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A SURVEY OF MUSSELS (MOLLUSCA: BIVALVIA) IN THE PLATTE RIVER SYSTEM AND ASSOCIATED IRRIGATION AND HYDROPOWER CANAL AND LAKE SYSTEMS WEST OF OVERTON, NEBRASKA

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ABSTRACT

More than 8,000 specimens of freshwater mussels, representing ten species, were identified from the Platte River, seven irrigation canals and ten canal lakes west of Overton, Nebraska. Only 18 of these identified specimens, representing five species, were collected from the Platte River, indicating the canal and lake systems associated with the Platte River provide more habitat for freshwater mussels than the river. Population estimates for five canals and three lakes are given. A review of previous mussel surveys as well as species lists and hypotheses regarding habitat preferences are discussed.

† † †

The Central Nebraska Public Power and Irrigation District ("Central") conducted a survey of freshwater mussels in the Platte River and associated irrigation and hydropower canals west of Overton, Nebraska, in the summer and fall of 1991 and continuing through the fall of 1994. Much of the early survey work was provided to Perkins (Freeman and Perkins, 1992) and is included in that report. The results of all of the Central studies to date are presented here.

BACKGROUND

The United States has the greatest diversity of freshwater mussels in the world, with 297 species. Approximately 43% of these native species are considered to be extinct or in danger of extinction (Neves, 1992). This reduction in the diversity of freshwater mussels has resulted in a need to compile as much data as possible on present populations.

Little information is available regarding the diversity and abundance of freshwater mussels in Nebraska. Aughey (1877) reported finding 83 species of freshwater mussels in Nebraska but, like other early studies done in Nebraska, did not give specific collection localities or are voucher specimens available for verification. Hoke (1994) confirmed 30 species of mussels from the Elkhorn River Basin and a literature search of freshwater mollusks collected throughout Nebraska between 1980 and 1993 by Clausen (pers. comm.) for the Nebraska Natural Heritage Program identified the collection of 32 species. While it is possible Nebraska has lost species of freshwater mollusks, problems with nomenclature and the lack of voucher specimens or collection data from the early studies make it impossible to assess the magnitude of this loss.

In a study of the freshwater mussels of the Platte River in Nebraska, Roedel (1990) located six species at two sites in a study of approximately 1.5 km of the south channel of the Platte River near the town of Wood River in Hall County, Nebraska. Roedel also reported two additional species found upriver in Dawson County. Lingle (1992), investigating approximately 2.4 km of the Platte River, including Roedel's Hall County sites, found eight species. Lingle found one species, *Uniomerus tetralasmus* that Roedel did not find, but failed to locate *Strophitus undulatus*, which had been reported in the earlier study.

Freeman and Perkins (1992) surveyed for mollusks in the Platte River system at 49 sites from the Missouri River to the Wyoming border and reviewed the reports and raw data available on Platte River mollusks. The survey report lists 11 species of mussels as being extant in the entire Platte River system (including drains, ponds and some irrigation canals) and nine species from the central and upper Platte systems. Included in that report were many of the collections done as a part of this study as well as those of Roedel and Lingle. Upon review by Dr. David Stansbery of Ohio State University of voucher specimens held at the University of Nebraska State Museum, the presence of *Strophitus*

undulatus as reported by Roedel was questioned by Freeman and Perkins. A species list, as developed from these studies, for the Platte River and associated waters in Nebraska is presented in Table 1.

STUDY AREA

The area of the Platte River valley surveyed for this study extends approximately 120 km west from Overton, Nebraska (Fig. 1). Central's Supply Canal, which diverts water at the confluence of the North and South Platte rivers, parallels the Platte River for this entire reach. Six smaller irrigation canals have their diversions at points within this stretch of river and Central's Phelps Canal has its origin at the terminus of the Supply Canal.

The Platte River valley is a mosaic of habitats including heavily forested areas, open scrub, wet meadows and row crops. The river itself has two or three anabranched channels, each with shifting sand bars rather than one large main channel. Much of the flow in this reach during the non-irrigation season is the result of diversion returns, surface drains, small tributary inflows and groundwater returns. Higher flows occur during the irrigation season as storage water is passed to the six canals from Lake McConaughy, 80 kilometers upstream, along with natural flow. Diversions into the Supply Canal range from 225 m^3/sec to 566 m^3/sec.

The six smaller canals and the Phelps Canal are de-watered during the non-irrigation season. However, five of the smaller canals and the Phelps Canal retain water in the first 1–3 km throughout the year.

METHODS

The rivers, lakes and irrigation canals were surveyed visually and tactilely while the authors walked and swam. Twenty-nine sites, nineteen of which consisted of approximately 30 km of river and 20 km of irrigation canals, were searched in addition to ten canal lakes.

Efforts were made at three of the ten lakes—Johnson Lake in Gosper and Dawson counties, Midway Lake in Dawson County and Lake Maloney in Lincoln County—to estimate abundance. Efforts were also made to estimate population size of known mussel beds at five canal sites. Population sampling was conducted when the canals were de-watered or flows were reduced for operational reasons. (Fig. 1)

Population sample sites in the canals were 2-m wide transects randomly selected over the length of the portion of each canal that retains water throughout the year (wetted area). The total area of each transect was measured and the percent of total wetted area calculated. The number of mussels of each species found within each transect was counted. This number along with the values for transect area and total wetted area was inserted into the following formula to calculate an approximate population size.

$$\frac{n}{N} = \frac{a}{A}$$

Where: N = total population,
n = number counted within the transect,
a = transect area, and A = total wetted area

In the fall of 1994 the canal below the J-2 Hydroplant (Fig. 1) was dewatered for maintenance reasons. This allowed for an actual count of all mussels in a 1-km stretch as opposed to the use of transects.

Identification of species in this study was done by using valve characteristics and, in the case of *S. undulatus*, dissection of soft body parts and genetic analysis by Dr. Hsiu-Ping Liu, Brian Kreiser and Dr.

Table 1. Freshwater mussels found in the central Platte River in Nebraska as given by Roedel (1990), Lingle (1992), and Freeman and Perkins (1992).

Species	Common name	Roedel	Lingle	Perkins
Anodonta imbecillis Say, 1829	paper floater	×	×	×
Anodonta grandis grandis Say, 1829	giant floater	×	×	×
Lasmigona complanata complanata (Barnes, 1823)	white heel-splitter	×	×	×
Potamilus ohiensis (Rafinesque, 1820)	pink paper shell	×	×	×
Quadrula quadrula (Rafinesque, 1820)	maple leaf	×	×	×
Strophitus undulatus undulatus (Say, 1817)	squaw foot	×		
Leptodea fragilis (Rafinesque, 1820)	fragile paper shell	×	×	×
Anodontoides ferussacianus (Lea, 1834)	cylindrical paper shell	×	×	×
Uniomerus tetralasmus (Say, 1831)	pond horn		×	×
Corbicula fluminea (Muller, 1774)	Asiatic clam			×

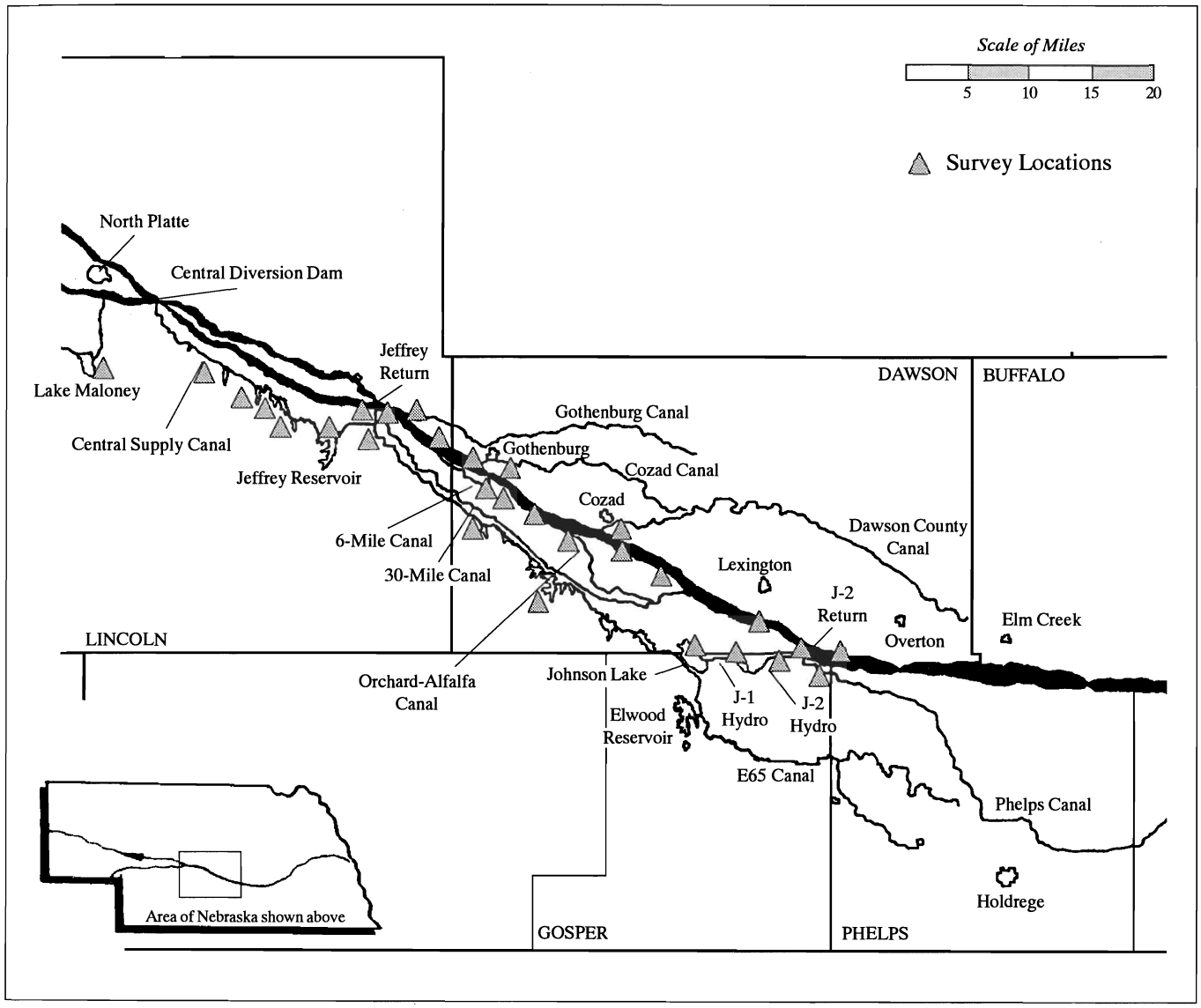

Figure 1. The upper Platte River and associated canal and lake systems. Counties are named in capital letters.

Shi-Kuei Wu of the University of Colorado. Voucher specimens representing each species were collected and are located at the University of Nebraska State Museum, Lincoln.

RESULTS

A total of 8,786 specimens representing nine native species of mussels were found in this survey of the lakes and canals of the irrigation systems (Table 2). Five native species, represented by a total of 18 specimens, were found in the Platte River channel. Most of the river specimens were widely scattered and all were collected within a few kilometers of the confluence of the river with an irrigation canal or drainage ditch return.

Large numbers of *Corbicula fluminea*, an exotic, were found at river and canal locations from the confluence of the North and South Platte rivers to near Cozad in Dawson County. The method of introduction of *C. fluminea* into the Platte River system is unknown. Large beds were located, consisting of all age groups, in a number of canals and specimens, both living and dead, were found in the river channel. While it has been stated that cold Nebraska winters should be limiting (Freeman and Perkins, 1992), the species is maintaining and possibly expanding its range within the system. The fact that numerous age classes and populations were found that apparently survived the drying of canal areas even over winter bears closer investigation.

Three species not previously collected in the Platte

Table 2. Freshwater mussels of the upper Platte River and associated irrigation and hydropower canals and lakes.

Species	River	Irrigation Canals	Lakes
Anodonta imbecillis Say, 1829	0	7	7
Anodonta grandis grandis Say, 1829	0	390	32
Lasmigona complanata complanata (Barnes, 1823)	2	7179	45
Potamilus ohiensis (Rafinesque, 1820)	10	358	369
Quadrula quadrula (Rafinesque, 1820)	0	243	118
Strophitus undulatus undulatus (Say, 1817)	5	17	0
Anodontoides ferussacianus (Lea, 1834)	1	10	0
Corbicula fluminea (Muller, 1774)	NC	NC	0
Toxolasma parvus (Barnes, 1823)	0	0	10
Sphaerium sp.*	NC	NC	NC
Total specimens**	**18**	**8,206**	**580**
Total species	**6**	**10**	**7**

*found as dead valves only
**not including *Corbicula fluminea*
NC - no counts made

River system, or whose existence within the system was questioned, were found in the course of this survey. They were the lilliput shell (*Toxolasma parvus*), the fingernail clam (*Sphaerium* sp.) and the squawfoot (*Strophitus undulatus*).

Relative abundance

Lasmigona complanata was the most abundant species in the smaller irrigation canals (49% of all specimens) and in the Central Supply Canal (98% of all specimens). *Potamilus ohioensis* was most abundant in the lakes (66% of all specimens) and the Platte River (55% of all specimens).

Quadrula quadrula, identified by Freeman and Perkins (1992) as the most abundant mussel in the Platte River, accounted for only 4.7% of the total specimens observed. The relative abundance of all species found in this study is given in Table 3.

Population sampling

Determining the populations of mussels in the irrigation canals associated with the Platte River was not a primary objective of this study. However, it was clear that there was a need to quantify the populations within the mussel beds to assess the value of the surveyed habitats.

Mussel densities in the various canals ranged from a low of 535/ha in the Gothenburg tailrace to a high of 3,030/ha in the Phelps County Canal. Population estimates for the number of live mussels in five of the canals are given in Table 4.

The three reservoirs sampled in an effort to estimate mussel population size were surveyed when they

Table 3. Relative percent abundance of bivalves in different habitat types (not including *Corbicula fluminea*).

Species	River (N = 18)	Small canals (N = 1,711)	Central supply canal (N = 6, 492)	Lakes (N = 580)	All types (N = 8,801)
Lasmigona complanata (Barnes, 1823)	11.0	48.5	97.8	7.7	79.6
Potamilus ohiensis (Rafinesque, 1820)	55.0	16.8	1.1	63.7	11.3
Quadrula quadrula (Rafinesque, 1820)	0.0	14.2	0.0	20.3	4.7
Anodonta grandis Say, 1829	0.0	18.6	1.1	5.5	3.8
Anodonta imbecillis Say, 1829	0.0	0.4	0.0	1.2	0.1
Anodontoides ferussacianus (Lea, 1834)	5.0	0.6	0.0	0.0	0.3
Strophitus undulatus (Say, 1817)	28.0	1.0	0.0	0.0	0.2
Toxolasma parvus (Barnes, 1823)	0.0	0.0	0.0	1.7	0.1

Table 4. Freshwater mussel population estimates for four canals in the upper Platte River valley.

Canal	Population estimate
Gothenburg Tailrace	535/ha
Jeffrey River Return	2,342/ha
J-2 River Return	1,514/ha
Phelps County Canal	3,030/ha
Supply Canal/J-2 Tailrace*	1,855/ha

*Determined by a one-kilometer linear count of all visible bivalves. The number per ha was then calculated.

were drawn down for maintenance. Representative areas were measured and populations recorded in each lake. Very rough population estimates could be derived by estimating the area similar to the surveyed site available within the lake. Johnson Lake, with a surface area of about 1,000 ha, was estimated to have a population of 26,000 mussels, or about 26/ha. Lake Maloney, with a surface area of about 650 ha, was estimated to have a population of 9,800 mussels, or about 15/ha. Midway Lake with a surface area of 120 ha was estimated to have a population of 2,880 mussels or about 24/ha.

Population estimates and densities reported here are conservative at best. The population estimates given were derived from crude sampling techniques and probably underestimate total populations. Most areas surveyed were those subjected to fairly regular drawdowns. It is hypothesized that these areas subject to regular seasonal stress would have a lower population of mussels. A much more rigorous sampling technique incorporating all areas and habitats available in the Central District Supply Canal and the deeper portions of the lakes should be conducted to quantify more accurately the mussel populations.

DISCUSSION

Studies by Roedel (1990), Freeman and Perkins (1992), Lingle (1992) and this study show limited use of the upper and middle Platte River by freshwater mussels. However, based upon our study of more than 8,000 specimens of mussels, it is clear that the hydro and irrigation canals and their associated lakes in the Platte River valley provide extensive habitat suitable for large populations of several species of freshwater mussels.

Table 5. Host fish for freshwater mussels found in the upper Platte River valley.

Mussel species	Host fish
Anodonta imbecillis Say, 1829	*Lepomis cyanellus*, green sunfish *Semotilus atromaculatus*, creek chub
Anodonta grandis grandis Say, 1829	*Cyprinus carpio*, carp *Perca flavescens*, yellow perch *Pomoxis annularis*, white crappie *Lepomis cyanellus*, green sunfish
Anodontoides ferussacianus (Lea, 1834)	*Pimephales notatus*, bluntnose minnow *Pimephales promelas*, flathead minnow *Notropis cornutus*, common shiner
Lasmigona complanata (Barnes, 1823)	*Cyprinus carpio*, carp *Lepomis cyanellus*, green sunfish *Pomoxis annularis*, white crappie *Micropterus salmoides*, largemouth bass
Leptodea fragilis (Rafinesque, 1820)	*Aplodinotus grunniens*, freshwater drum
Potamilus ohiensis (Rafinesque, 1820)	*Aplodinotus grunniens*, freshwater drum
Quadrula quadrula (Rafinesque, 1820)	*Pylodictis olivaris*, flathead catfish
Strophitus undulatus (Say, 1817)	no host
Toxolasma parvus (Barnes, 1823)	unknown
Uniomerus tetralasmus (Say, 1831)	unknown
Corbicula fluminea (Muller, 1774)	no host
Sphaerium sp.	no host

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