td>9.4</td>
</tr>
<tr>
<td>22.0</td>
<td>15.4</td>
<td>13.4</td>
<td>10.1</td>
</tr>
<tr>
<td>21.5</td>
<td>14.9</td>
<td>12.9</td>
<td>9.7</td>
</tr>
<tr>
<td>21.5</td>
<td>14.8</td>
<td>12.8</td>
<td>9.3</td>
</tr>
<tr>
<td>21.2</td>
<td>15.3</td>
<td>12.8</td>
<td>10.0</td>
</tr>
<tr>
<td>Shell Height</td>
<td>Shell Width</td>
<td>Aperture Height</td>
<td>Aperture Width</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>20.5</td>
<td>15.2</td>
<td>12.8</td>
<td>9.3</td>
</tr>
<tr>
<td>20.5</td>
<td>13.7</td>
<td>11.8</td>
<td>9.1</td>
</tr>
<tr>
<td>20.0</td>
<td>18.2</td>
<td>18.1</td>
<td>7.7</td>
</tr>
<tr>
<td>19.4</td>
<td>13.8</td>
<td>11.4</td>
<td>8.5</td>
</tr>
<tr>
<td>18.8</td>
<td>12.4</td>
<td>11.7</td>
<td>7.6</td>
</tr>
<tr>
<td>18.3</td>
<td>11.9</td>
<td>11.9</td>
<td>7.4</td>
</tr>
<tr>
<td>18.3</td>
<td>11.8</td>
<td>11.6</td>
<td>7.1</td>
</tr>
<tr>
<td>16.9</td>
<td>11.0</td>
<td>11.4</td>
<td>6.6</td>
</tr>
<tr>
<td>16.3</td>
<td>11.1</td>
<td>10.0</td>
<td>6.7</td>
</tr>
<tr>
<td>16.3</td>
<td>10.9</td>
<td>10.8</td>
<td>7.2</td>
</tr>
<tr>
<td>14.8</td>
<td>10.3</td>
<td>9.8</td>
<td>6.1</td>
</tr>
<tr>
<td>14.1</td>
<td>8.6</td>
<td>8.8</td>
<td>5.4</td>
</tr>
</tbody>
</table>

**GENITALIA:** Preputium cylindrical, stout, length approximately three times diameter. Length of penis sheath slightly less than length of preputium. Penis sheath somewhat bulbous on distal end. Preputium retractor consists of a single large muscle. Proximal portion of vas deferens nearly three times length of preputium and penis sheath. Preputium protractors rather obscure; one anteriad and one or two posteriadr.

**RADULA:** Laterals bicuspid; twelve or thirteen laterals, occasionally eleven. In one specimen, the first lateral had a small endocone. Mesocone long, obtusely pointed in last laterals. Usually two to four intermediates, rarely as many as seven. Intermediates with endocone nearly as long as mesocone. Number of marginals varies from 21 to 24, with usual being 21. Endocone of marginals generally with two to four cusps. Ectocone remains until near end of row of marginals. (In one membrane with 24 marginals, the twenty-third marginal tooth had a total of eleven cusps. This
same specimen had fourteen laterals on the left side of the central tooth, but apparently had sustained some injury because the extra teeth were malformed.) Formula (using average figures): 21-3-12-1-12-3-21 (36-1-36). For **Stagnicola emarginata**, Baker (1928, p. 237) gives formula: 23-2-10-1-10-2-23 (35-1-35).

**DISTRIBUTION AND ECOLOGY:** This snail has been found only in Holland Lake in the southern end of the Swan River drainage (map 8). It will probably be found eventually in other lakes in that area. Holland Lake has very clear, unpolluted water, and these snails have been collected near shore and slightly offshore in deeper water. They are usually most abundant in areas which have a rocky or gravelly bottom.

Genus **STAGNICOLA**, Subgenus **HINKLEYIA** Baker, 1928


**SHELL:** Small, compared to other species of **Stagnicola**. Nuclear whorl relatively large as characteristic of the genus **Stagnicola**. Spire generally longer than aperture. Columellar wall without plait or only slightly twisted. Spiral sculpture well developed.

**GENITALIA:** "Penis sheath and penis very short and thick, terminal portion of penis short and conical; vas
deferens very thick; lower prostate flattened, weakly folded, roughly D-shaped; vaginal sphincter well developed, somewhat eccentric, but not ball-like." (Taylor, et al., 1963, p. 239).

RADULA: Essentially same as other species of *Stagnicola*, with characteristic bicuspid laterals. Apparently (based on my own observations on *S. montanensis* and the figures given by Baker and others for *S. caperata*), number of laterals generally less than in *Stagnicola s. str*.

This subgenus is used here as it was redefined by Taylor, et al., in 1963. The subgenus *Hinkleyia* was erected by Baker (1928) to include the species *Stagnicola caperata* (Say). *Hinkleyia* was redefined to include *S. montanensis* (Baker) and *S. pilshryi* (Hemphill) (Taylor, et al., 1963).

**STAGNICOLA CAPERATA** (Say), 1829

(Pl. VI, figs. 1-8, 19, 20)


SHELL: Shell small, size 5 to 12 mm. (although specimens have been collected in eastern Montana which reach
15 mm. in length); turreted, elongate to globose; aperture round or slightly ovate. Inner lip thin, closely appressed to body whorl. Columellarl wall forming a flat extension over the umbilicus leaving a prominent umbilical chink. Whorls globose, 4½ to 5 whorls; sutures indistinct, occasionally deeply impressed. Length of aperture equal to or slightly greater than length of spire. Penultimate whorl nearly as broad as body whorl. Nuclear whorl small, rounded. Surface sculpture of fine incised spiral lines and many crowded, fine growth lines. Surface sculpture very distinct, giving appearance of many rows of small crescents; convex side of these crescents points towards aperture. Many specimens have raised spiral ridges of periostracum running in these incised spiral lines. Immature shells are globose in shape (Pl. VI, fig. 2), very similar to the young of Stagnicola bulimoides (Pl. VII, fig. 21).

The works of Baker and Henderson include several subspecies of S. caperata. Taylor, et al., (1963) have included these subspecies under the one specific name, and this usage is followed here.

MEASUREMENTS OF SHELLS:

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.9</td>
<td>6.1</td>
<td>6.0</td>
<td>3.9</td>
</tr>
<tr>
<td>10.9</td>
<td>5.9</td>
<td>5.8</td>
<td>3.4</td>
</tr>
<tr>
<td>10.9</td>
<td>6.2</td>
<td>5.4</td>
<td>3.7</td>
</tr>
<tr>
<td>10.5</td>
<td>6.2</td>
<td>6.0</td>
<td>3.7</td>
</tr>
<tr>
<td>9.9</td>
<td>5.7</td>
<td>5.6</td>
<td>3.6</td>
</tr>
<tr>
<td>9.4</td>
<td>5.8</td>
<td>5.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Union Creek ponds
ORIGINAL DESCRIPTION: "Shell suboval, a little oblong, obscurely yellowish horn color: spire half the length of the mouth: apex acute: whirls slightly wrinkled across, and with very numerous, subequidistant, elevated, minute, revolving lines: suture not very deeply impressed: aperture rather dilated; fold of the libium not profound.

Inhabits Indiana.

The remarkable character of this species consists in the numerous revolving lines with which the surface is marked; but these are so minute as to require the aid of a magnifier to bring them to view. It was found on land subject to inundation, near New Harmony, by Dr. Troost."

(Say, New Harmony Disseminator, p. 230, 1829.)

GENITALIA: Preputium large, cylindrical, at least half again as long as penis sheath. With one preputium retractor which divides several times before attaching to preputium, and often narrows slightly before inserting on columellar muscle. Penis sheath retractor shorter than preputium retractor, enlarged somewhat at its insertion. Penis sheath retractor inserted on columellar muscle just posterior to preputium retractor. With one or two narrow posterior preputium protractors and generally two anterior protractors.

RADULA: Laterals tricuspid, mesocone of laterals wide,
long and acute. Five, six, or seven lateral teeth, usual number is six. Numbers are approximately same as given for S. montanensis (p. 52). In those membranes which I have studied, I was able to see no essential difference between S. caperata and S. montanensis.

**DISTRIBUTION:** This species is widely distributed in Montana (map 9). However, it has not been collected in the Bitter Root Range; it apparently is replaced by S. montanensis, even though the latter is generally found at higher elevations than is S. caperata. "Stagnicola caperata is found most often in seasonal bodies of water. It is characteristic in such habitats as irrigation ditches, sloughs, and shallow ponds." (Taylor, et al., 1963, p. 267). In Montana, S. caperata is commonly found in roadside ditches, many of which are supplied with water only from ground seepage or from precipitation.

**STAGNICOLA MONTANENSIS** (Baker), 1913

*(Pl. VI, figs. 9-12)*


**SHELL:** Elongate, turreted, narrowly conical; whorls increasing in size quite regularly. Surface shiny or glossy, sculpture usually obvious at low magnification. Color dark
reddish-brown or brownish-black. Apex is blunt compared to *Fossaria*; young shells have much the same appearance as young of *S. caperata* (Pl. VI, fig. 2). Aperture ovate; parietal thickening indistinct; columellar wall erect, slightly curved, forming a flat extension over the umbilicus. Umbilical chink small.

**MEASUREMENTS OF SHELLS:** in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.8</td>
<td>5.8</td>
<td>5.4</td>
<td>3.6</td>
</tr>
<tr>
<td>12.5</td>
<td>5.8</td>
<td>5.8</td>
<td>3.7</td>
</tr>
<tr>
<td>12.2</td>
<td>6.2</td>
<td>5.1</td>
<td>3.5</td>
</tr>
<tr>
<td>11.6</td>
<td>5.6</td>
<td>5.2</td>
<td>3.5</td>
</tr>
<tr>
<td>11.5</td>
<td>5.5</td>
<td>5.1</td>
<td>3.5</td>
</tr>
<tr>
<td>11.4</td>
<td>5.4</td>
<td>5.4</td>
<td>3.8</td>
</tr>
<tr>
<td>10.5</td>
<td>5.3</td>
<td>5.0</td>
<td>3.0</td>
</tr>
<tr>
<td>10.4</td>
<td>5.4</td>
<td>5.4</td>
<td>3.8</td>
</tr>
<tr>
<td>9.5</td>
<td>4.9</td>
<td>4.8</td>
<td>2.9</td>
</tr>
<tr>
<td>7.9</td>
<td>3.9</td>
<td>3.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**ORIGINAL DESCRIPTION:** "Shell of medium size, rather thin, translucent, ovate-turreted; periostracum light horn color; surface shining, lines of growth distinct, crossed by very fine wavy spiral lines; whorls six, convex, the body whorl somewhat obese; sutures deeply impressed; spire acute, longer than the aperture; aperture ovate, outer lip thin; inner lip wide, somewhat triangular, reflexed over the umbilical region; there is no axial plait, but the inner lip is slightly indented where it touches the parietal wall; the umbilical chink is narrowly open. There are two rest period marks on one adult specimen.

Length 14.00; width 6.50; aperture length, 6.80; width 4.00 mill. adult
Length 9.00; width 5.00; aperture length, 5.50; width 3.00 mill. juv.
Length 14.25; width 8.00; aperture length, 7.00; width 4.00 mill. adult
Length 10.00; width 5.25; aperture length, 5.00; width 3.00 mill. juv."
Type locality. Hayes Creek, near Ward, Montana, in the Bitter Root Mountains, altitude 3825 feet."
(Baker, Naut., 27: 115, 116, 1913)

GENITALIA: Similar to S. caperata. Preputium rather stout, nearly twice length of penis sheath. Penis sheath swollen proximally. Penis sheath narrows to junction with preputium. The width of the penis sheath generally less than 2/3 of length. Taylor, et al., (1963) have stated that probably the only characteristic of the genitalia which may separate this species from S. caperata is the less developed penial knot in S. montanensis.

RADULA: Laterals bicuspid, mesocone of laterals rather long and acute. With 4 to 6 laterals, usual number 5. Two or three intermediate teeth, 2 more common. From 17 to 25 marginal teeth, 18 or 19 is usual number. Often, counts of teeth will be higher on right side than on left.

DISTRIBUTION: The type locality of S. montanensis was given as "Hayes Creek near Ward, Montana". No town of Ward now exists, but by making local inquiry, it was learned that at one time there was a post office by that name about eight miles south of Hamilton. The old brick building is still standing approximately 1/2 mile north of the Jim Ward Ranch on Hayes Creek. Stagnicola montanensis has been found in abundance in the boggy, spring-seepage areas on both sides of Hayes Creek near this ranch. This area undoubtedly represents the type locality of S. montanensis.
In Montana, *S. montanensis* appears to be limited in its distribution to the Bitterroot Mountains (map 9). Taylor, et al. (1963), give a number of localities for this species in southeastern Idaho and western Wyoming. Presumably, *S. montanensis* should be found in parts of northern Idaho as well. Further collecting will probably reveal a more widespread distribution in the Bitterroot Mountains, primarily above 4,000 feet.

Genus FOSSARIA Westerlund, 1885


Shell small; surface sculpture consists of prominent growth lines, seldom with incised spiral lines. Spiral sculpture, if present, obscure. Columellar wall smooth, inner lip forms a flat, somewhat triangular expansion over umbilicus. Umbilical chink usually present. Axis smooth, straight, not gyrate. Nuclear whorl small, apex of shell acute. Preputium longer than penis sheath. With a single preputium retractor. Radula (Pl. II, fig. 5) generally with tricuspid lateral teeth.

Hubendick (1951, p. 115) considers *Fossaria* to be a mere synonym of *Galba* Schranck 1803. However, as it is discussed by Baker (1928, pp. 283, 284), the genus *Galba* probably should be rejected on the basis that it was inaccurately described and no type specimen of the genus is
in existence.

Hubendick (1951) links the many American species of *Fossaria* to the one species *Lymnaea* (sic.) *humilus* Say. There is little question that he was incorrect in including *Stagnicola caperata* (Say) in this grouping.

There exists good morphological and environmental evidence that the *Fossaria* complex at least consists of several distinct races or species-groups. (At this point, it is difficult to assign any particular taxonomic category to these divisions within the genus *Fossaria*). In western Montana, the forms of *Fossaria* fit into three groups:

1. *E. parva* (Lea) and *E. dalli* (Baker);
2. *E. modicella* (Say) and its subspecies; and
3. *E. obrussa* (Say) and its subspecies.

The environmental situations of these three groups are definitive. In western Montana, *E. parva* and *E. dalli* are typically found in seepage areas or roadside ditches where there is a minimum of water. The water in these places is often temporary, and many of these localities are in the mountains quite far removed from any of the rivers or drainage basins.

*Fossaria modicella* is generally found on the wet, muddy shores of lakes or of the larger rivers. Along rivers, *E. modicella* is found in the sloughs, both in and out of the water. This species is also found in some of the creeks in
the Flathead valley which are dry for part of the year. Apparently, a favorable environment is one with a mud bot-
tom, slow moving water, and a certain amount of yearly fluc-
tuation in water level.

**Fossaria obrussa** is characteristically found in many
streams at lower elevations in western Montana. It has also
been found in some more or less exposed areas at the south-
ern end of Flathead Lake. This species is seldom collected
out of the water, and appears to be somewhat restricted to
areas in which the water is present throughout the year.

**FOSSARIA PARVA (Lea), 1841**

(Pl. VII, figs. 3-7)

Galba parva Baker, Lymn. Monograph, p. 243, 1911. Berry,
Lymnaea parva Henderson, Univ. Colo. Studies, 13(2): 165,
166, 1924.
Fossaria parva Baker, Wisc. Surv., Bull. No. 70, Pt. 1,
125, 126, 1936.

**SHELL:** Small, turreted; length of spire equal to or
slightly less than length of aperture. Surface shining;
surface sculpture of fine, closely set growth lines. Sur-
face occasionally with obscure spiral lines. Whorls approxi-
mately five, rounded; sutures well marked. Aperture circu-
lar or slightly ovate; columellar wall continuous with
parietal wall; columellar wall not appressed to body whorl
at umbilicus, but rolled over umbilicus leaving a narrow, deep umbilical chink.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.9</td>
<td>3.9</td>
<td>3.6</td>
<td>2.8</td>
</tr>
<tr>
<td>6.9</td>
<td>3.9</td>
<td>3.6</td>
<td>2.7</td>
</tr>
<tr>
<td>5.9</td>
<td>3.6</td>
<td>3.3</td>
<td>2.3</td>
</tr>
<tr>
<td>5.6</td>
<td>3.2</td>
<td>3.0</td>
<td>2.1</td>
</tr>
<tr>
<td>5.6</td>
<td>3.0</td>
<td>2.7</td>
<td>1.9</td>
</tr>
<tr>
<td>5.5</td>
<td>3.3</td>
<td>2.9</td>
<td>2.3</td>
</tr>
<tr>
<td>5.1</td>
<td>3.1</td>
<td>2.9</td>
<td>1.9</td>
</tr>
</tbody>
</table>

GENITALIA: Penis sheath slightly shorter than preputium; narrow, with a conspicuous bulb-like swelling on distal end. Penis sheath retractor inserted on columellar muscle near the insertion of preputium retractor; or occasionally inserted on preputium retractor near its insertion.

RADULA: Laterals bicuspid (in those specimens from two localities which were studied), mesocone of laterals long and narrow, twice length of ectocone of first few laterals. Occasionally, intermediates will have a bicuspid ectocone. Five to seven lateral teeth, usual number is six. Total number of teeth on one side averages twenty. Hubendick (1951) reports bicuspid laterals for Lymnaea (sic) parva sterkii.

DISTRIBUTION: The ecology of this species has been discussed earlier (p. 54). Fossaria parva is widely distributed in western Montana (map 12), and is the only species of Fossaria which is commonly collected at high
elevations.

FOSSARIA DALLI (F. C. Baker), 1906
(Pl. VII, figs. 8-12)

Lymnaea dalli Henderson, Univ. Colo. Studies, 13(2): 166,
1924.
Fossaria dalli Baker, Wisc. Surv., Bull. No. 70, Pt. I,
125, 1936.

SHELL: Small, turreted, spire slightly longer than
aperture. Whorls well rounded, slightly shouldered. Sides
of whorls at base slope inward to suture; number of whorls
five. Sutures deeply impressed. Spire obtusely conical,
nuclear whorl small, flatly rounded. Surface sculpture of
fine, raised growth lines. Columellar wall continuous with
parietal wall, forming a dent or constriction where it meets
parietal wall. Columellar wall erect, forming a flat ex-
tension over umbilical region. Inner lip not appressed to
body whorl except at point where it meets parietal wall.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>2.9</td>
<td>2.8</td>
<td>2.0</td>
</tr>
<tr>
<td>5.4</td>
<td>2.8</td>
<td>2.3</td>
<td>1.7</td>
</tr>
<tr>
<td>5.2</td>
<td>2.6</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>4.9</td>
<td>2.4</td>
<td>2.2</td>
<td>1.6</td>
</tr>
<tr>
<td>4.9</td>
<td>2.8</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>4.5</td>
<td>2.6</td>
<td>2.3</td>
<td>1.8</td>
</tr>
<tr>
<td>4.2</td>
<td>2.5</td>
<td>2.3</td>
<td>1.6</td>
</tr>
<tr>
<td>4.0</td>
<td>2.4</td>
<td>2.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Logging road
W. of Polson
Cow Creek,
Bitterroot
GENITALIA and RADULA: Because of a lack of preserved material, I have not had the opportunity, as yet, to examine the anatomy of this species. Presumably, it will not differ significantly from that of *E. parva*. The one radular membrane examined had seven tricuspid laterals and was essentially the same as that of *E. parva*.

In comparing this species with *Fossaria parva*, Baker (1928, p. 289) has stated:

"It differs from *parva* in its smaller size, rounder and more turreted whorls, slenderer outline, longer and narrower aperture and smaller and less conspicuous umbilicus. The whorls are inclined to be shouldered, also a feature not emphasized in *parva*. ... The inner lip of *dalli* is different from that of *parva*, being generally more erect; in *dalli* there is a denting in or constriction at the point of juncture of the inner lip and the parietal wall which is not notably apparent in *parva*.

"Young specimens of *parva* are similar to *dalli*, but may be distinguished by the less number of whorls in shells of the same size and in the different shape of the whorls. ..."

DISTRIBUTION: This species has a distribution in western Montana similar to that of *E. parva* (map 12). *Fossaria dalli*, however, is often found at lower elevations than is *E. parva*. A common habitat is under boards and on sticks at the water's edge of many of the ponds and small eutrophic lakes in western Montana.
FOSSARIA MODICELLA (Say), 1825

(Pl. VI, figs. 13, 14, 25-30; Pl. VII, figs. 1, 2)

Lymanea modicella Say, Jour. Phil. Acad., 5: 122, 1825.


SHELL: Medium to small, usually thin and fragile; whorls rounded to flatly rounded; body whorl elongate; aperture ovate, slightly narrowed at suture, nearly same length as spire. Surface shining, surface sculpture consists of distinct, rather coarse growth lines, occasionally with indistinct spiral lines (these are more pronounced on the larger shells). Sutures well impressed; nuclear whorl small, rounded, similar to other species of Fossaria. Inner lip thin, narrow, somewhat rolled over umbilical region, appressed to body whorl at point of contact with parietal wall. Umbilical chink small, narrow. As Baker has mentioned for Galba humilus modicella (1911, p. 267), this species in Montana also will have, occasionally, a faintly zebred shell. Markings usually indistinct, narrow white stripes on a pale brown or tan colored shell.
MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.6</td>
<td>8.1</td>
<td>8.4</td>
<td>5.4</td>
<td>Bitterroot</td>
</tr>
<tr>
<td>15.4</td>
<td>8.0</td>
<td>8.5</td>
<td>5.2</td>
<td>River</td>
</tr>
<tr>
<td>15.0</td>
<td>8.1</td>
<td>8.3</td>
<td>5.3</td>
<td>&quot;</td>
</tr>
<tr>
<td>13.6</td>
<td>6.6</td>
<td>7.4</td>
<td>4.6</td>
<td>&quot;</td>
</tr>
<tr>
<td>12.9</td>
<td>7.0</td>
<td>7.3</td>
<td>4.9</td>
<td>&quot;</td>
</tr>
<tr>
<td>11.1</td>
<td>5.8</td>
<td>6.2</td>
<td>4.1</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.7</td>
<td>5.1</td>
<td>5.0</td>
<td>3.4</td>
<td>&quot;</td>
</tr>
<tr>
<td>11.6</td>
<td>6.0</td>
<td>6.1</td>
<td>3.9</td>
<td>Pond W. of</td>
</tr>
<tr>
<td>11.3</td>
<td>5.0</td>
<td>6.0</td>
<td>3.4</td>
<td>St. Regis</td>
</tr>
<tr>
<td>10.7</td>
<td>4.9</td>
<td>5.5</td>
<td>3.3</td>
<td>&quot;</td>
</tr>
<tr>
<td>10.0</td>
<td>4.9</td>
<td>5.4</td>
<td>3.6</td>
<td>&quot;</td>
</tr>
<tr>
<td>10.0</td>
<td>4.8</td>
<td>5.2</td>
<td>3.3</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.9</td>
<td>4.4</td>
<td>5.2</td>
<td>3.1</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.5</td>
<td>4.5</td>
<td>5.0</td>
<td>3.2</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

ORIGINAL DESCRIPTION: "Shell blackish, not elongated: whorls rather more than four, convex: suture deeply impressed: apex acute: aperture very regular, the labium and labrum being sub-equally curved; the fold of the columella rather slight.

Total length 7/20 of an inch; breadth 1/5; length of the aperture 1/5.

Smaller than any of the species I have hitherto described. It was found by Dr. M'Euen at Owego, on the Susquehanna river near the state of New York."

(Say, Jour. Phil. Acad., 5: 122, 123, 1825)

GENITALIA: Penis long and narrow, nearly as long as preputium; expanded distally and tapering proximally. Length of proximal portion of vas deferens slightly more than length of penial complex. Anterior preputium protractors heavier than posterior protractors. Number of anterior protractors usually two. Penis sheath retractor narrow, inserted on columellar muscle or on preputium retractor.
RADULA: Lateral tricuspid, six to nine lateral teeth. Usually one intermediate, and occasionally a few of last laterals will have a bicuspid ectocone. Number of marginals vary from 13 to 18. Total number of teeth on one side usually between 23 and 25.

DISTRIBUTION: Fossaria modicella is widely distributed throughout western Montana, primarily in the low lands in the drainage basins (map 10). The ecology of F. modicella has already been discussed (p. 54). Specimens from the Kootenai drainage have been referred to the subspecies rustica Lea, but lacking anatomical material, these are included, therefore, in the one species, F. modicella.

FOSSARIA OBRUSSA OBRUSSA (Say), 1825
(Pl. VI, figs. 15-18)


SHELL: Small, color light horn, becoming lighter in older shells as periostracum wears away. Length of aperture slightly longer than length of spire. Whorls distinctly shouldered, flat-sided; sides of whorls somewhat parallel. Sutures well-impressed. Aperture elongate ovate, outer lip
often flattened. Aperture narrowed near suture; occasional-
ly specimens will have aperture narrowed anteriad. Often
with a thickening just inside outer lip, or entire shell may
be thickened. Inner lip slightly twisted at point where it
joins parietal wall. Columellar wall flat, narrow, erect,
not extending over umbilical region. Umbilical chink open.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Width</th>
<th>Aperture Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4</td>
<td>5.3</td>
<td>6.8</td>
<td>3.5</td>
</tr>
<tr>
<td>12.2</td>
<td>5.6</td>
<td>6.5</td>
<td>3.7</td>
</tr>
<tr>
<td>11.9</td>
<td>5.2</td>
<td>6.4</td>
<td>3.4</td>
</tr>
<tr>
<td>11.2</td>
<td>5.2</td>
<td>6.0</td>
<td>3.5</td>
</tr>
<tr>
<td>10.7</td>
<td>4.4</td>
<td>5.1</td>
<td>3.0</td>
</tr>
<tr>
<td>10.0</td>
<td>4.8</td>
<td>5.5</td>
<td>3.2</td>
</tr>
<tr>
<td>9.8</td>
<td>4.5</td>
<td>5.6</td>
<td>2.9</td>
</tr>
<tr>
<td>9.6</td>
<td>5.5</td>
<td>5.1</td>
<td>3.8</td>
</tr>
<tr>
<td>8.7</td>
<td>4.1</td>
<td>4.8</td>
<td>2.7</td>
</tr>
<tr>
<td>10.2</td>
<td>4.9</td>
<td>5.9</td>
<td>3.2</td>
</tr>
<tr>
<td>10.0</td>
<td>4.8</td>
<td>5.9</td>
<td>3.0</td>
</tr>
<tr>
<td>9.8</td>
<td>5.0</td>
<td>5.9</td>
<td>3.4</td>
</tr>
<tr>
<td>9.7</td>
<td>4.9</td>
<td>5.2</td>
<td>3.0</td>
</tr>
<tr>
<td>9.5</td>
<td>4.6</td>
<td>5.1</td>
<td>3.0</td>
</tr>
<tr>
<td>9.4</td>
<td>4.7</td>
<td>5.2</td>
<td>3.0</td>
</tr>
<tr>
<td>9.0</td>
<td>3.0</td>
<td>4.4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

ORIGINAL DESCRIPTION: "Shell oblong, rather
slender, pale yellowish testaceous: whorls five,
slightly rounded: apex acute: suture deeply
impressed: aperture not dilated, within pure
white: columella with the sinus of the fold
very obvious.

LISTER, pl. 114, fig. 8.?

Total length 9/20 of an inch; aperture 1/4;
breadth nearly 1/5.

All the individuals that have occurred were
covered with an earthy slime. They inhabit a
small rivulet below the fish-ponds at Harrow-
gate, the seat of my friend Mr. J. Gilliams."
(Say, Jour. Phil. Acad., 5: 123, 1825)
GENITALIA: Those specimens which were examined showed no essential differences in the male genitalia which would distinguish them from *E. modicella*. There was some variation in the preputium retractors, but this variation is probably of no significance.

RADULA: Lateral teeth tricuspid, eight or nine laterals, occasionally ten. Usually three intermediates, although it is difficult to differentiate between lateral and intermediate teeth. Last laterals may have either a single cusp or two cusps on endocone. Some of the outer teeth may have a small cusp above ectocone. Total number of teeth on one side as many as 28.

DISTRIBUTION: *Fossaria obrussa*, like the other species of *Fossaria*, has a wide distribution in western Montana (map 11). This species is usually found at the edges of the mountain ranges; and is seldom found at any great elevation. See page 55 for a brief description of the ecology of *E. obrussa*.

**FOSSARIA OBRUSSA RODECKI** Baker, 1936

*(Pl. VI, figs. 21-24)*


SHELL: Small, most specimens have deeply impressed sutures, although there is some variation in this. Usually a few specimens in any population have sutures which are not
deeply impressed. Whorls either well rounded or distinctly shouldered. Inner lip triangular, extends over umbilical region leaving a conspicuous umbilical chink. Aperture circular to ovate, if ovate the narrowest part is at suture.

MEASUREMENTS OF SHELLS: in mm.

<table>
<thead>
<tr>
<th>Shell Height</th>
<th>Shell Width</th>
<th>Aperture Height</th>
<th>Aperture Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.9</td>
<td>5.5</td>
<td>5.6</td>
<td>3.8</td>
</tr>
<tr>
<td>10.5</td>
<td>6.0</td>
<td>5.2</td>
<td>3.5</td>
</tr>
<tr>
<td>10.0</td>
<td>5.5</td>
<td>5.3</td>
<td>3.4</td>
</tr>
<tr>
<td>10.0</td>
<td>4.8</td>
<td>4.6</td>
<td>3.0</td>
</tr>
<tr>
<td>9.9</td>
<td>4.7</td>
<td>4.8</td>
<td>3.1</td>
</tr>
<tr>
<td>9.6</td>
<td>5.0</td>
<td>5.0</td>
<td>3.2</td>
</tr>
<tr>
<td>9.0</td>
<td>5.0</td>
<td>4.9</td>
<td>3.3</td>
</tr>
<tr>
<td>8.9</td>
<td>4.6</td>
<td>4.5</td>
<td>3.2</td>
</tr>
<tr>
<td>8.2</td>
<td>3.8</td>
<td>4.3</td>
<td>2.5</td>
</tr>
<tr>
<td>7.8</td>
<td>3.9</td>
<td>3.4</td>
<td>2.5</td>
</tr>
<tr>
<td>6.7</td>
<td>3.6</td>
<td>3.1</td>
<td>2.0</td>
</tr>
<tr>
<td>6.7</td>
<td>3.3</td>
<td>3.2</td>
<td>2.0</td>
</tr>
<tr>
<td>6.6</td>
<td>3.7</td>
<td>3.0</td>
<td>2.2</td>
</tr>
<tr>
<td>11.4</td>
<td>4.5</td>
<td>5.9</td>
<td>2.8</td>
</tr>
</tbody>
</table>

10.6  4.7  5.5  3.2  Clearwater River
8.5   4.0  4.8  2.6  Flathead Lake
6.5   3.4  3.8  2.1  Lake
5.7   2.9  3.2  1.9  "
10.5  4.5  5.1  3.0  Bond Road,
7.7   3.7  3.9  2.2  Swan Valley

ORIGINAL DESCRIPTION: "Shell small, elongated, narrow; spire and aperture about equal in length; whorls 5-5½, loosely coiled, rounded, with distinct sutures; spire sharply pointed, somewhat scalariform in many specimens; body whorl flattened, elongated; aperture long ovate, narrow, wider at lower part; outer lip thin without varix; inner lip narrow, triangular, reflected over umbilical region leaving a small umbilical chink; columella with slight twist resembling a plait, a thin wash of callus on parietal wall; surface shining, sculpture of fine growth lines without spiral lines; color yellowish horn."
Length Diameter Aperture Aperture Height Diameter
10.0 mm. 4.1 mm. 5.0 mm. 2.0 mm. Holotype
9.0 mm. 3.6 mm. 4.1 mm. 1.6 mm. Paratype

(Baker, Naut., 49(4): 130, 1936)

GENITALIA and RADULA: Because of a lack of material, the anatomy of this form has not been studied. Probably, it will be found that there are no essential differences between typical *Fossaria obrussa* and this subspecies. While there is some overlap in features of the shell, the total range of variation of shell characters is distinctive for each of these forms.

DISTRIBUTION: *Fossaria obrussa rodecki* has been collected in clear, cold, well-oxygenated waters in the Swan and Clearwater drainages (map 11). This form may extend into Flathead Lake as well. Shells have been found on the shores at the north end of the lake which can easily be assigned to this subspecies.
SUMMARY

The family Lymnaeidae is a cosmopolitan group of fresh water snails. During the course of this investigation, over 300 collections of lymnaeid snails from western Montana were studied. Four genera and seventeen species or subspecies are reported. The greater part of the descriptions are based on features of the shell, although consideration has been given to the anatomy wherever possible. Problems of zoogeography have been discussed, particularly with those species which show a discontinuous distribution.

Distributions were mapped using collection data from the literature and collections at the University of Montana. Collection records from western Montana and references from the literature are included to document the distributions.

A brief description is given of those related species from the adjacent areas of Idaho, British Columbia, Wyoming, and eastern Montana.
APPENDIX A

DISTRIBUTIONAL DATA FOR WESTERN MONTANA LYMNAEIDAE

For the collection localities which follow, the catalog numbers are preceded by the initials of the institution which houses the collection. In the case of personal collections, the initials of the person holding the collection are given. This list contains published and unpublished collection localities, and has been made as complete as possible.

ANSP Academy of Natural Sciences of Philadelphia
CAS Chicago Academy of Science
CNHM Chicago Natural History Museum
FCB Collection of Frank Collins Baker; the collection now at the University of Illinois
MM Collection of Marie Mooar, Ypsilanti, Michigan
RBB Collection of Dr. Royal Bruce Brunson, Department of Zoology, University of Montana
RHR Collection of the author
UCM University of Colorado Museum
UIMNH University of Illinois, Museum of Natural History
UMIM University of Montana, Invertebrate Museum
UMMZ University of Michigan, Museum of Zoology
USNM United States National Museum

These data are arranged by species, following the arrangement in the text. Localities are listed under each species by county, and the counties are listed from south to north.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Lymnea stagnalis jugularis (Say)

MISSOULA COUNTY

"A small pool along the Bitterroot River, collected early in 1900." (Elrod, 1902a, p. 110).


Slough on Bitterroot River, 13 miles south of Missoula (Henderson, 1936, p. 115, for L. s. jugularis).

Lolo, no other data, R. B. Brunson (RBB 5854).

Clearwater River, 5 miles south of Seeley Lake, T. 14 N., R. 14 W., sec. 9, June 1, 1958, R. H. Russell (RHR 23).

Seeley Lake, T. 17 N., R. 15 W., sec. 34, S.W. ¼, Aug. 29, 1949, G. F. Weisel (RBB 32149).


LAKE COUNTY

Bog Road, Swan Valley, no other data, July 22, 1962, M. Mooar (MM 62G23).


West shore of Flathead Lake (Henderson, 1936, p. 115, for L. s. jugularis).


LINCOLN COUNTY

Lost Island Lake, Marion, T. 29 N., R. 26 W., sec. 31, July 28, 1960, R. H. Russell (RHR 151); (CNHM 106320).


Fish Lake, Stryker, T. 34 N., R. 24 W., sec. 29, July 26, 1949, R. B. Brunson (RBB 22449).

FLATHEAD COUNTY


Spencer Lake, Whitefish, T. 30 N., R. 22 W., sec. 5, August 3, 1960, R. H. Russell (RHR 199; CNHM 105868); August 5, 1961, R. H. Russell (RHR 548).


Ashley Creek, Marion, T. 27 N., R. 23 W., sec. 5, July 13, 1949, R. B. Brunson (RBB 24949).

Pond 1.7 miles south of Kintla Lake, T. 37 N., R. 21 W., sec. 31, August 6, 1961, R. H. Russell (RHR 289).

Pond 1.25 miles west of Kintla Lake, T. 37 N., R. 21 W., sec. 30, July 11, 1957, R. B. Brunson (RBB 3157); June 30, 1960 (RHR 126).

Lymnaea stagnalis brunsoni Russell

LAKE COUNTY


FLATHEAD COUNTY

Woods Bay, Flathead Lake, T. 26 N., R. 19 W., sec. 29,
April 30, 1966, R. H. Russell (RHR 1151).

**Radix auricularia** (Linne')

**MISSOULA COUNTY**

Clearwater River, Clearwater Junction, T. 14 N., R. 12 W., sec. 4, October 2, 1949, H. W. Newman (RBB 31849); April 4, 1964, R. H. Russell (RHR 413); April 2, 1966, R. H. Russell (RHR 1166).


**LAKE COUNTY**


**Stagnicola palustris elodes** (Say)

**DEER LODGE COUNTY**


Swamp ¼ mile south of overpass, T. 6 N., R. 9 W., sec. 20, September 22, 1956, D. Erickson (RBB 54256).

100 yards north of Galen turnoff, T. 5 N., R. 9 W., sec. 30, September 22, 1956, D. Erickson (RBB 54656).

Creek halfway between Galen and Warm Springs, T. 5 N., R. 9 W., sec. 6, September 22, 1956, D. Erickson (RBB 55356).


Pothole ¼ mile south of overpass, T. 6 N., R. 9 W., sec. 20, September 22, 1956, D. Erickson (RBB 59456).

Swamp and creek at south of overpass, T. 6 N., R. 9 W., sec. 20, September 23, 1956, D. Erickson (RBB 60456).

Dempsey Creek, T. 6 N., R. 9 W., sec. 5, September 23, 1956, D. Erickson (RBB 61256).

Swamp south of Racetrack Road, T. 6 N., R. 9 W., sec. 17, September 23, 1956, D. Erickson (RBB 62356).

Pond 7 miles south of Deer Lodge, T. 7 N., R. 9 W., sec. 33, September 23, 1956, D. Erickson (RBB 62656).

POWELL COUNTY

Carten Creek ponds, Gold Creek, T. 10 N., R. 11 W., sec. 25, March 24, 1966, R. H. Russell (RHR 1178).

GRANITE COUNTY


RAVALLI COUNTY

A pond near the Bitterroot River (Elrod, 1902, p.111).

Irrigation ditches south of Stevensville, T. 9 N., R. 20 W., sec. 34, May 18, 1958, R. H. Russell (RHR 14); July 5, 1965, R. H. Russell (RHR 954).

Ditch ½ mile north of Tin Cup Creek near Darby, July 19, 1965, R. H. Russell (RHR 1057).

Swampy field near Kootenai Creek, west of Stevensville, T. 9 N., R. 20 W., sec. 18, August 14, 1965, R. H. Russell (RHR 1000).

LEWIS AND CLARK COUNTY


MISSOULA COUNTY

Hell Gate River, el. 4800, August 14, 1860 (Cooper, 1869, p. 286).


Miller Creek sand pits, south of Missoula, T. 12 N., R. 20 W., sec. 1, May 12, 1965, R. H. Russell (RHR 827).


Runoff of Pattée Creek, south side of Missoula, T. 13 N., R. 10 W., sec. 33, August 7, 1958, R. H. Russell (RHR 28).


Frenchtown Lakes, T. 15 N., R. 21 W., sec. 29, April 18, 1959, T. E. Heck (RBB 3459); May 22, 1959, R. H. Russell (RHR 67); July 4, 1964, R. H. Russell (RHR 585); July 12, 1964, R. H. Russell (RHR 600, in part).


Blackfoot, T. 13 N., R. 17 W., sec. 3, May 31, 1958,
R. B. Brunson (RBB 258).

Twin Creek Road, Bonner, T. 14 N., R. 17 W., sec. 14, May 24, 1949, R. B. Brunson (RBB 15249).

Slough near Bonita, T. 11 N., R. 16 W., sec. 6, September 1, 1949, G. F. Weisel (RBB 33149); May 10, 1952, N. Blush (RBB 1452).


Union Creek overflow ponds, Potomac, T. 13 N., R. 16 W., sec. 10, April 5, 1965, R. H. Russell (RHR 734).

South end of Salmon Lake, T. 15 N., R. 14 W., sec. 9, August 28, 1965, R. H. Russell (RHR 1066).

Pond 4 mile east of Placid Lake, T. 16 N., R. 15 W., sec. 27, April 30, 1966, R. H. Russell (RHR 1148).

LAKE COUNTY


In creeks on Flathead Indian Reservation (Elrod, 1902, p.111).

Pond below spillway of McDonald Lake, T. 19 N., R. 19 W., sec. 10, July 1, 1954, R. B. Brunson (RBB 3554); June 25, 1959, R. H. Russell (CNHM 106321); May 14, 1964, R. H. Russell (RHR 496).


St. Mary's Lake, St. Ignatius, T. 17 N., R. 18 W., sec. 6, July 30, 1959, R. B. Brunson (RBB 4859); July 24, 1959, R. H. Russell (RHR 97).

Nine Pipes Reservoir, Ronan, T. 20 N., R. 20 W., sec. 26, July 13, 1956, A. Martin (RBB 51356); April 13, 1958, R. H. Russell (RHR 9); July 17, 1960, R. H. Russell (CNHM 105915).


Ronan, T. 20 N., R. 20 W., sec. 18, August 8, 1956, A. Martin (RBB 16356).

1 1/2 miles northeast of Ronan, T. 21 N., R. 20 W., sec. 36, July 4, 1957, R. B. Brunson (RBB 2357).


Pond on east shore of Flathead Lake, T. 23 N., R. 19 W., sec. 22, June 18, 1956, U. Osher (RBB 10556).


LINCOLN COUNTY


Drainage pond southwest of Rock Lake, T. 35 N., R. 26 W., sec. 5/8, July 17, 1956, A. Martin (RBB 48156).

Big Island Lake, near Timber and Rock Lakes, no other data, July 17, 1956, A. Martin (RBB 48556).


Alkali Lake on Garrison's Ranch, 5 miles northeast of Libby, T. 31 N., R. 30 W., sec. 30, July 16, 1956,
A. Martin (RBB 49356).


FLATHEAD COUNTY

At bridge over Swan River, east of Bigfork, T. 27 N., R. 19 W., sec. 32, June 29, 1960, R. H. Russell (CNHM 105756).

Soup Creek, South Fork Flathead River, T. 24 N., R. 17 W., sec. 27, May 29, 1965, T. Lawrence (RHR 1102).


McWinniger Slough, 5 miles east of Kalispell, T. 28 N., R. 21 W., sec. 1, July 10, 1959, R. H. Russell (RHR 88); May 11, 1959, T. E. Heck (RBB 3059); July 4, 1965, R. H. Russell (RHR 1028).

Musculium Pond, 6 miles east of Kalispell, T. 28 N., R. 20 W., sec. 6, June 26, 1960, R. H. Russell (CNHM 105867).

Upper end of Flathead Lake (Elrod, 1902, p. 111).


Creek 5 miles east of Marion, T. 27 N., R. 23 W., sec. 17, June 11, 1949, R. B. Brunson (RBB 15949).

Ashley Creek, Marion, T. 27 N., R. 23 W., sec. 5, July 13, 1949, R. B. Brunson (RBB 25049).

Ashley Lake, near outlet, Marion, T. 28 N., R. 23 W., sec. 8, August 6, 1963, M. Mooar (MM 6345).


Cow Creek, Whitefish, T. 31 N., R. 22 W., sec. 25, D. Follett (RBB 3351).

15 miles northwest of Whitefish, T. 32 N., R. 23 W.,
sec. 34, August 5, 1961, M. Mooar (MM 61263).

Pond near Talley Lake, T. 31 N., R. 23 W., sec. 15,
July 9, 1961, M. Mooar (MM 6166).

Pond near road to Talley Lake, 2 miles from highway, T.
31 N., R. 23 W., sec. 17, July 9, 1961, M. Mooar (MM 6158).

Lake on Stryker Ridge, T. 34 N., R. 24 W., sec. 35/27,
summer 1950, D. Follett (RBB 12950).

Pond 1 mile north of Polebridge, T. 35 N., R. 21 W.,
sec. 12, July 20, 1960, R. H. Russell (CNHM 105863).

Bowman Lake, T. 35 N., R. 20 W., sec. 5, July 18, 1960,
R. H. Russell (CNHM 105755).

Pond 1.7 miles south of Kintla Lake, T. 37 N., R. 21 W.,
sec. 31, August 6, 1961, R. H. Russell (RHR 291).

Pond 1.4 miles south of Kintla Lake, T. 37 N., R. 21 W.,
sec. 31, August 6, 1961, R. H. Russell (RHR 282).

Pond .7 miles south of Kintla Lake, T. 37 N., R. 21 W.,
sec. 31, August 6, 1961, R. H. Russell (RHR 268); August 22,
1957, R. B. Brunson (RBB 9157).

Pond 1.25 miles west of Kintla Lake, T. 37 N., R. 21
W., sec. 30, July 11, 1957, R. B. Brunson (RBB 3257); June
30, 1960, P. H. Baldwin (RHR 127).

SANDERS COUNTY

5 miles west of Dixon, T. 18 N., R. 22 W., sec. 17,
May 1, 1965, R. H. Russell (RHR 745).

Pond near Trout Creek, T. 24 N., R. 31 W., sec. 35,
May 13, 1956, R. B. Brunson (RBB 856).

Plains, T. 20 N., R. 26 W., sec. 22, May 13, 1956,
R. B. Brunson (RBB 456).

Pond near Noxon, T. 26 N., R. 32 W., sec. 19, May 12,
1956, R. B. Brunson (RBB 1556).

Government Creek, Noxon, T. 26 N., R. 32 W., sec. 20,
June 26, 1956, R. B. Brunson (RBB 11656).

Thompson River, T. 23 N., R. 27 W., sec. 23, June 26,
1956, R. B. Brunson (RBB 12156).

Thompson River, T. 24 N., R. 27 W., sec. 12, June 26,
1956, R. B. Brunson (RBB 12756).


_Stagnicola hinneyi_ (Tryon)

MISSOULA COUNTY


Canal adjacent to Clearwater River at Clearwater Crossing, T. 14 N., R. 12 W., sec. 4, April 4, 1964, R. H. Russell (RHR 412).

Clearwater River Bridge at Clearwater Crossing, T. 14 N., R. 12 W., sec. 4, April 4, 1964, R. H. Russell (RHR 416); August 28, 1965, R. H. Russell (RHR 1072); April 2, 1966, R. H. Russell (RHR 1167).

_Stagnicola elrodiana_ (Baker)

GRANITE COUNTY


LAKE COUNTY

Sin-yale-a-min Lake (St. Mary's Lake), St. Ignatius, T. 17 N., R. 18 W., sec. 6 (Elrod, 1902, p. 111); August 4, 1950, R. B. Brunson (RBB 10350); July 24, 1959, R. H. Russell (RHR 97).

McDonald Lake, T. 19 N., R. 19 W., sec. 11, type locality, (Elrod, 1902, p. 111); May 21, 1949, R. B. Brunson (RBB 14749); May 16, 1965, R. H. Russell (RHR 820); April 30, 1966, R. H. Russell (RHR 1131). Types, UMIM, topotypes (CAS 23709).

FLATHEAD COUNTY

Swan Lake (Elrod, 1902, p.111).

Upper Whitefish Lake, T. 34 N., R. 23 W., sec. 28, M. Mooar.
Stagnicola elrodi  Baker and Henderson

LAKE COUNTY

Flathead Lake, west shore, 13 1/2 miles north of Polson (Baker and Henderson, 1933, p. 31). Type locality. (UIMNH 233780; UCM 19134).

Flathead Lake, west shore 16 3/4 miles north of Polson (Baker and Henderson, 1933, p. 31).

Flathead Lake, no other data, collected 1897, M. J. Elrod (UMIM, uncat.).


Yellow Bay, 1 mile north of point of land, Flathead Lake, T. 22 N., R. 19 W., sec. 4, April 30, 1966, R. H. Russell (RHR 1139); March 26, 1966, R. H. Russell (RHR 1171); April 21, 1967, R. H. Russell and R. B. Brunson (RHR 1391).


West side of outlet, Flathead Lake, T. 22 N., R. 20 W., sec. 4, March 21, 1967, R. H. Russell (uncat.).


FLATHEAD COUNTY


MISSOULA COUNTY

Seeley Lake, T. 17 N., R. 15 W., sec. 34, S. W. ¼, August 29, 1949, G. F. Weisel (RBB 32149, in part).

Stagnicola emarginata n. ssp.

MISSOULA COUNTY

Holland Lake, T. 20 N., R. 16 W., sec. 35, August 9, 1949, L. G. Browman (RBB 30649); August 31, 1949, G. F. Weisel (RBB 32449); Summer, 1956, D. Browman (RBB 31456); May 30, 1964, R. H. Russell (RHR 527); August 28, 1965, R. H. Russell (RHR 1193); April 24, 1966, R. H. Russell (RHR 1193).

Stagnicola caperata (Say)

DEER LODGE COUNTY

100 yards north of Galen turnoff, T. 5 N., R. 9 W., sec. 30, September 22, 1956, D. Erickson (RBB 54556).


Creek halfway between Galen and Warm Springs, T. 5 N., R. 9 W., sec. 6, September 22, 1956, D. Erickson (RBB 55356).


Dempsey Creek, T. 6 N., R. 9 W., sec. 5, September 23, 1956, D. Erickson (RBB 61456).

POWELL COUNTY

Roadside slough along highway 1.6 miles west of Avon, T. 10 N., R. 8 W., sec. 29, April 30, 1949, R. E. Brunson (RBB 9649).

Taverner Ranch, small dry creek bed, no other data, April 17, 1966, R. H. Russell (RHR 1157).

Spring seepage into Morris Creek, Helmville Road, T. 11 N., R. 12 W., sec. 31, S. W. ¼, March 19, 1966, R. H. Russell (RHR 1146).

Carten Creek ponds, near Gold Creek, T. 10 N., R. 11 W., sec. 25, March 24, 1966, R. H. Russell (RHR 1180).

GRANITE COUNTY


MISSOULA COUNTY

Spring-fed roadside pond, Potomac Valley, T. 13 N., R. 16 W., sec. 9, June 2, 1956, R. B. Brunson (RBB 1056); May 11, 1958, R. B. Brunson (RBB 758); May 13, 1963, R. C. Lund (RBB 963); April 4, 1964, R. H. Russell (RHR 418).

24 miles east of Missoula (Henderson, 1936, p. 118, for S. caperata caperata).

East of Milltown (Henderson, 1936, p. 118, for S. caperata caperata).

Roadside slough and banks, Turah, T. 12 N., R. 18 W., sec. 1, el. 3325, April 12, 1949, R. B. Brunson (RBB 1449).


2 miles west of Frenchtown, T. 15 N., R. 21 W., sec. 29, July 12, 1964, R. H. Russell (RHR 600, in part).

Marshy area in Salmon Lake, 2 miles from south end, T. 15 N., R. 14 W., sec. 5, May 29, 1964, R. H. Russell (RHR 515).

LAKE COUNTY


Flathead Lake (Henderson, 1936, p. 118 for S. caperata caperata).

Bison Range, no locality given, August 4, 1955 (uncat.).


Yellow Bay, Flathead Lake, T. 24 N., R. 19 W., sec. 4, June 26, 1959, R. H. Russell (RHR 82); April 30, 1966, R. H. Russell (RHR 1140); March 26, 1967, R. H. Russell (RHR 1173).

SANDERS COUNTY

Swampy Creek, west side Lonepine Reservoir, T. 22 N., R. 24 W., sec. 4, March 20, 1967, R. H. Russell (RHR 1354).


FLATHEAD COUNTY


Flathead County, no other data, L. E. Swanson (USNM 463507); (Taylor, et al., 1963, p. 261).


Big Fork Bay, Flathead Lake, April 30, 1967, R. H. Russell (RHR 1160).


Dried pond, .9 mile from Kintla Lake, Glacier National Park, T. 37 N., R. 21 W., sec. 31, August 6, 1961, R. H. Russell (RHR 271).

Dried pond, 1.4 miles south of Kintla Lake, Glacier National Park, T. 37 N., R. 21 W., sec. 31, August 6, 1961, R. H. Russell (RHR 282).

LINCOLN COUNTY


Fish Lake, Stryker, T. 34 N., R. 24 W., sec. 29, July 26, 1949, R. B. Brunson (RBB 22749).
Stagnicola montanensis (Baker)

RAVALLI COUNTY

Ponds near Beavertail Creek, south of Darby, T. 1 N., R. 22 W., sec. 36, July 8, 1965, R. H. Russell (RHR 994).

Hayes Creek, 8 miles south of Hamilton, T. 4 N., R. 21 W., sec. 3, April 25, 1912, L. E. Daniels (UMMZ 76196, 27799; USNM 570589, 570929); June 26, 1915, J. Henderson (USNM 570590); June 19, 1965, R. H. Russell (RHR 848); October 3, 1965, R. H. Russell (RHR 1181).

Fossaria medicella medicella (Say)

DEER LODGE COUNTY

Creek six miles west of Avon (Henderson, 1936, p. 125).

Creek halfway between Galen and Warm Springs, T. 5 N., R. 9 W., sec. 6, September 22, 1956, D. Erickson (RBB 55456).

Pothole 1/2 mile south of overpass, T. 6 N., R. 9 W., sec. 20, September 22, 1956, D. Erickson (RBB 59556).

Taylor Creek, T. 8 N., R. 9 W., sec. 32, September 5, 1956, D. Erickson (RBB 52856).

Pond 7 miles south of Deer Lodge, T. 7 N., R. 9 W., sec. 25, September 23, 1956, D. Erickson (RBB 62756).

Warm Springs Creek, T. 5 N., R. 10 W., sec. 24, September 22, 1956, D. Erickson (RBB 57456).

Pothole 100 yards south of overpass, T. 6 N., R. 9 W., sec. 20, September 22, 1956, D. Erickson (RBB 60056).


Creek 1/4 mile north of overpass, T. 6 N., R. 9 W., sec. 17, September 22, 1956, D. Erickson (RBB 53556).

Creek 1/4 mile north of Warm Springs, T. 5 N., R. 9 W., sec. 18, September 22, 1956, D. Erickson (RBB 57156).

RAVALLI COUNTY

MISSOULA COUNTY

Hell Gate River (Ingersoll, 1874, p. 406).


Frenchtown Lakes, 18 miles west of Missoula, T. 15 N., R. 21 W., sec. 29, July 4, 1964, R. H. Russell (RHR 600, in part).


Sloughs on Bitterroot River, Lolo Grade, T. 12 N., R. 20 W., sec. 25, 26, April 9, 1949, R. B. Brunson (RBB 949).

Along Bitterroot River west of Missoula, T. 13 N., R. 21 W., sec. 1, April 18, 1959, T. E. Heck (RBB 2259).

SANDERS COUNTY


LAKE COUNTY

Kicking Horse Reservoir, T. 20 N., R. 20 W., sec. 25, September 6, 1949, R. B. Brunson (RBB 23549); July 24, 1959, M. Mooar (MM 5987); July 17, 1960, R. H. Russell (RHR 138); May 26, 1965, R. H. Russell (RHR 835).


Creek east of Allentown, T. 19 N., R. 20 W., sec. 13, W. B. Rowan (uncat.).


Swan River, T. 27 N., R. 19 W., sec. 32, W. B. Rowan (uncat.).


Cattails at end of Flathead Lake, T. 22 N., R. 19 W., sec. 5, July 12, 1961, M. Mooar (MM 6179).


Flathead Lake, west of Bull Island, T. 23 N., R. 20 W., sec. 11, July 11, 1956, M. Lowe (RBB 19556; 20156; 20856; 21956).

FLATHEAD COUNTY

McWinniger Slough, Kalispell, T. 28 N., R. 21 W., sec. 1, July 2, 1959, M. Mooar (MM 5916).


Cow Creek, beaverpond below stockyard at Whitefish, T. 31 N., R. 22 W., sec. 25, May 20, 1951, D. Follett (RBB 3151).

LINCOLN COUNTY


Fossaria ohrussa ohrussa (Say)

DEER LODGE COUNTY

Lost Creek, by highway, T. 5 N., R. 9 W., sec. 6, September 22, 1956, D. E. Erickson (RBB 58956).

Creek 3/4 mile north of Warm Springs, T. 5 N., R. 9 W., sec. 18, September 22, 1956, D. Erickson (RBB 57756).

Creek near Elliston (Henderson, 1936, p. 125).

POWELL COUNTY

Slough 6 miles west of Gold Creek (Henderson, 1936, p. 125).

RAVALLI COUNTY

Tincup Creek, T. 3 N., R. 21 W., sec. 21, June, 1960, G. Rumky (RBB 3660).

MISSOULA COUNTY

East of Milltown (Henderson, 1936, p. 125).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Cainas Creek, northeast of Milltown (Henderson, 1936, p. 125).

Lolo Creek (Henderson, 1936, p. 125).

Frenchtown (Henderson, 1936, p. 125).

O'Brien Creek, 6 miles west of Missoula, T. 13 N., R. 21 W., sec. 25, May 7, 1964, R. H. Russell (RHR 474).

LAKE COUNTY

Spring-fed pool, 6 miles east and north of Poislon, May 26, 1965, R. H. Russell (RHR 806); March 26, 1966, R. H. Russell (RHR 1135).


Warm spring off Flathead River near Moiese, T. 18 N., R. 21 W., sec. 4, November 28, 1954, Tyler (RBB 4654).


Narrows, west of Bull Islands, Flathead Lake, July 11, 1956, M. Lowe (RBB 18656; 20956).

Roadside pond near Biological Station south 40, T. 23 N., R. 19 W., sec. 23, August 1, 1949, R. B. Brunson (RBB 27949).

LINCOLN COUNTY

Marl Lake southwest of Trego, T. 34 N., R. 26 W., sec. 3, 4, July 4, 1956, A. Martin (RBB 14756).


Fossaria obrussa rodecki Baker

MISSOULA COUNTY


LAKE COUNTY

Swan Lake, J. Henderson and H. G. Rodeck. (UIMNH Z38975; FCB 3545; ANSP 166255).

**Fossaria parva** (F. C. Baker)

**DEERLODGE COUNTY**

Foster Creek Road, T. 5 N., R. 12 W., sec. 20, August 6, 1965, R. Schmidt (RHR 1051).


Taylor Creek, T. 8 N., R. 9 W., sec. 32, September 5, 1956, D. Erickson (RBB 52756).

**GRANITE COUNTY**

Kitchen Creek, T. 11 N., R. 16 W., sec. 18, April 26, 1949, R. B. Brunson (RBB 5549).

**MISSOULA COUNTY**


**LAKE COUNTY**

Near falls (above slide area) above McDonald Lake, T. 19 N., R. 19 W., sec. 11, May 16, 1964, E. Running Wolf (RBB 764); April 14, 1965, D. Weaver (RHR 705); April 18, 1965, D. Weaver (RHR 720).


**LINCOLN COUNTY**

Wolf Creek ponds, Libby, T. 29 N., R. 29 W., sec. 36, June 12, 1949, R. B. Brunson (RBB 19049).


**Fossaria dalli** (F. C. Baker)

**DEERLODGE COUNTY**

Swamp and creek, ½ mile south of overpass, T. 6 N., R. 9 W., sec. 20, September 23, 1956, D. Erickson (RBB 60756; 54156).
Creek halfway between Galen and Warm Springs, no other data, September 22, 1956, D. Erickson (RBB 55456).


Creek 3/4 mile north of Warm Springs, T. 5 N., R. 9 W., sec. 18, September 22, 1956, D. Erickson (RBB 57756).

Dempsey Creek, T. 6 N., R. 9 W., sec. 5, September 23, 1956, D. Erickson (RBB 61356).


RAVALLI COUNTY


MISSOULA COUNTY

Lolo Pass, T. 10 N., R. 24 W., sec. 11, no other data, (RBB 4052).

Pond 7-8 miles from mouth of Lolo Creek, T. 12 N., R. 21 W., sec. 35, April 3, 1948, R. B. Brunson (RBB 25848).


Seepage area, Bass Creek Road, near Florence, T. 10 N., R. 20 W., sec. 31, April 17, 1964, R. H. Russell (RHR 423).


LAKE COUNTY

Seepage area alongside logging road, 10 miles northeast of Polson, T. 23 N., R. 18 W., sec. 30, June 18, 1961, R. H. Russell (RHR 234).
FLATHEAD COUNTY

Rogers Lake, Marion, T. 27 N., R. 23 W., sec. 29, July 13, 1961, M. Mooar (MM 6189).

In ponds along Flathead Lake near Sommers, T. 27 N., R. 21 W., sec. 25, July 15, 1962, M. Mooar (MM 62G14).


LINCOLN COUNTY

Lost Island Lake, Marion, T. 29 N., R. 26 W., sec. 31, July 16, 1959, M. Mooar (MM 5971); July 28, 1960, R. B. Brunson (RBB 1460).

APPENDIX B

SPECIES STUDIED FROM AREAS ADJACENT TO WESTERN MONTANA

Collecting trips were made into eastern Montana, Wyoming, Idaho, and British Columbia for the purpose of collecting lymnaeid snails. Most of these species were anatomically studied and will be illustrated in separate publications. Only those species are listed here which do not occur in western Montana. The family Lancidae is considered separately in appendix C.

Family Lymnaeidae

Genus Stagnicola

S. apicina
S. idahoensis
S. bulimoides cockerelli

Stagnicola apicina (Lea) (Pl. VII, figs. 17, 18).

Lymnaea apicina Lea, Trans. Amer. Phil. Soc., VI, p. 102, Pl. 23, fig. 94, 1839.


Baker (1911) reports this species also from Yellowstone Lake. Henderson (1933) lists collections made on the Yellowstone River. Baker records the subspecies solida from the Salmon River, Idaho. I have not been able to examine solida, so no opinion on this form can be given here.

Stagnicola idahoensis (Henderson) (Pl. VII, figs. 13-16).
Lymnaea idahoensis Henderson, Naut., 44: 75-77, Pl. 6, fig. 8, 1931.


Salmon River near Whitebird, T. 28 N., R. 1 E., sec. 22, Idaho County, Idaho, December 27, 1966, R. H. Russell (uncat.).

The type locality of this species is the Little Salmon River near New Meadows, Idaho. Henderson (1936) also reports it from the Salmon River at Lucille, Idaho.

Stagnicola bullimoides cockerelli Pilsbry and Ferriss (Pl. VII, figs. 20-23).


Carlyle, Montana, September 24, 1947, R. B. Brunson (RBB 44347).

Old Oxbow of Milk River, 15 miles east of Havre, Blaine County, Montana, July 2, 1966, R. H. Russell (RHR 1262).

East outskirts of Kevin, Toole County, Montana, July 3, 1966, R. H. Russell (RHR 1269).


22 miles east of Broadus, August 5, 1966, J. H. Black (RHR 1353).

Reported by Baker (1911) from 5 miles south of Wibaux and from the Missouri River above the Falls. Henderson (1936) gives an additional record from a small lake 6 miles west of Shelby, Montana. This species is probably generally distributed throughout eastern Montana in potholes and temporary ponds. The works of Henderson (1924, 1936) give
several localities in southern Idaho.

Baker (1928) created the subgenus *Nasonia* to include *Stagnicola bulimoides* and *S. cubensis*. Taylor, et al., (1963) suggest that *Nasonia* possibly should not belong in the genus *Stagnicola*, but that it is closer to *Fossaria* as based on a few anatomical criteria. Weyrauch (1963) proposed the name *Bakerilimnaea* for *Nasonia*, which he considered to be preoccupied. Taylor (1966) then raised *Bakerilimnaea* to the generic level.

In the midst of all this taxonomic shifting, no one has thoroughly studied the anatomy of *S. bulimoides* to determine its precise relationships to the other species in the Lymmaeidae. Walter, after studying a single series of specimens, noted a few differences from *Stagnicola*, but he stated that the distinguishing features are minor. Radulae from specimens, which I have studied, of *S. bulimoides cockerelli* collected in eastern Montana show distinctly bicuspid lateral teeth. *Fossaria*, as described elsewhere, has tricuspid laterals.

For the purposes of this paper, the species *bulimoides* is considered to belong in the genus *Stagnicola*. Possibly the easiest solution would be to redefine the genus *Stagnicola* to include the few distinctive features of *bulimoides*.

Faunal lists or distributional data for recent Lymnaeidae
snails from areas adjacent to western Montana can be found through the following citations.

Eastern Montana

Baker, 1911
Berry, 1913, 1916, 1919
Cooper, 1869
Henderson, 1924, 1936

Wyoming

Baker, 1911
Beetle, 1961
Henderson, 1924, 1933, 1936
Taylor, et al., 1963

Idaho

Baker, 1911
Henderson, 1924, 1931, 1936
Taylor, et al., 1963

British Columbia

Baker, 1911
La Rocque, 1953
APPENDIX C
THE FAMILY LANCIDAE Pilsbry

The family Lancidae is known from most of the larger rivers of the Columbian system and many other coastal rivers of northern California and Oregon. Anatomically, it is closely related to the Lymnaeidae (H. B. Baker, 1925), although the shell is patelliform and the animal exhibits many secondary modifications which seem to be characteristic of fresh water Basommatophoran limpets (Hubendick, 1956).

Little is known of the phylogenetic relationships between the Lancidae and the Lymnaeidae. Likewise, the precise relationships between the various members of the Lancidae are poorly understood.

Morrison (1955) has redefined the genera *Lanx* and *Fisherola* (the two commonly recognized genera in the Lancidae) on the basis of muscle scars and other shell features. *Fisherola* appears to be restricted to the Columbia River, whereas *Lanx* is found in the coastal rivers to the south of the Columbia. *Fisherola* is very possibly monotypic, the several described forms all belonging to the species (or superspecies) *muttalli* (Haldeman). Morrison suggests that the species in the Lancidae, which are present today, may be relict types, each species restricted to a single river system and endemic to that system.
To my knowledge, no members of the Lancidae have been collected in Montana. La Rocque (1953) gives the range of Lanx (Fisherola) muttalli kootaneinsis Baird as the Kootenai and Spokane Rivers in British Columbia, Washington, Idaho, and western Montana. I seriously doubt that this range is based upon any actual collection from western Montana. However, Fisherola conceivably could be present in the Kootenai River in Montana, although I have not yet been able to find it.

A distributional summary of the species of Lancidae is given by Henderson (1929).

Collection records, in addition to those in the literature, are:


Map 1.

Western Montana showing major watersheds
Map 2.

Western Montana showing the probable extent of the front of the Cordilleran Ice Sheet; Wisconsin Stage of the Pleistocene.
Map 3.

Western Montana showing counties
Map 4.

Western Montana showing distribution of *Lymnaea stagnalis jugularis* (Say), filled circles; *L. stagnalis brunsoni* Russell, open circles; and *Radix auricularia* (L.), triangles
Map 5.

World-wide distribution of *Lymnaea stagnalis* (L.). European distributions after Hubendick, 1951; American distributions after Baker (1911), Hubendick (1951), and others.
Map 6.

World-wide distribution of *Radix auricularia* (L.). Southern Asiatic forms are somewhat distinct and are not represented. Paleartic distributions after Hubendick (1951); American distributions after various authors.
Map 7.

Distribution of *Stagnicola palustris elodes* (Say), filled circles, and *S. palustris wyomingensis* Baker, open circles.
Map 8.

Distribution of forms of *Stagnicola emarginata* in Western Montana. *S. binneyi* (Tryon), filled circles; *S. elrodiana* Baker, open circles; *S. elrodi* Baker and Henderson, filled triangles; *S. emarginata* n. ssp., open triangles.
Map 9.

Distribution of *Stagnicola caperata* (Say), filled circles; and *S. montanensis* (Baker), open circles.
Map 10.

Distribution of *Fossaria modicella* (Say).
Map 11.

Distribution of *Fossaria ohrussa ohrussa* (Say), filled circles; and *F. o. rodecki* Baker, open circles
Map 12.

Distribution of *Fossaria parva* (Lea), filled circles; and *F. dalli* (F. C. Baker), open circles.
PLATE I

Fig. 1. Morphological terms used in describing lymnaeid shells.

Fig. 2. Generalized diagram of the genitalia of a lymnaeid snail.
PLATE II

Fig. 1. Generalized radular tooth showing terms used in descriptions.

Figs. 2-5. Central tooth and a few teeth from one row of the radula of various lymmaeid snails.

Fig. 2. *Lymmaea stagnalis brumsoni* Russell. Flathead Lake.

Fig. 3. *Radix auricularia* (Linne'). Clearwater River.

Fig. 4. *Stagnicola binneyi* (Tryon). Clearwater River.

Fig. 5. *Fossaria modesta* (Say). Bitterroot River.
All figures enlarged approximately 1\(\frac{1}{2}\) times.


Fig. 1. Roger's Lake, Marion, Flathead County. (RHR 143).

Fig. 2. Seeley Lake, Missoula County. (RBB 32149).

Figs. 3, 4. Lake Inez, Missoula County. (RHR 17).

Figs. 5, 6. Sloughs near Bitterroot River, 5 miles south of Missoula, Missoula County. (RHR 812).

Fig. 7. Pond 1\(\frac{1}{2}\) miles from Kintla Lake on north side of road, Flathead County. (RBB 3157).

Fig. 8. Lake Inez, Missoula County. (RBB 11350).

Fig. 9. Spencer Lake, Flathead County (RHR 199).


Fig. 10. Holotype. (USNM 683584).

Fig. 11. Paratype. (UMIM 62).

Figs. 12-15. *Radix auricularia* (Linne').

Fig. 12. Clearwater Junction, Missoula County. (RBB 31849).

Fig. 13. Harper's Lake, Missoula County. (RHR 1107).

Figs. 14, 15. Elmo Bay, Flathead Lake. (uncat.).
PLATE IV

All figures enlarged approximately 1½ times.

Figs. 1-17. Stagnicola palustris elodes (Say).
Figs. 1,2. Long Lake, near Eureka, Lincoln County. (RBB 49056).
Fig. 3. Pond near Kicking Horse Reservoir, Lake County. (RBB 4356).
Figs. 4,5. Nine Pipes Reservoir, Lake County. (RHR 9).
Fig. 6. Swamp near Galen, Powell County. (RBB 54256).
Figs. 7-9. Ponds near Deep Creek, west of Missoula, Missoula County. (RHR 609).
Fig. 10. Lake on Stryker Ridge, Flathead County. (RBB 12950).
Figs. 11-14. Wallace Pond, Clinton, Missoula County.
Fig. 15. Pond near Kintla Lake, Flathead County. (RBB 9157).
Fig. 16. Union Creek overflow, Potomac, Missoula County. (RHR 734).
Fig. 17. South end Salmon Lake, Missoula County. (RHR 1066).
Figs. 18-21. Form wyomingensis Baker. Byrne Resort, Nimi­
rod, Granite County. (RHR 424).
Figs. 22,23. Stagnicola elrodiana Baker.
Fig. 22. Holotype, McDonald Lake, Lake County.
Fig. 23. Stoney Lake, Deerlodge National Forest, Gra­
nite County. (RBB 31749).
Figs. 24-26. Stagnicola binneyi Tryon. Junction of Clear­
water and Big Blackfoot Rivers, Missoula Coun­
ty. (RHR 381.)
PLATE V

All figures enlarged approximately 1½ times.


Figs. 1-6. Elmo Bay, Flathead Lake, Lake County. (un-cat.).

Figs. 7-9. Yellow Bay, Flathead Lake, Lake County. (RHR 1171).

Figs. 10-11. Same data. (RHR 1139).

Fig. 12. Flathead Lake, no other data, coll. M. J. Elrod, 1897.


Figs. 15-19. Stagnicola emarginata n. ssp.


Fig. 19. Holland Lake, Missoula County. (RBB 31456).

Fig. 20. Stagnicola elrodiana Baker. McDonald Lake, Ronan, Lake County. (RHR 492).
All figures enlarged approximately 3 times.

Figs. 1-8, 19,20. *Stagnicola caperata* (Say.)

Figs. 1,2. Union Creek overflow ponds, Potomac, Missoula County. (RBB 963).

Figs. 3,4. Frenchtown Lakes, Missoula County. (RHR 600).

Figs. 5,6. Carten Creek (Pleistocene), Powell County. (RHR 1084).

Fig. 7. Yellow Bay, Flathead Lake, Lake County. (RHR 1140).

Fig. 8. Union Creek ponds, Potomac, Missoula County. (RHR 418).

Figs. 19,20. Bison Range, Lake County. (uncat.).


Figs. 13, 14, 25-30. *Fossaria modicella* (Say).

Figs. 13,14. Fish pond, 2 miles west of St. Regis, Mineral County. (RHR 974).

Figs. 25-27. Sloughs along Bitterroot River, near Buckhouse Bridge, Missoula County. (uncat.).

Fig. 28. Creek near Galen, Powell County. (RBB 55456).

Fig. 29. Ducharme, Polson Bay, Flathead Lake, Lake County. (RHR 972).

Fig. 30. Kicking Horse Reservoir, Lake County. (RBB 23549).

Figs. 15-18. *Fossaria obrussa* (Say), spring fed pond, N.E. of Polson, Lake County (RHR 806).

Fig. 21. Clearwater River, Missoula County. (MM 62G27).

Figs. 22-23. Bond Creek, Lake County. (MM 62G18).

Fig. 24. Bay, West Narrows, Flathead Lake, Lake County. (RBB 6956, in part).
PLATE VII

Figs. 1-12 enlarged 5 times; figs. 13-26 enlarged 3 times.

Figs. 1-2. *Fossaria modicella* (Say), Milner Lake, Libby, Lincoln County. (RHR 257).

Figs. 3-7. *Fossaria parva* (Lea).

Figs. 3,4. Falls above McDonald Lake, Lake County. (RBB 764).

Figs. 5,6. Foster Creek Road, Deer Lodge County. (RHR 1051).

Fig. 7. Glen Lake, Eureka, Lincoln County. (RBB 4550).

Figs. 8-12. *Fossaria dalli* (Baker).

Figs. 8,9. Cow Creek trail, Ravalli County. (RBB 5760).

Figs. 10,11. Bass Creek Road, Missoula County. (RHR 423).

Fig. 12. Logging road N. E. of Polson, Lake County. (RHR 234).


Fig. 19. *Stagnicola emarginata* var. Tweedsmuir Park, B. C., Canada. (RHR 726).

Figs. 20-23. *Nasonia bulimoides cockerelli*.

Fig. 20. Carlyle, Dawson County, Montana. (RBB 44347).

Figs. 21,22. South of Choteau, Lewis and Clark County, Montana. (RHR 1275).

Fig. 23. Pond 15 miles east of Havre, Blaine County, Montana.
Figs. 24-26. *Lanx (Fisherola) ruttalli* (Haldeman). Salmon River, mouth of John Day Creek, Idaho County, Idaho. (RHR 1286).
LITERATURE CITED


—— 1911, The Lymnaeidae of North and Middle America, Recent and Fossil. Chicago Acad. Sci., Special Publ. 3, 539 pages.


Binney, W. G., 1865, Land and Fresh-Water Shells of North America, Part II, Pulmonata; Limnophila, and Thalas-


_____ 1902a, Collecting Shells in Montana. Nautilus, 15: 103, 104; 110-112.


_____ 1933, Mollusca of the Yellowstone Park, Teton Park,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.


Keep, Josiah, 1904, West American Shells, San Francisco, California.


Leach, 1819, Proof-sheets, pp. 141, 145.


Mitchell, R. D. and D. R. Cook, 1952, The Preservation and

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.


