DISTRIBUTION OF UNIONOID (BIVALVIA) FAUNAS IN MINNESOTA, USA

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INTRODUCTION

"No equal area on earth has such a diversity of Naiad life or such magnificent shells. Here are found the largest species in the world; here are forms with knobs, pustules, angles, lobes, and concentric sculpture. The nacre of many of them is wonderfully rich in tints of silver, pink, purple, salmon or red, and it is equaled in beauty by the elegant patterns of external painting, in stripes and mottlings and delicate hair lines."

- Charles T. Simpson (1896) on the Unionoidea of the Mississippi Valley

The distributions of the 46 species of freshwater mussels (Bivalvia: Unionoidea) that inhabit Minnesota were presented by Charlotte Webster Dawley in her doctoral thesis (1944) and a widely cited paper (Dawley, 1947). However, additional data have accumulated in the nearly half century since then. This paper seeks to update the literature record and establish the known distributions of these mollusks.

The life-cycle of a freshwater mussel involves the use of one or more species of fish or, in one case, an amphibian as a host for the parasitic larva or glochidium. In general, the major phase of dispersal occurs via of their host. Thus, barriers that inhibit the vagility of fish (drainage divides, waterfalls, etc.) also block the dispersal of the Unionoidea.

HYDROLOGY OF MINNESOTA. Minnesota's surface area of 218,500 km^2 is drained by three divergent watersheds (Figure 1). The Lake Superior System, the smallest, drains to the St. Lawrence River via Lake Superior. It is defined as the lake itself and all it's Minnesota tributaries. This system drains about 15,300 km^2 or 7% of the state.

The next largest watershed, draining 76,500 km^2 or 35% of the state, runs to Hudson Bay and is subdivided into the Red River System (the Red River of the North and all its Minnesota tributaries) and the Lake of the Woods System (the Rainy River and all Minnesota waters draining to Lake of the Woods). The two systems are confluent at Lake Winnipeg, Manitoba, but because they have different mussel faunas, they are considered separately.

The remaining 126,700 km^2 (58%) drains to the Gulf of Mexico via the Mississippi River. The basin is subdivided into the Upper and Lower Mississippi River Systems (following Underhill, 1989) based on their divergent histories and vastly disparate mussel faunas. The Upper Mississippi River System is that portion of the Mississippi River and all of its tributaries above the Falls of St. Anthony at Minneapolis.

The Lower Mississippi River System is the river and all of its Minnesota tributaries below the Falls of St. Anthony. This includes not only those watersheds draining directly into the Mississippi River in Minnesota (the St. Croix, Minnesota, Zumbro, Cannon, and Root River

St. Croix River Subsystem: Baker (1928), Bright (1988), Cooper (1834), Dawley (1944, 1947), Fuller (1978, 1980), Imlay (1972), Mathiak (1979), Stern (1983), Wilson and Danglade (1914).

Wilson and Danglade (1912) and Ellis (1931), provided only vernacular names, but these have been reworked in a scientific context by Wilson and Danglade (1914) and van der Schalie and van der Schalie (1950), respectively. Grant (1887) reported collecting unnamed Anodonta and Lampsilis from unspecified watersheds of the Arrowhead Region of northeastern Minnesota.

Few data are available on the Unionoidea of the Lake Superior System. Of the general Great Lakes literature reviewed (e.g., van der Schalie, 1961; Walker, 1913), most study has centered on the eastern lakes, emphasizing Lake Erie. The references cited above provide almost no information on the mussels found in the streams of the North Shore of Lake Superior (with the exception of the St. Louis River). Smith and Moyle (1944), however, surveyed the fauna of these streams, including the macrobenthos, and reported no unionoids. Since Moyle, in his other reports (1940, 1947), has provided mussel data it can be assumed that no unionoids are present in these streams.

For mussel distributions adjacent to Minnesota, the reader is referred to the following references:

NORTH DAKOTA: Cvancara (1966, 1967, 1970, 1975, 1976, 1983), Cvancara et al. (1966, 1972, 1976); SOUTH DAKOTA: Coker and Southall (1915), Over (1913); CANADA: Clarke (1973, 1981); WISCONSIN: Baker (1928), Havlik and Stansbery, (1977), Mathiak (1979), Stern (1983).

RESULTS

Figure 2 presents the distributions of the Unionoidea in Minnesota. For each species, the systematic assignment follows Williams et al. (1993), which claims to provide the same list as Turgeon et al. (1988) but with spelling and other such errors corrected. Figures depicting these mollusks can be found in Cummings and Mayer (1992) and Fuller (1985). The only exception, Elliptio complanata (Lightfoot, 1786), is illustrated in Clarke (1973:56-57, plate 3). The species list includes only those species verified to occur in Minnesota; distributions presented exclude erroneous records (see PROBLEMATICAL RECORDS below).

The Lower Mississippi Drainage System is divided into three subsystems: the Lower Mississippi River Subsystem, excluding the Minnesota and St. Croix River watersheds; the Minnesota River Subsystem, which includes the main stem of the river and all its tributaries; and the St. Croix River Subsystem, also including the main stem of that river and its tributaries.

QUESTIONABLE AND PROBLEMATICAL RECORDS

The single lot, JFB 2332 Lampsilis teres, labeled as coming from Leech Lake in the Upper Mississippi River System is likely the result of a cataloging error. Since Dawley (1944, 1947) apparently ignored it, the validity of this record is questionable.

OTHER PROBLEMATICAL DATA. Utterbackia imbecillis has never been reported from any of the Lake Superior or Hudson Bay drainage systems. This makes U. imbecillis unique among species reliably reported from the Upper Mississippi River System. Also making U. imbecillis distinctive is the fact that it may complete its reproductive cycle with or without a glochidial host (Dawley, 1944; Fuller, 1985). This would hamper its upstream vagility, and perhaps U. imbecillis could not extend beyond the Upper and Lower Mississippi River Systems before drainage connections were severed.

The presence of Anodontoides ferussacianus in the Lake of the Woods System is not supported by a specimen in the JFB, though both Baker (1935) and Dawley (1944, 1947) reported the species from that basin.

Strophitus undulatus has never been reported from the Lake Superior System and its presence in the Lake of the Woods System is supported by only a single literature record: Clarke (1973). Dawley (1944, citing Lefevre and Curtis, 1911) noted that S. undulatus is another mussel that can complete its life-cycle independent of a glochidial host. However, the mussel is not obligately anomalous in its reproduction; its widespread distribution indicates that it probably is dispersed by fish at least some of the time. Three of its published glochidial hosts (Hoggarth, 1992) are found in the that watershed as well as Minnesota's four other drainage systems (Underhill, 1989), providing a means of statewide distribution. The apparent absence of S. undulatus may actually be the result of the lack of an adequate survey of the St. Louis River System.

DISCUSSION

There is a pattern to the distributions of the Unionoidea in Minnesota. Species with similar distributions can be grouped into faunas; members of each fauna are hypothesized to have shared modes and tempos of dispersal into the state's drainage systems. Ninety-eight percent of the species (45 of 46) are found in the Lower Mississippi River System, supporting the hypothesis that the freshwater mussel fauna of Minnesota dispersed northward from southern refugia by way of the Mississippi River at the close of the Pleistocene (Johnson, 1980). The remaining species, Elliptio complanata, appears to have migrated into the state via Lake Superior from the St. Lawrence watershed.

Of the 45 species of unionoids reported from the Lower Mississippi River System, 30 have been reliably recorded from only that system; these mussels constitute the Lower Mississippi River Fauna (Figure 2). Much of this fauna is made up of mussels ecologically limited to larger rivers

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Lasmigona complanata (Barnes, 1823). Figures: Cummings & Mayer (1992:93), Fuller (1985:39). LSS: JFB 3308 Lake Superior, Minnesota Point, St. Louis Co.: Dawley (1944, 1947); Baker (1928): reporting Lea's type-locality. LWS: JFB 3305 Sturgeon River, Little Fork River watershed, St. Louis Co.: Dawley (1944, 1947). RRS: JFB 3302 Red Lake River, Crookston, Polk Co.: Dawley (1944, 1947). UMRS: JFB 7507 Mississippi River, Little Falls public access, Morrison Co. (collected by Bright et al.); reported by Dawley (1944) & Grier & Mueller (1922) that Wilson & Danglade (1914) found it in the UMRS; however, the data can not be located in that publication. LMRS: JFB 3301 Mississippi River, Minneiska, Wabasha: Dawley (1944, 1947). MRS: JFB 3299 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 3289 Lake St. Croix: Dawley (1944, 1947).

Elliptio complanata (Lightfoot, 1786). Figures: Clarke (1973:56-57, plate 3). LSS: JFB 3258 Lake Superior, Duluth, St. Louis Co.: Dawley (1944, 1947).

Lasmigona compressa (Lea, 1829). Figures: Cummings & Mayer (1992:97), Fuller (1985:41). LSS: JFB 3262 Cloquet River, St. Louis Co.: Dawley (1944, 1947). LWS: JFB 3261 Fall Lake, Lake Co.: Dawley (1944). RRS: JFB 7196 Otter Tail River, Otter Tail Co. (collected by Bright et al.). UMRS: JFB 3265 Sauk River, Stearns Co.: Dawley (1944, 1947), Moyle (1940). LMRS: JFB 5251 North Branch Middle Fork Zumbro River, Highway 57 Bridge, Dodge Co.: Bright et al. (1989). MRS: JFB 6017 Minnesota River, Yellow Medicine Co.: Bright et al. (1990). SCRS: JFB 3266 St. Croix River at the mouth of Sunrise River, Chisago Co.: Dawley (1944, 1947).

Arcidens confragosus (Say, 1819). Figures: Cummings & Mayer (1992:89), Fuller (1985:51). LMRS: JFB 2771 Mississippi River, Red Wing, Goodhue Co.: Dawley (1944, 1947). MRS: JFB 2773 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885).

Becker Co.: Radke (1992). UMRS: JFB 3995 Rum River, Anoka, Anoka Co.: Dawley (1944, 1947), Grant (1885). LMRS: JFB 2717 Cedar River, Austin, Mower Co.: Dawley (1944, 1947). MRS: JFB 2742 Cottonwood River, Garvin, Lyon Co.: Dawley (1944). SCRS: JFB 2753 Rush Creek: Dawley (1944, 1947).

Fusconaia flava (Rafinesque, 1820). Figures: Cummings & Mayer (1992:47), Fuller (1985:11). RRS: JFB 3014 Red River, 20 mi. N of Breckenridge, Wilkin Co.: Dawley (1944, 1947), Grant (1885). LMRS: JFB 3045 Mississippi River, Winona, Winona Co.: Dawley (1944, 1947). MRS: JFB 3044 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 3047 St. Croix River, Marine on St. Croix, Washington Co.: Dawley (1944, 1947).

Leptodea fragilis (Rafinesque, 1820). Figures: Cummings & Mayer (1992:121), Fuller (1985:20). LMRS: JFB 2919 Lake Pepin: Dawley (1944, 1947). MRS: JFB 2923 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 4613 St. Croix River, Marine on St. Croix, Washington Co.

Quadrula fragosa (Conrad, 1836). Figures: Cummings & Mayer (1992:29). LMRS: JFB 3127 Mississippi River, Nininger, Dakota Co. [collected November, 1886 by Winchell; reported as Q. quadrula by Dawley (1944, 1947)]. MRS: JFB 6356 Minnesota River, Sibley Co.: Bright et al. (1990).

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Lampsilis higginsi (Lea, 1857). Figures: Cummings & Mayer (1992:153), Fuller (1985:33-34). LMRS: JFB 2454 Mississippi River, Dresbach, Winona Co.: Dawley (1944, 1947). MRS: JFB 6396 Minnesota River, Carver Co.: Bright et al., 1990 (cf. L. higginsi); Dawley's (1944, 1947) record is JFB 2455 Obovaria olivaria. SCRS: JFB 2453 Lake St. Croix, Washington Co.: Dawley (1944, 1947).

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Potamilus ohiensis (Rafinesque, 1820). Figures: Cummings & Mayer (1992:123), Fuller (1985:22-23). LMRS: JFB 2963 Mississippi River, Red Wing, Goodhue Co.: Dawley (1944, 1947). MRS: JFB 2964 Minnesota River, Ft. Snelling: Dawley (1944, 1947); Grant's (1885) record is JFB 2920 Leptodea fragilis. SCRS: JFB 5543 St. Croix River, Interstate Park, Chisago Co., Minnesota; Dawley's (1944, 1947) record is JFB 2962 Leptodea fragilis.

Obovaria olivaria (Rafinesque, 1820). Figures: Cummings & Mayer (1992:109), Fuller (1985:35). LMRS: JFB 2829 Mississippi River, Dresbach, Winona Co.: Dawley (1944, 1947), Grant (1885). MRS: JFB 6520 Minnesota River, Pike Is., Hennepin Co.: Bright et al., 1990; Dawley's (1944, 1947) record is JFB 2832 Fusconaia ebena. SCRS: JFB 2826 St. Croix River at the mouth of Sunrise River, Chisago Co.: Dawley (1944, 1947).

Toxolasma parvus (Barnes, 1823). Figures: Cummings & Mayer (1992:131), Fuller (1985:54-55). LMRS: JFB 2974 Mississippi River, Wacouta, Goodhue Co.: Dawley (1944, 1947). MRS: JFB 2976 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 2973 St. Croix River, Marine on St. Croix, Washington Co.: Dawley (1944, 1947).

Amblema plicata (Say, 1817). Figures: Cummings & Mayer (1992:41), Fuller (1985:50). LSS: JFB 7567 Cloquet River, Brimson, St. Louis Co. RRS: JFB 3105 Red River, 20 mi. N of Breckenridge, Wilkin Co.: Dawley (1944, 1947), Grant (1885). LMRS: JFB 3083 Mississippi River, Dresbach, Winona Co.: Dawley (1944, 1947), Grant (1885). MRS: JFB 3093 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 3112 St. Croix River at the mouth of Sunrise River, Chisago Co.: Dawley (1944, 1947).

Quadrula pustulosa (Lea, 1831). Figures: Cummings & Mayer (1992:39), Fuller (1985:9). LMRS: JFB 3136 Mississippi River, Winona, Winona Co.: Dawley (1944, 1947), Holzinger (1887). MRS: JFB 3144 Minnesota River, Ft. Snelling: Dawley (1944, 1947). SCRS: JFB 3147 St. Croix River, Marine on St. Croix, Washington Co.: Dawley (1944, 1947).

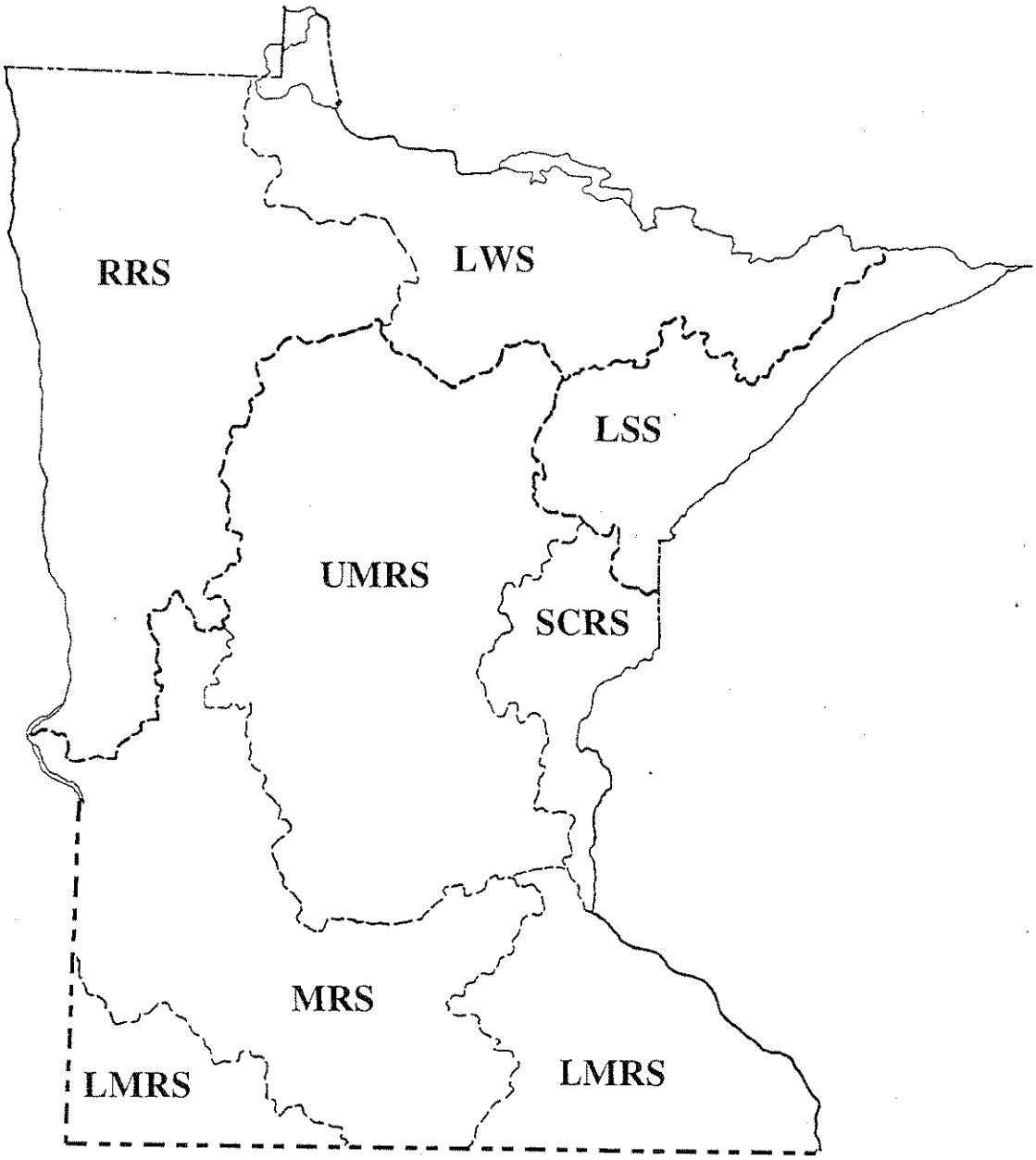
Epioblasma triquetra (Rafinesque, 1820). Figures: Cummings & Mayer (1992:163), Fuller (1985:44). SCRS: JFB 5701 St. Croix River, Sand Is., Chisago Co.

Truncilla truncata (Rafinesque, 1820). Figures: Cummings & Mayer (1992:115), Fuller (1985:46). LMRS: JFB 2896 Mississippi River, Winona, Winona Co.: Dawley (1944, 1947), Holzinger (1887). MRS: JFB 2897 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 2900 St. Croix River, St. Croix Falls, Polk Co., Wisconsin: Dawley (1944, 1947).

Cyclonaias tuberculata (Rafinesque, 1820). Figures: Cummings & Mayer (1992:49), Fuller (1985:10). LMRS: JFB 3198 Mississippi River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 3199 St. Croix River at the mouth of Sunrise River, Chisago Co.: Dawley (1944, 1947).

Strophitus undulatus (Say, 1817). Figures: Cummings & Mayer (1992:83), Fuller (1985:61). RRS: JFB 2784 Red River, 20 mi. N of Breckenridge, Wilkin Co.: Dawley (1944, 1947), Grant (1885). UMRS: JFB 7415 Mississippi River, Crow Wing State Park, Crow Wing Co. (collected by Bright et al.). LMRS: JFB 2793 Mississippi River, Red Wing, Goodhue Co.: Dawley (1944, 1947). MRS: JFB 6075 Minnesota River, Chippewa Co.: Bright et al. (1990). SCRS: JFB 2795 Grindstone River, Kettle River watershed, Pine Co.: Dawley (1944, 1947).

Tritogonia verrucosa (Rafinesque, 1820). Figures: Cummings & Mayer (1992:27), Fuller (1985:53). UMRS: JFB 3190 Sauk River, St. Cloud, Stearns Co.: Bright (1988), Dawley (1944), Moyle (1940). LMRS: JFB 3189 Mississippi River, Dresbach, Winona Co.: Dawley (1944, 1947), Grant (1885). MRS: JFB 3181 Minnesota River, Ft. Snelling: Dawley (1944, 1947), Grant (1885). SCRS: JFB 3191 St. Croix River, Taylors Falls, Chisago Co.: Dawley (1944, 1947).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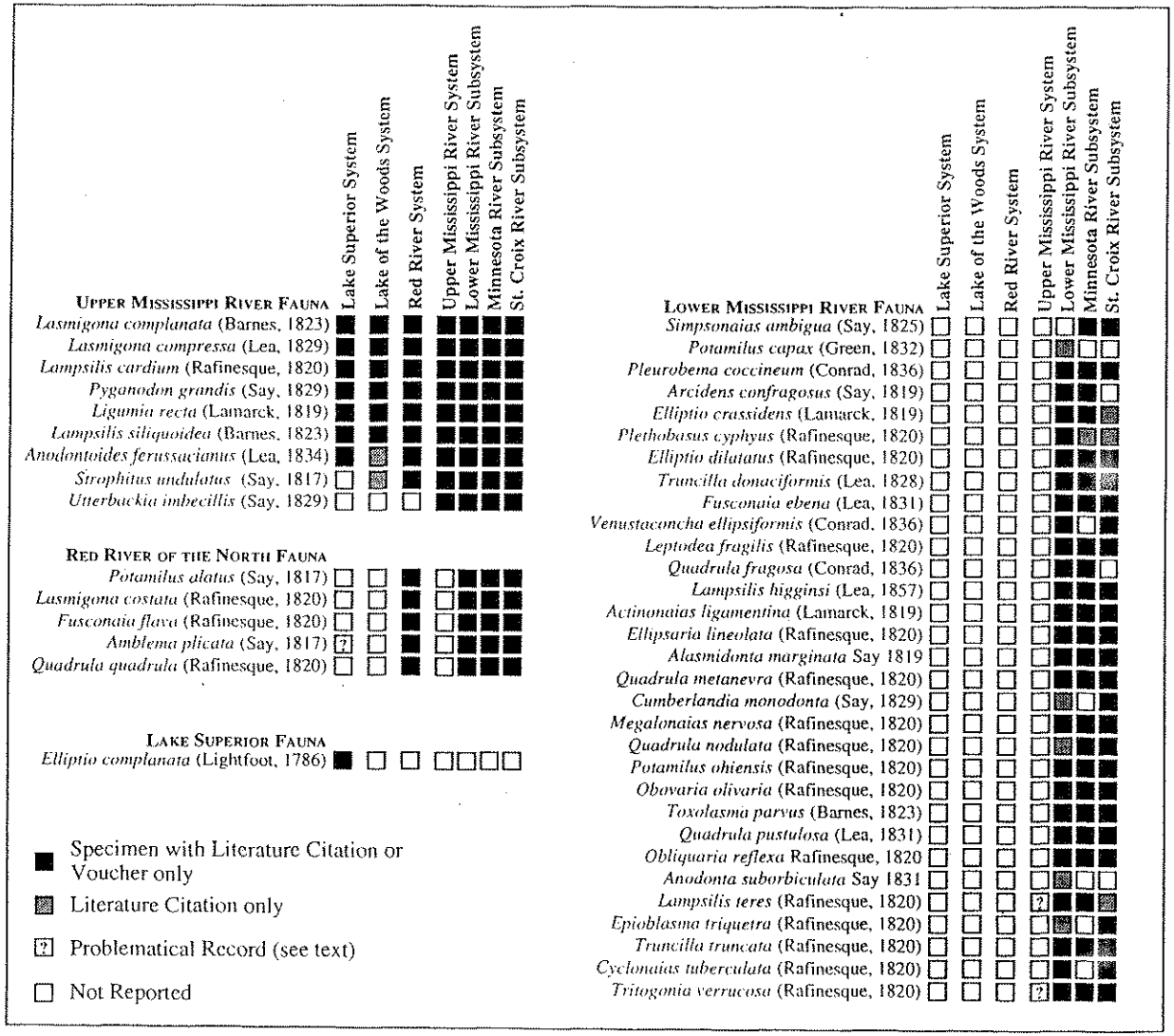
Lake Superior System
Lake of the Woods System
Red River System
Upper Mississippi River System
Lower Mississippi River Subsystem
Minnesota River Subsystem
St. Croix River Subsystem
UPPER MISSISSIPPI RIVER FAUNA
Lasmigona complanata (Barnes, 1823)
Lasmigona compressa (Lea, 1829)
Lampsilis cardium (Rafinesque, 1820)
Pyganodon grandis (Say, 1829)
Ligumia recta (Lamarck, 1819)
Lampsilis siliquoidea (Barnes, 1823)
Anodontoides ferussacianus (Lea, 1834)
Strophitus undulatus (Say, 1817)
Utterbackia imbecillis (Say, 1829)
RED RIVER OF THE NORTH FAUNA
Potamilus alatus (Say, 1817)
Lasmigona costata (Rafinesque, 1820)
Fusconaia flava (Rafinesque, 1820)
Amblema plicata (Say, 1817)
Quadrula quadrula (Rafinesque, 1820)
LAKE SUPERIOR FAUNA
Elliptio complanata (Lightfoot, 1786)
Specimen with Literature Citation or Voucher only
Literature Citation only
Problematical Record (see text)
Not Reported
LOWER MISSISSIPPI RIVER FAUNA
Simpsonaias ambigua (Say, 1825)
Potamilus capax (Green, 1832)
Pleurobema coccineum (Conrad, 1836)
Arcidens confragosus (Say, 1819)
Elliptio crassidens (Lamarck, 1819)
Plethobasus cyphyus (Rafinesque, 1820)
Elliptio dilatatus (Rafinesque, 1820)
Truncilla donaciformis (Lea, 1828)
Fusconaia ebena (Lea, 1831)
Venustaconcha ellipsiformis (Conrad, 1836)
Leptodea fragilis (Rafinesque, 1820)
Quadrula fragosa (Conrad, 1836)
Lampsilis higginsi (Lea, 1857)
Actinonaias ligamentina (Lamarck, 1819)
Ellipsaria lineolata (Rafinesque, 1820)
Alasmidonta marginata Say 1819
Quadrula metanevra (Rafinesque, 1820)
Cumberlandia monodonta (Say, 1829)
Megalonaias nervosa (Rafinesque, 1820)
Quadrula nodulata (Rafinesque, 1820)
Potamilus ohiensis (Rafinesque, 1820)
Obovaria olivaria (Rafinesque, 1820)
Toxolasma parvus (Barnes, 1823)
Quadrula pustulosa (Lea, 1831)
Obliquaria reflexa Rafinesque, 1820
Anodonta suborbiculata Say 1831
Lampsilis teres (Rafinesque, 1820)
Epioblasma triquetra (Rafinesque, 1820)
Truncilla truncata (Rafinesque, 1820)
Cyclonaias tuberculata (Rafinesque, 1820)
Tritogonia verrucosa (Rafinesque, 1820)